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## SWOT AND TOWS ANALYSIS: AN APPLICATION TO COCOA IN GHANA

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### *Abstract*

*The study was done in Ghana. The main objective of the study was to analyze the production, consumption and marketing stages of cocoa in Ghana. A qualitative research approach was adopted for the study. Theoretical studies and literatures related to the study were explored in gathering relevant data required to outline and analyse the attributes necessary for the enhancement of the production, consumption and marketing stages of Ghana's cocoa industry. Secondary and qualitative data were reviewed and collected from research findings, literature, journals and other publications conducted by the United Nations FAO, International Cocoa Organization (ICCO), Ghana Cocoa Board (COCOBOD), and other individual researchers and organizations. The SWOT analysis revealed a good number of opportunities provided by the external environment and advantages in the internal environment that can be capitalized to enhance the cocoa industry in Ghana. A TOWS analysis matrix was constructed to determine possible strategies that can be adopted to manage the production sector within its environments.*

*Key words:* SWOT analysis, TOWS analysis, cocoa, Ghana

## INTRODUCTION

### *Background*

Agriculture remains the largest sector of Ghana's economy, engaging about 52 percent of the labour force thus, its development has a greater impact on employment and poverty reduction than the other sectors of the economy [8][4]. Cocoa is by far Ghana's most important crop as it represents the country's major agricultural export commodity, being the second largest source of foreign exchange which accounts for about 30 percent of Ghana's total export earnings. It is an important contributor to the country's economic development thus, a core component of the economy. Cocoa dominates the entire agricultural sector, acting as a major source of income for approximately 800,000 farmers and many others working along the cocoa value chain thus, a significant source of employment [14]. According to the Bank of Ghana, the sector accounts for more than 9% of agricultural Gross Domestic Product [11]. Ghana's cocoa cultivation, is well noted within the developing world to be one of the most modeled commodities [14]. The basic

stages of cocoa production include growing the trees, harvesting of pods, fermentation and drying of the beans.

All affairs related to cocoa in Ghana are controlled and managed by the Cocoa Board (COCOBOD) of Ghana. COCOBOD is a government controlled institution mandated with the responsibility of determining the buying price of cocoa in Ghana with the intention of protecting farmers from the volatile prices on the world market. Besides the price-fixing, COCOBOD is also into the sales of higher quality hybrid seeds, provision of technical assistance to cocoa farmers and conducts research on cocoa plant-related diseases. The mission of the Board is to encourage and facilitate the production, processing and marketing of good quality cocoa in the most efficient and cost effective manner. COCOBOD has five independent subsidiaries, namely: Cocoa Research Institute of Ghana (CRIG), Cocoa Health and Extension Division (CHED), Seed Production Division (SPD), Quality Control Company (QCC), and Cocoa Marketing Company (CMC). Each subsidiary is tasked with their respective functional obligation to enhance

the growth and development of the cocoa sector.

At present, Ivory Coast is the world's highest producer of cocoa beans followed by Ghana as the world's second highest producer with average annual output of about 800,000 metric tons (MT) [2]. However, according to the 2016/2017 cocoa production forecast of the International Cocoa Organization, out of the 4.7 million tons of the world cocoa production, approximately 3.6 million tons is produced in Africa with Ivory Coast producing the highest of about 2 million tons followed by Ghana producing 950,000 tons [7]. Cocoa is produced in six out of the ten geographical and administrative regions of Ghana with the Western region accounting for over 50 percent of total cocoa production [2]. Majority of cocoa farmers in Ghana operate on small scale with average farm sizes of two to three hectares with less than 10 percent of cocoa farmers operating on large scale. Ghana's estimated average cocoa yield is around 400 kilograms per hectare (kg/ha) for small scale producers which falls below that of other producing nations such as Cote d'Ivoire and Indonesia with estimated yield of 1.4 tons and one ton per hectare, respectively [2][9]. Many factors underscore this low productivity including scientific and technical issues such as the soil fertility status and quality of planting materials as well as diseases and pest issues. Small scale mining, whether legal or illegal, also have a great toll on arable lands.

Cocoa has many uses and is consumed in many different forms worldwide. However, the basis of all cocoa products is the grindings of its beans. The most common and popular consumable products of cocoa is the cocoa butter for chocolate and cocoa powder which is used in many beverages and food flavorings. However other consumable forms include; Animal feed from cocoa husk, Soap production from potash (Cocoa pod husk ash), Organic mulch and soil conditioner in crop production from cocoa bean shells, cosmetic products from cocoa butter, etc. In Ghana, considering that COCOBOD sells only a small quantity of the cocoa beans to local processing companies the consumption of

cocoa by-products is negligible. There are four prime cocoa processing companies in Ghana that handles the transformation of the cocoa beans into primary products, such as, cocoa liquor, cocoa butter, cocoa powder and cocoa cake. However, only 10 percent of these locally processed cocoa goes into the production of confectionary products such as chocolate bars, cocoa beverages, cocoa powder, ice cream etc, for the local market. There are about only ten companies that produce these cocoa confectionary products in Ghana [3].

Marketing of cocoa in Ghana is classified under two levels; Internal and External marketing levels. The internal level involves marketing of cocoa within the boundaries of the country while the external involves marketing across the country's borders via export. Not until the year, 1993 when the government finally yielded to the World Bank's recommendation of introducing the participation of other privately Licensed Buying Companies (LBCs) into the internal marketing of cocoa, the government through the Produce Buying Company (PBC) was the sole institution legally responsible for the internal marketing of cocoa from the farm gates. The introduction of the privately Licensed Buying Companies (LBCs) created a fair competition with the Produce Buying Company (PBC) which used to be the only buyer of cocoa at the farm-gate since 1977[1]. Ghana however remains the only country where the state retains control of the entire volume of cocoa exports through the Ghana Cocoa Board (COCOBOD), and an overwhelming presence in the internal market via the PBC [12]. Currently COCOBOD has licensed 41 companies to engage in the internal marketing of cocoa [5]. Through external marketing, 53.99 percent of Ghana's cocoa is shipped to Europe, 30.16% to Asia, 8.06% to North America and 7.79% to other countries [5].

Despite Ghana's position as the world's second largest exporter of cocoa, annual production and yield is relatively low. Efforts by Government to boost production and increase foreign earnings hasn't been met as expected. Over the past decades, Ghana's

production scale has not been able to match up to their closest competitor, Ivory Coast. There is a big difference in production scale and yield between these two countries. The sector is still faced with inefficiency in production and farmers are faced with challenges with regards to access to certain inputs and technology. Annual yield of cocoa per hectare as well as output has been relatively poor.

#### ***Problem Statement***

Farmers are not satisfied by the buying prices of cocoa set by government. Another significant factor in purchase variability is cocoa smuggling. Each year, there are significant, and mostly unrecorded, flows of cocoa traded across Ghana's borders. The vast majority of this trade moves across the roughly 370-mile, largely porous border between Ghana and Ivory Coast. Many cocoa farms are being lost to local gold mining activities due to the relatively higher lucrativeness of that sector.

Financial earnings and employment capacity of the cocoa sector has been underutilized due to the relatively lower scale of cocoa processing and confectionary products manufacturing for the local market. About 90% of cocoa produced in Ghana is exported abroad in its primary form as a raw material. The cocoa value chain in Ghana is short of product diversification ventures such as processing and alternative product manufacturing units.

The study was done in Ghana. Ghana has a total area of 238,540 km<sup>2</sup> on the western coast of Africa. The north-south boundary of the country is approximately 670 km and the east-west, maximum width of approximately 560 km. Ghana is bordered by Ivory Coast to the west, Burkina Faso to the north and Togo to the east. On the south is the Gulf of Guinea and the Atlantic Ocean. The country is divided into 10 administrative regions. Cocoa is produced in six of these regions and that cocoa is a very crucial plant in Ghana.

#### ***Objectives of the study:***

The main objective of the study is to analyze the production, consumption and marketing stages of cocoa in Ghana.

#### ***The specific objectives are:***

(i) to evaluate the internal environments of the cocoa sector in Ghana.

(ii) to evaluate the external environment of the cocoa sector in Ghana.

(iii) to develop strategies in addressing the internal weaknesses and external threats facing the cocoa sector by means of a SWOT and TOWS matrix.

## **MATERIALS AND METHODS**

### **Materials**

A qualitative research approach was adopted for the study. Theoretical studies and literatures related to the study were explored in gathering relevant data required to analyse and describe the attributes necessary for the enhancement of the production, consumption and marketing stages of the cocoa industry in Ghana.

The research targeted eight critical actors and stakeholders of Ghana's cocoa industry and collected relevant data related to their roles in the production consumption and marketing stages of the industry. These actors were; the Ministry of Finance and Economic Planning (MOFEP), Ghana Cocoa Board (COCOBOD) and subsidiaries, License (cocoa) Buying Companies, local Cocoa processing companies, Cocoa farmers, International buyers/ global companies, Civil Society Organisations and Research Institutions of Ghana (CRIG, ISSER, RM&E).

Secondary and qualitative data were collected for analyses. These data are research findings reviewed and collected from literatures, journals and other publications conducted by the United Nations FAO, International Cocoa Organization (ICCO), Ghana Cocoa Board (COCOBOD), and other individual researchers and organizations.

### **Methods**

SWOT analysis and TOWS matrix were employed in the analysis of the study. SWOT analysis is an analytical method used to recognize and classify significant internal (i.e. strengths and weaknesses) and external (i.e. opportunities and threats) elements within an organization or business. It is one of the most acclaimed instrument for conducting audit and

analysis to determine the strategic position of the business in its operating environment.

TOWS matrix is an analytical instrument used to generate a combination of internal and/or external factors to address specific weaknesses or threats within its operational environments. It does this to generate, compare and select best operational strategies. Its main purpose is to indicate strategies necessary to construct the best definite business model for a firm that will align the firm's resources and capabilities to the requirements of its operational environment [10].

The SWOT analysis technique was used to identify the current internal and external environmental conditions within which the production, consumption and marketing stages of the cocoa industry operates in Ghana. And the TOWS matrix was constructed to develop possible strategies to strengthen and enhance the cocoa sector towards meeting its objectives.

SWOT and TOWS analysis method was used to analyse and evaluate the qualitative data collected for each of the three operational stages (production, consumption and marketing) of the cocoa industry in Ghana.

**Steps in SWOT analysis and TOWS matrix**

*Step 1:* SWOT analysis involved the collection and evaluation of key data from the above aforementioned data sources. These are qualitative data pertaining to the current state of the cocoa industry in Ghana, specifically relating to the production, consumption and marketing stages.

*Step 2:* For each of the three operational stages (production, consumption and marketing) of Ghana's cocoa industry, qualitative data on the recent state of the industry are collected and sorted into four categories: strengths, weaknesses, opportunities, and threats. Strengths and weaknesses generally stem from factors within the boundaries of the three operational stages in the industry, whereas opportunities and threats usually arise from external factors as in figure 1 below. Organizational surveys are an effective means of gathering some of this information, such as data on an

organization's finances, operations, and processes [6].

*Step 3:* This involves the development of a TOWS matrix for each of the three operational stages (production, consumption and marketing) of the cocoa industry as demonstrated in tables 1 and 2 below.

*Step 4:* This involves incorporating the SWOT and TOWS analysis into the decision-making process to determine which measures to take in strengthening and developing the cocoa industry of Ghana.



Fig. 1. SWOT analysis chart  
 Source: Author's own illustration.

Table 1. TOWS matrix [13].

	Strengths	Weaknesses
Opportunities	How do I use these strengths to take advantage of these opportunities?	How do I capitalize on my opportunities to overcome the weaknesses or minimize the weaknesses that prevent me from taking advantage of these opportunities?
Threats	How do I use my strengths to reduce the impact of these threats?	How do I address the weaknesses that will make these threats a reality?

Source: Author's own illustration

Table 2. TOWS matrix and strategy determination process

SWOT matrix	Strengths(S)	Weaknesses(W)
Opportunities(O)	S*O strategies	W*O strategies
Threats(T)	S*T strategies	W*T strategies

Source: Author's own illustration.

## RESULTS AND DISCUSSIONS

### SWOT analysis of the cocoa production stage

Table 3. SWOT analysis of the production stage of cocoa in Ghana

		Strengths	Weaknesses
Internal factors		<b>S1:</b> Free extension and technical services to farmers by COCOBOD subsidiaries. <b>S2:</b> Favorable climate and soil for high cocoa production capacity <b>S3:</b> Cocoa is cultivated in 6 out of the 10 regions of Ghana <b>S4:</b> Available vast land and resources for cocoa production. <b>S5:</b> Well-functioning national cocoa management board (COCOBOD) <b>S6:</b> Cocoa industry is prioritized by government. <b>S7:</b> Free on Board (F.O.B) prices of cocoa for farmers <b>S8:</b> World's 2 <sup>nd</sup> largest exporter ranking for the Ghana cocoa industry <b>S9:</b> World class quality cocoa production. <b>S10:</b> Good standing for loan acquisition /factoring. <b>S11:</b> Good market share	<b>W1:</b> Low level of technology adoption in the cocoa production sector of Ghana <b>W2:</b> Little capital and high cost of production input for farmers <b>W3:</b> Low level of education amongst cocoa producers in Ghana. <b>W4:</b> Individual farmers farm on small scale (3-4ha/farmer). <b>W5:</b> Relatively low annual production of cocoa beans <b>W6:</b> Farmers complain of low farm gate buying price of cocoa by government. <b>W7:</b> About 43% of farms still under the cultivation of varieties with lower productivity.
		Opportunities	Threats
External factors		<b>O1:</b> Vast employment and poverty reduction opportunities for cocoa farmers provided by the cocoa production sector <b>O2:</b> Provision of significant foreign exchange for national development. <b>O3:</b> Meeting the high demand for cocoa beans across the world. <b>O4:</b> Opportunity for government to establish state owned cocoa farms to substitute for the high demand. <b>O5:</b> Opportunity to attract foreign investors to provide cocoa production technology and input services in Ghana. <b>O6:</b> Possible opportunity of increasing production vol.	<b>T1:</b> Competition from the mining sector for land. <b>T2:</b> Competition from the growing population and estate industry for land <b>T3:</b> Loss through pest and disease infestation <b>T4:</b> Competition from higher capacity cocoa producing countries

Source: Author's own construction of SWOT based on reviewed literature and observations

For the purpose of this study, production stage of cocoa entailed and was limited to land preparation, nursing of cocoa seedlings, management and husbandry practices, harvesting of cocoa, extraction of beans, drying of beans through to the grading and bagging of the cocoa beans. Relevant data pertaining to the production stages of the cocoa industry were collected and analysed, then categorized under strengths, weaknesses,

opportunities and threats depending on their impact on the cocoa sector and national development as a whole.

### SWOT analysis of the cocoa consumption stage

For the purpose of this study, the consumption stage of cocoa entailed and was limited to consumption by subsequent processing companies through to final consumers and involves processing of cocoa beans into secondary products through to tertiary products along the value chain to the consumers. Relevant data pertaining to the consumption stages of the cocoa industry were collected and analysed, then grouped as strengths, weaknesses, opportunities and threats depending on their impact to the cocoa sector and national development as a whole.

Table 4. SWOT analyses of the Consumption stage of cocoa in Ghana

		Strengths	Weaknesses
Internal factors		<b>S1:</b> Readily available raw materials for cocoa processing and confectionary industries. <b>S2:</b> Raw materials for cocoa processing and value addition are relatively cheaper. <b>S3:</b> Readily available labour for operating cocoa processing factories. <b>S4:</b> Government priority on value addition and local patronage through processing and local consumption of cocoa products	<b>W1:</b> Low number of existing cocoa processing and confectionary companies <b>W2:</b> Poor product diversification amongst existing cocoa processing companies in Ghana. <b>W3:</b> Low level of investment in the cocoa processing sector. <b>W4:</b> Very low percentage of cocoa beans is sold to the local processing companies.
		Opportunities	Threats
External factors		<b>O1:</b> Cocoa consumption provides employment opportunities in the area of cocoa processing and product marketing. <b>O2:</b> Cocoa consumption provides investment opportunities for local entrepreneurs to venture into the various enterprises in the cocoa value chain. <b>O3:</b> It provides avenue to generate internal revenue and foreign exchange for the nation. <b>O4:</b> There is opportunity for the creation of other cocoa by-product industries such as animal feed, organic manure etc.	<b>T1:</b> Competition from already existing multinational cocoa processing and confectionary companies. <b>T2:</b> Possible change in consumer demand for cocoa products.

Source: Author's own construction of SWOT based on reviewed literature and observations

### SWOT analysis of the cocoa marketing stage

For the purpose of this study, the marketing stage of cocoa entailed and was limited to all activities involved in both the internal and external marketing levels of cocoa between cocoa farmers and the final buyers. Relevant data pertaining to the marketing stages of the cocoa industry were collected and analysed, then grouped as strengths, weaknesses, opportunities and threats depending on their impact to the cocoa sector and national development as a whole.

Table 5. SWOT analyses of the Marketing stage of cocoa in Ghana

	Strengths	Weaknesses
Internal factors	<p><b>S1:</b> Ghana receives highest cocoa prices due to premium world class quality</p> <p><b>S2:</b> State controlled external marketing system through the Cocoa Marketing company (CMC) of Ghana.</p> <p><b>S3:</b> Liberalized internal marketing system with good competition.</p> <p><b>S4:</b> Good local and global customer base due to good marketing services.</p> <p><b>S5:</b> Free on Board (F.O.B) price agreement with global customers.</p> <p><b>S6:</b> Ghana operates a traceability marketing system.</p>	<p><b>W1:</b> Monopolized external marketing system (Government being the sole exporter of cocoa)</p> <p><b>W2:</b> National political interference in the cocoa marketing management</p> <p><b>W3:</b> Low market share for processed cocoa which attracts higher value.</p> <p><b>W4:</b> Prices of cocoa beans are predetermined by government rather than farmers.</p> <p><b>W5:</b> Low profit margin for cocoa traders due to high tax marketing cost.</p>
	Opportunities	Threats
External factors	<p><b>O1:</b> Increased market demand for Ghana's cocoa due to relatively high quality of beans.</p> <p><b>O2:</b> Employment creation through introduction of the liberalized (private) licensed buying companies for cocoa marketing.</p> <p><b>O3:</b> Attraction of global marketing aid from International marketing companies such as Fairtrade as well as the Int. cocoa organization</p>	<p><b>T1:</b> Marketing competition from the world's highest producers and exporters of cocoa (Ivory coast).</p> <p><b>T2:</b> Possible loss through global cocoa price fluctuation.</p> <p><b>T3:</b> Possible decline in global demand or price for cocoa due to the emergence of alternative product or an economic crises.</p>

Source: Author's own construction of SWOT based on reviewed literature and observations

### TOWS analysis matrix

To further strengthen, fix the weaknesses and address the environmental threats of the cocoa sector, a TOWS matrix was created by the combination of some possible attributes that interact to manage and enhance the sector.

This would provide an efficient and effective way to achieve the set objectives of the cocoa sector of Ghana.

Table 6. TOWS matrix for the production stage of Ghana's cocoa industry

	Strengths		Weaknesses	
Opportunities	S6*O1=SOA S7*O1=SOB S2*O2=SOC S3*O2=SOD S4*O2=SOE S7*O2=SOF S5*O3=SOG S9*O3=SOH S7 * O4=SOI S10*O4=SOJ	S3*O5=SOK S6*O5=SOL S8*O5=SOM S11*O5=SON S1*O6=SOO S2*O6=SOP S3*O6=SOQ S4*O6=SOR S11*O6=SOS	O2*W1=OWA O3*W1=OWB O2*W2=OWD O3*W2=OWE O6*W2=OWF O3*W3=OWG O2*W4=OWH O3*W4=OWI O5*W4=OWJ O6*W4=OWK	O1*W5=OWL O2*W5=OWM O3*W5=OWN O6*W5=OWO O3*W6=OWP O6*W6=OWQ O2*W7=OWR O3*W7=OWS O5*W7=OWT O6*W7=OWU
	Threats	S5*T1=STA S6*T1=STB S5*T2=STC S6*T2=STD S1*T3=STE S5*T3=STF	S6*T3=STG S2*T4=STH S3*T4=STI S4*T4=STJ S5*T4=STK S9*T4=STL S11*T4=STM	T1 T3 W1 W5 W7

Source: Author's own construction of TOWS matrix based on the SWOT results

There are many combinations of elements that will develop and improve the cocoa production sector as indicated in the TOWS matrix above but for the purpose of the study, a few will be discussed.

### S6\*O1=SOA Model:

In this model, the cocoa industry can capitalize on the government's priority interest in the industry to attract state investment into implementing an input subsidypolicies for farmers so as to enhance production. This initiative can bring about a significant increment in annual cocoa production that will generate foreign exchange for government as well as improve the lives of individual farmers.

### S3\*O5= SOK Model:

Ghana is enriched with favorable climate and soil for the production of cocoa in commercial quantities. Six out of the ten administrative regions are rich cocoa producing areas and there is vast natural resources for the expansion of cocoa production. There are over 800.000 cocoa farmers in the country yet annual production volume is relatively low and for many years Ghana has failed to catch

up to its closest competitor, Ivory Coast in terms of production volume. This has been attributed to the lack of technology and efficient inputs by cocoa farmers.

These strengths can be capitalized as guarantee for the government to invite foreign investors or by itself though COCOBOD, invest in a state owned agro input centre that will provide state of the art equipment and other efficient inputs such as improved varieties of cocoa seedlings and fertilizers which can serve the technological needs of the cocoa industry at a subsidized or contract price conditions for the farmers. With such inputs being available for farmers at subsidized prices or at flexible payment schemes, annual cocoa production is likely to improve.

**S1\*O6=SOO**

With COCOBOD’s resourceful subsidiaries such as the cocoa research institute, seed production unit and disease control unit, effective extension services should be provided for cocoa farmers at all stages of the production cycle so as to closely monitor and guide the farmers throughout the production period. This can ensure that farmers apply best practices to increase productivity hence increased yield.

**T1 Model**

Government must create a policy against the destruction of cocoa farms for gold mining and mineral exploration activities.

Table 7. TOWS matrix for the consumption stage of Ghana’s cocoa industry

	Strengths	Weaknesses
Opportunities	S1*O2=SOA S2*O2=SOB S3*O2=SOC S1*O1=SOD S2*O1=SOE S3*O1=SOF	O2*W1=OWA O4*W2=OWB
Threats	S4*T1=STA	T2 W4

Source: Author’s own construction of TOWS matrix based on the SWOT results

Such as a policy would help preserve valuable cocoa assets and ensure continuous cocoa

production.

**S1\*O2=SOA / S2\*O2=SOB / S3\*O2=SOC Models:**

There is readily available primary raw (cocoa beans) materials at a relatively cheaper price. The high unemployment rate in the country also guarantees readily available Labour. These strengths can be capitalized with investment from government or other entrepreneurs to set up many more cocoa processing and confectionary factories that will add value to the cocoa beans. This will ensure local consumption and patronage of cocoa products as well as a higher internal revenue and foreign exchange for the nation.

**S1\*O1=SOD / S2\*O1=SOE / S3\*O1=SOF Models:**

The availability of the needed factors of production (capital, land and labour) can be capitalized by government to invest in cocoa processing and confectionary factories that will promote the cocoa sector whiles creating employment to ease the poverty situation in the country. This will further create other job avenues in the area of transport, input market, and all the other units on the cocoa value chain.

**S4\*T1=STA Model:**

The government can capitalize on its priority interest in the cocoa sector to create a policy that reduces importation of foreign cocoa confectionary products into the local market and promotes the marketing of local cocoa confectionary products. Government must also encourage the exportation of cocoa in processed or semi processed forms by increasing investment in the local processing sector.

**O2\*W1=OWA Model:**

To promote local cocoa consumption, government can reduce business operational tax in the cocoa processing sector so as to encourage entrepreneurs to invest in setting up many more local cocoa processing companies that will produce many consumable cocoa products in the local market.

**O4\*W2=OWB Model:**

There are lots of cocoa by-products that go waste during the cocoa beans extraction process. By-products such as cocoa pod and husk are left to go waste in Ghana. These are

important by-products that can be used in the manufacture of cosmetic items such as soap, they can also be processed into animal feed or organic fertilizer for crop production. These areas can be capitalized to create cocoa product diversification through the production of these cosmetics, animal feeds and organic fertilizers.

**T2**

By investing in the processing of cocoa by products, cocoa products diversification can be achieved through the production of cosmetics, animal feeds and organic fertilizers from cocoa pods and husk.

**W4**

Government should ensure the expansion of market share for local cocoa processing sector by implementing appropriate policy targeted at the cocoa marketing sector.

Table 8. TOWS matrix for the marketing stage of Ghana's cocoa industry

	Strengths	Weaknesses
Opportunities	S3*O2=SOA S1*O1=SOB	O2*W2 O1*W5
Threats	S1*T1 S4*T2	T1

Source: Author's own construction of TOWS matrix based on the SWOT results

**S3\*O2=SOA Model:**

The concept of the liberalized licensed buying company can be further promoted to create more employment by attracting interested entrepreneurs to obtain operating license as internal cocoa marketing agencies. This will not only increase employment opportunity but also create a good competitive environment for the cocoa marketing sector.

**S1\*O1=SOB Model:**

Ghana can further strengthen its competitive advantage of producing world class premium cocoa beans to attract more demand for its cocoa beans. Furthermore, government can also encourage organic cocoa farms which

will increase the country's market share due to quality.

**S1\*T1=STA Model:**

Ghana's cocoa market share has always been threatened by its closest competitor, Ivory Coast. Ghana can further strengthen its competitive advantage of maintaining its reputation for world class premium cocoa beans.

**S4\*T2=STB Model:**

Ghana must strive to maintain its local customer base in order to reduce loss in the event of a global economic crises that may affects international demand for its cocoa and cocoa products.

**O2\*W2=OWA Model:**

The cocoa internal marketing decentralization system concept can be replicated in the other areas of cocoa industry management which has been solely under government control. This will reduce national political interference in the sector.

**T1 Model:**

In order to fully face the external marketing completion from its close competitors, The Ghana cocoa industry can focus on adding value to the cocoa beans by semi-processing them to increase the value and market share.

**CONCLUSIONS**

Results of the study indicates that, the cocoa industry of Ghana is the principal agricultural sector that projects the country on the global map in terms of agricultural trade. Cocoa represents the second largest source of export earnings accounting for about 30 percent of the nation's total export revenue. According to Bank of Ghana, the sector accounts for more than 9% of agricultural Gross Domestic Product thus making cocoa Ghana's most important crop [11]. It towers over the agricultural sector and is a chief source of livelihood provider for roughly eight hundred thousand farmers likewise many others who are engaged in trade, transportation, and processing of cocoa. Ghana's cocoa cultivation is recognized within the developing world as one of the most modelled commodities [14].

The research targeted three major stages of the cocoa industry of Ghana; the production stage, consumption stage and the marketing stage of the industry.

The production stage is the basis and the most important of all. The major challenges of the production stages of the cocoa industry were the relatively poor yield of cocoa per acre of land cultivated, Inability for Ghana's cocoa production to catch up with its close competitor, Ivory Coast and the lack of efficient technology and inputs to enhance productivity that is visible in yield.

However, results of a SWOT analyses of the production stage indicated tremendous strengths that the industry possesses such as:

- Free extension and technical services to farmers by COCOBOD subsidiaries.

- Favorable climate and soil for high cocoa production capacity

- Well-functioning national cocoa management board (COCOBOD)

- Cocoa industry is prioritized by government.

- Free on Board (F.O.B) prices of cocoa for farmers

- World's 2<sup>nd</sup> largest exporter ranking for the Ghana cocoa industry

- World class quality cocoa production.

Good standing for loan acquisition /factoring.

- Good global market share.

Some of the major weaknesses of the production stage were:

- Low level of technology adoption in the cocoa production sector of Ghana

- Little capital and high cost of production input for farmers

- Low level of education amongst cocoa producers in Ghana.

- Relatively low annual production of cocoa beans

- Farmers complain of low farm gate buying price of cocoa by government.

- About 43% of farms still under the cultivation of varieties with lower productivity.

The SWOT analysis revealed a good number of opportunities that the external environment provides to the cocoa industry in Ghana. The major opportunities that the sector can take advantage of are as follows:

- Vast employment and poverty reduction opportunities for cocoa farmers, provided by the cocoa production sector

- Provision of significant foreign exchange for national development.

- Meeting the high demand for cocoa beans across the world.

- Opportunity for government to establish state owned cocoa farms to substitute for the high demand.

- Opportunity to attract foreign investors to provide cocoa production technology and input services in Ghana.

- Possible opportunity of increasing production volume

A number of factors that could pose threats to the development and sustainability of the cocoa production sector of Ghana were also analysed. The major ones are as follows:

- Competition from the mining sector for land.

- Competition from the growing population and estate industry for land

- Loss through pest and disease infestation

- Competition from higher capacity cocoa producing countries.

A TOWS analysis matrix was constructed to determine possible strategies to manage the production sector within its environments. Some of the strategies were identified as follows:

- The cocoa industry can capitalize on the government's priority interest in the industry to attract state investment into setting up an input subsidy policies for farmers so as to enhance production. This initiative can bring about a significant increment in annual cocoa production that will generate foreign exchange for government as well as improve the lives of individual farmers.

- Ghana is enriched with favorable climate and soil for the production of cocoa in commercial quantities. There are over 800,000 cocoa farmers in the country. These strengths can be capitalized as feasibility guarantee for the government to invite foreign investors or by itself though COCOBOD, invest in a state owned agro input centre that will provide state of the art equipment and other efficient inputs such as improved varieties of cocoa seedlings and fertilizers which can serve the technological needs of the cocoa industry at a

subsidized or contract price conditions for the farmers. With such inputs being available for farmers at subsidized prices or at flexible payment schemes, annual cocoa production is likely to improve.

-With COCOBOD's resourceful subsidiaries such as the cocoa research institute, seed production unit and disease control unit, effective extension services should be provided for cocoa farmers at all stages of the production cycle so as to closely monitor and guide the farmers throughout the production period. This can ensure that farmers apply best practices to increase productivity hence increased yield.

-Government must create a policy against the destruction of cocoa farms for gold mining and mineral exploration activities. Such a policy would help preserve valuable cocoa assets and ensure continuous cocoa production.

The SWOT analysis conducted on this stage revealed the following strengths:

-Readily available raw materials for the local cocoa processing and confectionary industries.

-Raw materials for cocoa processing and value addition will be relatively cheaper due to the absence of import or export charges.

-Readily available labour for operating local cocoa processing factories.

-Government priority on value addition and local patronage through processing and local consumption of cocoa products

The following weaknesses were identified and analysed:

-Low number of existing local cocoa processing and confectionary companies

-Poor product diversification amongst existing local cocoa processing companies in Ghana.

-Low level of investment in the local cocoa processing sector.

-Very low percentage of cocoa beans is sold to the local processing companies.

The following opportunities were identified and analysed:

-Cocoa consumption provides employment opportunities in the area of cocoa processing and product marketing.

-Cocoa consumption provides investment opportunities for local entrepreneurs to

venture into the various enterprises in the cocoa value chain.

-It provides avenue to generate internal revenue and foreign exchange for the nation.

-There is opportunity for the creation of other cocoa by-product industries such as animal feed, organic manure etc.

-The following threats were identified and analysed;

-Competition from already existing multinational cocoa processing and confectionary companies.

-Possible change in consumer demand for cocoa products.

A TOWS analysis matrix was constructed to determine possible strategies to adopt in managing the consumption stage of the sector within its environments. Some of the strategies were identified as follows:

-There is readily available primary raw (cocoa beans) materials at a relatively cheaper price. The high unemployment rate in the country also guarantees readily available Labour. These strengths can be capitalized together with investment from government or other entrepreneurs to set up many more cocoa processing and confectionary factories that will add value to the cocoa beans. The availability of local cocoa products and confectionaries will ensure local consumption and patronage of cocoa products as well as a higher internal revenue and foreign exchange for the nation.

-The availability of the needed factors of production (capital, land and labour) can be capitalized by government to invest in cocoa processing and confectionary factories that will promote the cocoa sector whiles creating employment to ease the poverty situation in the country. This will further create other job avenues in the area of transport, input market, and all the other units on the cocoa value chain.

-The government can capitalize on its priority interest in the cocoa sector to create a policy that reduces importation of foreign cocoa confectionary products into the local market and promotes the marketing of local cocoa confectionary products. Government must also encourage the exportation of cocoa in processed or semi processed forms by

increasing investment in the local processing sector.

-There are lots of cocoa by-products that go waste during the cocoa beans extraction process. By-products such as cocoa pod and husk are left to go waste in Ghana. These are important by-products that can be used in the manufacture of cosmetic items such as soap, they can also be processed into animal feed or organic fertilizer for crop production. These areas can be capitalized to create cocoa product diversification through the production of these cosmetics, animal feeds and organic fertilizers.

-By investing in the processing of cocoa by products, cocoa products diversification can be achieved through the production of cosmetics, animal feeds and organic fertilizers from cocoa pods and husk.

-Government should ensure the expansion of market share for local cocoa processing sector by implementing appropriate policy targeted at the cocoa marketing sector.

The SWOT analysis conducted on this stage revealed the following strengths:

-Ghana receives highest cocoa prices due to premium world class quality

-State controlled external marketing system through the Cocoa Marketing company (CMC) of Ghana.

-Liberalized internal marketing system with good competition.

-Good local and global customer base due to good marketing services.

-Free on Board (F.O.B) price agreement with global customers.

-Ghana operates a traceability marketing system.

The following weaknesses were identified and analysed;

-Monopolized external marketing system (Government being the sole exporter of cocoa)

-National political interference in the cocoa marketing management

-Low market share for processed cocoa which attracts higher value.

-Prices of cocoa beans are predetermined by government rather than farmers.

-Low profit margin for cocoa traders due to high tax marketing cost.

The following opportunities were identified and analysed:

-Increased market demand for Ghana's cocoa due to relatively high quality of beans.

-Employment creation through introduction of the liberalized (private) licensed buying companies for cocoa marketing.

-Attraction of global marketing aid from International marketing companies such as Fairtrade as well as the International cocoa organization (ICCO)

The following threats were identified and analysed:

-Marketing competition from the world's highest producers and exporters of cocoa (Ivory Coast).

-Possible decline in global demand or price for cocoa due to the emergence of alternative product or an economic crises.

A TOWS analysis matrix was constructed to determine possible strategies to adopt in managing the marketing stage of the sector within its environments. Some of the strategies were identified as follows:

-The concept of the liberalized licensed buying company can be further promoted to create more employment by attracting interested entrepreneurs to obtain operating license as internal cocoa marketing agencies. This will not only increase employment opportunity but also create a good competitive environment for the cocoa marketing sector.

-Ghana can further strengthen its competitive advantage of producing world class premium cocoa beans to attract more demand for its cocoa beans. Furthermore, government can also encourage organic cocoa farms which will increase the country's market share due to quality.

-Ghana's cocoa market share has always been threatened by its closest competitor, Ivory Coast. Ghana can further strengthen its competitive advantage of maintaining its reputation for world class premium cocoa beans.

-Ghana must strive to maintain its local customer base in order to reduce loss in the event of a global economic crises that may affects international demand for its cocoa and cocoa products.

-The cocoa internal marketing decentralization system concept can be replicated in the other areas of cocoa industry management which has been solely under government control. This will reduce national political interference in the sector.

-In order to fully face the external marketing completion from its close competitors, The Ghana cocoa industry can focus on adding value to the cocoa beans by semi-processing them to increase the value and market share.

## REFERENCES

- [1]Adu-Appiah. A., Wayo Seini, A., Mensah-Bonsu, A., Dzomeku, B.M., 2013, Internal marketing policy of cocoa in Ghana: farmers' incentives and challenges. *International J. of Innovation and Applied Studies*. 4 (4): 658-664.
- [2]Asamoah, M., Owusu-Ansah, F., 2017, Report on land tenure & cocoa production in Ghana a crig/wcf collaborative survey, Cocoa Research Institute Of Ghana (Crig) And The World Cocoa Foundation (WCF) 1411 K St, NW Suite 500 Washington, Dc 20005.
- [3]Asante-Poku, A., Angelucci, F., 2013, Analysis of incentives and disincentives for cocoa in Ghana. *Monitoring African food and Agricultural Policy (MAFAP), Technical notes series*. Food and Agricultural Organization (FAO), Rome.
- [4]FAO, 2006, Country pasture/forage resource profiles, publishing policy and support branch, office of knowledge exchange, research and extension, food and agriculture organization. Viale delle Terme di Caracalla, 00153 Rome, Italy.
- [5]Ghana Cocoa Board, 2014. 45<sup>th</sup> Annual Report and financial statements for the year ended: 30. Sept .14, Ghana Cocoa Board, Cocoa House 41 Kwame Nkrumah Avenue P.O. Box GP 933 Accra-Ghana.
- [6]Harrison, J.P., 2010, Strategic planning and swot analysis: chapter five, essentials of strategic planning in healthcare. Health Administration Press.
- [7]ICCO, 2017, <https://www.icco.org>, Accessed on 24.12.2018.
- [8]IFAD, 2012, Republic of Ghana country programme evaluation. Independent Office of Evaluation. Document of the International Fund for Agricultural Development. Report No. 2433-GH. IFAD Print shop, Rome, Italy.
- [9]Opoku-Ameyaw, K., Baah, F., Gyedu-Akoto, E., Anchirinah, V., Dzahini-Obiatey, H. K., Cudjoe, A.R., Acquay, S., Opoku, S.Y., 2010, Cocoa Manual—A Source Book for Sustainable Cocoa Production. Cocoa Research Institute of Ghana, Tafo, Akim.
- [10]Osita, I. C., Onyebuchi, I. R., Justina, N., 2014, *International Journal of Innovative and Applied Research*. 2(9): 23-3.
- [11]UNDP, 2013, The Ghana cocoa platform: support for development and operation of cocobod's Ghana cocoa platform. UNDP and COCOBOD.
- [12]Vigneri, M., Santos, P., 2007, Ghana and the cocoa marketing dilemma: What has liberalisation without price competition achieved?. ODI and University of Sydney. Overseas Development Institute 111 Westminster Bridge Road, London SE1 7JD.
- [13]Whalley, A., 2010, Strategic Marketing. Andrew Whally and Ventus Publishing APS.
- [14]World Bank Assessment, 2011, Ghana Cocoa SCRA Report, Agricultural Risk Management Team, Agricultural and Rural Development (ARD) department, 1818 H Street, NW Washington, D.C. 20433 USA.

## ORGANIC VITICULTURE: REAL OPPORTUNITIES FOR IMPLEMENTATION

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### Abstract

*Organic viticulture is becoming increasingly popular around the world. This trend is based on a system of technological methods aimed at maintaining the biodiversity of grapevine, the successful cultivation and consumption of grapes with minimal use of chemical treatments, and therefore with minimal content of their residues in the crop. Viticulture would benefit from the creation of new varieties of grapevine, with stable productive potential, to produce high-quality derivative products. As a result of interspecific hybridization (*Vitis vinifera* L. ssp. *sativa* D.C. x *Muscadinia rotundifolia* Michx.), promising own-rooted table grape and wine grape varieties have been created and identified, for example: Malena, Nistreana and Algumax, and Augustina, Alexandrina and Ametist, respectively. The cultivation of interspecific genotypes of grapevine can reduce the negative impact on the environment by reducing the number of chemical treatments of plants.*

**Key words:** organic, grapevine, interspecific genotypes, breeding

### INTRODUCTION

Organic viticulture is becoming increasingly popular around the world. This trend is based on a system of technological methods aimed at maintaining the biodiversity of grapevine, the successful cultivation and consumption of grapes with minimal use of chemical treatments, and therefore with minimal content of their residues in the crop [2, 3, 19]. A research on this issue was carried out by the Research Institute of Organic Agriculture, in Switzerland, which published data on the total area of organic vineyards in the world. In 2015, this area was more than 400 thousand hectares. It has been found out that the transition of vineyards from traditional to organic technologies takes 3 years, after which the grape harvest is considered to comply with the established requirements. As for the growth rate of the area of vineyards cultivated according to the organic technologies, it was established that from 2005 to 2015, it trebled. The world leaders, in terms of area of organic vineyards and production of organic grapes, are Spain – with 85 thousand hectares, France – 75 thousand hectares, Italy – 65 thousand hectares, Mexico

– 35 thousand hectares and China – 20 thousand hectares. Currently, the shares of areas of organic vineyards in European countries are as follows: Austria – 10.7 %, Italy – 10.3 %, Spain – 8.9 %, France – 8.7 %, Germany – 7.5 %, Portugal – 1.5 % [19]. More than 270 thousand hectares of organic vineyards are cultivated on the European continent, which makes up 67.5 % of the total area of organic vineyards in the world. This new trend in grape cultivation is developing rapidly in China, Turkey, Italy, Germany, Argentina, Chile, Australia and South Africa.

### MATERIALS AND METHODS

The subject of the research was the collection of grapevine plants of the Institute of Genetics, Physiology and Plant Protection, Chisinau, Republic of Moldova. The collection includes 140 genotypes of interspecific and intraspecific, grafted and own-rooted genotypes of grapevine. The method of distant hybridization was used to create interspecific own-rooted genotypes of grapevine [4-7]. Studies were conducted in accordance with the methods of describing

grapevine varieties [1, 8, 9], Methodical Recommendations for Grapevine Breeding, Study of grapes to determine how to use them. Uvology [11]. The physicochemical assessment of derivative products of interspecific genotypes of grapes was performed in accordance with the methods for analysing derivative products [12, 10, 16]. To determine the resistance of the studied genotypes to phylloxera, pathogenic microorganisms etc., the methods mentioned in Normal and Pathological Anatomy of Grapevine Roots and Complex Protection of Grapevine [14-17] were used.

## RESULTS AND DISCUSSIONS

In the European market, there is a great demand for organic grapes, and it equally applies to grapes intended for consumption while fresh (table varieties) and those for the production of wine and distilled drinks. The organic cultivation of grapevine leads, on the one hand, to a reduction in the contamination of grapes with residues of the substances used to protect them from diseases and pests, and on the other hand, to a lower degree of environmental pollution (soil, water and air). The European Union supports organic viticulture, by subsidizing this type of activity of winegrowers (at the transition stages from traditional to organic cultivation of grapevine), covering the losses of economic agents whose vineyards have suffered from hail, epiphytotic diseases and prolonged rains that have led to crop loss. However, taking into account the fact that the demand for organic grapes (table and wine grapes) is constantly raising, not only in Europe, but also in North America and East Asia, at present, their price is 40-60 % or even 100 % higher. This, of course, attracts winegrowers, and today about 10 % of vineyards in the countries of the European Union are certified as "organic". In France, in Alsace, some programs have been created to inform people about the peculiarities of the organic cultivation of grapevine, and their students are representatives of the grape-growing and winemaking industry of most EU countries, as

well as Canada, the USA, Israel, Australia, New Zealand, China etc.

Currently, the technology of cultivation of organic grapevine must be consistent with certain standards: for example, the use of copper is limited to 3 kg per hectare per year, and the maximum sulphur application – 6 kg per hectare per year. There are countries where these standards differ in the direction of a slight decrease, but in all cases, the extract (infusion) of nettle, bark and leaves of oak, leaves of walnut, calendula etc. are widely used along with fungicides based on copper and sulphur.

However, the cultivation of grapes according to the organic technologies in the Republic of Moldova faces certain difficulties, which are the main reason behind the slow introduction of this new trend of the grape-growing and winemaking. One of them is the absence of biopreparations, produced on an industrial basis, to inhibit the growth of micromycetes (*Botrytis cinerea* etc.) and pests (leafroller moths etc.). For example, in France, a biopreparation made from *Trichoderma viride* is produced under the brand name Trichodermin B14; it has been proven to suppress the growth of mould fungi on berries and leaves in rainy weather by more than 60 % [13]. However, it has been found that this biofungicide loses a part of its action during the months with dry weather (August-September) which reduces the effectiveness of the treatment and increases the risk of micromycete infection at the beginning of the rainy period (September-October) [18]. Moreover, it has been found that the action of Trichodermin B14 is inhibited by residues of copper ions on leaves and berries, which remain after previous treatments of vineyards. In this case, the scientists from the French National Institute for Agricultural Research [3] have begun to grow the biomass of the antagonist *Trichoderma viride*, against grey mould, enriched with copper ions. Under these conditions, the biofungicide was resistant to the inhibiting effect of copper residues on leaves and berries and provided more than 75 % growth inhibition in mould fungi.

Another problem in organic viticulture is the isolation of areas with grapevine in the stages of conversion (within 3 years) from those cultivated nearby, by traditional technology. As a rule, the easiest way of solving this problem is to choose an entire vineyard (plantation), surrounded by other agricultural crops (fodder grasses, sometimes cereals etc.), or shelterbelts, often encountered in our country. The generally accepted rules for organic cultivation of grapes also stipulate the absence of any source of chemical or biological pollution (wastewater treatment plants, chemical plants, landfills etc.). In our opinion, the prices for the certification of plantations, which have been established by international organizations, licensed in this regard, are too high and unjustified, especially in cases of small plantations of grapes and other berries, fruits etc.

Other advantages of organic methods are a significant reduction in environmental pollution, lower costs for the purchase and use of expensive chemicals, as well as higher sale prices for wine and table grapes. In the EU markets, the price of certified organic grapes is 40-60 % or even 100 % higher as compared with the price of grapes cultivated by traditional methods.

Among the main problems faced by this new technology of cultivation of grapevine, there are the difficulties of using classical varieties of the genus *Vitis vinifera* L., because of the high susceptibility to the attack of micromycetes and pests, and the low frost tolerance. These are very important factors under the harsh conditions of the continental climate in our country, with high humidity and heavy rains in spring, which create favourable conditions for the development of dangerous diseases and pests, and which complicate the timely and effective use of chemical remedies in the framework of the organic technology. On the other hand, in the second half of summer and early autumn, the weather contributes to the development of other diseases, among which, powdery mildew (caused by *Oidium*) and grey mould of grapes are the most dangerous. The way out of this difficult situation may be the wide use of new grapevine varieties with higher

resistance to biotic and abiotic environmental conditions [4]. The last fifty years of breeding grapevine have resulted in the creation of some promising varieties of wine grapes to be cultivated by organic methods: Viorica, Legend, Riton, Luminita, (Moldova), Bianca, Chardonel, Aletta, (Hungary), Vidal Blanc, Triumph of Alsace, Shamborsin (France), Fleurtaï, Soreli, Savignon Cretos, Julius, Sagiovese etros, Merlot Chorus, Cabernet, Jerez, Julio, Caberigne Cretos, Julius, Sagiovese etret (Italy), Cabernet Jura, Pinotin, Cabernet blanc (Switzerland), Aromatny, Muscat Odessa, Zagreus, Rubin Tairovsky, Aghat Tairovsky, Golubok, Illichivsky early, Sparkling, Ovidiopol, Odessa Black, Rodnichek etc. (Ukraine). Grapevine varieties with high resistance to diseases and pests have been obtained and recommended for breeding and cultivation in Crimea – by the Institute of Viticulture and Winemaking “Magarach”, in Russia – by the All-Russian Research Institute of Viticulture and Winemaking “Ya.I. Potapenko”, in Bulgaria – by the National Institute of Viticulture and Oenology in Pleven, in Romania – by the Research and Development Institute for Viticulture and Winemaking “Valea Călugărească”. However, the above-listed varieties are susceptible to phylloxera, which makes it necessary to create vineyards from planting material grafted on phylloxera-resistant rootstocks. The viticulture sector needs new grape varieties, with stable productive potential, for the production of high-quality derivative products. The European grapevine varieties of *Vitis vinifera* L. ssp. *sativa* D.C., registered in the Republic of Moldova, as well as in other wine-producing countries, are susceptible to phylloxera (*Phylloxera vastatrix* Planch.) and that is why vineyards should be created from planting material grafted on phylloxera-resistant rootstocks. Besides, because grapevine is sensitive to low temperatures in winter, additional measures are necessary to protect plants during the period of vegetative rest.

To obtain competitive products, it is necessary to use mandatory chemical treatments to prevent or destroy pests, micromycetes and other pathogenic agents. However, these

treatments affect the cost of production and pollute the environment. The creation of own-rooted grapevine plantations is a good prospect, but for this, it is necessary to enrich the grape assortment with new genotypes, resistant to diseases and pests. As a result of research, a methodology was developed for the creation of own-rooted interspecific genotypes of grapevine *Vitis vinifera* L. ssp. *sativa* D.C. x *Muscadinia rotundifolia* Michx., resistant to biotic and abiotic factors. Donors of valuable agrotechnological traits were included in the breeding process, as a result of which high-quality, stable and productive grapevine genotypes were created.

Mastering the biological potential of interspecific genotypes will allow obtaining high-quality products from grapes, reducing costs and the use of chemicals in the process of controlling micromycetes and pests. The created genotypes have significant agrobiological and technological potential, which allows developing further research in the field of genetics and breeding of grapevine, using the method of distant hybridization. Thus, after of crossing *V. vinifera* x *M. rotundifolia*, interspecific genotypes of grapevine have been created in BC<sub>3</sub>, with acquired agrobiological and technological properties, which allow expanding the area where grapevine can be cultivated in the northern regions and reducing the number of chemical treatments that will contribute to obtaining ecological products and protecting the environment. In the process of identifying the genetic functionality of the related taxa, *V. vinifera* and *M. rotundifolia*, characterized by low combining ability, it was found that this obstacle could be overcome by backcrossing. A wide range of recombinants, which allows improving the efficiency of distant hybridization in the process of selection of valuable characteristics, has been obtained as a result of this process. The differences in the classification of interspecific genotypes of grapevine based on DNA profiles (SSR markers) and ampelographic criteria prove the importance of *genotype x environment* specific interactions in the development of biological and technological features of the

hybrid. The multilateral research on biological and agrotechnological features, the participation in hybridization of the genotypes of different ecological and geographical origin of *V. vinifera* and *M. rotundifolia* and the elimination of aneuploid forms during subsequent crosses leads to the stabilization of the interspecific genome ( $2n = 38$ ) with valuable agrobiological features and stability. The interspecific genotypes *V. vinifera* x *M. rotundifolia* can be propagated by cuttings from own-rooted, competitive planting material, to obtain early-ripening grapes.

When creating new grapevine varieties, by interspecific and intraspecific hybridization, it is very important to take into account the concentration, in the berries, of such chemicals as resveratrol, which ensures the resistance of the plant to adverse environmental factors. A comparative analysis of the concentration of resveratrol in the juice of wild grapes and its concentration in the berries, obtained after hybridization, has shown that, in the juice of wild grapes, the concentration of resveratrol is approximately two times higher than in subsequent generations, obtained as a result of hybridization. That is, as more generations are created, moving away from the wild representatives of the species, the concentration of resveratrol in the juice of the grapes keeps decreasing. The created interspecific genotypes of grapevine have been studied in detail according to agrobiological and technological criteria.

The evaluation of the quality of grapes and derived products, over the years, has made it possible to select and cultivate promising own-rooted genotypes of grapevine. The interspecific genotypes of *V. vinifera* x *M. rotundifolia* are easily propagated by cuttings and can be cultivated on their own roots, thereby offering the opportunity to skip some practical steps, as well as reduce financial costs in the process of producing planting material and growing grapevine. According to the uvological and oenological criteria, the grapes of the new genotypes are not inferior to the classical varieties of *V. vinifera* in their biochemical composition and organoleptic qualities. Besides, they can be grown in the

northern areas, where most plants of *Vitis vinifera* L. ssp. *sativa* D.C. do not withstand low temperatures in winter. Studying the physicochemical properties of blue-violet grapes of the interspecific genotypes (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.), it has been found that phenols, resveratrol and pectins are present in them in larger quantities than in green-yellow grapes, also exceeding the amount of these substances in the berries of the varieties of *V. vinifera* L. The quantity of resveratrol in the juice of berries of the interspecific genotypes of grapevine is 6.68 mg/l in berries with a green-yellow hue (BC<sub>3</sub>-510 etc.), 9.3 mg/l in berries with a pink hue (BC<sub>3</sub>-520 etc.) and 14 mg/l in berries with a blue-violet hue (BC<sub>2</sub>-3-1, BC<sub>3</sub>-660 etc.). From the populations of interspecific genotypes BC<sub>3</sub> (*V. vinifera* x *M. rotundifolia*), several promising own-rooted varieties have been selected, among them, there are table grapes, such as Malena, Nistreana and Algumax, and wine grapes: Augustina, Alexandrina and Ametist.

## CONCLUSIONS

From the populations of interspecific genotypes BC<sub>3</sub> (*V. vinifera* x *M. rotundifolia*), several promising own-rooted varieties of table grapes have been selected, such as Malena, Nistreana and Algumax, and other selected varieties, such as Augustina, Alexandrina and Ametist, can be used as table grapes too, but also as wine grapes.

Growing interspecific genotypes of grapevine will decrease the negative impact on the environment by reducing the number of chemical treatments.

Due to the high resistance of distant hybrids to pests and diseases, the costs associated with the creation of planting material are reduced. Besides, as mentioned above, the number of chemical treatments during the cultivation process is reduced, thus minimizing environmental pollution.

In addition, the area of cultivation of grapevine can be expanded to the north, where the climatic conditions are unfavourable for the varieties of *V. vinifera*, which cannot tolerate the low winter temperatures, while the

studied interspecific genotypes are more winter-hardy.

## REFERENCES

- [1]Alexandrescu, I., Oslobeanu, M., Jianu, L., Pituc, P., 1972, Mica enciclopedie de viticulture (The small encyclopedia of viticulture). "Glasul Bucovinei" Publishing House, Iași, 1972.
- [2]Alexandrov, E., 2017, The genotypes feed-back to the environmental factors. In: Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development. Vol. 17, Issue 1: 43-48.
- [3]Alexandrov, E., 2016, The concentration of the chemical compounds and the color of berry to the varieties of the interspecific hybrids to the vines (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.). In: Scientific Papers Series Management, Economic in Agriculture and Rural Development, Vol. 16, Issue 1: 53-56.
- [4]Alexandrov, E., 2016, Interspecific hybrids of vines (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.) with increased resistance to biotic and abiotic factors. In: Scientific Papers Series Management, Economic in Agriculture and Rural Development, Vol. 16, Issue 1: 39-44.
- [5]Alexandrov E., 2015, New requirements in the creation of varieties of vine with the economic and ecological effect in the conditions of climate change. In: Scientific Papers Series Management, Economic in Agriculture and Rural Development, vol. 15, Issue 3: 35-42.
- [6]Alexandrov E., 2012, Hibrizii distanți ai viței de vie (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.). aspecte biomorfologice și uvologice. (The distant hybrids of vine (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.). Biomorphological and uvological aspects), Chișinău, 140 p.
- [7]Alexandrov E. 2010, Hibridarea distantă la vița de vie (*Vitis vinifera* L. x *Vitis rotundifolia* Michx.). (Distant hybridisation in vine (*Vitis vinifera* L. x *Vitis rotundifolia* Michx.)). Chișinău: „Print-Cargo” SRL, 192 p.
- [8] Ampelograficheskiy atlas sortov i form vinograda selektsii Natsional'nogo Nauchnogo Tsentra «Institututa vinogradarstva i vinodeliya im. V.Ye.Tairova». (The ampelographic atlas of varieties and forms of grapes for breeding by the National Scientific Center "Institute of Viticulture and Winemaking named after VE Tairov".) K.: Agrar. Nauka, 2014. 138 s.
- [9]Entsiklopediya vinogradarstva (Encyclopedia of viticulture). v 3-kh tomakh. Kishinev. 1986-1987.
- [10]Gaina, B., Lafon-Lafourcade, S., Dubos, B., 1981-1983, Incidence eonologique du traitement biologique de la vigne par *Trichoderma veride* a l'egard de la pourrituregrise. Inestitud'oenologiqic, Raport des activites de recherches, p.75.
- [11]Gaina, B., Alexandrov, E., 2015, Pagini din istoria si actualitatea viticulturii (Pages from viticulture

history and actuality). Chisinău: Lexon-Plus, Reclama Printing Hiuse, 260 p.

[12]Gaina, B., 1990, Enologiya i biotekhnologiya produktov pererabotki vinograda (Enology and biotechnology of grape processing products). Shtiintsa, Kishinev, 167 s.

[13]Gaina, B., Pucheu-Plante, B., Lafon-Lafourcade, S., 1981-1983, Insidene de dezvoltare des moisissures sur le raisin a l'egard de la calitate des mouts e des vins. Institut d'oenologie, Raport des activites de recherches, p.61.

[14]Nedov, P., 1977, Imunitet vinograda k filloksere i vzbuditelyam gnieniya korney (Immunity grapes to phylloxera and pathogens root rot.). Shtiintsa, Kishinev, 169 s.

[15]Nedov P., 1978, Filloksernaya problema i selektsiya vinograda na kompleksnyy imunitet k vreditelyam i boleznyam. Genetika i selektsiya vinograda na imunitet (The phylloxeric problem and the selection of grapes for complex immunity to pests and diseases. Genetics and selection of grapes for immunity). Trudy Vsesoyuznogo Simpoziuma. Kiyev, s. 35-45.

[16]Nedov, P., Guler, P., 1987, Normal'naya i patologicheskaya anatomiya korney vinograda (Normal and pathological anatomy of the roots of grapes.). Kishinev: Shtiintsa, 151 s.

[17]Print, I., 1965, Vinogradnaya filloksera i mery bor'by s ney (Grape phylloxera and measures to combat it.). Moskva: Nauka, 294 s.

[18]Ungureanu, P.N., 1960, Osnovy vinodeliya Moldovy (Basics of Moldova winemaking). Trudy MNIISViV, Tom. 5, Izd. Kartea Moldovenyaske. Kishinev. 1960, 296 s.

[19]Vlasov, V.V., Mulyukina, N.A., Zelenyanskaya, N.N. i dr., 2018, Vinograd (Grapes). Odessa, Astroprint. 616 s.

## CORPORATE GOVERNANCE AND FIRM PROFITABILITY IN AGRICULTURAL SECTOR: EVIDENCE FROM ASIAN COUNTRIES

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### Abstract

*The objective of this research is to determine the relationship between corporate governance practices and firm profitability for the companies in agricultural sector of Asian countries for the period of 2008 to 2017 as agriculture is one of the most important sectors in these economies. The results demonstrate that the variables of board independence, ownership concentration, audit committee independence, leverage and sales growth have significant positive relationship with return on assets (ROA), whereas, the variables of quality of corporate governance, board size, CEO duality and firm size have significant negative association with return on assets (ROA). Moreover, the endogeneity of the board structure variable was investigated by applying the Two Stage Least Squares (2SLS) regression model. The results of the 2SLS regression model depicts that variables of board independence, audit committee independence and sales growth have significant positive association with return on assets (ROA), whereas, the variables of quality of corporate governance, leverage and firm size have significant negative relationship with return on assets (ROA).*

**Key words:** corporate governance, return on assets, agricultural sector, Asian countries, firm profitability

### INTRODUCTION

This paper studies association of governance practices and business profitability by incorporating a sample of companies from agricultural sector in Asian countries. There are several theories which point out association of governance practices with wealth of shareholders. Stewardship and agency theories recommend that governance is about maximization of shareholders wealth thus points out the link of governance with wealth of shareholders. The profitability is a fundamental factor of wealth creation. The debate regarding optimum capital structure also establishes the link of capital structure with profitability and wealth of shareholders. However, the association of governance practices with profitability has not been sufficiently investigated and several studies have pointed out the need for such kind of research.

This research empirically examines this issue by utilizing data of companies from agricultural sector in Asian countries as

empirical studies regarding governance practices are comparatively lesser for Asian countries and there is a gap in existing literature for effect of governance systems on business performance in agricultural sector. These gaps in existing literature offer strong motivations to conduct this study as this study will bridge these gaps in empirical literature.

The study aimed at bridging this gap by investigating whether better governance practices could result in improving business performance by utilizing a sample of firms from agricultural sector in 20 Asian countries from Year 2008 to Year 2017. This research conduct analysis to determine relationship of governance systems variables with business profitability and controlling for variables of level of leverage, firm size, sales growth and volatility of stock prices for companies from agricultural sector.

*The objective of this research is to determine whether Better Governance practices Results in increasing the Firm's Profitability.*

The study on correlation of governance practices systems with business profitability

in Asian economies will facilitate investors, policy makers and managers to have improved insights of governance practices role in organizations. Each of these companies represents a unique economic situation. Moreover, as the companies included in the sample are taken from agricultural sector, therefore, findings of this research are extremely significant for policy makers and decision makers in agricultural sector.

The remaining research has been organized as follows: the literature review has been presented in section 2; research methods: research framework has been provided in section 3. The section 4 presents results for firm profitability and corporate governance practices, whereas, the section 5 provides conclusion and directions regarding future research.

#### *Literature review*

The corporate governance literature in developed and developing economies presented controversial results for correlation of corporate governance with financial performance of organizations [18]. Several studies analyzed relationship of corporate governance with business performance but findings are not conclusive.

Most of studies have supported positive association of governance practices with financial performance of companies e.g. [17] examined association of independent board composition with business performance for Bangladeshi companies and detected independent board directors improve firm value and performance.

[12] observed effect of board's activity, capital structure and ownership structure on business performance. The findings revealed that composition of board and investors having substantial voting power have positive relationship with business performance. [15] assessed relationship of governance practices with performance of Indonesian organizations and disclosed that all internal governance systems excluding size of board and audit committee along with managerial ownership have significantly positive influence on firms' performance.

[14] studied relationship of governance practices and financing strategies with

performance of companies by utilizing data for 84 public firms on Tehran Stock Exchange for 2007-2011. The authors found that capital structure, financing decisions and corporate governance practices affect performance of businesses. Additionally, [19] assessed link among corporate governance practices, business performance, risk taking attitude and ownership structure of firm. The results demonstrated that improvement in governance practices has positive effect on performance and risk level of firm, whereas, governance practices has negative correlation with ownership concentration.

Some researchers have also found negative association of governance practices with business profitability e.g. [18] checked influence of CEO duality on organizational performance by utilizing sample of 204 firms in Istanbul from 2009 to 2010. The results found negative relation of CEO duality with firm performance. The stockholders will get higher return in businesses which have separate chairman and CEO.

Some researchers have also discovered neutral correlation of governance practices with firm performance e.g. [18] explored correlation of corporate governance with profitability and value of Turkish companies and found insignificant association of corporate governance with financial performance. [10] examined influence of governance practices on financial distress and performance of banks in UAE. The researcher discovered positive and significant relation of financial distress with corporate governance systems insignificant relation of corporate governance practices with performance level.

[20] investigated correlation of corporate governance practices with performance of insurance firms during 2005-2009 for Ghana. The results showed that independent audit committees have positive association with performance of insurance businesses in Ghana. [10] examined relation of independent audit committees with organizational performance for 106 financial listed companies in Amman for period of 2008-2009 and concluded that independent audit committees have significant effect on company performance. [1] described that

institutional ownership has significant impact on performance of Pakistani businesses. [3] demonstrated that a relationship exist between governance index and business performance in Indian economy.

We can also see from the literature review that few studies depicted a positive association of governance practices with firm performance, whereas, some other studies depicted a negative and insignificant correlation of corporate governance practices with firm performance. Moreover, there is dearth of literature which provides insights for association of governance practices with firm profitability in agricultural sector of Asian economies. Therefore, major purpose of this research is to bridge this research gap by investigating relationship of corporate governance practices with firm performance in agricultural sector of Asian economies for the period of 2008 to 2017 as regulatory authorities are trying to encourage better governance practices in agriculture sector of Asian countries. This study anticipates a positive correlation of changes in corporate governance practices with firm profitability measured through return on Assets (ROA) for firms from Asian countries.

Consequently, the hypothesis of this research is as follows:

*H1: Better Corporate Governance Practices Results in Increasing the Return on Assets (ROA).*

## MATERIALS AND METHODS

This section presents the framework for this research. It also provides empirical models of this study. The methodology to determine association of corporate governance practices with firm performance for firms from agriculture sector in Asian countries has also discussed.

The Figure 1 presents conceptual framework of this research. The variables for corporate governance practices which past studies and regulators in Asian countries specified as significant principles are recorded on the left hand side. These variables include: Board Independence, Ownership Concentration, Audit Committee Independence, Quality of Corporate Governance, Board Size, CEO Duality

Corporate Governance, Board Size and CEO Duality. The proxy for firm profitability is specified on the righthand side which is return on assets (ROA). The return on assets has been computed as net income divided by total assets [5].

The effects of control variables on ROA have also controlled in the model and these variables include: Firm Leverage, Firm Size, Sales Growth and Firm's Systematic Risk. These variables are employed as the influencing factors in the relationship of corporate governance practices and firm performance.

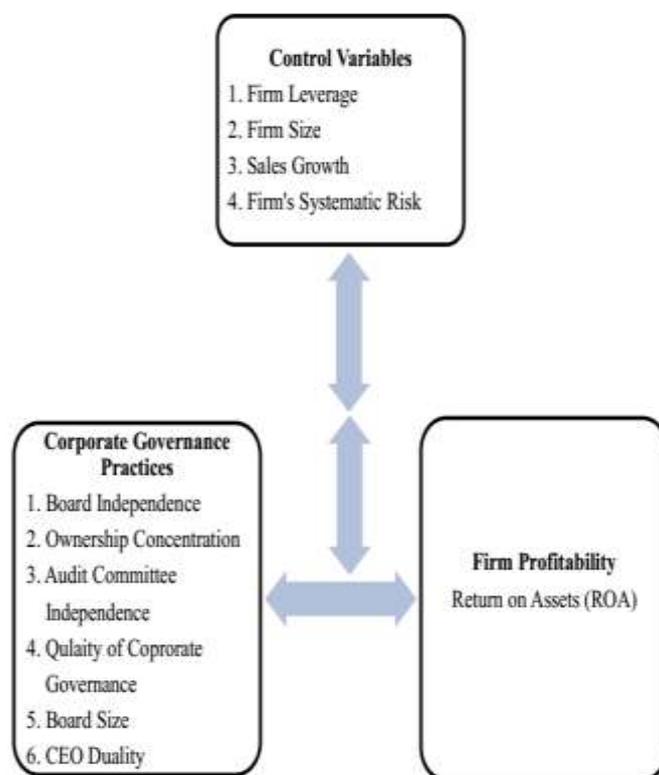


Fig. 1. Possible Relationship of attributes for Governance Practices and Firm's Profitability  
 Source: Adapted from the Corporate Governance Practices and Cost of Capital: Evidence from Asian Countries (p. 100), by Zeshan Anwar, 2017, PhD Dissertation, The University of Lahore, Pakistan.

### Data and Selection of Sample

This research uses quantitative research technique, as the purpose is to find the relationship of certain factors of corporate governance practices with firm profitability for firms from agriculture sector in Asian economies. The hypothesis is developed based on results of prior studies in corporate governance area.

The sample of this research is selected from firms of agriculture sector in 20 Asian countries. The data covers the period of Year 2008 to Year 2017 and it excludes financial companies and the firms for which complete dataset is not available.

The required data is collected from annual reports of companies, stock exchanges of concerned countries and organization's web sites.

The final sample of 363 non-financial companies from agriculture sector is included in the dataset of this research as the representatives of companies from agricultural sector in Asian countries (Appendix I).

#### Variables

Dependent and independent (explanatory) variables utilized in this research are explained in following portion.

The dependent variable of firm profitability measured through return on assets (ROA) has been measured as dividing the net income after taxes with total assets [5].

The independent variables used in this research are factors described as components of governance practices by past studies (table 1).

These factors influence performance of the firm positively or negatively. Just like the measures of governance practices incorporated in previous research [5], this study will also include the variables of BI, OWN, AI, QCG, BSIZE and DUAL. Specifically, most of factors to be analyzed are variables of internal governance practices which effect firm's profitability as depicted by previous research. The approaches by which these factors are estimated in this research are described as follows:

Board Independence (BI) is percentage of outsider directors to total directors on the board (independent directors). An outsider director is a board member who is not included in team of executive managers and they are not employees of the firm and they don't have any other affiliation with the organization.

The outsider board directors are distinguished from insider directors who are currently serving or have previously served as the firm's executive managers.

Table 1. Explanation and Measurement of Variables

Variables	Measurement Technique
<b>Dependent</b>	
ROA	The net income divided by the total assets
<b>Independent</b>	
BI	Board Independence measured as independent directors divided with total directors
OWN	Ratio of Common Stock owned by five largest to total issued stock
AI	Measured as independent directors divided by total directors on audit committee
QCG	Quality of Corporate Governance calculated as: $QCG = f(BS, OS \text{ and } AI)$
BSIZE	Board Size calculated as total board directors
DUAL	The firms with dual role of CEO are equal to one and zero, otherwise
SIZE	Natural logarithm of total assets
VOLA	One year volatility of firm stock prices
LEV	The ratio of total debt to total assets
SALESGROW	The log of sales growth rate

Source: Adapted from the Corporate Governance Practices and Cost of Capital: Evidence from Asian Countries (p. 116), by Zeshan Anwar, 2017, PhD Dissertation, The University of Lahore, Pakistan.

The variable of ownership concentration (OWN) as considered in this research is percentage of stocks owned by top five stockholders to total issued stock in a firm.

An independent audit committee is also an important variable for better governance practices. The variable of Audit Committee Independent (AI) calculated as ratio of independent directors to total directors in committee.

This research also employs an index for determining quality of governance practices. In this study, following the work of [13] and [2], variable for Quality of Corporate Governance (QCG) will be calculated through following equation (Appendix II):

$$QCG = f(BI, AI, OWN, DUAL) \quad (1)$$

where BI = board independence, AI = audit committee independence, OWN = Ownership Concentration and DUAL = CEO Duality.

The above equation shows the theoretical framework for measurement of governance.

These factors will be used independently as a proxy for governance practices and also collectively for calculating governance scores for each organization.

The board size (BSIZE) is also a significant variable for governance activities in a company and is represented as total board directors and calculated as total board directors. Separation of board chairman and CEO is also critical component of governance practices in firm and it has major influence on business performance and capital cost. This research represents CEO and board chairman separation as CEO Duality (DUAL) and it takes value of one if chairman and CEO are same and value of zero if CEO and chairman are different persons.

The control variables which are having predictive power regarding an organization's profitability as shown by the empirical literature are also included in the regression models for controlling their predictive influences. These variables include Firm Size, Volatility, Leverage and Sales Growth. The explanation and measurement of dependent variables, independent variables and control variables has been provided in the Table 1.

#### *Research Methodology*

For analyzing the stated hypotheses, this research will estimate panel data regression equation. This regression equation will be estimated with Pooled OLS Regression Model, Fixed Effects and Random Effects Models; then Hausman Test will be used to identify whether Fixed or Random Effects Model would be applicable for the specific regression equation. In case test statistic will be rejected, it means that the fixed effects technique will fits data better as compared to random effects technique and therefore, fixed effects models should be preferred. Secondly, the regression diagnostics would be estimated for checking the problems of Auto Correlation/Serial Correlation and Heteroskedsticity. Thirdly, in case the problems of serial correlation or heteroskedasticity would be detected from the regression diagnostics then it implies that the Fixed Effect or Random Effects Regression Models would provide spurious regression results. Therefore, to overcome this problem,

Panel Corrected Standard Errors (PCSE) Regression Model would be employed to estimate the regression equations. Fourthly, the Two Stage Least Squares (2SLS) Model would be employed to check endogeneity problem of the independent variables.

The base regression model for testing relationship of corporate governance practices with firm's profitability is stated below.

$$ROA_{i,t} = \beta_0 + \beta_1 BI + \beta_2 OWN + \beta_3 AI + \beta_4 QCG + \beta_5 BSIZE + \beta_6 DUAL + \beta_7 LEV + \beta_8 SIZE + \beta_9 SALES\text{GROW} + \beta_{10} VOL + U_t$$

## **RESULTS AND DISCUSSIONS**

As the literature describes that most of the time the panel data suffers with the problems of autocorrelation / serial correlation and heteroskedasticity and in this case, the results of fixed effect or random effects regression models may provide spurious regression results. Therefore, the regression diagnostics tests have been used to check problems of heteroskedasticity and serial correlation in panel dataset used in this study for analysis.

The Wooldridge test of autocorrelation in panel data has been used for checking the presence of auto correlation / serial correlation in data used in this study and results describes that the probability value of F statistics is 0.0000, so we would reject null hypothesis of absence of first order autocorrelation and accept the alternative hypothesis of presence of first order autocorrelation in dataset. So, we concluded that the dataset used in this study incorporates the problem of autocorrelation / serial correlation.

In order to verify presence of heteroskedasticity problem, the Modified Wald Test for groupwise heteroskedasticity has been utilized and findings demonstrates that probability value of Chi2 is 0.0000, so we would reject null hypothesis that panel data does not have the problem of heteroskedasticity against the alternative hypothesis that the panel data does have the problem of heteroskedasticity. So, we can conclude that the dataset used in this study suffers with the problem of heteroskedasticity.

Therefore, the fixed effects or random effects regression models may not be suitable in this scenario as they may provide spurious regression results.

There is a problematic situation as common techniques of panel analysis are incapable of handling both cross sectional dependence and serial correlation simultaneously. [4] reported that ‘Panel Corrected Standard Error’ (PCSE) model provides considerably better results for handling both problems. So, based on the literature, the PCSE regression model has been also employed to establish correlation of cost of debt with governance variables along with control variables and the results have been reported in table 2.

Table 2. Panels Corrected Standard Errors (PCSE) Regression Model

Panel-corrected		
ROA	Coef.	Std. Err.
BI	4.338*	2.227
OWN	2.528*	1.361
AI	1.052**	1.136
QCG	-.526***	.187
BSIZE	-.071	.074
Dual	-1.106	.777
LEV	2.990*	1.602
SIZE	-1.331***	.257
SALESGROW	.404	.246
VOLA	-.053	.681
_cons	20.161	3.370
Rho	.613	
***Significant at p-value <1%, **Significant at p-value <5%, *Significant at p-value <10%		

Source: Adapted from the Corporate Governance Practices and Cost of Capital: Evidence from Asian Countries (p. 184), by Zeshan Anwar, 2017, PhD Dissertation, The University of Lahore, Pakistan.

The results have indicated that variable of board independence, audit committee independence and ownership concentration have positive and significant impact on return on assets (ROA) for companies in agricultural sector of Asian economies which mean that higher board independence and more ownership concentration would result in increased return on assets. The control variable of leverage also has positive and significant correlation with return on assets. These finding are same to the results of

previous studies, for example [6]; [7]; [9]; [11]; [16] and [21].

The results also depicts that the variables of quality of corporate governance has negative and significant correlation with return on assets in Asian countries. The control variable of firm size also has negative and significant association with return on investment which means that the companies in agricultural sector of Asian countries have lesser return on assets. Moreover, the variables of board size, CEO duality, sales growth and volatility of stock prices have insignificant impact on return on assets.

For checking the problem of endogeneity of board independence, the 2SLS model has been applied and variable of board independence has been considered as endogenous variable based on the literature, whereas, the variables of board size and CEO duality have been considered as instrumental variables. The results of the 2SLS regression model have been presented in table 3.

Table 3. The Two Stage Least Squares (2SLS) Regression Model

2SLS Regression Model		
ROA	Coef.	Std. Err.
BI	20.007***	3.569
OWN	1.072	.774
AI	.304**	.956
QCG	-.826***	.305
LEV	-2.033***	.780
SIZE	-1.016***	.076
SALESGROW	1.197***	.240
VOLA	-.352	.309
_cons	13.562	1.346
Instrumented: BI		
Instruments: OWN AI QCG LEV SIZE SALESGROW VOLA Dual BSIZE		
***Significant at p-value <1%, **Significant at p-value <5%, *Significant at p-value <10%		

Source: Adapted from the Corporate Governance Practices and Cost of Capital: Evidence from Asian Countries (p. 186), by Zeshan Anwar, 2017, PhD Dissertation, The University of Lahore, Pakistan.

The results demonstrate that the variables of BI and AI has positive and significant impact on ROA which means that more independent boards would result in higher return on assets. The control variable of sales growth also has positive and significant correlation with ROA

which means that the firms having higher sales growth would also have higher ROA. The results are similar to the findings of [6].

The findings also demonstrate that the variable of QCG has negative and significant impact on ROA for firms in agricultural sector of Asian economies. The control variables of leverage and firms size also have negative and significant correlation with return on assets which means that the firms having higher leverage ratio and larger size would have lesser return on assets. Moreover, the variables of ownership concentration and volatility of stock prices have insignificant influence on return on assets.

In order to test the endogeneity for variable of board independence, the Durbin and Wu-Hausman tests have been applied and based on the p-value of Durbin and Wu-Hausman test statistics of 0.0002 and 0.0002 respectively, we reject null hypothesis that variables are exogenous and accept the alternate hypothesis that variables are not exogenous. We conclude that the problem of endogeneity does exist in regression model and board independence is the endogenous variable in this model, therefore, 2SLS regression model is best for estimation.

After verifying the endogeneity of the variables, the test for the First Stage Regression Summary Statistics has been employed to determine whether the instrumental variables are weak or not and results showed that Minimum eigenvalue statistic is 197.176; this value needs to be compared with critical values at 10%, 15%, 20% and 25%. The minimum eigenvalue is greater than all the critical values, so we would reject null hypothesis that instruments are weak and accept alternative hypothesis that the instrumental variables are not weak.

After determining the endogeneity of board independence; the test of Overidentifying restrictions has been used and the p-value statistics for the both Sargan Test and Basman Test are 0.1692 and 0.1694 respectively, so we cannot reject null hypothesis that instruments set are valid and model is correctly specified. So, we conclude that the instrumental variable included in this model namely board size and CEO duality are

both valid instruments and 2SLS regression model which has been employed for the analysis in this study is correctly specified.

## CONCLUSIONS

The results depict that the variables of board independence, audit committee independence and sales growth have positive and significant association with ROA, whereas, the variables of QCG, leverage and firm size have negative and significant correlation with ROA. The corporate governance practices are very important for all firms as it strengthens trust of investors, creditors and all stakeholders regarding organizational activities. These practices are even more important for firms in agricultural sector as large number of shareholders and stakeholders have involvement in these organizations. The findings of this study suggested that better corporate governance practices result in higher performance for Asian firms in agricultural sector. These results justify most of the past research and corporate governance theories in general and agency cost theory in particular regarding role of corporate governance activities in lowering agency cost and improving firm performance. These findings are significant as sample considered in this study comprises of firms from agricultural sector in Asian countries; therefore it is important for policy makers of these firms to further improve and develop their corporate governance activities as they would gain the benefits of increased profitability. It would result in further development and growth of these firms as investors and creditors are more interested to invest in those firms where corporate governance structures are better. Moreover, the size and share capital of these firms is quite large; therefore, the results of this study are also very important for investors and creditors around the world as they can forecast the performance of these firms based on their corporate governance systems. Furthermore, better governance practices consider interests of all stakeholders including efforts for improving lives and welfare of labor/workers/employees which ultimately

leads towards social welfare of the society as a whole.

The future research could concentrate on extending this study in various directions. Some of these directions are identified as follow:

- (i) Firstly, the future researchers could clarify this association for firms in other sectors.
- (ii) Secondly, separate analysis of each country should be conducted in future research.

## REFERENCES

- [1] Afza, T., Nazir, M. S., 2015, Role of institutional shareholders' activism in enhancing firm performance: The case of Pakistan, *Global Business Review*, 16: 557-570.
- [2] Ali Shah, S.Z, Butt, S.A, Hassan, A., 2009, The impact of corporate governance on the cost of Economics, 14(1): 139-171.
- [3] Arora, A., Bodhanwala, S., 2018, Relationship between Corporate Governance Index and Firm Performance: Indian Evidence, *Global Business Review*, 19: 675-689.
- [4] Beck, N., Katz, J. N., 1995, What to do (and not to do) with time-series cross-section data, *American political science review*, 89: 634-647.
- [5] Bradley, M., Chen, D., 2014, Does board independence reduce the cost of debt?, *Financial Management*, 44: 15-47.
- [6] Chahine, S., 2004, Corporate governance and firm value for small and medium sized IPOs, *Financial Markets and Portfolio Management*, 18: 143-159.
- [7] Chin, T., Vos, E., Casey, Q., 2004, Levels of ownership structure, board composition and board size seem unimportant in New Zealand, *Corporate Ownership and Control*, 2: 119-128.
- [8] Dogan, M., Elitas, B. L., Agca, V., Ögel, S., 2013, The impact of CEO duality on firm performance: evidence from turkey, *International Journal of Business and Social Science*, 4: 149-155.
- [9] Gunasekarage, A., Locke, S., Reddy, K., Scrimgeour, F., Corporate governance practices of large firms in New Zealand and firm performance: an empirical investigation. 19th Annual Australasian Finance and Banking Conference, 2006. 15-19.
- [10] Hamdan, A. M., Sarea, A. M., Reyad, S. M. R., 2013, The impact of audit committee characteristics on the performance: Evidence from Jordan, *International Management Review*, 9: 32-42.
- [11] Hutchinson, M., 2002, An analysis of the association between firms' investment opportunities, board composition and firm performance, *Asia-Pacific Journal of Accounting & Economics*, 9: 17-38.
- [12] Ivashkovskaya, I., Stepanova, A., 2011, Does strategic corporate performance depend on corporate financial architecture? Empirical study of European, Russian and other emerging market's firms, *Journal of Management & Governance*, 15: 603-616.
- [13] Love, I., Klapper, L. F., 2004, Corporate governance, investor protection, and performance in emerging markets, *Journal of Corporate Finance*, 10(5): 703-728.
- [14] Moradi, N. S., Aldin, M. M., Heyrani, F., Iranmahd, M., 2012, The effect of corporate governance, corporate financing decision and ownership structure on firm performance: a panel data approach from Tehran stock exchange, *International Journal of Economics and Finance*, 4: 86-93.
- [15] Nuryanah, S., Islam, S., 2011, Corporate Governance and Performance: Evidence from an Emerging Market, *Malaysian Accounting Review*, 10: 17-42.
- [16] Prevost, A. K., Rao, R. P., Hossain, M., 2002, Determinants of board composition in New Zealand: a simultaneous equations approach, *Journal of Empirical Finance*, 9: 373-397.
- [17] Rashid, A., De Zoysa, A., Lodh, S., Rudkin, K., 2010, Board composition and firm performance: Evidence from Bangladesh, *Australasian Accounting, Business and Finance Journal*, 4(1): 76-95.
- [18] Sayilir, Ö., 2012, Relationship between corporate governance and financial performance of Turkish companies, *International Journal of Business and Social Science*, 3(14)Special issue, 59.
- [19] Shah, A. A., Kouser, R., Aamir, M., Hussain, C. M., 2012, The impact of the corporate governance and the ownership structure on the firm's financial performance and its risk taking behavior, *International Research Journal of Finance and Economics*, 93: 44-55.
- [20] Tornyeva, K., Wereko, T., 2012, Corporate governance and firm performance: Evidence from the insurance sector of Ghana, *European Journal of Business and Management*, 4: 95-112.
- [21] Young, B., 2003, Corporate governance and firm performance: Is there a relationship, *Ivey Business Journal*, 68: 1-5.

Appendix I: Firms Included in Final Sample from Agricultural Sector of Asian Countries

Region	Country	Firms Included in Final Sample
East Asia	China	51
	Japan	126
	South Korea	37
	Taiwan	19
	Hong Kong	25
South Asia	India	25
	Pakistan	2
Central Asia	Kazakhstan	1
ASEAN	Thailand	10
	Vietnam	1
	Malaysia	7
	Singapore	10
	Indonesia	3
	Philippines	7
Eurasia	Russia	20
Middle East	Saudi Arabia	10
	Israel	2
	Qatar	2
	UAE	4
	Kuwait	1
<b>Total Sample</b>		<b>363</b>

Appendix II: Scoring Criteria and their Weights for QCG

**1. Number of INEDs in Board of Directors: (Weight 25%)**

Range	Score
0%-----20%	1
21%-----40%	2
41%-----60%	3
61%-----80%	4
81% and above	5

**2. No. Of INEDs in Audit Committee: (Weight 25%)**

Range	Score
0%-----20%	1
21%-----40%	2
41%-----60%	3
61%-----80%	4
81% and above	5

**3. Ownership (Weight 25%)**

Range	Score
0%-----20%	5
21%-----40%	4
41%-----60%	3
61%-----80%	2
81% and above	1

**4. CEO (Weight 25%)**

	Duality:
Value of 0	2
Value of 1	1



## PRODUCTION AND TECHNO-ECONOMIC OPPORTUNITIES OF USE OF WHEY IN INDUSTRIAL PROCESSES

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### Abstract

Whey represents the least utilized by-product in the Serbian food industry, although it is very nutritious and poorly used in nutrition. More than a half of nutrients present in milk are also present in whey, including proteins (around 20%), wherefore it is considered as the most valuable product in nutritive sense. The first part of the article covers the statistical results, which show the production of milk and whey (whey in different forms of sale (a product code)) that occurs during the production of cheese in Serbia (2014-2017) and they comprise the results of a realized production, supplies at the end of the year and the quantity of sales. In the second part of the article the authors compared the obtained results, which were shown during the technological-economic profitability testing of the production plants: lactose and the whey protein concentrate, a functional drink based on whey and carrot during the production of cheese, as well as the whey protein bioactive hydrolyzes described in two scenarios, A and B, which have given a positive result in industrial production. There are numerous applicable techniques for the assessment of an economic profitability. The Super Pro Designer simulation software was used in this article for the results obtained. It is equipped with a wide spectrum of processes and is a powerful tool that can be used for the mathematical assessment of economic parameters.

**Key words:** profitability, techno-economic analysis, whey, lactose, proteins

### INTRODUCTION

In the milk processing industry in Serbia, cow's milk is the most commonly used quantity in terms of quantity.

Today, goats and sheep milk are a significant market place. In recent years, Serbia has recorded an increase in the share of milk delivered to dairy farmers, which is over 60%, but still a significant amount of milk (about 35%) remains on farms for personal consumption, calving and processing into dairy products intended for the market which are mainly cheese, cream peppers in cream, vurdica (cheese from whey) and the like (Table 1 and Table 2.).

Milk delivered to dairies is most often used as a raw material that has great potential because it can get a large number of products on the market [2; 3].

The paper also presents the amount of cheese production from which whey is produced after its production.

Table 1. Annual production and use of milk (all milk) in dairies in Serbia, in 2017 year

Availability (entry) of milk	Quantities (000 t)
Cow's milk (from farms)	862,082
Sheep's milk	0,201
Goat milk	0,514

Source: Statistical Office of the Republic of Serbia 2018 [12]

Cheese is one of the oldest forms of "preservation" of milk. It is a fresh or mature product that is obtained by clotting the protein in the milk with the extraction of whey and is one of the basic foods. According to the coenzyme, the cheese test, the amount of water and the method of production of cheeses can be extra hard, hard, semi-hard, semi-soft, soft cheese and cheese spreads.

During the acidic or enzymatic treatment of milk, cheese is formed, during which a large amount of whey is extracted during the process. This implies that in the practical

sense about 10.00 L of milk is consumed for the production of 1.00 kg of cheese, with 9.00 L of whey [13; 5; 1].

Table 2. Annual use of milk (all milk) in dairies for cheese production, in Serbia, in 2017 year

Cheese to hardness	Amounts (000 t)
Soft cheese	23,519
Medium-soft cheese	-
Medium-hard cheese	13,068
Hard cheese	2,103
Extra hard cheese	0,016
Fresh cheese	11,385
Processed cheese	1,798
Whey total	6,753
Surprise (liquid state)	2,632
Surprise (concentrated state)	0,031
Powdered powder or block	0,014

\*The milk input is calculated on the basis of milk fat content

and proteins in dairy products.

Source: Statistical Office of the Republic of Serbia 2018 [12]

According to the results of research by scientists, the production of cheese has increased in the last few years, and the production of cheese has been shown to increase the world production of whey to an average of about 2% annually [11].

About 50% of the total obtained amount of world whey is treated and transformed into various food products, about 45.0% is directly used in liquid form, 30.0% in whey powder, 15.0% is used as lactose and the rest as protein concentrates [7; 9; 8]. In food and fermentation industry 50% of waste whey is used, while the rest are discharged into watercourses without previous processing which represents a very significant loss of nutritionally valuable raw materials [4; 6].

The other hand causes great environmental problems, considering high values of chemical oxygen demand, (COD) and biological oxygen demand (BOD). Considering the environmental pollution, the disposal of waste whey causes many problems, since it affects the physical and chemical soil structure, reduces crop yields, and discharging into watercourses leads to a high consumption of oxygen and death of flora and fauna [10; 12].

The production of three different production processes, where as the main raw material of

whey, presents the techno-economic analysis of the plant for the production of lactose and whey protein concentrate, a plant for the production of a functional beverage in the process of cheese production, where, with a cost-effective production and use of the plant, and at the same time the amount of whey obtained is used to produce fermented juice in combination with carrot juice and the cost-effectiveness of the plant for the production of bioactive proteins of whey proteins [15]. Super Pro Designer software was used for all three cost-benefit testing of the plant.

## MATERIALS AND METHODS

In the testing process for the analysis of techno-economic cost-effectiveness, Super Pro Designer software was used, which is a valuable tool for engineers and scientists.

It is equipped with numerous possibilities that meet the needs and the most complicated simulations and allows the user to simultaneously design and analyze the processes of production and economics of the entire project. The basic material in all three trials was used wheat as a raw material with 0.5% fat obtained from the dairy industry of Serbia [10; 14].

As a raw material, the whey left after the production of cheese and sterile skimmed milk with 0.5% milk fat was used.

In a particular software package, a model that has the basic characteristics of the real system is set, and by adjusting the basic parameters it is possible to analyze and predict the costs for many industrial processes. The investment appraisal as well as its alternatives is based on: economic indicators: net present value (NPV), internal rate of return (IRR), and period return of investment (PR). These indicators allow comparison of investment projects, techno-economic analysis and cost-benefit analysis: which includes a profitability analysis that can be done with or without time value of money, and sensitivity analysis: which implies the impact of the price of products and the capacity of the process on the indices of cost-effectiveness, capital investments, payback period, net present value and cash flow.

## RESULTS AND DISCUSSIONS

In Serbia, of the total milk production, the largest amount is of cow's milk, 99%, which the processing industry redeeming for various types of processing products (Table 3).

Increase in production can be noticed, and with the increase in milk production, the quantities of milk products produced are also increasing. In year 2013 was taken as the base year and in relation to sit there is a slight increase in the production of cow's milk (by 55 million litters), which is the highest in 2017, which is 3.8% more, and also the litters of milk per bovine cow is on the rise compared to 2013, especially in 2016, which is 3.528 l, which is 8.7% more than in 2013 [10; 12]. Therefore, we have a higher average for five years, which are 3.4 litters per bovine cow (while the previous year the average was 3.1).

Table 3. The quantity of cow's milk produced in Serbia during the period 2013-2017

Year	Total cow milk (mil.liters)	Index - total production 2013=100	Litters per bred cow
2013	1,451	100	3,246
2014	1,491	102.75	3,269
2015	1,501	103.44	3,477
2016	1,504	103.65	3,528
2017	1,506	103.79	3,505
<b>Average</b>	<b>1,490</b>	<b>103.40</b>	<b>3,405</b>

Source: Statistical Office of the Republic of Serbia 2018 [12]

The total milk production in Serbia, about 92% comes from family farms, and the remaining 8% from social enterprises and cooperatives. Milk is delivered to over 50% of the total milk production in Serbia, and the rest is spent on farms, or sales in peasant markets, whether fresh or processed.

The structure of milk processing in the developed countries of the EU is in favour of durable global products such as permanent cheeses, milk powder and butter. Based on this change in the production structure, it can be expected in favour of the production of various types of cheese, yoghurt and other fermented milk drinks that already generate

higher profit on the market and satisfy the market demand.

In Serbia, whey remains one of the insufficiently used by-products of the food industry. Due to its non-use, whey becomes a very big polluter, which is in complete disagreement with the potentials it possesses.

Table 4. Realized production, stocks and sales of industrial products (whey\*) in Serbia during the period 2013-2017

Product code	Production achieved (tons)	Inventories at the end of the year (tons)	Sale (tons)
1051.55.30	145	0	59
<b>2014</b>			
1051.55.30	313	4	194
<b>2015</b>			
1051.55.60	306	1	186
<b>2016</b>			
1051.55.60	690	2	692
<b>2017</b>			
1051.55.60	547	0	549

\*Surprise and modified whey powder, granules and other

Solid forms, whether concentrated or not concentrated, sweetened

Source: Statistical Office of the Republic of Serbia 2018 [12]

According to the data from Table 4, it can be concluded that the realized production of whey in different rituals is growing in the Republic of Serbia from 2013 to 2016. However, in 2017 only 79.3% was produced in comparison with the previous year, which is for 20.7% less.

In table 5 were given the economic parameters for all three different production processes, i.e. the techno-economic analysis of the cost-effectiveness of the production plant, and the results of total investments, the repayment period, the internal rate of return and net present value were determined. According to the established amounts of indicators, this product is economically justified.

Table 5. Display of economic parameters of factories for analyzed scenarios

Economic Parameters	Lactose and concentrate whey protein	Integration Cheese / whey - Carrot juice	Scenario	
			A	B
Total invest (\$ 000)	20,985	210,51	22,940	17,402
PR (year)	1.59	0.15	3.06	0.09
IRR (%)	45,86	10,464	17.73	230.55
NPV (\$·10 <sup>6</sup> )	68,118,000	384,61	25,38	1,635,5

Source: Author's calculation obtained by program SuperPro Desinger [2]

From the results obtained for a lactose production plant with a basic capacity of 1,000 kg h<sup>-1</sup> total capital investments amount to 20,985,000 dollars. Since the repayment period shows the length of the period during which the invested funds will be returned, this test is 1.59 per year. This is a very short period of time, which shows that it will be faster to raise funds that can be used for other purposes. The internal rate of return (IRR), after tax, is 45.86%. This rate is far higher than the average size of the decision to accept the project. Net present value (NPV) means that investment in the added value of products, i.e., processing whey is economically justified and can be accepted.

Other tests related to the techno-economic analysis of the cost-effectiveness of the plant for the production of functional drinks based on whey also indicate that this production has acceptable parameters that lead to the integrated production process of cheese / beverage production of whey and carrots more economically viable than the basic process of cheese production.

Due to excellent economic indicators, the integrated process of cheese /beverage production of whey and carrots allows for a faster return on capital of 0.15 years (PR), with higher NSV of 10,464.04 \$ and IRR with values of 384.61%.

A plant that simultaneously produces cheese and whey and carrot beverages is economically more attractive compared to a plant that produces only cheese.

The cost-benefit analysis of the plant for the production of bioactive hydrolyzes of whey proteins included two possible scenarios: - Scenario A which implies the use of whey; - Scenario B, which implies the use of whey concentrate as a source of protein.

Total capital investments for a factory with a base capacity of 1,000 kg h<sup>-1</sup> amount to \$ 22,940,000 for Scenario A, while Scenario B is \$ 17,402,000. If taken to analyze that the sales price of the bioactive protein hydrolyzes of whey protein is \$ 20 kg<sup>-1</sup>, scenario A obtains an internal rate of return on investment (IRR) of 17.73% and Scenario B is 230.55%. With a discount rate of 7%, the net present value (NSV) for scenario A is \$ 25.38 million and \$ 1,635.6 million for Scenario B. Based on the results obtained, it can be concluded that scenario B represents much more attractive investment than the Scenario A. The results obtained conclude that scenario B indicates that enzymatic modification of whey proteins is a highly profitable business in the production of bioactive hydrolyzes of whey proteins [2].

The payback period for scenario B is 0.09 years and much shorter than 3.06 years for scenario A. According to the obtained results, this way of processing whey is very profitable, and especially economically justified processing according to scenario B.

Taking into account all three of the above-mentioned techno-economic solutions, the exploitation of whey by transforming it into added-value products based on whey proteins are processes that offer an environmentally acceptable and economically viable solution.

## CONCLUSIONS

It is known that whey is very rich in vitamins, minerals and especially proteins and lactose. Part of the money spent on dumping whey can be directed and profit. That's why there are many opportunities for the exploitation and use of whey today.

A significant amount of money spent on the dumping (dumping) of whey can be converted into profit. This can be done through the production of functional value-added products, such as:

- Concentrated protein WPC;
- Lactose powder LAC;
- The possibility of using carrot juice in the production of functional;
- Fermented beverages based on whey;
- Obtaining to bioactive protein hydrolyzes of whey protein, etc.

The evaluation of investments as well as its alternatives is based on economic indicators: net present value, internal rate of return and period on investment returns.

All presented results obtained using the licensed software Super Pro Designers indicate the profitability of the use of whey in the process of processing the dairy industry, since all processes represent a double solution for waste management as well as the economic potential for dairy development in Serbia.

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## REFERENCES

- [1]Arsić, S., Bulatović, M., Rakin, M., Jeločnik, M., Subić, J., 2018, Economic and ecological profitability of the use of whey in dairy and food industry, Large Animal Review, (Italian bimonthly scientific Journal by SIBAR, Italian Association of Farm Animal Veterinary Medicine), Padova, Italy, Bol. 24, No. 3, 2018., pp. 99-105.
- [2]Arsić, S., 2018, Analiza tehnno-ekonomske opravdanosti iskorišćenja surutke u Srbiji, Doktorska disertacija /Analysis of the techno-economic justification of the exploitation of whey in Serbia. Doctoral dissertation/, University of Belgrade Belgrade, 2018,
- [3]Arsić, S., Vuković, P., Kljajić, N., 2018, Utilization of Whey in Dairy and Food Industry Production Profitability, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, University of Agricultural Sciences and Veterinary Medicine of Bucharest, Romania, 2018, Vol.18(1):73-78
- [4]Börgardts, P., Krischke, W., Trösch, W., Brunner, H., 1998, Integrated Bioprocess For The Simultaneous Production of Lactic Acid and Dairy Sewage Treatment, Bioprocess Engineering, 19, pp. 321–329
- [5]Bulatović, M., 2015, Proizvodnja i karakteristike funkcionalnih fermentisanih napitaka na bazi surutke, Doktorska disertacija, Univerzitet u Beogradu, TMF Beograd, 2015, /Production and characteristics of functional fermented beverages based on whey, Doctoral dissertation/, University of Belgrade, TMF Belgrade, 2015
- [6]Ghaley, A. E., Kamal, M.A., 2004, Submerged yeast fermentation of acid cheese whey for protein production and pollution potential reduction, Water Research, 38, 631 - 644
- [7]Jelen, P., 2003, Whey Processing, in: H. Rginski, J.F. Fuquau, P.F. Fox (Eds.), Encyclopedia of Dairy Sciences, Vol. 4, Academic Press – An Imprint of Elsevier, Boston, London, 2740.
- [8]Jelen, P., 2009, Whey-based functional beverages. In Functional and Speciality Beverage Technology, Paquin P, ed. New York: CRC Press, pp. 259– 296.
- [9]Klasnja, M.T., Sciban, M.B., 2000, Osnovi procesa anaerobnog prečišćavanja otpadnih voda prehrambene industrije i industrije pića /Fundamentals of the process of anaerobic wastewater treatment of the food and beverage industry/, Acta Periodica Technologica 31 (2000) 1 - 748.
- [10]Kljajić, N., Savić, M., Arsić, S., 2009, Proizvodnja mleka i mlečnih proizvoda u Republici Srbiji /Production of milk and dairy products in the Republic of Serbia/, Ekonomika, Niš, 2009, Vol. 55, Br. 6, pp. 166-177.
- [11]OECD-FAO Agricultural outlook 2010-2019, 2010, highlights, pp. 83, [http://www.fao.org/fileadmin/user\\_upload/newsroom/docs/ENGLISH\\_outlook.pdf](http://www.fao.org/fileadmin/user_upload/newsroom/docs/ENGLISH_outlook.pdf), Accessed April 10, 2013).
- [12]Statistical Yearbook of the Republic of Serbia, 2017, Republic Statistical Office of Serbia, 2018. Belgrade.
- [13]Siso, M.I.G., 1996, the biotechnological utilization of cheese whey - a review, Bioresource Technology, 57, pp. 1–11.
- [14]Sredojević, Z, Gajić B., Jeločnik M., 2010, Economic Evaluation of the Interaction between Crops Production and Livestock Breeding Based on the Organic Production of Farms in Serbia, Petroleum – Gas University of Ploiesti, Buletinul Viol LXII, N<sup>o</sup> 3/2010, Economics sciences series, Romania, pp. 27-37, [www.upg-bulletin-se.ro/archive/2010.pdf](http://www.upg-bulletin-se.ro/archive/2010.pdf), Accessed Jan.10, 2019.
- [15]Wright, S., 2007, A protein punch, Beverage World, pp. 126–135.



## THE FARMER SOCIO-ECONOMIC PROFILE AND MARKETING CHANNEL OF BALI-CALF AT BALI PROVINCE

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### Abstract

*The marketing channel of Bali-cattle has not yet identified and its uncertainty often affected by the socioeconomic profile of the farmer. Several socioeconomic motives such as the need to hold great traditional ceremonies called Ngodalin, marry off their child, build a house, and many others motives that encourage the farmer to sell their Bali-calf to the middleman called Belantik even with an inappropriate price. The study aimed to determine the socioeconomic profile of the farmer and marketing channel of Bali-calf at Bali Province. The research done with the exploratory methods with explanatory research design through survey and the data analysed with quantitative and qualitative approach. The marketing channel of Bali-calf identified at Badung and Buleleng District which chosen by purposive sampling based on the highest Bali-cattle population. The structured questioner used as an interview guideline to help obtain the answer from the respondent, which also equipped with an opened question. The results showed that 90% of respondents are in the productive age, only 6.67% respondents has main job as livestock farmer with average farming experience of 22.18 years. The cattle ownership average is 4.5 cattle/farmer with the motives of livestock farming for savings (48.88%) 48% and the motives for Bali-calf sales is a need for education fee (54%) with traditional ceremonies as the second reason (16.67%). The motives drive vary marketing channel that 73% dominated by direct selling from the farmer to the middleman (Belantik) then the middleman sold the Bali-calf at the animal market the it goes to the slaughterhouse.*

**Key words:** marketing channel, socioeconomic, Bali-calf

### INTRODUCTION

Bali is one of the Bali-cattle (*Bos javanicus domesticus*) breeding centre areas. Bali-cattle is one of the superior kind of cattle for meat source and livestock breeding. However, the marketing of Bali-calf are still uncertain. Some socioeconomic reason make farmers should sold Bali-calf in inappropriate condition. This indirectly could decrease the population of Bali-cattle, which do not wanted by the government.

Current livestock practice has become unprofitable business. Price that received by the farmers are very low so that the farmer's share also low that around 63-69% from the consumers price [9]. [10] also mentioned that Bali-cattle farming are unprofitable and even detrimental especially if all of the farmers expenses calculated included breed cost, feed cost, medicine, labour and all other farming expenses.

The condition causes a weak bargaining position of the farmer in the marketing of Bali-cattle and often misused by the middleman. To increase the income of the Bali-cattle farmers, an effective solution to improve the marketing system needed. One of the solution to improve the marketing system of Bali cattle that is profiling the farmers socioeconomic motives and identified current marketing plot. The research aimed to determine the socioeconomic profile of Bali-cattle farmers and identify the marketing channel of Bali-calf at Bali Province.

### MATERIALS AND METHODS

The methodology of the research is exploratory research with explanatory research design [8]. Data collected through survey of the Bali-calf marketing channel at District Badung and Buleleng at Bali Province from March to August 2018. Analysis of the

data has been done quantitative and quantitatively, which quantitative as the main approach that forms a system which suitable with the real system [1]. Quantitative data taken from the respondent which is farmer, related to the breeding experience, cattle ownership, and several factor that related with the Bali-cattle breeding. Qualitative data taken from the farmer, middleman, cattle seller and the government concerning the marketing channel of Bali-Calf.

## RESULTS AND DISCUSSIONS

### *Respondent Age*

Table 1 showed the distribution of respondent age. Based on the Labor Laws of the Republic

of Indonesia No. 13/2003, 90% respondent was included in productive age that consists of 12.22% (21-35 years old), 50% (36-50 years old) and 27.78% (51-64 years old). Only 10 % of the respondent was not included in the productive limit age, which is above 64 years old.

The older farmer usually fanatics towards the tradition and hard to assimilate the knowledge which can change a mindset, work ethic and the farming way. The old farmer usually apathetic on innovation, while the younger generation generally have a high work spirit, high curiosity, and high interest to adopt the innovation [11] [4]. The high percentages of the productive age respondents is a good potential for Bali-cattle business development.

Table 1. Distribution of Respondent Age

No.	Age	Buleleng District		Badung District		Total	
		Number	Percentage (%)	Number	Percentage (%)	Number	Percentage (%)
1.	≤20	0	0	0	0	0	0
2.	21-35	8	17.78	3	6.67	11	12.22
3.	36-50	26	57.78	19	42.22	45	50
4.	51-64	8	17.77	17	37.78	25	27.78
5.	≥65	3	6.67	6	13.33	9	10
<b>Total</b>		45	100	45	100	90	100

Source: Field Survey, 2018

### *Respondents Job*

As shown on Table 2, the majority of respondents (64.45%) have their main jobs as field hand or farm workers, 28.88% of respondents are retired, builders, laborers, fisherman, agricultural extension workers and trader, then only 6.67% of respondents that has main job as livestock farmer.

The results shows that livestock farmers in Bali is part-time jobs, as evidenced by the results of the survey found that only 6.67% of respondents had the main job as livestock farmer. Generally, the people in Bali has main job as an agricultural farmer (74.19%), while livestock farming was just a sidelines [9].

Table 2. Respondents Job

No.	Causative Factor	Buleleng District		Badung District		Total	
		Number	Percentage (%)	Number	Percentage (%)	Number	Percentage (%)
1.	Livestock Farmer	3	6.67	3	6.67	6	6.67
2.	Field Hand	26	57.78	32	71.11	58	64.45
3.	Other (Driver, Retired, Labor, Trader, Fisherman)	16	35.55	10	22.22	16	28.88
<b>Total</b>		45	100	45	100	90	100

Source: Field Survey, 2018

### *Farming Experience*

The results (Table 3) showed that the

respondent had a long-lived experience of farming, which averaged 22.18 years. The

average farming experience time in Buleleng Regency and Badung Regency is 23.38 and 20.97 years respectively.

The experience in farming for a long time indicates that the respondent farmers have adequate knowledge and skills in the

management of livestock farming. More experienced will help improve their skills [5]. Longer experience can influence attitudes, thinking patterns and behaviour of farmers in carrying out their business [2].

Table 3. Farming Experience

No.	Time (Years)	Buleleng District		Badung District		Total	
		Number (Person)	Percentage (%)	Number (Person)	Percentage (%)	Number (Person)	Percentage (%)
1.	<3	0	0	0	0	0	0
2.	3-10	14	31.11	12	26.66	26	28.89
3.	11-20	18	40	20	44.44	38	42.22
4.	21-30	7	15.56	3	6.67	10	11.11
5.	31-40	5	11.11	7	15.56	12	13.33
6.	> 40	1	2.22	3	6.67	4.45	
<b>Total</b>		45	100	45	100	45	100

Source: Field Survey, 2018

### Cattle Ownership

The results (Table 4) shows the cattle ownership is average is 4.5 cattle per farmer with the 406 cattle. The ownership is consists

of 82 bull, 187 cow, 49 calf bull and 88 calf heifer. It is in line with [7], which mentioned the maximum amount of cattle is average 4 to 5 cattle per farmer.

Table 4. Cattle Ownership

No.	Livestock Category	Buleleng District		Badung District		Total	
		Number	Average	Number	Average	Number	Average
1.	Bull	49	1.09	33	0.73	82	0.91
2.	Cow	99	2.20	88	1.96	187	2.08
3.	Calf-Bull	31	0.67	18	0.40	49	0.54
4.	Calf-Heifer	46	1.02	42	0.93	88	0.97
<b>Total</b>		225	4.98	181	4.02	406	4.50

Source: Field Survey, 2018.

### Motives for Livestock Farming

Table 5 showed that the main reason for Bali-cattle farming is savings (48.88%), the other reason is to utilize agriculture wastes as feed (24.45%), spending a spare time (16.67%) and

increase the income (10 %). Livestock farming in Indonesia, generally done as sideline and livestock has been ruled as savings that can be sold anytime when the farmer need high amount of money [6].

Table 5. Farmer Motivation

No.	Motivation	Buleleng District		Badung District		Total	
		Number	Percentage (%)	Number	Percentage (%)	Number	Percentage (%)
1.	Savings	24	53.33	20	44.44	44	48.88
2.	Utilization Of Agriculture Waste	10	22.22	12	26.67	22	24.45
3.	Spending a Spare Time	8	17.78	7	15.56	15	16.67
4.	Increasing Income	3	6.67	8	13.33	9	10
<b>Total</b>		45	100	45	100	90	100

Source: Field Survey, 2018

As mentioned by [3], main motives in livestock farming is savings utilize agricultural wastes and take advantage of spare time.

**Motives for Bali-calf Sales**

From 90 respondents, the results (Table 6) showed that 53.33% respondents sold the Bali-calf for education fee of their child. Ceremonies reason become the second motive

(16.67%). The other motives are house renovation (15.56%), limitation of feed (11.11%) and limitation of the cage (3.33%). Besides high attention to the education of their child, traditional ceremonies need high amount of money, that is why the farmer sold Bali-calf in inappropriate condition both the cattle maturity and price.

Table 6. Motives for Cattle Sales

No.	Motivation Marketing	Buleleng District		Badung District		Total	
		Number	Percentage (%)	Number	Percentage (%)	Number	Percentage (%)
1.	Education	24	53.33	24	53.33	48	53.33
2.	Ceremony	8	17.78	7	15.56	15	16.67
3.	House Renovation	9	20.00	5	11.11	14	15.56
4.	Limitation of Feed	3	6.67	7	15.56	10	11.11
5.	Cage Not Available	1	2.22	2	4.44	3	3.33
<b>Total</b>		<b>45</b>	<b>100</b>	<b>45</b>	<b>100</b>	<b>90</b>	<b>100</b>

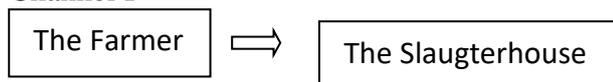
Source: Field Survey, 2018.

**Bali-calf Marketing Channel**

The marketing channel of Bali-calf is a marketing activity that facilitate the delivery of Bali-calf from farmers to other livestock consumers. Until now, the marketing of cattle in Bali Province still dominated by

middleman/*Belantik*. This caused by various limitations possessed by farmers including lack of capital, low level of marketing knowledge of farmers. Based on the direct observation there are several marketing channels of Bali-calf (Fig.1).

Channel I



Channel II



Channel III

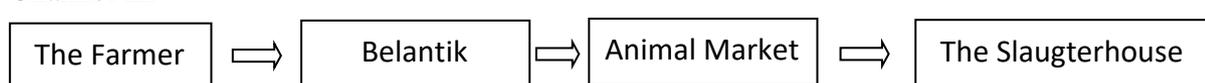


Figure 1. Current Bali-calf Marketing Channel  
 Source: Own desi

Figure 1, it can be seen that the marketing process of Bali-calf starts from the farmers who sold in three ways namely direct sales to slaughterhouse, direct sales to the nearest animal market or direct sales to middleman/*Belantik*. The marketing channels for Bali-calf are quite varied. Marketing

agents use marketing channels that show how the flow of commodities flows from farmers to the final consumers (slaughterhouse). Other marketing agents involved are middleman/*Belantik* and animal market. Table 7 shows that respondents prefer to sell Bali-calf going through the

middleman/*Belantik*. Of the 100 respondents, 73 people chose to sell Bali-calf going through middleman/*Belantik*, because they did

not want to bother and bear the risk of transportation.

Table 7. Percentages of Bali-calf Marketing Channel Used

Bali-Calf Marketing Channel	Kab. Buleleng		Kab. Badung		Total	
	Number	Percentage (%)	Number	Percentage (%)	Number	Percentage (%)
Slaughterhouse	7	14	7	14	14	14
Animal Market	7	14	6	12	13	13
Middleman/ <i>Belantik</i>	36	72	37	74	73	73
TOTAL	50	100	50	100	100	100

Source: Own calculations.

## CONCLUSIONS

The research resulting in the respondents' profile of 90% of respondents are in the productive age, 6.67% respondents are livestock farmer, average farming experience of 22.18 years with the cattle ownership average of 4.5 cattle/farmer. The motives of livestock farming are dominantly for savings (48.88%) 48% and the farmers sold Bali-calf for education fee (54%) or holding traditional ceremonies (16.67%). From several marketing channel the results shows the sales are dominated by direct selling from the farmer to the middleman (*Belantik*) (73%).

## REFERENCES

[1]Astiti, N. M. A. G. R., Suparta, I. N., Oka, I. G. L., Antara, I. M., 2016, Marketing System of Calf Bali. Int. Res. J. of Eng. IT and Sci. Res. Vol. 2(11):73-80.  
 [2]Barnadib, I., 1982, Several Things about Education. Studing, Yogyakarta, [https://www.google.com/search?q=Barnadib,+I.,+1982,+Several+Things+about+Education.+Studing,+Yogyakarta.&tbm=isch&tbo=u&source=univ&sa=X&ved=2ahUKewi8pfv6me\\_fAhVlgaYKHX4iAA0QsAR6BAgAEAE&biw=1829&bih=938](https://www.google.com/search?q=Barnadib,+I.,+1982,+Several+Things+about+Education.+Studing,+Yogyakarta.&tbm=isch&tbo=u&source=univ&sa=X&ved=2ahUKewi8pfv6me_fAhVlgaYKHX4iAA0QsAR6BAgAEAE&biw=1829&bih=938), Accessed Oct.5, 2018.  
 [3]Hasnudi, M., 2004, Analysis of Beef Cattle Trading System in Jrengik Subdistrict, Sampang District, Madura. Research Report. Faculty Animal Husbandry of Bogor Agricultural Institute, Bogor.  
 [4]Mardikanto, T., 2009, Agricultural Extension System. Agribusiness Development Center and Social Forestry. 1st Ed., Surakarta: Sebelas Maret University Press. Solo.  
 [5]Mosher, A.T., 1987, Motivate and Develop the Agriculture. Jakarta: Yasaguna.  
 [6]Murtidjo, B.A. 2004. Beef Cattle Farming. Jakarta : Kanisius.

[7]Rahayu, S. 2014. The Reproductive Performance of Bali Cattle and It's Genetic Variation: A Review. J. of Biol. Res. Vol. 20:28-35.  
 [8]Singarimbun, M and Effendi, S. 2006. Survey Research Methodology. Penerbit Pustaka LP3ES Indonesia, Jakarta.  
 [9]Sukanata, I W., Suciani, I G.N. Kayana., I W. Budiarta. 2010. Review of Critical of The Implementation of Trade Quota Policies and The Efficiency of Marketing Inter-Island Beef Cattle. Research Report. Faculty of Animal Husbandary of Udayana University, Denpasar.  
 [10]Sukanata I W., Suciani, I G.N. Kayana., I W. Budi Rahayu. 2009. Strategy to Increase Beef Cattle Production in The Province of Bali in Supporting National Meat Self-Sufficiency. Research Report. Faculty Animal Husbandary of Udayana University, Denpasar.  
 [11]Sukartawi. 1993. Basic Principles of Agricultural Economics (Theory and Application). Jakarta: PT. Raja Grafindo Persada.



## WILLINGNESS TO PAY FOR PEACEFUL CO-EXISTENCE BETWEEN CROP FARMER AND SEDENTARY PASTORALIST'S HOUSEHOLDS IN OYO AND KWARA STATES, NIGERIA

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### Abstract

*The paper assessed willingness to pay for peaceful coexistence between crop farmer and sedentary pastoralist's households in Oyo and Kwara States, Nigeria. The broad objective of the study is to determine factors influencing the respondent households' willingness to pay for peaceful coexistence. Specifically, the study describes the economic and social benefits of peaceful coexistence to the respondents, identifies the perceived causes of conflicts in the past between the two sets of economic agents, determines the respondents' WTP for peaceful cohabitation, and analyzes the determinants of their WTP for coexistence in the study area. The analysis revealed that the respondents in the study area were more willing to pay for cattle entrustment contract and resource/product exchange than calf sharing and milk sharing as coexistence practices. The analysis further revealed that age, household size, farm size, herd size, membership of association(s) and farm income positively and significantly influenced the respondents' willingness to pay for coexistence practices. The willingness to pay for coexistence practices is an indication of peaceful cohabitation of these important economic agents in the study area. The paper employed a quantitative and a qualitative analysis using descriptive statistics comprising percentages and means in describing the socioeconomic characteristics of the respondents. Binary choice logit model was used in capturing the WTP for peaceful coexistence based on the dichotomous choice contingent valuation approach. The effect of the various socioeconomic factors on the respondents' WTP for coexistence were examined by specifying and estimating the binary choice logit regression model.*

**Key words:** crop farmers, sedentary pastoralists, willingness to pay, coexistence

### INTRODUCTION

Agricultural production in any country requires an enabling environment to reach its maximum potential. Sustainable development in agriculture, among other things, demands a peaceful co-habitation of producer communities [1]. It is only through cooperation that local communities could implement sustainable common pool of resource conservation and management strategies. Stable and harmonious communities are only the ones that are able to be resilient and creative to respond to environmental stresses and sustain their livelihoods rather than those which are frustrated by the circumstances in their localities. However, an important but somewhat overlooked challenge facing agriculture and rural development in Nigeria

today is the problem associated with farmer-pastoralist conflicts over arable land use. Farmer and pastoralist communities in many parts of the country have long suffered from the violent conflicts. In addition to the obvious and devastating costs in human life, these conflicts take an enormous toll on the economic health of families and households and undermine local economic progress [16]. Increasing frustration and impoverishment of farmers occasioned by perennial and extensive farm plot destruction and the ensuing bitter conflicts are eroding the gains of agricultural and rural development interventions [1].

Access to natural resources especially land and water, is essential for livelihood production in rural areas of Africa. The most vulnerable tend to be people with poor access to natural resources upon which to build their

livelihood strategies [23]. Poor subsistence farmers and pastoralists depend on the availability of usable land and pasture for their livelihoods. Sustained natural resources ensures sustainable livelihoods for these actors [24]. Resource conflict, a major output of poor resource governance, is a formidable threat to both natural resources and human security [9]. It is also detrimental to rural livelihoods, food security, and social co-existence [2]. Unhealthy competition for finite environmental resources, lack of management, divergent attitudes and beliefs, as well as poor institutions trigger and exacerbate natural resource conflicts. Resource scarcity, whether perceived or actual, is a crucial component of environmental conflicts [6]. Resource conflict problems are likely to be aggravated when no institution appears to be in control, the extant regulations governing resource access and use are not enforced, or strategies for sustainable natural resources management are not translated into actions.

Although conflict between farmers and pastoralists is a recurring issue in almost all countries in West Africa, crop and livestock farming systems are keys for future global food security. The demand for animal products is rising and the livestock revolution could drive sustainable rural development and be an opportunity for thousands of smallholder farmers [14]. There are many interactions between crop and livestock production systems which vary between regions and farms, depending on household resources and external drivers (policies and markets). These interactions have several benefits to individual farmers, households, rural communities and society at large [15]. The mutually beneficial interactions between the two production systems can only be achieved under a peaceful co-existence condition [18].

Co-existence is defined as recognizing each other's status and rights as human beings, developing a just and inclusive vision for each community's future, and implementing economic, social, cultural or political development across former community divides. According to Berns and Fitduff [5], co-existence describes societies in which

diversity is embraced for its positive potential, equality is actively pursued, interdependence between different groups is recognized, and use of weapons to address conflicts is increasingly obsolete.

The traditional lifestyle of nomadic pastoralists – freely moving with their herds – is under threat worldwide and rapidly disappearing due to many reasons [19]. More and more cattle keepers have adopted a sedentary lifestyle and are co-existing with crop farmers and deriving livelihoods from other non-pastoral activities. Politicians support sedentarization because they want to enforce development, and nomadic pastoralism is often seen as backward. Many policy makers think settlement is the condition for development.

Using some parts of the savanna ecosystem in the country (Oyo and Kwara States) where large number of crop farmers and sedentary pastoralists live together as a reference point, the study would try to proffer answers to the following questions: What benefits do these economic agents derive from peaceful co-existence? What were the perceived causes of conflicts between farmers and pastoralists in the past? How much are these agents willing to pay to live together in peace, and what factors influence their willingness to pay (WTP)?

### **Objectives of the study**

The broad objective of this study is to determine factors influencing willingness to pay for peaceful coexistence between crop farmer and sedentary pastoralist households in Oyo and Kwara States, Nigeria. Specifically, the study describes the economic and social benefits of peaceful co-existence to the respondents, identifies the perceived causes of conflicts in the past between the two groups of resource users, determines the respondent households' WTP for peaceful cohabitation and analyzes the determinants of their WTP for co-existence in the study area.

### **Theoretical Framework**

The measure of use and non-use values of public goods where market demand and supply functions do not exist have made economists to set up hypothetical markets, and through the use of contingent valuation

method. Contingent valuation is a method of estimating the value that a person places on a good, usually one that is not sold in market, such as environmental quality, good health and peaceful co-existence [13]. The WTP is determined by applying the Contingent valuation method (CVM). Willingness to pay provides estimates for the use value and social costs of these goods for proper policy formulation [17]. The theoretical underpinning is based on the indirect utility framework.

The annual respondent's WTP is the amount that must be taken away from the individual's income in order to live in peace, while keeping his utility constant.

$$V(y - WTP, p, q_1; Z) = V(y, p, q_0; Z) \dots (1)$$

where

V denotes the indirect utility function, y is income, p is the vector of prices by individual, and  $q_0$  and  $q_1$  are the alternative levels of the quality indexes (with  $q_1 > q_0$ , indicating that  $q_1$  refers to peaceful co-existence). Z represents relevant socio-economic characteristics that are likely to affect the individuals' indirect utility

The commonly use approach to eliciting information about the respondent's WTP is the so-called dichotomous-choice format. A dichotomous choice payment question asks the respondent if he would pay ₦X to obtain the good. There are only two possible responses to a dichotomous choice payment question: "yes and no". The naira amount ₦X is varied across respondents, and is usually termed the bid value.

## MATERIALS AND METHODS

### Conceptual Framework

Definition and selection of the appropriate payment vehicle depends on the resource to be valued, the socio-economic characteristics of the sample and the institutional structure governing the area [4]. The resource to be valued in this case is peaceful co-existence, therefore, the trade-offs in monetary terms that the respondents are prepared to bear to maintaining peace over resource use as economic agents is taken as the payment vehicle for peaceful co-existence.

The respondents engage in four practices that result into mutual benefits for the households. These are: resource/products exchange; cattle entrustment contract; calf and milk sharing. The trade-off to a crop farmer's household ranges from ₦150,000: to ₦300,000: while to a sedentary pastoralist's household the trade-off is between ₦150,000: to ₦400,000:00. These prices were supplied by the respondents during the interview.

### Study Area

The study area consists of Oyo and Kwara States, Nigeria. Specifically, the study was conducted in Oyo North and Kwara South. These two locations belong to the guinea savanna region of Nigeria. Guinea savanna is at times called rich savanna. The annual rainfall is 1,000 to 1,500mm and the rainy season lasts six months. The vegetation of the study area favours pastoral farming and the cultivation of cereal crops, grain legumes of all types, root crops, tubers, fruits and vegetables. This location was purposively selected because of the possibility of gathering useful information on the existing interactions between crop farmers and sedentary pastoralists.

Agricultural sector forms the base of the overall development thrusts of the two states, with farming and pastoralism as the main occupations of the people in the area. Pastoralism is carried out in the area by the pastoral Fulani while crop farming is carried out by the Yoruba indigenes who are originally the land owners in the area.

### Sampling Techniques

The target population of this study consists of crop farmers and sedentary pastoralists. The study was based on primary data. The data were obtained from selected households through a well-structured questionnaire. The dichotomous choice contingent valuation method (DC-CVM) recommended by the NOAA panel [4] was employed to obtain the WTP. Qualitative data were collected through the use of focus group interview.

Multi-stage sampling technique was used in selecting respondents for interview. There are thirteen and six Local Government Areas (LGAs) in Oyo North and Kwara South respectively. The first stage involved a

purposive selection of six LGAs (four from Oyo North and two from Kwara South) based on their proximity, vegetation that favours pastoral farming and climatic condition that supports cultivation of different types of crops. The selected LGAs are Saki East, Olorunsogo, Irepo, Oorelope (in Oyo State), Moro and Asa (in Kwara State). In the second stage five farming communities where both crop farmers and sedentary pastoralists co-exist were randomly selected. In the last stage, six crop farmers and four herdsmen were randomly selected from each community. Thus, 180 crop farmers and 120 sedentary pastoralists were interviewed. Interview schedule using a structured questionnaire that was initially subjected to face validity and reliability test using split-half technique was used to collect data from crop farmers and sedentary pastoralists on their willingness to pay for peaceful co-existence and how much they are willing to pay. Willingness to pay was measured at nominal level as a dichotomous variable of Yes (1 point) and 0 (no point).

The payment vehicle used in the survey is monetary value of the amount that a respondent is willing to sacrifice to ensure peaceful cohabitation with other resource user in the community. Under a peaceful co-existence scenario, both groups of resource users have some trade-offs to pay, however. The parcel of land that the crop farmer releases for the use of sedentary pastoralist is the trade-off he pays while the latter hires mature herders to control the movement of his flock during pasturing. The trade-off of each agent constitutes the payment vehicle (bid amount).

**Data Collection**

Primary data (both quantitative and qualitative) were used for the study. Quantitative data were collected with the aid of structured questionnaire. Data collected on the socioeconomic characteristics of the respondents and the amount that they were willing to pay for each of the coexistence practices, their perceived social and economic benefits of peace and causes of conflicts in the past. Qualitative data were collected with the aid of Focus Group Discussion (FGD).

Information were collected on the respondents’ perceived social and economic benefits of peace and causes of conflicts in the past.

**Analytical Procedure**

**Descriptive analysis**

Descriptive statistics comprising frequency, percentages and averages (means) were used to analyse the socioeconomic characteristics of the respondents and to determine the average amount that the respondents were willing to pay for each coexistence practice.

**Binary logit analysis**

The binary choice logit model was used in capturing the Willingness to Pay (WTP) for peaceful co-existence based on the dichotomous choice contingent valuation approach. The effect of the various socioeconomic factors were examined by specifying and estimating the binary choice logit regression model following the approach of Hanemann [10] from Cooper and Loomis [7] as stated by Okojie [21] thus:

$$Li = \frac{1}{1 + \exp^{-(\beta_0 + \beta_i X_j)}} \dots\dots\dots (2)$$

where:

Li = Respondents response to the bid offer (1 if yes and 0 if otherwise)

$\beta_0$  = Constant

$\beta_i \dots\dots\dots\beta_n$  = coefficients of the explanatory variables  $X_1 \dots\dots\dots X_n$

The explanatory variables are:  $X_1$  = Gender,  $X_2$  = Age,  $X_3$  = Household size,  $X_4$  = Farm and/or herd size,  $X_5$  = Membership of association,  $X_6$  = Farm income,  $X_7$  = Level of education,  $X_8$  = Work experience.

The objective of this study is to determine factors affecting crop farmer and sedentary pastoralist households’ willingness to pay for peaceful co-existence. Thus, the dependent variable, peaceful co-existence, in this case is a dummy variable, which takes a value of zero or one depending on whether or not a respondent is willing or non-willing to pay for peaceful co-existence. The independent variables are both continuous and binary. Since a probability associated with a respondent’s willingness to pay for peaceful co-existence is desired, a binary logit model is used.

## RESULTS AND DISCUSSIONS

### Socioeconomic benefits of peaceful coexistence

Peaceful cohabitation of two economic agents portends important livelihood outcomes that result into economic and social benefits for the agents. Under a peaceful cohabitation condition, the respondents in the study area revealed that they enjoy the following positive livelihood outcomes as shown in Table 1: increase in productivity and income, assets, livelihood activities, increase in level of trust, and conducive business environment. Majority of the respondents (67.8%) of crop farmers and (86.7%) of sedentary pastoralists' households agreed that peaceful cohabitation leads to increase in productivity and income in a general sense. This is in line with the finding of [1] that sustainable development in agriculture, among other things, demands a peaceful cohabitation of producer communities.

Table 1. Socioeconomic Benefits of Peaceful Coexistence

Benefits	Crop Farmers		Sedentary Pastoralists	
	Frequency	Percentage	Frequency	Percentage
Increase in productivity & income	122	67.8	104	86.7
Increase in assets	20	11.1	8	6.7
Increase in livelihood activities	14	7.8	2	1.6
Increase in level of trust	14	7.8	3	2.5
Conducive business environment	10	5.5	3	2.5
<b>Total</b>	<b>180</b>	<b>100.0</b>	<b>120</b>	<b>100.0</b>

Source: Field Survey, 2017.

### Causes of Conflicts in the Past

The respondents equally specified the following as causes of conflicts in the past as shown in Table 2: high level of mistrust, crop field damage by animals, competition for land and water, and poisoning of animals. In a nutshell, majority of the respondents (78.9%) of crop farmers and (85%) of sedentary pastoralists' households revealed that crop damage by the animals of the pastoralists is the major cause of conflicts between themselves in the past. However, the respondents opined that conflicts arising from these causes were locally resolved by the

leaders of both groups (Local community chiefs and Fulani elders' group). Also, the sedentary pastoralists in the study area have created social structures geared towards minimizing conflicts with farmers (the hosts) and preserving the overall harmony between the two groups that is necessary for their production symbiosis. The Fulani pastoralist group has an elected official (Ruga) who regulates the grazing and pasture use of his group. He is in charge of selecting migration routes and deciding where specific animals will graze. He is also responsible for internal and external dispute management and settling conflicts between farmers and his group.

Table 2. Causes of Conflicts in the Past

Causes	Crop Farmers		Sedentary Pastoralists	
	Frequency	Percentage	Frequency	Percentage
High level of mistrust	28	15.6	10	8.4
Crop damage by animals	142	78.9	102	85.0
Unguided competition for land & water	4	2.2	4	3.3
Poisoning of animals	6	3.3	4	3.3
<b>Total</b>	<b>180</b>	<b>100.0</b>	<b>120</b>	<b>100.0</b>

Source: Field Survey, 2017.

### Socioeconomic Characteristics of the Respondents

Socio-economic characteristics are important attributes that help to enhance farm entrepreneurs (both crop farmers and pastoralists) efficiency to adopt practices that can improve their production. They help to shape the entrepreneurial abilities of farmers in rational decision making, especially those relating to agricultural enterprises [11]. Given this understanding, the relevant socio-economic characteristics of the respondents were investigated in order to ascertain their relevance to the respondents' willingness to pay for peace.

Table 3 shows the socio-economic characteristics of the respondents. The table shows that the respondents were predominantly male, (91%) crop farmers and (99%) sedentary pastoralists. This is the pattern of most agricultural communities in Africa where male dominates the population.

Table 3. Socio-economic characteristics of the respondents

Variable	Crops Farmers	Sedentary Pastoralist	
	Percent	Percent	
<b>Sex of household head</b>			
Male	91.1	100.0	
Female	8.9	0.0	
<b>Age (Years)</b>			
31-40	5.0	3.3	
41-50	19.4	23.4	
51-60	35.6	31.4	
>60	40.0	42.4	
Mean	54	52	
<b>Household Size (Number)</b>			
3-6	13.4	15.0	
7-10	47.2	34.3	
11-14	31.1	41.2	
>14	8.3	9.5	
Mean	10	11	
<b>Farm size (Ha)</b>		<b>Herd Size (Herd count)</b>	
0-5	6.7	50-100	10.8
6-10	42.5	101-150	20.9
11-15	35.2	151-200	22.5
>15	15.6	>200	45.8
Mean	9.2	135	
<b>Membership Association</b>			
Yes	88.4	90.2	
No	11.6	9.8	
<b>Farm Income(N'000)</b>			
100-150	16.4	4.2	
151-200	34.6	6.8	
201-250	38.2	22.4	
>250	10.8	66.6	
<b>Work Experience</b>			
1-10	8.4	9.2	
11-20	8.6	14.8	
21-30	72.3	68.8	
>30	10.7	7.2	
Mean	22.4	21.6	
<b>Level of Education</b>			
No formal	75.4	88.5	
Primary	15.3	8.2	
Secondary	9.3	3.3	
<b>Residency (Years)</b>			
1-10	N/A	6.8	
11-20	N/A	88.0	
>20	N/A	5.2	

Source: Field survey 2018.

The average household sizes were 10 and 11 persons respectively. In the traditional agricultural production, family labour plays a significant role in the farm labour supply. An average farmer/pastoralist first uses all sources of labour in his family before hiring labour in order to reduce the cost of production [20]. This suggests the possibility of much availability of family labour for both groups of respondents. The mean average ages of the respondents were 54 and 52 years respectively. This implies that most of the respondents were relatively old. The table further shows that the respondents have long years of farming and herding experiences. Proficiency and skill acquisition usually grow with years of experience. Majority of the respondents have farming and herding

experiences above 20 years (83% and 76%) respectively. The average farm size of the crop farmers was 9.2 hectares while the average number of livestock of the sedentary pastoralists was 135 herds (comprising cattle, sheep and goats). About 88% of the sedentary pastoralists had been resident in their respective communities for more than 21 years. This may be the reason for mutual understanding the sedentary pastoralists had with the crop farmers (host). The respondents' education level was low, with majority of the crop farmers (75%) and sedentary pastoralists (89%) having no formal education.

#### Distribution of Respondents According to their Willingness to Pay for Co-existence Practices

In the course of the survey, the respondents were made to understand the economic meaning of WTP as the amount of trade-offs in monetary terms that they would be prepared to bear to maintain peace in resource use. Distribution of the respondents according to their WTP for co-existence is shown in Table 4. From the table, 91% and 85% of the sampled crop farmers and sedentary pastoralists' households were readily willing to pay for peaceful coexistence. The results show that sustainable development in agriculture, among other things demands a peaceful cohabitation of producers as opined by [1].

Table 4. Distribution of Respondents According to their Willingness to Pay for Co-existence Practices

Variable	Crop Farmers		Sedentary Pastoralists	
	Frequency	Percentage	Frequency	Percentage
Willing to pay	164	91.1	102	85.0
Not willing to pay	16	8.9	18	15.0
<b>Total</b>	<b>180</b>	<b>100.0</b>	<b>120</b>	<b>100.0</b>

Source: Field Survey, 2017

#### Respondents' Distribution of Prices for Willingness to Pay for Coexistence

The WTP was assessed using the CV approach. After the hypothesized prices of the four co-existence practices were explained to the respondents, they were asked to disclose the maximum amount they would be willing to pay in order to guarantee a perfectly peaceful community. The idea is that rational individuals are willing to pay for a public

good up to that amount that the public good benefits them. However, the bid amount for the respondents' WTP in this study is limited to the amount of trade-off under a particular co-existence practice. In all, the four practices were grouped together as one product (coexistence). The distribution of the respondents according to the prices they are

willing to pay is shown in Table 5. The results show that 93% of the willing crop farmers were willing to pay ₦150,000 – ₦350,000 for peaceful coexistence while 83% of the willing sedentary pastoralists were willing to pay ₦250,000 -- ₦500,000 for peaceful coexistence.

Table 5. Distribution of Respondents According to their willingness to pay

Amount (₦) per annum	Crop Farmers				Sedentary Pastoralists			
	No. of Respondents	%	Min. (₦)	Max. (₦)	No. of Respondents	%	Min. (₦)	Max. (₦)
≤ 150,000	12	7	85,000	140,000	6	6	78,000	132,000
150,001-250,000	20	12	160,000	245,000	12	12	170,000	246,000
250,001-350,000	122	74	248,000	342,000	22	22	262,000	320,000
350,001-500,000	10	7	350,000	500,000	62	61	350,000	500,000

Source: Field Survey, 2017.

### Results of Logit Regressions showing Socioeconomic Factors Influencing the Respondents' Willingness to Pay for Coexistence

The results of the logit model are presented in Tables 6 and 7 for crop farmers and sedentary pastoralists respectively. Table 6 shows that four explanatory variables were positively significant variables influencing WTP for co-existence for the crop farmers. These include age of household head, household size, farm size, and membership of social association. Age, household size, and membership of social association were found to be statistically significant at 5% probability level while farm size was statistically significant at 10%. The result of the logit model showed that age of household head, household size, farm size, and membership of social association increase the probabilities of farmers' willingness to pay for peaceful cohabitation. The result further showed that older farmers were 7.7% more willingly to pay for peace in comparison to younger farmers. This could be attributed to the fact that older farmers in the community could have been involved in resource use conflict in the past which possibly had resulted into loss of valuables for them. To them, the economic benefits of peace could be imagined.

The result further showed that farmers with large family size were 8.1% more willing to pay for peace than farmers with small family

size. Farmers with large family size would be readily willing to pay any amount to live in peace and to prevent occurrence of conflict because of what it portends for the vulnerable members of households. This finding is in consonant with the finding of [12].

Table 6. Logit regression model showing socioeconomic factors influencing crop farmer households' WTP for co-existence

Variable	Coeff.	T-value	Marginal effects
Age	0.239	0.472	0.077***
Years of experience	0.480	0.813	0.108
Education	0.263	1.124	0.056
Household size	1.045	2.819	0.081***
Farm size	0.111	1.671	0.099***
Membership of association	1.963	0.856	0.022***
Membership of coop	0.030	1.576	0.006
Farm income	0.088	3.836	0.004
Off-herd income	-0.526	0.745	0.124
Constant	1.338		
Log likelihood	-57.721		
R <sup>2</sup>	0.63		

Source: Field Survey, 2017.

Farmers who belong to many social associations and/or clubs were found to be more willing to pay for peace than those who do not belong to any. Social clubs could be sources of good information about the danger of conflict and benefits of peace. Farmers who are members of social association were found to be 2.2% more willing to pay for peaceful co-existence. The result of logit regression additionally showed that farmers with large

farm size were 9.9% more willing to pay for peace. As the farm size increases, the probability of WTP for peaceful co-existence also increases. This finding is in line with the finding of [8] and [12].

The estimates of parameters of the variables determining the sedentary pastoralists' WTP for peaceful co-existence are presented in Table 7.

Table 7. Logit regression model showing socio-economic factors influencing sedentary pastoralist households' WTP for co-existence

Variable	Coeff.	T-value	Marginal effects
Age	0.253	1.154	0.056***
Years of experience	1.817	1.732	0.107
Education	0.988	0.433	0.124
Household size	0.864	1.648	0.082***
Herd size	1.406	2.586	0.044***
Membership of association	0.484	1.742	0.076***
Membership of coop	0.749	0.763	0.443
Income (herd)	0.187	2.271	0.081***
Off-herd income	1.964	1.631	0.442
Constant	5.426		
Log likelihood	76.72		
R <sup>2</sup>	0.68		

Source: Field Survey, 2017.

Result of the logit model showed that five explanatory variables were positively statistically significant; these are age of household head, household size, herd size, membership of social association/club, and income from pastoral business. The result showed that older sedentary pastoralists who had lived for some time in the community were 5.6% more willing to pay for peace arrangement with other resource users than younger ones. The finding of this survey may be attributed to the fact that older sedentary pastoralists are known in the community and possibly have come into a mutual and beneficial terms with their hosts with a view to living in peace and harmony. The result further showed that sedentary pastoralists with large family size were 8.2% more willing to pay for peace just as their counterparts in crop farming sub-sector. Also sedentary pastoralist's household with large herd size were 4.4% more willing to pay for peace than household with small herd size. Additionally, sedentary pastoralists who are members of social associations were more willing to pay for peace. Should such household members

take part in destructive conflict in the community, they are more likely to be traced to their clubs/social associations. This finding is in consonant with the finding of [12].

According to him, the ability of the Fulani pastoralists to settle in a particular location outside their local environment is dependent on the information they could gather through networks and interaction. Finally, sedentary pastoralists with higher income from pastoral business were more willing to pay for peace. This indicates that keeping the influences of other factors constant, the decision of sedentary pastoralists in favour WTP for peace increases by a factor of 8.1% as pastoral income increases by a thousand Naira. Sedentary pastoralist' households with higher income levels were willing to pay for peace in order to secure continuity in business since their budget constraint becomes less stringent and the households could afford to pay. This finding is consistent with the findings of [22] and [3].

## CONCLUSIONS

The respondents were very conscious of the benefits (social and economic) derivable directly or indirectly from peaceful cohabitation. Positive relationship between co-existence and households' livelihoods had been established in the study. The study also makes it clear that households suffer beyond the devastating losses of family members, injury, trauma, and fear; farmer-pastoralist conflict deeply damages the well-being of households and communities. The findings of this study suggest that in order to ensure sustainable economic progress in the agricultural sector of the Nigerian economy, prevention of inter-communal conflict, particularly conflict between farmers and pastoralists in the country is timely essential. In order to realize the economic benefits of sustained peace in the agricultural producer communities, the Nigerian government should take action in the following areas.

It is deducible from the WTP of the respondents that they agreed to the opinion that since they benefit directly or indirectly from peaceful cohabitation; therefore, they

were willing to pay for co-existence to ensure sustainable enjoyment of the benefits embedded therein. The results of the study can therefore be used in agricultural policy formulation aiming at enhancing symbiotic relationship between crop and livestock production systems through cohabitation policy. To guarantee a sustained peace, governments at all levels should embark on a rigorous enlightenment campaigns on the economic and social benefits of peaceful cohabitation among agricultural producer communities.

The Federal government should make policies and programmes that will promote and encourage sedentariness of pastoralists in any parts of the country. Such will make pastoralists in general to be touched with livelihood-improvement developmental projects.

At the moment, part of the local population in the country is still reluctant to see the Fulani pastoralists establish permanent settlements in some territories. However, the sedentary pastoralists interviewed said they are resolved to stay in their locations at any price (i.e. they were willing to pay for co-existence). As their status is seemingly illegal, Federal government should regularize their residency. A pragmatic approach is necessary to implement this policy.

Since nomadism is the central issue in Africa in general and Nigeria in particular, its transformation should be seen as a question of national emergency. But while nomadism lasts, the country should establish and manage a network of pastures fully equipped with watering points and veterinary clinics. The areas demarcated should be fully developed to encourage nomads/pastoralists to settle down near these permanent pasture-lands. There should be an integrated approach towards the utilization of crop residues, offal and agro-allied by-products for the development of livestock feed.

## REFERENCES

[1]Adelakun, O. E., Adurogbangba, B., Akinbile, L.A., 2015, Socioeconomic effects of farmer-pastoralist conflict on agricultural extension service delivery in

Oyo State, Nigeria. *Journal of agricultural extension*, 19(2):59-70.

[2]Adisa, R.S., Adekunle, O.A., 2010, Farmer-herdsmen conflicts: A factor analysis of socioeconomic conflict variables among arable crop farmers in North Central Nigeria. *Journal of human ecology*, 30(1):1-9.

[3] Alexopoulos, G., Koutsourisa, A., Tzouramanib, E., 2008, The financing and orientation of extension services in Greece: a case study concerning rural youth. A paper presented at Change in knowledge systems and extension services: role of new actors, 8<sup>th</sup> European IFSA.

[4]Arrow, K., Solow, R., Portney, P., Leaemer, E., Radner, R., Schuman, H., 1993, Report of the NOAA panel on contingent valuation. *Federal Register*. Vol. 58, pp. 4016-4064.

[5]Berns, J., Fitzduff, M., 2007, Complementary approaches to coexistence work: What is coexistence and why a complementary approach? *Coexistence International*, Brandeis University, Massachusetts, USA.

[6]Bob, U., Bronkhorst, S., 2010, Environmental conflicts: Key issues and management implications. *African journal on conflict resolution*, 10(2): 103-119.

[7]Cooper, J., Loomis, J., 1992, "Sensitivity of Willingness to Pay Estimates to bid Design in dichotomous choice Contingent Valuation models". *Land Economics* Vol. 68(2) pp. 211-224.

[8] Fabusoro, E., 2009, Use of collective action for land accessibility among settled Fulani agro-pastoralist in Southwest Nigeria. *Sustainability Science*. 4(2), 199-213.

[9]Fasona, M., Fabusoro, E., Sodiya, C., Adedayo, V., Olorunfemi, F., Elias, P., Oyedapo, J., Oloukio, G., 2016, Some dimensions of farmers'-pastoralists' conflicts in the Nigerian Savanna. *Journal of global initiatives: Policy, Pedagogy, Perspective*, 10(2): 88-108.

[10]Hanemann, W. M., Smale, M., von Oppen, M., 1996, Nonmarket Valuation under Preference Uncertainty: Econometric models and Estimation. *CUDARE Working Papers*, University of California, Berkley, Paper 794.

[11]Haruna, U., Garba, M., Nasiru, M., Sani, M.H., 2010, Economics of Sweet Potato Production in Toro Local Government Area of Bauchi State, Nigeria. *Proceedings of 11<sup>th</sup> Annual National Conference of National Association of Agricultural Economists (NAAE)*.

[12]Horna, J.D., Smale, M., von Oppen, M., 2005, Farmers willingness to Pay for Seed-Related Information: Rice Varieties in Nigeria and Benin, EPT Discussion Paper 142. *International Food Policy Research Institute: Washington, DC*.

[13] Hoyos, D., Mariel, P., 2010, Contigent Valuation: Past, Present and Future. *Prague Economic Papers*, 4:329-343.

[14]ICRISAT (International Crops Research Institute for the Semi-Arid Tropics), 2015. Crops and livestock systems. <http://exploreit.icrisat.org/page/crops> and

livestock systems/921, Accessed on 22nd December, 2018.

[15] ILRI (International Livestock Research Institute)., 2014. Livestock, people and the environment, ILRI, Nairobi, Kenya.

[16]Mercy Corps., 2015, The economic costs of conflict and the benefits of peace: Effects of farmer-pastoralist conflict in Nigeria's middle belt on households. Mercy Corps, Oregon.

[17]Mitchell, R.C., Carson, R.T., 1989, Using surveys to value public goods: the contingent valuation method. Resources for the future, Washington DC. 463 p.

[18]Moritz, M., 2010, Understanding herder-farmer conflicts in West Africa: Outline of a processual approach. Society for applied anthropology in human organization, 69(2):1-25

[19]Msuya, D.G., 2015, Pastoralism beyond ranching: a farming system in severe stress in Semi-Arid Topics especially in Africa. Journal of Agriculture and Ecology Research International. 4(3): 128-139.

[20]Muhammad-Lawal, A., Omotesho, O.A., Falola, A., 2009, Technical Efficiency of youth participation in Agriculture: A Case study of the youth-in- Agriculture Programme in Ondo State, Southwestern Nigeria. Nigerian Journal of Agriculture, Food and Environment, 5(1):20-26.

[21]Okojie, I.O., 2007, Socio-economic and environmental attitudinal determinants of rainforest protection: A logit model analysis. ASSET Series C 2(1): 204-218.

[22]Oladele, O.I., 2008, Factors determining farmers' willingness to pay for extension services in Oyo state, Nigeria. Agriculture Tropical Et Subtropica 4(14): 165-170.

[23]Pasteur, K., 2011, From vulnerability to resilience, a framework for analysis and action to build community resilience. Practical action publishing, Washington DC.

[24]Rennie, J. K., Singh, N., 1996, Participatory research for sustainable livelihoods, Winnipeg, Canada: IISD.

## PARTICULARITIES OF THE YOUTH LABOUR MARKET IN ROMANIAN RURAL AREAS

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### Abstract

*At the present conjuncture, high levels of youth rate employment and diminishing the unemployment phenomenon of this category of persons are the priority objectives of the economic policy of all the countries that can be achieved through the balance between supply and demand on the labour market. Thus, the issue of employment among young people and especially those from the rural areas has become more prominent at the beginning of the 21st century on national and regional development agendas. The challenge of youth employment in rural areas has its own dimensions and is present in all rural areas, regardless of their socio-economic development stage. The economic development of rural areas, the lack of employment opportunities, the low quality of education and training, without an adequate link between labour markets, the decline in young people's interest and motivation to engage in agricultural activities, are only some of the factors that generate pressures on youth labour market in rural areas. In addition, they have to enter a volatile labour market in the process of structural change under the intensified impact of the changes determined by the digitization and intensive automation of all sectors of activity that entails the destruction and disappearance of jobs, at a much faster rate than the economy and the productive sectors, services, etc., in creating and generating new jobs in particular. The paper presents a synthesis of youth's labour market peculiarities in the Romanian rural areas.*

**Key words:** employment, rural area, unemployment, vulnerabilities, youth

### INTRODUCTION

The rural issue has been and continues to be one of the most important and complex economic, social, political, cultural, moral, ecological issues, etc. of our country. The important structural changes and the essential mutations that have taken place over the last decades in Romania have deeply affected the state of the Romanian countryside.

Contemporary rural space tends to exceed the field of agricultural activities and is no longer just the place where the agricultural population is working and living, but also a place where certain industrial and commercial activities are being carried out and which tends to become a place of residence and recreation for the population

The socio-economic development of the Romanian rural communities was influenced in the first place by the demographic evolutions of a society in the process of modernization and transformation. Thus, the process of population decline in the rural area

was permanent, due to the rural - urban migration (attenuated since 2008), negative natural increase of the population, relatively high infant deaths per 1000 live-births, etc.

If we look at the youth market in terms of its main characteristics, we find that in a segmented labor market they are included in a niche that is suffering from even greater segmentation and is subject to inherent stiffness.

In the increased context of polarization of jobs and increased economic uncertainty due to successive financial crises, the young people find themselves in a position that makes them extremely sensitive to economic fluctuations [24].

In Romania, on 1 January 2018, the young population (aged 15-34) living in rural areas was 2.13 million people, of which 1.112 million were aged 15-24 years and 1.022 million people aged 25-34 years old.

The low insertion of the rural youth into the labour market is due to factors such as: i) the

lack of jobs at local level [1]; ii) the specific entry barriers, often resulting from lack of experience; iii) the professional qualification level of rural youth is often considered as inappropriate to market requirements; iv) the access to information on available employment is a problem for young people in rural areas; v) a marked gender difference on occupations and fields of activity (young people are predominantly present in construction and industry, while young women are mostly engaged in trade, education, health and social assistance); vi) a greater chance of losing the job during an economic downturn; vii) "path of dependence": joblessness at young age increases the probability of unemployment later.

## MATERIALS AND METHODS

The methodology used in the paper consists in using a combination of quantitative and qualitative methods, combining multiple data sources to capture the youth's labour market peculiarities in rural areas.

Also, using the methods used it was also intended to ensure the achievement of its objectives.

The methodology used takes into account the development of the following:

- ♦ identifying labour market challenges in the new conjectures;
- ♦ analyses on the dynamics and structural changes of the labour market.

By using the descriptive statistical analysis (charts, tables) it was intended to visualize and summarize the detached information from a set of data. A typology of employment among young people in rural areas, unemployment and vulnerability was achieved using the classification analyses. The factorial analysis has been used to identify the determinants of rural youth employment on the labour market, the effects of long-term unemployment, migration and the aging on this segment of population.

The data used in the performed analyses were those published in the Annual Reports of the National Agency for Employment, Romanian National Institute of Statistics (TEMPO-

Online database), Statistical Yearbooks of Romania (2000-2018), studies and statistics on the demographic evolution of Romania and the rural areas realised by national and international organizations, specialized papers published in the country and abroad.

## RESULTS AND DISCUSSIONS

In the last two decades, the world of the Romanian village has continued the process of transformation started in the 90s, which led to the modification of the specificity of the rural localities, as well as of the demographic, occupational and value coordinates of the population.

The socio-economic transformations of the last decades have made the Romanian countryside characterized by a significant heterogeneity, determined by the uneven development of the villages. In this context, the profile of the contemporary rural area is dominated by several evolutionary models, ranging from the shape of the developed countryside, the area of urban expansion to the traditional rural area dominated by large-scale subsistence agriculture [23].

### **Evolutions and involutions of Romanian rural areas in the 21st century**

In Romania (with a rural population of 9.03 million people in 2018 [2], [3]) the share of the rural population (46.225%) is the highest among the Member States, followed by Poland and Bulgaria [17].

Romania (the seventh largest country in the European Union), with a countryside that almost covers 87% of the country's total area and 46.2% of the population, of which 20.76% occupied in agriculture, had in 2016 a share of agriculture in GDP of only 4.7% [2].

Significant is the fact that in Romanian rural there is a pronounced phenomenon of aging agrarian labour force: from the total population occupied in agriculture in 2017, 7.1% were over 65 years old and 45.15% over 45 years [3].

From the point of view of demographic evolution, the Romanian rural areas is characterized by a strong heterogeneity (both socially and economically) between different parts of the country. Thus, rural localities

located close to the cities or tourist areas record positive demographic trends (determined mainly by the urban-rural migration movement) and isolated localities, as well as those remote from the urban centers, are experiencing negative demographic developments. Therefore, it can be said that, in general, the evolution of the rural population follows the socio-economic evolution of the rural communities [5]. The analysis of the pyramid of rural population ages over the last two decades (Fig. 1 a) and b)) reveals major changes in the age structure of the population.

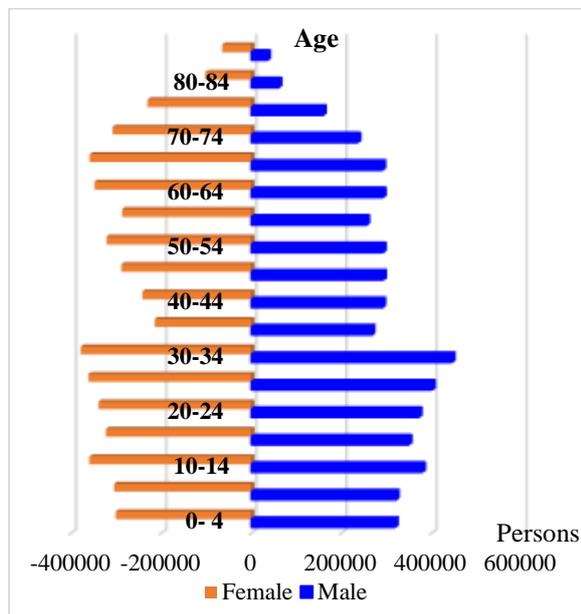


Fig. 1. a) Age pyramid for rural population, 2003  
 Source: Own calculation based on TEMPO-online data - National Institute of Statistics, www.insse.ro

The overall birth reduction recorded after 1990 has led to a narrowing of the pyramid base. In the next years while the birth rate will continue to decrease and the structure and size of the migratory flows of the young population will continue to grow, there will be a reversed demographic pyramid, which the base will be the representation of younger generations and at its peak the reunion of the third and fourth age cohorts.

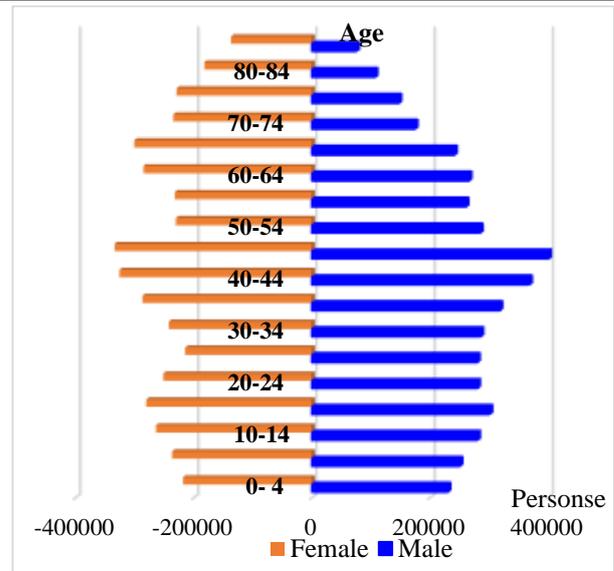


Fig. 1. b) Age pyramid for rural population, 2018  
 Source: Own calculation based on TEMPO-online data - National Institute of Statistics, www.insse.ro

Also, the analysis of the evolution of age structure of rural population (Fig. 2) indicates the decrease in the share of the young population aged between 0 and 15 years (from 20.99% to 17.62%) over the last two decades, while increasing the share of the population over 66 years (by almost 2 percent, up to 25.06%).

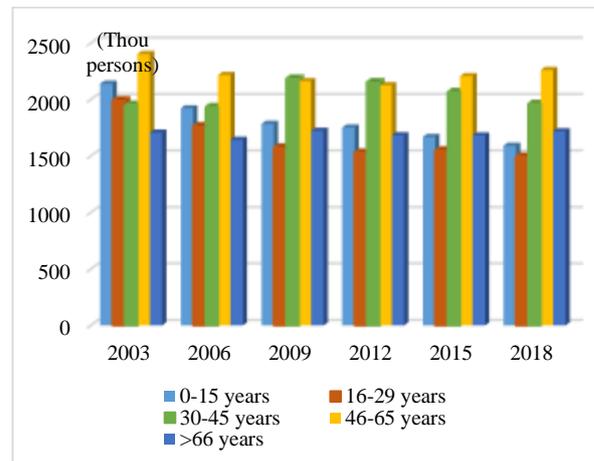


Fig. 2. Age structure of the rural population  
 Data source: TEMPO-online data, www.insse.ro

In this context, in the last 20 years, the employment rate in the Romanian rural area had a downward trend, reaching 53.9% in 2017, thus departing significantly from the European Union average of 73% [13], [18]. The underdevelopment also indicates both a lack of economic development in rural areas, the impossibility to absorb the labour in both

agricultural and non-agricultural activities and a significant degree of risk with a high potential for deepening local underdevelopment.

The Romanian agriculture is presented in its vast majority as a subsistence farming. At national level in 2016 only 9.9% of farmers were employed and 0.3% patrons, while 53.9% were self-employed and 35.92% unpaid family workers [2]. The analysis of the statistical data of the last two decades shows therefore the reality of a farming dominated by subsistence family farms, the agricultural enterprises being a minority whose development is at least unlikely.

Another phenomenon faced by rural space is the internal and international migration [4].

Regarding internal migration, the trends were quite stable and the region that "lost" the largest number of inhabitants was, during the analysed period, the South-Muntenia and North-East regions [15]. People with the highest availability to migrate are usually young people of the working population who migrate to urban areas in search of better jobs and a more attractive social life. Thus, if in 2000 internal migration was dominated by rural-urban flows for the 20-29 age segment, in 2017 it also expanded for the age group of 15-19 years.

It is worth noting that, in the last 25 years there has been an unequal exchange of human resources between the town and the village, consisting in the depopulation of rural areas by young and competitive segments. Depopulation and repopulation of the rural areas does not occur uniformly at the level of demographic and educational levels turning the rural environment into a strong social and economic risk region.

#### Youth and the labour market in rural areas

The employment of young people in rural areas or their decision to continue their studies (possibly combined with part-time work) depends on a number of economic and social factors, the financial situation of the young person, the support that parents or other family members can offer him, the availability of public funds for studies, the duration of the transition from school to work; the expansion of the service sector (requiring more skilled

labour); by demographic processes that determine the structure of the population; reducing the interest and motivation of young people to engage in agricultural activities [1], [11], [14].

In rural areas on January 1, 2018 there were 3.073 million youth aged 15-35. In the period 2003-2018 the evolution of the number of youth in rural areas had a decreasing trend, in 2018 they were with 835.7 thousand persons less than in 2003 [12].

The youth employment rate in rural areas had a declining trend in the first decades of the 21st century (Fig. 3).

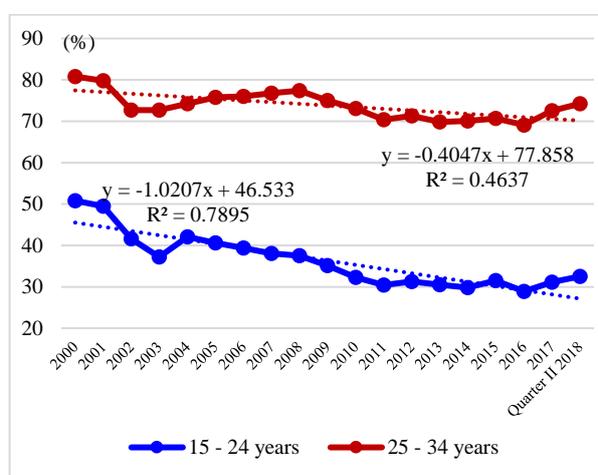


Fig. 3. Evolution of the employment rate of young people in rural areas

Data source: TEMPO-online data, www.insse.ro

The analysis of young employment must be implicitly linked to an estimate of the relationship between the labour market demands and the level of training/qualification of young people.

Thus, the studies elaborated on this topic and the statistical data show that the level of training of young people in the rural labour market is much lower than in the urban one. Thus, the youth in the rural area make their studies mainly at the secondary vocational level.

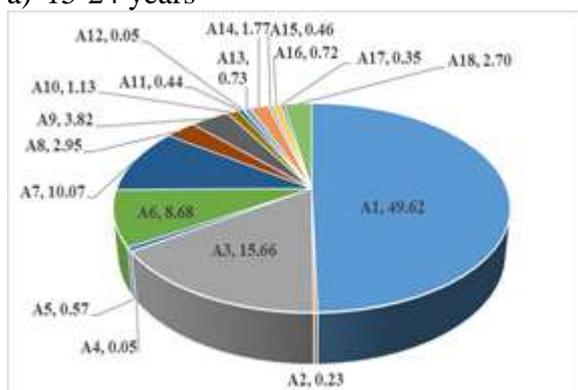
In recent years, besides the decrease in the absolute number of children of school age, the gross rate of schooling in rural areas has also been reduced. There is also a hidden form of school dropout, namely an extreme low participation in educational activities (the students come to school only a few times a month) and these cases are not documented in

official statistics, and so the actual schooling indicators may be even lower. The main factors that lead to decrease in schooling rates are the poverty affecting families with children, the parental migration, the discrepancies in the financing of the education system, and a lack of normative framework that would set the responsibilities of parents, schools and local governments for schooling. The analysis of statistical data points out that young people aged 15-24, respectively 25-34 years of age in rural areas in 2017 were also trained in activities other than those related to agriculture such as Manufacturing, trade (15.66% and 20.29% respectively), Wholesale and retail trade; repair of motor vehicles and motorcycles (10.07% respectively 13.09%), Construction (8.68%, respectively 12.09%), hotels and restaurants (3.82%, respectively 2.16% ) (Fig.4 a) and b)).

In Fig.4, the meaning of the symbols A1-A18 is the following one:

- A1 Agriculture, forestry, fish farming
- A2 Mining and quarrying
- A3 Manufacturing
- A4 Production and distribution of electric and thermal energy, gas and warm water and conditioning air
- A5 Water distribution; salubrity, managing of waste, decontaminate activities
- A6 Constructions
- A7 Trade
- A8 Transports and storage
- A9 Hotels and restaurants
- A10 Informations and communications
- A11 Financial intermediations and assurance
- A12 Real estate transaction
- A13 Professional, scientific and technical activities
- A14 Activities of administrative and support service
- A15 Education
- A16 Health and social work
- A17 Cultural and recreative entertainment activities
- A18 Other service activities, staff and social.

a) 15-24 years



b) 25-34 years

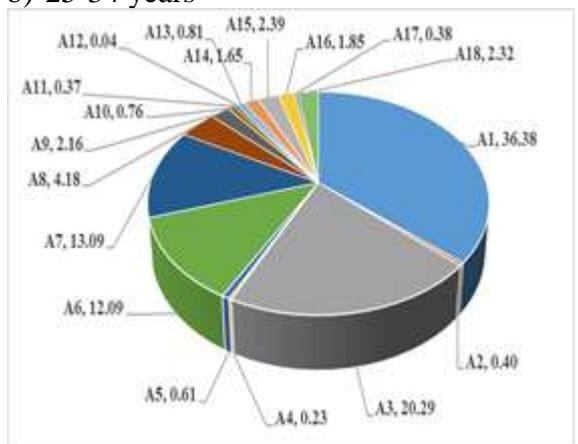


Fig. 4. Share of employed young people by economic activities in rural areas in 2017

Data source: TEMPO-online data, www.insse.ro

From the point of view of the structural indicators, the share of the employed population in the agricultural activities in the Romanian rural area is very high. Even though in recent years this occupational category has also seen a downward trend among young people, however, it is still the main occupation sector of the rural population. In categories self-employed and unpaid family worker, according to INS statistics [3], there are 134.88 thousand youth aged 15-24 years old and 153.457 thousand youth aged 25-34 in the quarter II 2018. In the two age categories 179.9 thousand persons, respectively 445.9 thousand young people have the employed state. Only a small proportion of young people working in rural areas have the status of self-employed (52.8 thousand people aged 15-24 and 156.5 thousand people aged 25-34); and a much smaller proportion of them are employers (only 6.8 thousand people aged 25-34 years). The youth unemployment is a characteristic phenomenon for all market-economy countries and the resolution of this problem depends, to a great extent, on the quality of employment policies [21].

The weaker consolidation of the rural labour market relations, the lack of employment opportunities in this environment leads to a lower flexibility of this market and therefore

an increase of the unemployed number. Generally in the rural areas, the values for the unemployment rate were lower than the national average by about two percentage points between 2000 and 2015. Starting in 2016, rural unemployment is slightly above the national average [16]. The most vulnerable age categories in terms of the unemployment spectrum are young people under 20 and those aged 20-24 (Fig. 5). This coincides with the situation of fresh graduates of secondary or tertiary education or those who have dropped out of school, which makes it even more difficult to find a job. Labour market statistics for youth indicate that for the youth aged 20-25 years and 30-34 years the chances of being registered among the employed population are extremely high. The unemployment rate for these two age groups among young people in rural areas has not exceeded very rarely, and by very little, the level of 7%, over the last ten years.

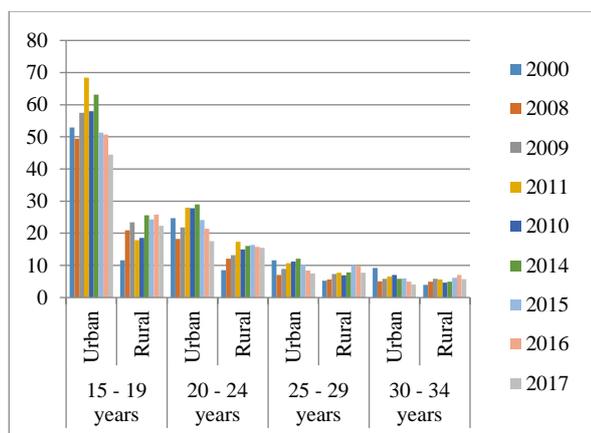


Fig. 5. Evolution of youth unemployment rate in rural areas by age group, (%)

Data source: TEMPO-online data, www.insse.ro

Also, long-term unemployment for young people in rural areas is more pronounced for the 15-24 age group (Fig. 6).

In rural, the youth unemployment rate is higher than that of young women, regardless of the age group analysed and is dependent on the level of education (the higher the level of training is lower both the number of unemployed young people is higher).

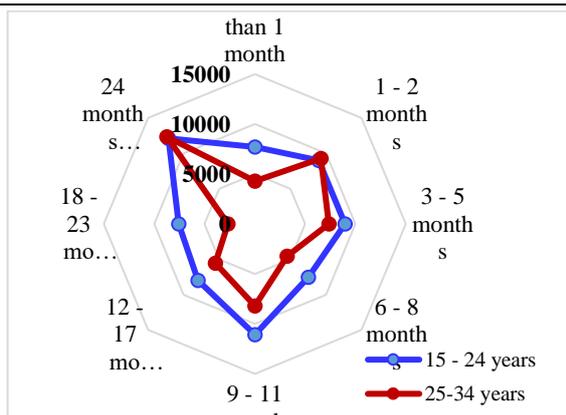


Fig. 6. ILO unemployed in rural areas by the duration of unemployment, by age group, in 2017, (persons)

Source: Own calculation based on TEMPO-online data - National Institute of Statistics, www.insse.ro

The study of labour market indicators for young people in rural areas indicates the complexity of the problems affecting the 2.13 million youth (aged 15-34). These communities must overcome the barriers generated by education, training and the labour market, and, last but not least, to face the challenge of the aging phenomenon of the population.

## CONCLUSIONS

Rural issues have been, and continue to be, one of the most important and complex topics, economic, social, political, cultural, moral, ecological, etc. of our country. The important structural changes, and the essential mutations that have taken place over the last decades in Romania, have affected in depth the Romanian countryside, respectively of the village, of the agriculture and Romanian peasant.

In the last two decades, both the national and the rural ones, the main demographic trends were the declining and aging populations of Romania. According to official statistical data, in 2018 the youngsters represented less than 23.63% of the rural population (about 2.13 million people). However, the share of youth in the total population is lower in rural than in urban.

According to the level of education, gender, age and ethnicity, there are the following categories of vulnerable young people on the labour market:

- Unqualified young people who have not graduated a higher secondary education institution, abandoning school at some point;
- Young people aged 19-25, most often fresh graduates, without professional experience, “new entry into the labour market”;
- Women represent a significant share in the category of inactive young people.

The structure of demand for labour force is also reflected in the current employment profile of rural youth (despite the agricultural potential of Romania, only about 5% of young people have income from agricultural activities).

Both in rural and urban areas is a strong relationship between certain occupations and gender. Thus, in construction and industry, men predominantly work, while women are majority in trade, education, health and social care. Very often, young people are employed as skilled, unskilled workers and service and trade workers.

The level of professional qualification of rural youth is often considered by many employers and authorities to be inadequate to market requirements.

Another negative and lasting phenomenon on the labour market in Romanian rural area is the unemployment. In 2017, the youth unemployment rate aged 20-24 reached 15.5%, for those in the 25-29 years to 7.7% and 5.7% for those with aged 30-34. The unemployment has affected all young people, regardless of their level of training.

Differences in unemployment rates have also been reported between young men and women: youth unemployment being almost double that seen by young women.

Increasing the duration of unemployment, was also due to the persistence of volatile and fragile economic conditions on rural labour market.

A high level of unemployment leads to the emergence of a number of social problems that can affect both economic development and the social development of rural communities.

Even though, in the last two decades, a set of laws have been formulated and promulgated for young people in general [6] - [9] and for those in rural areas in particular [10], or

strategies in the field of youth policies, learning lifelong or reducing school dropout [19], [20], [22] young people from Romanian rural area continue to be a vulnerable group on the labour market.

In this context, the young economically active rural population is put in a position either to accept work for a modest income or to choose the path of migration into urban areas to find a job more attractive and better paid, or to go abroad.

## REFERENCES

- [1]Accesul tinerilor pe piață muncii – Institutul Național de Statistică (The youth access in the labour market, National Institute of Statistics), 2016, [www.insse.ro](http://www.insse.ro), Accessed on Nov.9, 2018.
- [2]Anuarul Statistic al României, 2018, Institutul Național de Statistică al României (Romanian Statistical Yearbook, 2018, National Institute of Statistics), pp: 57, 132, 399.
- [3]Baza de date TEMPO-online a Institutului Național de Statistică, [www.insse.ro](http://www.insse.ro), (TEMPO-online database of the National Institute of Statistics) Accessed on Jan.9, 2019.
- [4]Dosa, D., 2015, Migrația tinerilor din mediul rural in mediul urban, [www.academia.edu](http://www.academia.edu), (Migration of young people from rural into urban areas), Accessed on Sept. 28, 2018
- [5]Ghețău, V., 2018, Demografia României, Editura Academiei Române, (Romanian Demography, Romanian Academy Publishing House), pp: 33.
- [6]Legea nr. 350 / 2006 Legea tinerilor publicata in Monitorul Oficial nr. 648 din 27-07-2006 (Law no. 350/2006 The Law of Young People published in the Official Gazette no. 648 of 27-07-2006).
- [7]Legea 76/2002 privind sistemul asigurărilor pentru șomaj și stimularea ocupării forței de muncă cu modificările și completările ulterioare, (Law 76/2002 on the unemployment insurance system and the stimulation of employment with subsequent amendments and completions), [www.anofm.ro](http://www.anofm.ro), Accessed on May 16, 2016.
- [8]Legea nr. 279/2005 privind ucenicia la locul de muncă (republicată în 2012), (Law no. 279/2005 on apprenticeship at work (republished in 2012)) [www.euroavocatura.ro](http://www.euroavocatura.ro), Accessed on Oct. 11, 2014.
- [9]Legea nr. 333/2006 privind înființarea centrelor de informare și consiliere pentru tineri, (Law no. 333/2006 on setting up information and counseling centers for young people), [www.juris.ro](http://www.juris.ro), Accessed on Jan. 18, 2014.
- [10]Legea nr. 646/2002 privind sprijinul acordat de stat tinerilor din mediul rural, (Law no. 646/2002 on state support for young people from rural areas) [www.lege5.ro](http://www.lege5.ro), Accessed on Feb. 9, 2014.

[11] Mitulescu, S., Plăeșu, A., Dalu, A. M., Neacșu-Dalu, C.C, Boeru, I., Iftode, O., Manu, M., Stefănescu, I., 2015, Aspecte privind incluziunea socială a tinerilor aflați în afara sistemelor de educație, formare și ocupare profesională (NEET), (Aspects on the Social Inclusion of Young People Outside the Education, Training and Occupation Systems (NEETs)), <http://www.ise.ro>, Accessed on Nov. 2016.

[12] Mitulescu S., 2008, Tinerii din mediul rural. Nevoi și așteptări specifice, (Young people in rural areas. Specific needs and expectations), <http://www.ise.ro>, Accessed on Mar. 16, 2012.

[13] O politică agricolă comună flexibilă, echitabilă și durabilă, Reprezentanța Comisiei Europene în România, (A flexible, fair and sustainable common agricultural policy, Representation of the European Commission in Romania), <https://ec.europa.eu>, Accessed on Oct. 4, 2018.

[14] Prognoza evoluției și tendințelor pieței muncii – amenințări și oportunități 2018, Ministerul Tineretului și Sporturilor, (Forecast of labour market evolution and trends - threats and opportunities, 2018, Ministry of Youth and Sports), <http://mts.ro>, Accessed on Jan 14, 2019.

[15] Sandu, D., 2018, Migrația internă în schimbările din România: 1920 –2016, (Internal Migration in Romanian Changes: 1920 –2016), <https://media.hotnews.ro>, Accessed on Nov.16, 2018.

[16] Situația șomajului la 31 decembrie 2016, ANOFM, (Unemployment situation at 31 December 2016, NAE), [www.anofm.ro](http://www.anofm.ro), Accessed on Jan 26, 2017.

[17] Statistici Eurostat, (Eurostat statistics), ([www.eu.europa.eu](http://www.eu.europa.eu), Accessed on Dec. 11, 2018.

[18] Statistici, Agenția Națională pentru Ocuparea Forței de Muncă, (Statistics, National Agency for Employment), [www.anofm.ro](http://www.anofm.ro), Accessed on Jun. 12, 2018.

[19] Strategia educației și formării profesionale din România pentru perioada 2016-2020, (Romania's education and training strategy for the period 2016-2020), <https://www.edu.ro>, Accessed on Feb.24 2018.

[20] Strategia Națională de Învățare pe tot Parcursul Vieții 2015 -2020, (National Lifelong Learning Strategy 2015 -2020), [www.research.gov.ro](http://www.research.gov.ro), Accessed on Mar 22, 2017.

[21] Strategia Națională în domeniul politicii de tineret pentru perioada 2015 – 2020, (National Strategy for youth policy for 2015-2020), [www.unicef.ro](http://www.unicef.ro), Accessed on Sept 29, 2017.

[22] Strategia pentru Reducerea Părăsirii Timpurii a Școlii în România, (The Strategy for Reducing Early School Leaving in Romania), <https://www.edu.ro>, Accessed on Sept 9, 2017.

[23] Șerban, A., Juravle (Gasler), A., 2012, The Romanian Rural Areas in the Context of European Development Strategies, „Revista Română de Sociologie”, serie nouă, anul XXIII, nr. 3–4, p. 265–281, București, 2012, <https://ideas.repec.org>, Accessed on Apr 17, 2016.

[24] Verick, S., 2011, Who is Hit Hardest during a Financial Crisis? The Vulnerability of Young Men and

Women to Unemployment in an Economic Downturn, Ed. ILO/Palgrave Macmillan, pp.19.

## CHALLENGES FOR THE PORK SECTOR IN ROMANIA

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### Abstract

*This paper aimed to analyse the evolution of the pork sector in Romania which was and is still affected by the African Swine Fever. The research method is based on a quantitative approach, based on national and international time data series for livestock, production and trade and the authors analysed the Romanian pork market evolution in the EU context. The results indicated significant loose of sector power which needs several years to recover from this crisis. Since pork is by far the preferred meat for the Romanian consumer, this will increase the imbalance of the pork trade in the next years, with consequence on the internal market prices and position of the Romanian pork producers within the market.*

**Key words:** African Swine Fever, market, pork, Romania, trade

### INTRODUCTION

Between 2007-2014 the pork production declined in Romania due to significant livestock decline [7]. The decrease of pigs' livestock in Romania from 5.6 million heads in 2009 to 4.9 million heads in 2017 was correlated with a switch in the top of the regions with the highest livestock, the West Region replacing the South Region of Development in the top with almost 1 million of heads [4]. The new and main important cause of decrease of pig livestock in Romania in 2018, the African swine fever (ASF), came in Europa in 2007 through a Georgia Black Sea harbour and entered EU in 2014. [6]. In Romania the African Swine Fever was first detected at the end of July 2017 in a household located at the periphery of the city Satu Mare [1] but the Romanian authorities have been alerted by the European Commission since month March of the same year when a meeting Task Force was held by DG SANTE in Suceava city, when have been presented methods for preventing of entry of this disease virus in Romania. [2]. The disease spread rapidly in the main production areas starting with the South East Region at the end of June 2018 when was recorded in a slaughterhouse belonging to a company which held a pig farm in Tulcea County. From a

report of The National Sanitary Veterinary and Food Safety Authority of Romania [8] presented in Bruxelles in September 2018, it can be understanding the huge impact of disease on the pig livestock, which led to sacrifice of over 300 thousand pigs and lock the activity in more than 15 commercial farms. Since Romania was a net importer of meat and edible meat products [3], and the most significant deficit before this disease was at the group of pork [5], this crisis imbalanced more the trade with pork products. This paper aimed to evaluate the recent situation of pork sector in Romania and to underline the main challenges of this sector in relation to the main pork producers and exporters from the EU to Romania.

### MATERIALS AND METHODS

For this paper were first analysed the evolution of EU livestock, pork production and the exports, in quantitative and value terms. Then were determined the main EU pork exporters and we calculated how much of their exports are delivered on Romanian markets and what was the variation of their exports share on the Romanian market. The data were provided by ITC, the joint agency of the WTO and United Nations and Food and

Agriculture Organization of the United Nations.

## RESULTS AND DISCUSSIONS

Germany has by far the largest pig livestock in the EU, accounting over 58 million heads, followed by Spain which increased its livestock from 40 to 50 million heads in the last decade, while Denmark, the third EU pig

producer recorded a decline from 20.1 million heads in 2010 to less than 17.5 million heads in 2017. A significant decline of pig livestock was recorded in France from 25.4 million heads in 2009 to 23.8 million heads in 2017, while in Romania the pig livestock declined under 5 million heads (Table 1), and the impact of African Swine fever from 2018 will be marked soon by the national statistic.

Table 1. Pig livestock (heads)

	2009	2010	2011	2012	2013	2014	2015	2016	2017
<b>Germany</b>	56,315,240	58,625,628	59,735,680	58,365,864	58,622,058	58,934,837	59,435,349	59,480,468	58,408,370
<b>Spain</b>	40,887,908	40,847,016	41,743,364	41,594,556	41,418,464	43,484,000	45,890,524	49,083,785	50,072,755
<b>Denmark</b>	19,331,500	20,137,800	20,898,500	19,485,000	19,102,000	18,857,500	18,716,700	18,356,533	17,465,533
<b>Netherlands</b>	13,815,660	13,943,600	14,593,700	14,317,700	14,013,580	14,595,890	15,485,070	15,373,890	15,169,000
<b>Belgium</b>	11,161,285	11,900,000	11,764,596	11,695,145	11,915,000	11,855,070	11,886,693	11,181,334	10,919,769
<b>Poland</b>	20,062,224	21,256,676	22,055,910	20,604,816	20,278,472	21,665,978	21,748,332	22,098,424	22,188,959
<b>France</b>	25,497,210	25,348,236	25,005,000	24,388,000	24,387,873	23,332,517	23,312,352	24,138,654	23,858,700
<b>Ireland</b>	2,420,800	2,657,300	2,905,000	2,972,300	2,903,700	3,042,800	3,226,000	3,316,600	3,355,100
<b>Austria</b>	5,598,387	5,632,463	5,601,002	5,432,959	5,431,798	5,409,578	5,414,234	5,227,573	5,152,595
<b>Hungary</b>	4,868,637	4,918,241	4,687,213	4,239,317	4,017,421	4,446,798	4,842,570	4,905,868	5,050,984
<b>Romania</b>	<b>5,697,726</b>	<b>5,255,000</b>	<b>5,545,000</b>	<b>5,362,000</b>	<b>4,793,000</b>	<b>5,668,000</b>	<b>5,759,000</b>	<b>5,985,000</b>	<b>4,924,340</b>

Source: FAO.

Germany has also the largest pork production from the EU, more than 5.5 million tons being marketed on the internal and external market. Romania with a pork production that declined

at 0.45 million tons in 2017 is not able to cover the internal pork meat demand, and its market is plenty of pig meat imported from the EU.

Table 2. Pork production (tons)

	2009	2010	2011	2012	2013	2014	2015	2016	2017
<b>Germany</b>	5,264,505	5,488,369	5,616,074	5,474,021	5,506,772	5,527,769	5,570,490	5,589,639	5,505,572
<b>Spain</b>	3,290,571	3,368,921	3,469,345	3,466,323	3,431,214	3,555,606	3,854,658	4,181,091	4,298,893
<b>Denmark</b>	1,585,000	1,668,200	1,720,200	1,669,000	1,589,400	1,593,900	1,600,591	1,579,405	1,532,387
<b>Netherlands</b>	1,274,980	1,294,000	1,347,166	1,332,731	1,306,950	1,370,890	1,456,220	1,452,840	1,455,677
<b>Belgium</b>	1,082,036	1,123,769	1,108,255	1,109,610	1,130,572	1,118,330	1,124,310	1,060,541	1,044,561
<b>Poland</b>	1,735,700	1,894,800	1,936,300	1,848,600	1,775,500	1,864,500	1,976,000	2,008,800	2,047,800
<b>France</b>	2,261,593	2,254,688	2,217,368	2,161,653	2,130,578	2,120,315	2,148,452	2,185,430	2,136,276
<b>Ireland</b>	195,600	214,300	233,800	241,400	239,300	254,100	276,400	282,700	294,200
<b>Austria</b>	540,299	545,818	544,166	530,263	529,284	527,442	529,118	514,892	508,494
<b>Hungary</b>	453,484	452,073	434,707	393,712	368,153	412,292	455,088	457,808	469,829
<b>Romania</b>	<b>470,567</b>	<b>428,891</b>	<b>454,415</b>	<b>442,942</b>	<b>396,070</b>	<b>459,756</b>	<b>470,055</b>	<b>500,777</b>	<b>451,940</b>

Source: FAO.

In 2017 the EU accounted for two thirds of all world pork export. The main exporter was Germany, followed by Spain and Denmark both in terms of value (Table 3) or quantity (Table 4). While Denmark seems to lose a tempo in the pork trade, especially on the UK market, Spain gained large sectors on the EU

and world pork markets. The scale economy is the main reason which led to decrease in the number of pig farms in some traditional EU producer countries, where pig production became more concentrated, being developed in large scale farms. Most of these countries had recorded significant improvements in

productivity, so at the EU level, the pork sector remains solid, and the pork exports were not affected by particular production developments in some of the EU countries. Poland is one of the EU countries which tripled their exports in the last years, while France recorded a significant loss of its share on the international pork markets. The development of the processing industry was

affected in some of the main producer countries, where the pig production was decoupled by the national processing industry. In some EU countries, the number of pigs slaughtering decreased since the pork market prices and the processing cost determined the producers to invest in slaughterhouses situated in other countries of the EU.

Table 3. Top 10 European Union exporters for meat of swine, fresh, chilled or frozen (US Dollar thousand)

Exporters	Exported value in 2009	Exported value in 2010	Exported value in 2011	Exported value in 2012	Exported value in 2013	Exported value in 2014	Exported value in 2015	Exported value in 2016	Exported value in 2017
<b>World</b>	23,519,969	24,931,330	30,061,040	30,509,742	31,085,714	31,497,679	25,488,107	27,550,860	30,129,460
<b>European Union (EU 28)</b>	16,200,094	16,585,662	19,767,118	19,911,150	21,202,993	20,437,563	16,464,482	17,929,956	19,613,359
<b>Germany</b>	3,990,960	4,051,758	4,921,991	5,006,181	5,303,544	5,051,956	3,986,293	4,349,885	4,762,901
<b>Spain</b>	2,325,803	2,322,514	2,903,042	2,999,062	3,170,556	3,382,357	2,998,204	3,550,205	4,068,663
<b>Denmark</b>	3,129,593	3,114,869	3,567,755	3,343,764	3,398,027	3,217,429	2,537,523	2,628,643	2,741,676
<b>Netherlands</b>	1,847,830	1,825,829	2,229,324	2,209,977	2,289,806	2,425,022	1,929,597	2,018,068	2,169,655
<b>Belgium</b>	1,611,139	1,539,602	1,712,925	1,751,237	2,036,212	1,684,892	1,310,014	1,318,556	1,442,361
<b>Poland</b>	364,424	573,231	805,155	966,883	1,221,172	922,314	757,948	836,970	1,062,392
<b>France</b>	1,092,736	1,073,887	1,230,911	1,214,747	1,246,655	1,115,887	830,036	878,573	931,178
<b>Ireland</b>	198,507	249,178	333,012	381,552	421,967	472,604	422,676	486,341	502,587
<b>Austria</b>	499,980	479,357	570,909	512,118	506,175	558,889	374,199	410,366	431,179
<b>Hungary</b>	319,112	434,090	461,153	409,842	400,618	419,030	342,936	355,032	399,516
<b>%EU in World</b>	<b>68.88</b>	<b>66.53</b>	<b>65.76</b>	<b>65.26</b>	<b>68.21</b>	<b>64.89</b>	<b>64.60</b>	<b>65.08</b>	<b>65.10</b>

Source: International Trade Center and own calculations.

Table 4. Top 10 European Union exporters for meat of swine, fresh, chilled or frozen (Tons)

Exporters	Exported quantity in 2009	Exported quantity in 2010	Exported quantity in 2011	Exported quantity in 2012	Exported quantity in 2013	Exported quantity in 2014	Exported quantity in 2015	Exported quantity in 2016	Exported quantity in 2017
<b>World</b>	9,041,843	9,587,138	10,418,450	10,556,750	10,477,525	10,596,207	10,996,882	11,719,148	11,596,632
<b>European Union (EU 28)</b>	6,025,205	6,574,793	7,087,599	7,028,580	7,197,602	7,249,283	7,585,436	7,969,324	7,762,800
<b>Germany</b>	1,440,110	1,544,780	1,700,168	1,693,699	1,732,721	1,757,952	1,778,914	1,869,922	1,818,896
<b>Spain</b>	882,291	879,828	995,319	1,029,067	999,463	1,076,366	1,254,383	1,487,458	1,517,410
<b>Denmark</b>	1,089,031	1,153,809	1,211,141	1,102,590	1,085,548	1,090,664	1,130,866	1,128,625	1,093,046
<b>Netherlands</b>	641,760	774,779	846,492	824,402	797,262	889,269	940,316	925,788	911,800
<b>Belgium</b>	655,703	666,313	667,752	684,682	777,521	696,764	722,622	687,352	672,040
<b>Poland</b>	147,295	257,491	309,753	358,812	441,309	374,196	394,493	415,282	471,514
<b>France</b>	469,419	484,211	491,909	481,344	483,336	455,488	437,113	444,308	423,110
<b>United Kingdom</b>	108,363	138,016	144,539	152,670	180,585	181,713	186,955	206,039	215,986
<b>Ireland</b>	82,476	103,386	124,673	132,311	132,461	148,519	169,465	183,823	192,062
<b>Austria</b>	171,254	170,413	183,273	161,865	153,982	177,595	158,579	166,931	154,566
<b>%EU in World</b>	<b>66.64</b>	<b>68.58</b>	<b>68.03</b>	<b>66.58</b>	<b>68.70</b>	<b>68.41</b>	<b>68.98</b>	<b>68.00</b>	<b>66.94</b>

Source: International Trade Center and own calculations.

Germany is the main pork export supplier for the Romanian market (Table 5). Spain has recorded the highest increase of pork on the Romanian market. From 2009 to 2017 Spain doubled its exports in Romanian pork market, and the Romanian preferences for these products can be associated with the large community of Romanian from Spain which

has begun to bring the consumer influence of pork products with Spanish origin on their relatives from Romania, fact that was speculated by the Spanish pork exporters. Certain Spanish specific stores have also been established on the Romanian market. The high level of the pork imports from Hungary can be related to the low cost for transport and

consumer preference of the Hungarian communities which totalize more than 1.2 million inhabitants. In 2017 the total import of pork in Romania totalized 0.23 million to (Table 6), which is half of the internal pork production. Both in quantitative and value terms, Germany, Spain and Hungary are the main suppliers for our internal market. Poland gained in the last decade large share on the Romanian pork market. Only 3% of the Germany pork exports came in Romania in

2017, but should be considered that around 20% of Hungary pork exports can be found on the Romanian pork market. In terms of quantity, Germany exported 62 thousand to of pork meat on Romanian market in 2017, representing 3.45 % of its total exports, but in 2009, Germany exported in Romania over 73 thousand to of pork products, which represented at that time 5.13 % of its total exports of pork products.

Table 5. Top 5 supplying markets for meat of swine, fresh, chilled or frozen imported by Romania (US Dollar thousand)

Exporters	Imported value in 2009	Imported value in 2010	Imported value in 2011	Imported value in 2012	Imported value in 2013	Imported value in 2014	Imported value in 2015	Imported value in 2016	Imported value in 2017
<b>World</b>	<b>531,331</b>	<b>403,791</b>	<b>360,419</b>	<b>331,644</b>	<b>357,726</b>	<b>378,390</b>	<b>327,996</b>	<b>380,264</b>	<b>541,906</b>
<b>Germany</b>	170,376	125,206	110,171	96,479	106,005	123,480	101,246	88,037	142,828
<b>% from World</b>	<b>32.07</b>	<b>31.01</b>	<b>30.57</b>	<b>29.09</b>	<b>29.63</b>	<b>32.63</b>	<b>30.87</b>	<b>23.15</b>	<b>26.36</b>
<b>Spain</b>	62,412	36,745	26,675	25,973	38,740	52,557	56,121	97,127	131,730
<b>% from World</b>	<b>11.75</b>	<b>9.10</b>	<b>7.40</b>	<b>7.83</b>	<b>10.83</b>	<b>13.89</b>	<b>17.11</b>	<b>25.54</b>	<b>24.31</b>
<b>Hungary</b>	85,558	74,001	66,457	87,390	98,712	67,687	58,096	67,259	79,085
<b>% from World</b>	<b>16.10</b>	<b>18.33</b>	<b>18.44</b>	<b>26.35</b>	<b>27.59</b>	<b>17.89</b>	<b>17.71</b>	<b>17.69</b>	<b>14.59</b>
<b>Netherlands</b>	42,711	31,949	35,816	39,117	34,652	44,014	37,791	38,578	57,209
<b>% from World</b>	<b>8.04</b>	<b>7.91</b>	<b>9.94</b>	<b>11.79</b>	<b>9.69</b>	<b>11.63</b>	<b>11.52</b>	<b>10.15</b>	<b>10.56</b>
<b>Poland</b>	7,336	5,820	5,273	4,569	5,485	17,195	18,096	22,707	44,463
<b>% from World</b>	<b>1.38</b>	<b>1.44</b>	<b>1.46</b>	<b>1.38</b>	<b>1.53</b>	<b>4.54</b>	<b>5.52</b>	<b>5.97</b>	<b>8.20</b>

Source: International Trade Center and own calculations.

Table 6. Top 5 supplying markets for meat of swine, fresh, chilled or frozen imported by Romania (Tons)

Exporters	Imported quantity in 2009	Imported quantity in 2010	Imported quantity in 2011	Imported quantity in 2012	Imported quantity in 2013	Imported quantity in 2014	Imported quantity in 2015	Imported quantity in 2016	Imported quantity in 2017
<b>World</b>	<b>228,458</b>	<b>198,914</b>	<b>157,696</b>	<b>156,454</b>	<b>150,118</b>	<b>163,559</b>	<b>188,689</b>	<b>196,966</b>	<b>232,387</b>
<b>Germany</b>	73,902	62,332	49,949	39,993	44,555	57,022	63,257	50,701	62,733
<b>% from World</b>	<b>32.35</b>	<b>31.34</b>	<b>31.67</b>	<b>25.56</b>	<b>29.68</b>	<b>34.86</b>	<b>33.52</b>	<b>25.74</b>	<b>27.00</b>
<b>Spain</b>	23,414	14,822	9,927	9,869	12,248	17,861	25,490	42,406	47,901
<b>% from World</b>	<b>10.25</b>	<b>7.45</b>	<b>6.30</b>	<b>6.31</b>	<b>8.16</b>	<b>10.92</b>	<b>13.51</b>	<b>21.53</b>	<b>20.61</b>
<b>Hungary</b>	35,562	35,396	27,718	53,502	44,183	26,714	30,088	31,455	35,049
<b>% from World</b>	<b>15.57</b>	<b>17.79</b>	<b>17.58</b>	<b>34.20</b>	<b>29.43</b>	<b>16.33</b>	<b>15.95</b>	<b>15.97</b>	<b>15.08</b>
<b>Netherlands</b>	16,849	14,835	15,086	15,564	13,919	18,244	21,297	20,093	24,702
<b>% from World</b>	<b>7.38</b>	<b>7.46</b>	<b>9.57</b>	<b>9.95</b>	<b>9.27</b>	<b>11.15</b>	<b>11.29</b>	<b>10.20</b>	<b>10.63</b>
<b>Poland</b>	4,633	5,120	3,391	2,629	3,117	9,062	13,445	13,488	20,882
<b>% from World</b>	<b>2.03</b>	<b>2.57</b>	<b>2.15</b>	<b>1.68</b>	<b>2.08</b>	<b>5.54</b>	<b>7.13</b>	<b>6.85</b>	<b>8.99</b>

Source: International Trade Center and own calculations.

In 2017 Spain has the highest share of its pork exports on the Romanian market, representing 3.24 % of its total pork exports (Table 7). Poland pork exports to Romania increased in the last years the concern of Romanian producers who faced in this way a new and important competitor on the market. The

challenges of the internal market can be seen from different points of view. In terms of quantity (Table 8), it can be seen that the Romanian imports have increased to over 1.8 million tons. The producers have been affected by the African Swine Fever both in terms of livestock and price. They lost pigs

with captive bullets and it takes several months until the production can be relaunched. The farms had to fire the employees and activity can be hardly restarted. The risk of new cases of AFS makes some producers circumspect in their attempting to resume the production, since the disease has spread in 18 Romanian counties and around 300 localities. Some measures related to the restriction for animal movements and campaign for the decreasing of domestic swine in the affected areas can

also be a brake in the relaunch of pork sector in the disease area.

The retail of pork product made in small enterprises has collapsed and many businesses have been closed. Also many businesses related with providing inputs to the pig farms were closed or severally affected. The pork processors are now obliged to import higher quantity of frozen pork which they use in the preparation of sausages and this can lead to an increase of the price of Romanian pork products on the market.

Table 7. The pork value imported by Romania from the supplying markets (US Dollar thousand)

Exporters	2009	2010	2011	2012	2013	2014	2015	2016	2017
<b>Germany</b>	3,990,960	4,051,758	4,921,991	5,006,181	5,303,544	5,051,956	3,986,293	4,349,885	4,762,901
<b>Value imported by Romania from Germany</b>	170,376	125,206	110,171	96,479	106,005	123,480	101,246	88,037	142,828
<b>%</b>	4.27%	3.09%	2.24%	1.93%	2.00%	2.44%	2.54%	2.02%	3.00%
<b>Spain</b>	2,325,803	2,322,514	2,903,042	2,999,062	3,170,556	3,382,357	2,998,204	3,550,205	4,068,663
<b>Value imported by Romania from Spain</b>	62,412	36,745	26,675	25,973	38,740	52,557	56,121	97,127	131,730
<b>%</b>	2.68%	1.58%	0.92%	0.87%	1.22%	1.55%	1.87%	2.74%	3.24%
<b>Hungary</b>	319,112	434,090	461,153	409,842	400,618	419,030	342,936	355,032	399,516
<b>Value imported by Romania from Hungary</b>	85,558	74,001	66,457	87,390	98,712	67,687	58,096	67,259	79,085
<b>%</b>	26.81%	17.05%	14.41%	21.32%	24.64%	16.15%	16.94%	18.94%	19.80%
<b>Netherlands</b>	1,847,830	1,825,829	2,229,324	2,209,977	2,289,806	2,425,022	1,929,597	2,018,068	2,169,655
<b>Value imported by Romania from Netherlands</b>	42,711	31,949	35,816	39,117	34,652	44,014	37,791	38,578	57,209
<b>%</b>	2.31%	1.75%	1.61%	1.77%	1.51%	1.81%	1.96%	1.91%	2.64%
<b>Poland</b>	364,424	573,231	805,155	966,883	1,221,172	922,314	757,948	836,970	1,062,392
<b>Value imported by Romania from Poland</b>	7,336	5,820	5,273	4,569	5,485	17,195	18,096	22,707	44,463
<b>%</b>	2.01%	1.02%	0.65%	0.47%	0.45%	1.86%	2.39%	2.71%	4.19%

Source: International Trade Center and own calculations

Table 8. The pork quantities imported by Romania from the supplying markets (Tons)

Exporters	2009	2010	2011	2012	2013	2014	2015	2016	2017
<b>Germany</b>	1,440,110	1,544,780	1,700,168	1,693,699	1,732,721	1,757,952	1,778,914	1,869,922	1,818,896
<b>Imports of Romania from Germany</b>	73,902	62,332	49,949	39,993	44,555	57,022	63,257	50,701	62,733
<b>%</b>	5.13%	4.04%	2.94%	2.36%	2.57%	3.24%	3.56%	2.71%	3.45%
<b>Spain</b>	882,291	879,828	995,319	1,029,067	999,463	1,076,366	1,254,383	1,487,458	1,517,410
<b>Imports of Romania from Spain</b>	23,414	14,822	9,927	9,869	12,248	17,861	25,490	42,406	47,901
<b>%</b>	2.65%	1.68%	1.00%	0.96%	1.23%	1.66%	2.03%	2.85%	3.16%
<b>Hungary</b>	107,100	158,639	151,845	136,244	132,939	132,377	139,530	134,533	<b>No quantity</b>
<b>Imports of Romania from Hungary</b>	35,562	35,396	27,718	53,502	44,183	26,714	30,088	31,455	35,049
<b>%</b>	33.20%	22.31%	18.25%	39.27%	33.24%	20.18%	21.56%	23.38%	-
<b>Netherlands</b>	641,760	774,779	846,492	824,402	797,262	889,269	940,316	925,788	911,800
<b>Imports of Romania from Netherlands</b>	16,849	14,835	15,086	15,564	13,919	18,244	21,297	20,093	24,702
<b>%</b>	2.63%	1.91%	1.78%	1.89%	1.75%	2.05%	2.26%	2.17%	2.71%
<b>Poland</b>	147,295	257,491	309,753	358,812	441,309	374,196	394,493	415,282	471,514
<b>Imports of Romania from Poland</b>	4,633	5,120	3,391	2,629	3,117	9,062	13,445	13,488	20,882
<b>%</b>	3.15%	1.99%	1.09%	0.73%	0.71%	2.42%	3.41%	3.25%	4.43%

Source: International Trade Center and own calculations.

## CONCLUSIONS

Romania was the main affected country by the African Swine Fever. The low security of the Romanian farms and the late reaction of the factors involved it generated a real and major crisis on the internal pork market. All the pork supply chain has been affected and the market is now under pressure of the import pork products from the EU countries. The Romanian trade balance with pork products will become even deficient and prices on the pork market can have surprising developments since the internal production cover about one third from the consumption needs.

## REFERENCES

- [1]ANSVA Informare de presă, 2019, A fost confirmat primul focar de pestă porcină africană în România la porcii din gospodării în județul Satu – Mare ( It was confirmed the 1st outbreak of ASF in Romania at the pigs from households in SatuMare County), <http://www.ansvsa.ro/blog/a-fost-confirmat-primul-focar-de-pesta-porcina-africana-in-romania-la-porcii-din-gospodarii-in-judetul-satu-mare>, Accessed on Feb. 2, 2019
- [2]ANSVA, 2019, Întâlnire a Task Force pentru pesta porcină africană organizată de Comisia Europeană la Suceava (28 – 30 martie), (A task force meeting organized by European Commission for ASF in Suceava, March 28-30), <http://www.ansvsa.ro/blog/intalnire-a-task-force-pentru-pesta-porcina-africana-organizata-de-comisia-europeana-la-suceava-28-30-martie/>, Accessed on Jan. 15, 2019
- [3]Beciu, S., Arghiroiu, A.G., 2017, Evolution of the Romanian trade with agro-food products, Proceeding of the 29th IBIMA Conference, 3-4 May Vienna, Austria, p. 4282-4288
- [4]Beciu, S., Arghiroiu, A.G., Lădaru G.R., 2016, Recent evolutions of livestock at regional level in Romania, Scientific Papers Series "Management, Economic Engineering in Agriculture and rural development, Vol. 16(4): 49-54.
- [5]Beciu, S., Arghiroiu, A.G., Costaiache G.M., Chihaiia, A., 2017, Study about Romania's position in the international trade with meat, Scientific Papers Series "Management, Economic Engineering in Agriculture and rural development, Vol. 17(4): 67-71.
- [6]Chenais, E., Depner, K., Guberti, V., Dietze, K., Viltrop, A., Stähl, K., 2019, Epidemiological considerations on African swine fever in Europe 2014–2018, Porcine Health Management, Vol 2019, 1:10.
- [7]Popescu, A., 2016, Research on concentration of pork production in Romania, Scientific Papers Series

"Management, Economic Engineering in Agriculture and rural development, Vol. 16(1): 405-410.

[8]SCOPAFF Meeting, 2018, Updated Situation of ASF in Romania, The National Sanitary Veterinary and Food Safety Authority of Romania, [https://ec.europa.eu/food/sites/food/files/animals/docs/req-com\\_ahw\\_20180919\\_pres\\_asf\\_rou.pdf](https://ec.europa.eu/food/sites/food/files/animals/docs/req-com_ahw_20180919_pres_asf_rou.pdf), Accessed on 20.01.2019.

## PERCEPTION OF THE BEEKEEPERS REGARDING THE PRINCIPLES OF SUSTAINABLE DEVELOPMENT IN THE NORTH-EASTERN REGION OF ROMANIA

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### Abstract

*The aim of the presented research consisted in determining the beekeepers' behavior related to the sustainable development values and principles, based on the assessment of their acceptance level, as well as through the determination of the impact upon the apiaries' economic performances, as a result of following them. The field research occurred by questionnaires applied during the last trimester of the year 2018, on a sample of 114 subjects. The gross profit of the studied population was about 0.9 thousand euro, the profit rate 12.0%, the capital productivity 0.34 % and the net income -0.9 thousand euro. The stated believes of beekeepers regarding the sustainable development have been favourable with an average score of 4.2 on a Likert scale from 1 to 7. Solid but negative correlations have been recorded between the gross profit of apiaries and the beekeeper attitude to equality, respect for nature and shared responsibility, with values of Pearson coefficient of: -0.84, -0.92 and -.84, respectively. These results reflect the necessity to strength the sustainable development values within the beekeeping from the studied area.*

**Key words:** beekeepers' behaviour, sustainable development, economic performance

### INTRODUCTION

The economic theory, as a matter of principle, may lead to understand the dynamic and dialectic interdependence characteristic to the moral dimension and the economic conduct [3]. The neo-classical company is perceived as the entity where the production occurs as efficiently as possible, within the limits of the faced objective constraints [19], [20].

The conventional neo-classical theory is based on the hypothesis regarding the selfish conduct of the companies, which determines lower unit costs and higher profits than in the case of the companies taking ethically-based decisions. The conventional wisdom leads to the belief that the altruistic or ethical companies can not survive on a competitive market where there is no effective demand for products obtained within processes based on the equity principles [10]. The final consumers may be shaped as rational utility maximizers, they optimize the future

consumption and they are consistent with this consumption behaviour. Thus, the consumer utility may be maximized as far as the ethical or altruistic behaviour is concerned [6].

In time, two ways leading to the achievement of a fair production in competitive conditions have been highlighted. The first consists in the mitigation of the unitary consumption by increasing the productive capacity and by implementing a specific model of human resources management. The second way implies the access to the technological progress, which leads to the improvement of the production function in the case of the firm engaging an ethical behavior [3]. In some cases, the salary-related costs are diminished by the social responsibility that may be capitalised as a motivational factor for certain activities. Thus is highlighted another pattern to approach the economy, in which case the labour force is ensured by the orientation of a part of society towards ethical motivations. This phenomenon seems to be specific for the

industry branches [12]. Also, it is imperative the issuing of some new methods to determine the environmental costs, which are meant to overlap with an integrated approach on environment protection and to lead to ensuring the performance/efficiency of sustainable economic activities [14].

The beekeeping is recognised as an activity with a significant impact on the environment where it occurs [1], [5], as well as on the life quality in the rural area [14], [15]. Still, to maximize the agricultural production in order to increase the profit might have negative implications upon the natural and social environment [11]. In the same time, using more intensive farming practices in Romanian agriculture, determines the increased vulnerability of bees and apiaries [13].

The Romanian beekeeping is characterized by a number of 1.45 million of bee-families owned in the year 2017 by 42,864 beekeepers. The total honey production recorded in the year 2017 reached about 24,611 tones per year, with a mean of 22,781 tones per year during the period 2008-2017. The average number of bee families per apiary in the year 2017 was about 33.8 hives, with a production of 558 kg honey per apiary and an average honey production of 25.3 kg per hive. The honey is the main product harvested by the beekeepers and its selling is mainly made directly to the final consumers, on the agri-food markets and sometimes to the units specialised in honey acquisition and processing. The average honey consumption in Romania in the period 2008-2017 reached about 0.62 kg/person/year [22].

The apiary management is mostly stationary (84%), the other beekeepers move to some zones with a higher potential for the honey production than the zones from where they do come from [21]. These beekeepers use means of transport or their own vehicles. The applied beekeeping management includes verified traditional elements, sometimes outdated, associated with modern technologies used mostly accordingly [16].

The degree of apiary endowment grew up in most cases due to the accession of European funds. The beekeepers use wooden hives,

manual centrifuge machine (in generally) and other relatively rudimentary equipment [16].

The efficiency of using production factors has a prominent place within the efforts towards the accomplishment of a sustainable agricultural development [2], [4], [7], [8], [17]. This shift is, in the same time, favourable for environment protection, as well as for identifying the economically efficient systems [9].

## MATERIALS AND METHODS

The hereby presented research studies started from the hypothesis: "The economic efficiency of apiaries is determined by the beekeeper believes regarding the sustainable development". This means that the economic efficiency is correlated with the degree of recognizing and following the sustainable development values by the beekeepers from the North-Eastern Region of Romania. The first step consisted in establishing the beekeeper believes concerning the sustainable development. The second step was represented by the identification of the correlation between the answers regarding the sustainable development values and the main economic indicators of apiaries. Finally have been drawn up statements confirming some of the actual theories on the possibility to ensure the competitiveness of the economic units that follow the ethical values on which the sustainable development is founded.

Therefore, the research aimed to establish the beekeeper behaviour in the light of sustainable development. This purpose determined two objectives: 1. to assess the acceptance level of sustainable development values; 2. to establish the impact of following the sustainable development values upon the economic efficiency of apiaries.

The field research was carried out by questionnaires applied in the last term of the year 2018, with questions regarding the apiary consumption and results recorded in the year 2018 on a sample of 114 beekeepers from the North-Eastern Region of Romania. The sample has been realised through Neyman method, with 5% criterion of deviation and 95% level of trust.

The statistical data processing was realised with IT-applications as MS Excel, SPSS (Kolmogorov-Smirnov test, T-test, Pearson correlation), and to the field information have been added data received from the North-East Regional Directorate of Statistics and the Beekeepers Association.

The analysis of consumption and economic results was carried out by using indicators as: number of bee families, total production, average price, consumptions concerning the financial capital and workforce, value of different services and products acquisitions from third parties. Based on these indicators have been determined: total income, total expenses, net income (without the value of the own consumed resources), net income with respect to total consumptions, capital productivity and labour productivity [21].

The beekeepers received a questionnaire structured on twenty statements based on the fundamental values of sustainable development. The questionnaire used the Likert scale with grades from 1 to 7: 1 – Very false; 2 – Not true; 3 – To some extent false; 4 – Neutral 5 – To some extent true 6 - True; 7 – Very true [18].

*Freedom considerations construct:* Q1 - “In some instances, parents should take into consideration the probability that they and their descendants may face the circumstances when they are feeling hungry” / “All parents have the right to expect that they and their children will be raised free from hunger”; Q2 - “Sometimes the threat of violence is necessary to achieve social good” / “All people have the absolute right to live their lives free from the fear of any violence”; Q3 - “In some instances, people deserve lower levels of justice” / “The highest level of justice should be available for all people at all times”;

*Equality considerations construct:* Q4 - “People who contributed the most to economic development deserve greater access to its benefits” / “People must have equal access to the benefits generated by development regardless of whether they contributed to that development or not”; Q5 - “The nations that foster economic development the most deserve greater access

to its benefits” / “All nations must have equal access to benefits from economic development”; Q6 - “Those citizens most responsible for economic prosperity should receive more of the resulting benefits” / “The benefits of global economy should be shared equally among all nations”;

*Solidarity considerations construct:* Q7 - “If we earn our benefits then it is not necessary to give others some of our gains” / “Those who benefit the most must help provide for those who benefit the least”; Q8 - “Just because one faces few burdens from global change does not mean that they must give assistance to those who are more burdened” / “Those who bear a substantial burden from global changes should receive assistance from those who are less burdened”; Q9 - “We must first address the suffering of our own before helping others with their suffering” / “Those who suffer the most deserve help from those who suffer the least”;

*Tolerance considerations construct:* Q10 - “There are some people’s beliefs that do not deserve respect” / “All human beings must respect the diversity of beliefs across all people”; Q11 - “Peace within societies invariably begins with promoting the society’s traditional way of life” / “Peace within societies invariably begins with openness toward others’ ways of life”; Q12 - “In some cases, it becomes necessary to repress differences across societies” / “People must not repress any differences across societies”;

*Respect for nature construct:* Q13 - “Sometimes some natural resources need to be sacrificed for important developments” / “All precautions must be taken to protect natural resources in our development efforts”; Q14 - “Current patterns of production only require minor adjustments to protect the welfare of the natural environment” / “Current patterns of production must be substantially changed to protect the welfare of the natural environment”; Q15 - “People need only make minor changes to their current consumption out of respect for nature” / “People must make major changes to their current consumption out of respect for nature”; Q16 - “To a certain extent, the natural environment will look after itself to the benefit of future generations” / “It

is the obligation of a society to vigorously protect the natural environment for the benefit of future generations”;

*Shared responsibility construct:* Q17 - “We are responsible for assuring that people within our society have their rights for freedom maintained but we are not responsible for these rights for people in other societies” / “We are all responsible for assuring that all people’s rights to freedom are maintained”; Q18 - “A civilized nation must accept responsibility for improving the welfare of its less fortunate citizens but is not responsible for the welfare of another nation’s citizens” / “Civilized nations must accept responsibility for improving the welfare of less fortunate individuals around the world”; Q19 - “We are responsible when members of our immediate society do not tolerate cultural differences but are not responsible for the behaviour of members of distant societies” / “We all share responsibility when members of our global society do not tolerate cultural differences”; Q20 - “Each civilized nation should focus on ending injustices in their own borders and not influence other nations in their efforts” / “It is the moral obligation of civilized nations to work together to end global injustices”. [18]

## RESULTS AND DISCUSSIONS

The economic results determined on the sample level have indicated the following values: total capital: 10.5 thousand euro; own resources: 1.9 thousand euro; total income: 36.7 thousand euro; total expenses: 35.8 thousand euro; gross profit: 0.9 thousand euro; number of employees: 1.3 persons; profit rate: 12.0%; capital productivity: 0.34 %; labour productivity: 30.3 thousand euro/person; net income: -0.9 thousand euro.

The beekeepers’ answers regarding the sustainable development ranged from neutral to favourable (average score 4.2) (Table 1).

Table 1. Beekeeper answers in value groups

Question group	Value
Freedom considerations construct	4.6
Equality considerations construct	3.8
Solidarity considerations construct	3.7
Tolerance considerations construct	4.4
Respect for nature construct	5.7
Shared responsibility construct	3.3

Source: Own calculation.

*Freedom considerations construct:* The answers of the questioned subjects had the following average values: Q1 – 2.2; Q2 – 5.1; Q3 – 6.4. It pointed out the fact that the majority of beekeepers consider that, in some cases, the parent should understand that it might be possible the case when they and their families have to feel hungry, and, by the other hand, they consider that all peoples should have access in any moment to the highest level of justice. Here appears the fingerprint of the Romanian people’s history, marked by vicissitudes, and for this reason the subjects expect the future to be not significantly different. In the same time, it is obvious the imperative need to ensure an equal justice for all citizens.

*Equality considerations construct:* Q4 – 2.1; Q5 – 3.3; Q6 – 6.1. The subjects consider, in generally, that the peoples who contributed mostly to the economic development deserve to have a wider access to its benefits, but, in the same time, all the economic benefits obtained globally should be equally divided among the nations of the world.

*Solidarity considerations construct:* Q7 – 4.3; Q8 - 3.6; Q9 - 3.1. In generally, the subjects’ attitude is proven to be relatively neutral with respect to the solidarities values, as well as to tolerance - tolerance considerations construct: Q10 – 4.2; Q11 – 4.1; Q12-4.9.

*Respect for nature construct:* Q13-5.2; Q14 - 6.1; Q15 – 5.4; Q16 – 6.2. The subjects are convinced that it is an urgent need to adjust the current production technologies to the requirements imposed by the natural environment protection, for the benefit of the next generations, and the responsibility of fulfilling this objective belongs to the whole society. This attitude is determined, probably, by the specific character of beekeeping that is significantly influenced by the quality of natural environment.

*Shared responsibility construct:* Q17-3.1; Q18 – 2.5; Q19 - 3.1; Q20 - 4.4. This reflects that the beekeepers consider that a civilized country should take up the responsibility for fostering and increasing the economic and social wellbeing of their disadvantaged citizens, as well as for ensuring the right to freedom and tolerance related to their

members. In the same time, a civilized country can not be responsible for the prosperity or poverty of another nation, and its citizens are not responsible for the persons belonging to other societies.

Regarding the impact of the beekeepers believes upon the economic results obtained in their own apiaries, correlations among all answers and all indicators have been made, but their level was not significant, except those few proved to be important.

Between the profit rate and the answers to the questions from the group "Freedom considerations construct", it was identified a poor negative correlation (Pearson coefficient -0.58) that might be justified by the legacies from the communist period in the beekeepers attitude, in which case an authority-based management is considered efficient (Table 2).

Table 2. Correlation between the profit rate and the answers to the questions from the group *Freedom considerations construct*

		Freedom considerations construct	Profit rate
Freedom considerations construct	Pearson Correl. Sig. (2 tailed)	1	-.58** .000
	Sum of Squares & Cross-products Covar.	368.55	-3291.61
	N.	114	114
Profit rate	Pearson Correl. Sig. (2 tailed)	-.58** .000	1
	Sum of Squares & Cross-products Covar.	-3291.61	88041.1
	N.	114	114

\*\* Correl. is significant at the 0.01 level (2-tailed)

Source: Own calculation.

The correlation between the net income and the answers to the questions from the group "Freedom considerations construct" was very poor and negative of about -.43, statistically ensured for a level of 1.0% (Table 3).

Table 3. Correlation between the net income and the answers to the questions from the group *Freedom considerations construct*

		Freedom considerations construct	Net income
Freedom considerations construct	Pearson Correl. Sig. (2 tailed)	1	-.43** .000
	Sum of Squares & Cross-products Covar.	368.55	-275.50
	N.	114	114
Net income	Pearson Correl. Sig. (2 tailed)	-.43** .000	1
	Sum of Squares & Cross-products Covar.	-275.50	1099.36
	N.	114	114

\*\* Correl. is significant at 0.01 level (2-tailed).

Source: Own calculation.

We justify this correlation through the fact that the majority of beekeepers who are owning small in size apiaries, in order to

obtain additional incomes, use own labour force and own capital, but the apiaries do not ensure a market value related rewarding.

A solid correlation was obtained between the gross profit and the answers to the questions concerning equality (Pearson coefficient -0.84), showing that the beekeepers who have a favourable attitude to equality insurance do not obtain a significant gross profit (Table 4).

Table 4. Correlation between the gross profit and the answers to the questions from the group *Equality considerations construct*

		Equality considerations construct	Gross profit
Equality considerations construct	Pearson Correl. Sig. (2 tailed)	1	-.84** .000
	Sum of Squares & Cross-products Covar.	340.05	-241.30
	N.	114	114
Gross profit	Pearson Correl. Sig. (2 tailed)	-.84** .000	1
	Sum of Squares & Cross-products Covar.	-241.30	240.65
	N.	114	114

\*\* Correl. is significant at the 0.01 level (2-tailed).

Source: Own calculation.

Also, a solid correlation was obtained between the gross profit and the answers to the questions regarding the environment protection (Pearson coefficient -0.92). Despite the fact that the beekeepers answers prove that they respect the environment, those beekeepers having beliefs against this green value register the highest gross profits (Table 5). These results raise questions concerning the technology and the applied management and might represent the objective of a future research.

Table 5. Correlation between the gross profit and the answers to the questions from the group *Respect for nature construct*

		Respect for nature construct	Gross profit
Respect for nature construct	Pearson Correl. Sig. (2 tailed)	1	-.92** .000
	Sum of Squares & Cross-products Covar.	300.20	-293.01
	N.	114	114
Gross profit	Pearson Correl. Sig. (2 tailed)	-.92** .000	1
	Sum of Squares & Cross-products Covar.	-293.000	340.05
	N.	114	114

\*\* Correl. is significant at the 0.01 level (2-tailed).

Source: Own calculation.

Regarding the shared collective responsibility, the inverse correlation of -.84 with the gross profit indicates a superior level of profitability at the beekeepers that do not follow believes supporting the shared responsibility (Table 6).

We consider that the relatively reduced size and depth of our research had not allowed to show the positive relations between the sustainable development values and the economic results of beekeepers.

Table 6. Correlation between the gross profit and the answers to the questions from the group *Shared responsibility construct*

		Shared responsibility construct	Gross profit
Shared responsibility construct	Pearson Correl.	1	-.84**
	Sig. (2 tailed)		.000
	Sum of Squares & Cross-products	270.3	-255.19
	Covar.	2.4	-2.258
	N:	114	114
Gross profit	Pearson Correl.	-.84**	1
	Sig. (2 tailed)	.000	
	Sum of Squares & Cross-products	-255.2	340.1
	Covar.	-2.26	3.01
	N:	114	114

\*\* Correl. is significant at the 0.01 level (2-tailed).

Source: Own calculation.

Otherwise, the displayed values might be considered as worrying for sustainable development of beekeeping in the North-Eastern Region of Romania.

## CONCLUSIONS

The gross profit of the studied population reached 0.9 thousand euro, the profit rate 12.0%, the capital productivity 0.34 % and the net income -0.9 thousand euro.

The stated believes of beekeepers regarding the sustainable development were neutral towards favourable, with an average score of 4.2 on a scale from 1 to 7.

Solid but negative correlations have been recorded between the gross profit of apiaries and the beekeepers attitude with regard to equality, respect for nature and shared responsibility with values of the Pearson coefficient of -0.84, -0.92 and -.84, respectively.

## REFERENCES

[1]Abrol, D.P., 2012, Pollination Biology Biodiversity Conservation and Agricultural Production, Springer Netherlands, 509–544.  
 [2]Agapi, S.I., Bocanici, M., Vintila L.A., Tapaloaga, P. R., Chelmu, S.S., 2016, The promotion of innovative technologies for the use of renewable energy in the processing of wild berries for the development of sustainable bioeconomic practices in the mountain area of Romania, Abstracts/Journal of Biotechnology 231S; S4–S109.  
 [3]Altman, M., 2002, Economic theory, public policy and the challenge of innovative work practices.

Economic and Industrial Democracy: An International Journal, 23, 271–290.

[4]Baishaya, A., Sharma, G.L., 1990, Energy budgeting of rice-wheat cropping system, Indian Journal. Agron. 35(1&2): 167-177.  
 [5]Beard, C., 2015, Honeybees (*Apis mellifera*) on public conservation lands. A risk analysis, Publishing Team, Department of Conservation, 9–13.  
 [6]Becker, G., 1996, Accounting for Tastes. Cambridge, MA: Harvard University Press, 114-129.  
 [7]Blaxter, K. L., 1962, Energy Metabolism in Animals and Man, New York, N.Y.: Cambridge Univ. Press.  
 [8]Cichocka, D., Claxton, J., Economidis, I., Högel, J., Venturi, P., Aguilar, A., 2011, European Union research and innovation perspectives on biotechnology, Journal of Biotechnology, 156: 382–391.  
 [9]De Jonge, A.M., 2004, Eco-efficiency improvement of a crop protection product: the perspective of the crop protection industry, Crop Protect, 23(12):1177–86.  
 [10]Friedman, M., 1953, The Methodology of Positive Economics, in: Friedman M. (Ed.), Essays in Positive Economics, University of Chicago Press, 3–43.  
 [11]Gupta, R. K., 2014, Technological Innovations and Emerging Issues in Beekeeping, Vol. 1: Technological Aspects of Beekeeping, Springer Netherlands, 507-554.  
 [12]Jones, P.R., Cullis J.G., 2002, Merit want status and motivation: The knight meets the self-loving, Public Finance Review, 30.2, 83-101.  
 [13]Loos, J., Turtureanu, P.D., Von Wehrden, H., Hanspach, J., Dorresteyn, M., Frink, J.P., Fischer, J., 2015, Plant diversity in a changing agricultural landscape mosaic in Southern Transylvania (Romania), Agriculture Ecosystems & Environment, Vol: 199, Elsevier Science BV, Netherlands, 507-554.  
 [14]Mărcuță, A., Mărcuță, L., Dinu, T., Tindeche, C., Niculae, I., 2015, The role of 'green' accounting in quantifying the environmental impact upon the economic activities, 15th International Multidisciplinary Scientific GeoConference-SGEM, Albena, Book 5, Vol. 3, 2015, 721-727.  
 [15]Mwakatob, A.R., Machum, R.M., 2010, Beekeeping for poverty reduction and biodiversity conservation, Bees for Development Journal, 101: 5–7.  
 [16]Popescu Agatha, 2010, Considerations on Romania's position in the European and World Honey Trade, Scientific Papers, Series D, vol. LIII, Animal Science: 183-188.  
 [17]Rafiee, S., Mousavi Avval, S.H., Mohammadi, A., 2010, Modelling and sensitivity analysis of energy inputs for apple production in Iran, Energy, 35(8): 3301-3306.  
 [18]Shepherd, D.A., Kuskova, V., Patzelt, H., 2009, Measuring the values that underlie sustainable development: The development of a valid scale, Journal of Economic Psychology, 2009, 30: 246–256.  
 [19]Stigler, G.J., 1976, The x-istence of x-efficiency, American Economic Review, 66, 213–216.  
 [20]Stigler, G.J., 1946, The economics of minimum wage legislation, American Economic Review, 36, 358–365.

[21]Ștefan, G., Bodescu, D., Bohateruț, V.M., Cucu, C., 2010, Ghid tehnico-economic de bună practică în apicultură, Publisher Terra Nostra Iași, 56-62.

[22]<http://www.fao.org/faostat>, Accessed on Jan.3, 2019.



## THE PROBLEMS OF LAND REFORM INCOMPLETENESS IN UKRAINE

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### Abstract

*The course of Land reform in Ukraine is analyzed, its positive and negative results are revealed both in the issues of rational agricultural lands use, especially in solving the ecological component in land use and in the problems of social and economic development of rural territories. Legislative documents and subordinate acts of the Ukrainian state that regulate carrying out Land reform or have a direct relation to Land reform and other scholars' research on this topic is the main database for conducting scientific studies. According to the authors, the conducted studies show that in the theoretical positions of Land reform all the problematic issues concerning the land use organization; mainly environmental components have not been taken into account. Moreover, the issues of the development of village infrastructure and raising the peasants'- landowners' living standards have not been also taken into consideration. Generally, the goal of Land reform in Ukraine has not been achieved to the full extent. It has led to significant shortcomings in agricultural production and a decrease of Ukrainian peasants' living standards. The scientific novelty of the article is the issue that it is indispensable to hold a national discussion of the theoretical foundations of the reform before carrying out the reform in the state, which affects more than half the population. The scientific approaches for state structures regarding correction of drawbacks in land use, which have been revealed in the course of carrying out Land reform, are developed and recommended and ways of solving some problems of rural territories development are suggested.*

**Key words:** land reform, land shares, agro-industrial complex, market relations, land protection, ecologization of technologies

### INTRODUCTION

The conditions, forms, and approaches to the agricultural lands use are radically changing due to the current changes in the economic mechanism of the development of the agro-industrial complex, introduced in Land Reform in Ukraine.

Land reform, which has been carried out in Ukraine since the beginning of the 90s of the previous century and has lasted for almost 28 years, with its destruction of achievements of a positive experience in agricultural production, was doomed to failure at once. The state of rural settlements, and, particularly, the miserable situation of peasants' living standards, which we observe today, is the thing that actually shows the current state of the agricultural sector in our state is. Land shares as a virtual property with

practically impossible transformation into a real private property (commodity), is mainly used in large agricultural firms and have not made the owner from the peasant without rights.

### MATERIALS AND METHODS

A study on the legislative framework, according to which Land reform is implemented in Ukraine, has been conducted. It has been established that in the theoretical positions of Land reform all the problematic issues concerning the land use organization; especially environmental components have not been taken into account. Moreover, the issues of the development of village infrastructure and raising the peasants'- landowners' living standards have not been also taken into consideration. One can explain

it by the fact that from the very beginning of Land reform, the peasants have not understood its essence, as well as its final goal until to the full extent. Nobody had previously discussed the theoretical achievements of changes in land relations with peasants in Ukraine. The authors of the theory of Land reform are unknown. For instance, we only know about Stolypin Agrarian Reform.

Specialists-scholars in agrarian sciences O. Dorosh, V. Holian, I. Irtysheva, M. Khvesyk, L. Novakovskiy, A. Sokhnych, M. Stupen [3, 4, 5, 6, 10 ] and others constantly do researchers of the results of Land reform implementation, land relations improvement in the context of carrying out Land reform.

In addition, the publications of the above-mentioned authors inform that an active search for ways to improve land relations and economics of land use has been actively done in the course of the entire time of carrying out Land reform in Ukraine. In particular, the realistic description of Land reform in Ukraine is provided in the monograph of M. Khvesyk and V. Holian [5] "Institutional Model of Nature Use in the Context of Global Challenges". The authors of the mentioned scientific publication write that due to the information about the experience of reforming land relations in Ukraine one can highlight a number of problems of its implementation and also prove the necessity to improve the state policy in the field of land use management, thanks to the land management.

Land relations reforming and the development of rural territories are processes that are closely linked and identified as priorities during the period of Land reform. The successful resolution of these interconnected priorities should lead to a stable increase in peasants' – landowners' standard of living. A lot of papers have already been written about the impact of Land reform on the land relations transformation and the development of rural territories, but the infrastructure of the village is becoming even more miserable every day, and the living standards of the owners of land shares are deteriorating. Profits grow only in the managers of the large agrarian companies, agricultural holdings, which lease land shares from peasants.

## RESULTS AND DISCUSSIONS

These changes have been further intensified since the introduction of administrative and territorial reform in Ukraine, especially they relate to the organization of agricultural lands use on the territory of established merged territorial communities.

On January 31, 2018, the Cabinet of Ministers of Ukraine issued an order № 60-p "On the Transfer of Agricultural Land Plots of State Property into Communal Ownership of the Merged Territorial Communities" [8] significantly complicated the state control over the use and protection of land, particularly, agricultural lands. Although it is understandable that the truth is that at any stage in the development of society, any state does everything that it can in order not to lose control over the rational land use. Thus, the question arises: who and how will be responsible for the efficient land use in Ukraine?

Today, the term "reform" has become quite popular for the authorities, and is not completely obvious and favorable for citizens, because in most cases there is no coherent vision of this process. In many cases, the reforms can lead to the deterioration in citizens' lives, the state of infrastructure, the decline of agricultural lands.

One can monitor the same situation with the land reform that has been going on in the country for more than a quarter of the century and only a small group of people who are owners of large agrarian business can be satisfied with the positive results. Plenty of the owners, owners of land shares from Land reform were disappointed, desperate in the issues of justice and had a negative attitude to reforms.

Nowadays, the state actively implements administrative and territorial reform. If political, legal, economic and social institutions are not created, as well as norms that meet the best standards and values of the developed democratic countries are not studied thoroughly, then this reform will result as Land reform.

As a result of the implementation of Land reform in Ukraine, significant changes in the

development of rural territories have occurred, but, considering the analysis, it is not always the best one as it prevents the efficient use of labor and production potential of rural territories, the normal development of the village.

However, users of land plots, large agrarian formations, and agrarian holdings, avoid participation in the development of village infrastructure in every way. Tenants of private land plots (shares) want this problem to be solved by the state and territorial communities, but to get all profits from the land only by themselves.

Similar approaches to this problem are supported by individual scholars who justify the position as follows: Land reform is intended to divide the performance of productive and social functions. So, the first one is to be performed by agrarians, and the second one – by the state.

It is thought that such approaches are not quite fair. The authors, developers, organizers and implementers of this reform, but not citizens of Ukraine should be responsible for problems that arose in context with the implementation of Land reform.

In fact, the peasants' right to dispose of their property is limited not only to a moratorium on the sale of their own land plots but also on the results of work on the land. Basically, other people exploit soil fertility, as a factor in gaining profit in the process of land use.

The state creates conditions for peasants regarding the loss of their owner's functions, restricts their constitutional rights, and stimulates agricultural production, which does not provide the necessary amount of lease for expanded reproduction instead of actual protecting the peasants' rights on land due to a lease system and regulating land relations [6, p.24].

Agriculture is almost an alternative type of economic activity and does not provide profits for the development of small agricultural enterprises and rural population in the territories of the rural communities that are being actively established now. It led to the necessity to develop rural development programs at the state level.

The concept of Rural Territories Development, which states that agrarian transformation that had taken place in Ukraine in recent years allowed increasing the gross output of agricultural products, was approved in the order of the Cabinet of Ministers of Ukraine dated on September 23, 2015. However, it did not contribute to the social and economic development of rural territories and an increase of the living standards of the rural population, therefore. That is why there is a need for a comprehensive approach to the solution of rural territories development issues, based on the principles of sustainable development. In the concept of rural development, there is the improvement of the system of rural territories management among the major priorities and mechanisms of preparation of the agrarian sector of the state for functioning in under free trade zone with the EU conditions [9].

Territorial planning of land use is related to spatial sustainable development. In particular, territorial planning of land use should be considered as one of the main levers of the state land policy regarding the harmonization of state, business and public interests in the field of land use and protection in the rural territories for the long-term period, without disturbing the balance between preserving of the nature and resource potential and solving the entire complex of social, economic, demographic, cultural institutional and other problems [3].

One can achieve it by creating new jobs, attracting investments in technical re-equipment of existing enterprises, introducing up-to-date production technologies and modern management.

The state has paid less attention to the protection issues of lands, especially agricultural ones, and, moreover, agricultural producers virtually ceased to take measures to the soil conservation since the first years of independence of Ukraine. It is of vital importance to develop a mechanism for the withdrawal of land that tenants use unsatisfactorily at the legislative level in order to correct this situation [2].

It is imperative to develop a comprehensive system of land management measures, which

should be a constituent part of land organization projects for the prevention of the vulnerability of agricultural production from natural climatic conditions and its adaptation to these conditions.

However, one should understand that the state will not allocate funds from the state budget to private households for doing land organization projects. Private landowners must opt for projects themselves, and the land management service should offer the landlords several land organization models for their territories and several ways to implement them [1, p. 95].

Analyzing the efficiency of agricultural lands use and the reduction of the quality of arable land, one should note that the principal reason is the low level of financial and organizational management, as well as corruption schemes of leased land resources use [4, p. 155].

Taking into consideration the fact that today Ukraine is on the way to European integration, the approaches to the organization of the use of agricultural lands must comply with European standards. First of all, the consideration of environmental aspects must be taken into account. In addition, it is necessary to exclude land plots that are used in violation of the actual land legislation and lands that are not cultivated and are weed nurseries from agricultural cultivation. In other words, one should arrange the use of unclaimed land shares, shares of deceased citizens, whose heirs did not reprocess property rights, as well as lands under project roads, windbreaks and some other ones without the owner. These lands are located in the land masses and are mostly used without legal documents. In contrast to it, only illegal land users have benefits and profits from the use of these lands [2].

## CONCLUSIONS

All in all, the scientific novelty of the article is the issue that it is indispensable to hold a national discussion of the theoretical foundations of the reform before carrying out the reform in the state, which affects more than half the population. The current situation is recognizable for everyone, that is, the rapid

resolution of the problems of rural territories as well as their development will not take place without active state intervention in the process of completing the state reform in Ukraine. Therefore, the state has already taken decisive steps to remedy the shortcomings in carrying out Land reform. Thus, since January 1, 2019, the Law of Ukraine "On Amendments to Certain Legislative Acts of Ukraine Concerning the Issue of Collective Ownership of Land, Improvement of Land Use Rules in Agricultural Land Areas, Raidership Prevention and Stimulation of Irrigation in Ukraine" came into force [7], which took into account the correction of almost all of these shortcomings. Provided that the authorities demonstrate the political will regarding the organization of the implementation of the mentioned Law of Ukraine, there are all principal fundamentals for the really successful completion of Land reform and bringing agricultural lands use to the scientifically sound methods, which will influence the development of the village and rural territories positively and will raise the living standards of the rural population.

In addition, it is of vital importance for the central executive authorities in the shortest time:

- To establish land management projects development regarding the ecological and economic justification of land use organization as an obligatory one for all land users in a legislative way;
- To create a favorable legal framework for actively attracting investments in agricultural development, as well as to develop a state policy regarding stimulation of investors;
- To provide local authorities with the necessary powers and to identify sources of funding, including at the expense of business entities, which lease land shares on the territory of the local council for the maintenance of rural territories infrastructure in the proper condition and their further development.

## REFERENCES

- [1]Bohira, M., 2008, Land Management under Market Conditions: Ecological and Economic Aspect.

Monograph.– Lviv: Lviv National Agrarian University.– “New World- 2000”, 225 p.

[2]Bohira, M., 2017, The Influence of Market Economy on Rational Land Use, Balanced Nature Use, №1, pp.88-91.

[3]Dorosh, O., 2015, Organizational and Institutional Provision of Territorial Planning of Rural Territories Land Use. P. 22-25. Journal “Economist” №8. August, 2015.

[4]Irtysheva, I., Sokhnych, A., 2012, Innovative Rural Territories Development: Adaptation of International Experience in National Realities: Monograph. – Mykolaiiv: “Ilion”, 176 p.

[5]Khvesyk, M., Holian V., 2007, Institutional Model of Nature Use in the Context of Global Challenges: Monograph. – Kyiv: Kondor, 480 p.

[6]Land Organization reference Book / edited by L. Novakovskiyi. – the fourth issue redone and added. – Kyiv: Agrarian Sciences, 2015. – 492 p.

[7]Law of Ukraine “On Amendments to Certain Legislative Acts of Ukraine Concerning the Issue of Collective Ownership of Land, Improvement of Land Use Rules in Agricultural Land Areas, Raidership Prevention and Stimulation of Irrigation in Ukraine” [Electronic resource]. – URL: <http://zakon.rada.gov.ua/laws/show/2498-19>.

[8]Order of the Cabinet of Ministers of Ukraine from On January 31, 2018 № 60-p. “On the Transfer of Agricultural Land Plots of State Property into Communal Ownership of the Merged Territorial Communities”

<https://www.kmu.gov.ua/ua/npas/pitannya-peredachi-1>, Accessed on Dec.10, 2018.

[9]Order of the Cabinet of Ministers of Ukraine dated September 23, 2015 “On Approval of the Concept of Rural Territories Development”. Scientific and Production Journal “Land Management Bulletin”, № 10. pp.60-63.

[10]Stupen, M., Taratula, R., 2013, Land reform: the standard of practice / Theoretical foundations and practical aspects and the development of resource-friendly technologies for the development of agro-industrial efficiency and development of rural areas: materials of the International Scientific and Practical Forum, September 18-20, 2013. Lviv, pp.431-435.



## AGRICULTURAL LABOUR PRODUCTIVITY AND ITS IMPACT IN FARMING SYSTEM

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### **Abstract**

*The aim of the article is to demonstrate the differences between labour productivity in the Romanian agriculture and the European Union countries, determining the impact on the farming system. The article is made with the help of the data from the Eurostat and the National Institute of Statistics. It use three different modalities to estimate agricultural labour productivity in European Union and in Romania. Labour productivity in agriculture, forestry and fishery sector is still very low in Romania compared to EU-28 member countries. Labour productivity in Romanian agriculture sector is lower than in other members' countries of European Union, where it is very significant (Dutch, Danish, Belgian or French productivity is 10-15 times higher). Analysing labour productivity in Romania's agriculture sector by economic activities, it is noted that agriculture has the smallest labour productivity. In view of the existence of a large number of employed persons in Romania agriculture (10.45% of the total population), it is very important to increase labour productivity in Romania because it has a major impact on economic growth and the standard of living.*

**Key words:** labour productivity, agriculture, Romania, EU, impact

### **INTRODUCTION**

The agricultural productivity has been defined by several researchers with reference to their own opinions and disciplines. So the term agricultural productivity was interpreted in different ways by agronomists, farmers, economists and geographers. In agricultural geography as well as in the economy, agricultural productivity is defined both as "input production" and "production per unit area". Improving agricultural productivity takes place when production factors are used in a much more efficient way [2].

Agricultural productivity can be defined as a measure of efficiency in an agricultural production system which employs land, labour, capital and other related resources [1]. Labour productivity is one of the most important synthetic indicators of the economic activity of agriculture, which reflects the efficiency or fruitfulness of the work spent in the production process [6].

Labour productivity means the income of the population engaged in agriculture and can be measured in terms of output per worker. It

takes into account all the labour which contributes to agriculture production, the labour that is used directly on the farm as well as that used indirectly off the farming producing the materials and services used on agricultural production" [3].

Agriculture is one of the most important sector in Romanian economy and it is necessary to analyze the evolution of labour productivity and identify the causes which could influence and contribute to the development of agriculture sector [7]. The knowledge of the real level of labor productivity in Romanian agriculture and especially the cases of this level is an essential requirement for defining a coherent agricultural policy meant to reduce the recession of this sector of activity [10]. Labour productivity estimates from agriculture can support the structure of labour market policies and supervisor their effects. Productivity measures can contribute to the comprehension of how labour market performance affects living standards because „when the intensity of labour utilization (the average number of

annual working hours per head of the population) is low, the creation of employment opportunities is an important means of raising per capita income in addition to productivity growth” [5].

In this context, the principal purpose of the paper is to analyze one of the fundamental and greatest problem facing Romanian agriculture, namely low labour productivity and implicitly the relatively low yield of agricultural production [8].

## MATERIALS AND METHODS

Agricultural labour productivity is an important economic indicator that is permanently in relation to economic terms as growth, competitiveness, and living standards within an economy.

Labour productivity (W) was calculated using the following formulas [7]:

$$W = \frac{TP}{EPaff} \quad (1)$$

where:

TP= Total population, measured in number of persons;

EPaff= the employed persons in agriculture, forestry and fishery, measured in number or hours worked;

W= labour productivity represents the efficiency of one persons employed in agriculture in producing goods for the population of the country.

$$W = \frac{OAI}{EPaff} \quad (2)$$

where:

OAI= Output of the agricultural industry, measured in Euro;

EPaff= the employed persons in agriculture, forestry and fishery, measured in number or hours worked

"W= represents the value of output (at basic prices) per unit of labour during a given time reference period. Output of the agricultural industry is made up of the sum of the output of agricultural products, agricultural services and of the goods and services produced in inseparable non-agricultural secondary activities", as defined by EU Commission.

$$W = \frac{GVAai}{EPaff} \quad (3)$$

where:

GVAa= Gross Value Added of the agricultural industry, measured in Euro;

EPaff= the employed persons in agriculture, forestry and fishery, measured in number or hours worked;

W= represents the value of output (at basic prices) less the value of intermediate consumption produced per unit of labour during a given time reference period.

Agricultural labour productivity is calculated by using the three formulas indicated above both in Romania and European Union.

The period analysed in this study was 2007-2017.

The data for the period 2007-2017 were collected from both Eurostat Database and the National Institute of Statistics and have been statistically processed and interpreted.

## RESULTS AND DISCUSSIONS

The number of persons employed in agriculture, forestry and fishery was been observed in evolution both in Romania and European Union. In 2017 compared with there has been a decrease in the number of persons that are employed in agriculture, forestry and fishery with -18.4 % in EU and - 28.4 % in Romania.

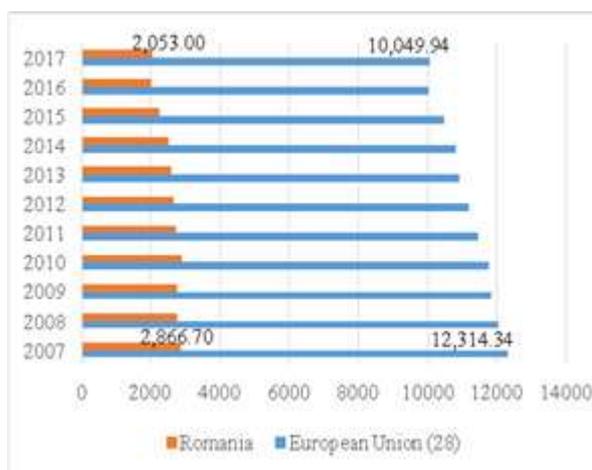


Fig. 1. Evolution of persons employed in agriculture, forestry and fishery in EU and Romania in 2007-2017  
 Source: Own design based on the data provided by Eurostat Data Base, <https://ec.europa.eu/eurostat/data/database> [4].

The above figure illustrates that Romania has an important and big impact in the share of persons that are employed in agriculture,

forestry and fishery in EU, between 20 and 25% in 2007- 2017 period.

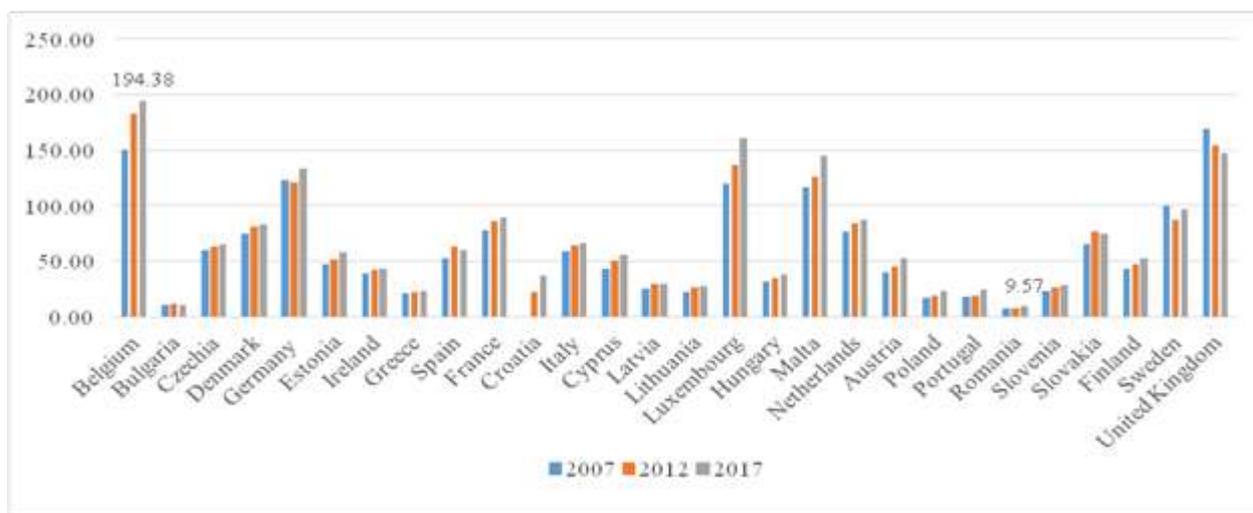


Fig. 2. Labour productivity measured in the number of persons per employed person in agriculture, forestry and fishery  
 Source: Own design and calculations based on the data provided by Eurostat Data Base, <https://ec.europa.eu/eurostat/data/database>, [4]

Analysing the labour productivity measured in the number of persons per employed person in agriculture, forestry and fishery, we observe that Romania has the smallest labour productivity from European Union. In 2017, in Romania an employed person in agriculture industry worked to feed another 10 persons, while in European Union that person fed approximately 49 persons. Romania has the

biggest share from European Union of the employed person in agriculture, forestry and fishery (10.45%), while from example, Belgium is to the opposite part, with 0.51 % of the total population of the country which work in agriculture industry, this explains why in Belgium, 194 persons was fed in 2017 by one person that working in agriculture industry.

Table 1. Labour productivity calculated by dividing the total agricultural output by the number of employed workers / worked hours in agriculture, forestry and fishery in 2007-2017 period

Specification	Unit	2007	2009	2011	2013	2015	2017	2017/2007
<b>EU (28)</b>	Euro/ person	28,884.48	28,204.29	34,132.19	37,850.07	38,363.90	41,042.10	142.09%
<b>Romania</b>		2,180.13	2,238.08	2,358.97	2,623.05	3,160.89	3,629.17	166.47%
<b>EU (28)</b>	Euro/ worked Hour	14.62	14.38	17.50	19.84	20.01	21.47	146.82%
<b>Romania</b>		1.25	1.29	1.36	1.69	2.10	2.42	193.09%

Source: Own calculations based on the data provided by Eurostat Data Base, <https://ec.europa.eu/eurostat/data/database>, [4].

Calculating the agricultural labour productivity by dividing the total output by the number of workers/ worked hours, it was found that both in Romania and European Union there is an increase of agricultural labour productivity. Romania has a low labour productivity level: 8.8% of the EU-28 average in 2017, which it means that in Romania a

person employed in agriculture, forestry and fishery helps to achieve 3,629.17 Euro output of the agricultural industry. It is important to note that in 2007- 2017 the labour productivity of Romania measured as the output of the agricultural industry/ worked hours almost doubled or an increase of some 93%.

Table 2. Labour productivity calculated by dividing the total agricultural output by the number of workers employed/ worked hours in agriculture, forestry and fishery in 2007-2017 period\*

Country	GVAa per person employed EU (28) = 100			GVAa per hour worked EU (28) = 100			2017/ 2007 (%)	
	2007	2012	2017	2007	2012	2017	GVAa/ person employed	GVAa/ hour worked
Austria	105.94	113.37	107.48	78.86	88.01	84.68	143.55	156.99
Belgium	290.13	310.24	228.05	238.22	260.87	179.27	111.22	110.03
Bulgaria	13.40	17.90	16.15	17.67	22.83	20.77	170.57	171.86
Croatia	....	42.68	48.03	....	47.57	51.42	...	...
Cyprus	134.51	135.92	123.81	81.00	83.02	78.80	130.24	142.24
Czechia	56.14	57.06	57.70	56.85	55.93	56.09	145.42	144.25
Denmark	282.46	380.07	256.61	320.08	464.47	335.35	128.54	153.18
Estonia	84.12	97.48	68.79	79.29	90.95	66.04	115.71	121.77
Finland	90.73	81.50	57.56	74.34	67.42	50.96	89.77	100.23
France	280.61	277.55	219.88	221.84	218.45	186.55	110.87	122.95
Germany	189.94	188.36	189.33	213.72	213.41	225.21	141.04	154.07
Greece	90.21	75.08	70.11	88.11	71.51	62.96	109.97	104.48
Hungary	57.14	63.08	76.07	0.00	65.12	77.59	188.37	...
Ireland	124.28	114.83	160.78	111.16	93.40	124.10	183.04	163.23
Italy	225.25	228.71	195.14	161.77	172.28	142.87	122.58	129.13
Latvia	32.12	33.14	33.36	30.74	30.76	30.85	146.95	146.75
Lithuania	41.47	72.85	65.90	47.84	71.67	67.06	224.87	204.97
Luxembourg	248.21	204.04	185.36	716.62	528.32	469.83	105.67	95.86
Malta	126.19	114.87	105.40	50.73	...	...	118.18	0.00
Netherlands	352.07	318.75	335.38	375.59	321.97	332.05	134.79	129.26
Poland	29.28	32.77	36.02	29.68	31.37	33.86	174.03	166.78
Portugal	34.65	28.13	37.33	43.32	37.64	48.41	152.47	163.38
Romania	17.21	16.37	20.98	19.56	20.11	26.76	172.44	200.02
Slovakia	50.20	57.23	50.34	53.18	57.29	51.92	141.90	142.75
Slovenia	38.95	35.06	33.37	37.82	33.68	32.55	121.22	125.84
Spain	232.96	201.93	206.92	234.66	193.78	204.93	125.67	127.68
Sweden	144.85	115.99	104.08	125.90	105.23	93.09	101.66	108.11
United Kingdom	167.74	177.39	143.06	150.64	149.37	118.28	120.68	114.80

Note: (...) not available; \* GVAa is measured in Euro.

Source: Own calculations based on the data provided by Eurostat Data Base, <https://ec.europa.eu/eurostat/data/database>, [4]

Table 2 shows the evolution of labour productivity levels in EU member countries with respect to EU average (EU-28=100). In this case, the labour productivity was obtained by dividing gross value added of the agricultural industry by workers employed in agriculture, forestry and fishery, measured in number or hours worked. Bulgaria, together with Romania have the lowest labour productivity levels: 16.15 %, respectively 20.98 % of the EU-28 average in 2017, when talking about labour productivity expressed in euro per workers and 20.77 %, respectively 26.76 % of the EU-28 average, when considering labour productivity expressed in euro/ worked hour. In 2017, among EU countries, the agricultural labour productivity

record level belongs to Netherlands (335.38%), followed by Denmark (256.61%) and Belgium (228.05%). In Romania, the agricultural labour productivity is situated on an upward trend in 2007-2017 period. It is noted that the indicator increased by 72.44 % from 2,178.12 Euro/ person in 2007 to 3,755.88 Euro/ person in 2017. This growth was mostly influenced by the increase of Gross Value in agriculture, forestry and fishery by 23.49 %, despite the fact that the employed workers in agricultural sector decreased by 38.26%.

Labour productivity in agriculture, forestry and fishery measured as Euro per employed persons in the agricultural sector as determined by the National Institute of

Statistics (transformed into Euro, at an exchange rate: Euro 1 = Lei 4.70), increased by 120.7 % from 1,738.19 euro/ worked hour in 2007 to 3,836.49 euro/ worked hour in 2017. It is noted that the average of labour productivity in the national economy is much higher than the labour productivity in the agriculture, forestry and fishery, for example in 2017, it was 4.96 times bigger.

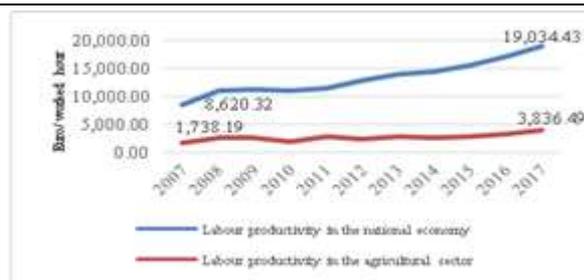


Fig. 3. Labour productivity in the national economy and in agriculture, forestry and fishery, Romania, 2007-2017  
 Source: Own design based on the data provided by NIS, 2007- 2017. [9]

Table 3. Labour productivity in the national economy and in agriculture, forestry and fishery in Romania,

2007- 2017Years/ Labour productivity	2007		2010		2013		2017	
	Euro/ hour	%	Euro/ hour	%	Euro/ hour	%	Euro/ hour	%
<b>In the national economy</b>	4.60	100	5.89	128.24	7.70	167.59	10.60	230.56
<b>In the agricultural sector</b>	1.00	100	1.11	110.64	1.81	180.85	2.55	255.32
<b>Share of agriculture (%)</b>	21.76		18.77		23.48		24.10	

Source: Own calculation based on the data provided by NIS, 2007- 2017. [9]

Labour productivity in agriculture, forestry and fishery measured as Euro per worked hour in the agricultural sector as determined by the National Institute of Statistics (transformed into Euro, at an exchange rate: Euro 1 = Lei 4.70) increased highly significant from 1 Euro/ worked hour in 2007 to 2.55 lei/ worked hour in 2017, meaning an increase by 2.55 times. However, in agriculture, industry and fishery, the labour productivity is very small compared with the average of the national economy which increases from 4.60 Euro/ worked hour in 2007 to 10.60 Euro/ worked hour in 2017.

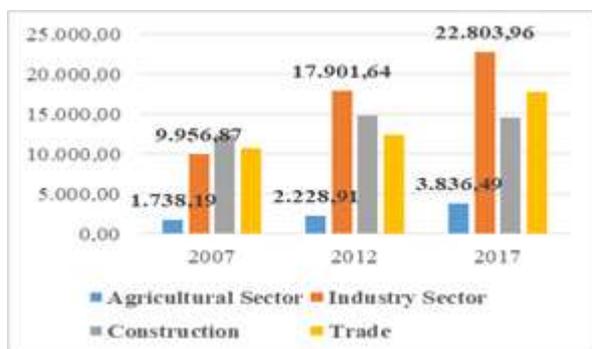


Figure 4. Labour productivity by economic activities in Romania, 2007-2017 (Lei/ employed person)  
 Source: Own design based on the data provided by NIS, 2007- 2017. [9]

Taking into account four activities of Romanian national economic, it observe that

agricultural labour productivity has the lowest level. In 2007, Romania has an excellent labour productivity in construction activity which is brought forward from 2007 to 2017 by industry sector. It is very important to mention that in Romania, the real estate transactions have the biggest level of labour productivity which increase from 123 thousands Euro/ employed person in 2007 to 650 thousands Euro/ employed person in 2017.

## CONCLUSIONS

Analysing the labour productivity in the agricultural sector, there is an increase of this indicator both in Romania and in the European Union. However, labour productivity in Romania is still very low compared to the European Union average. Firstly, the share of the population working in agriculture sector is declining. It is observed an important and big productivity increase that makes this reduction in labour possible. Romania is the only country of European Union where the persons employed in agriculture sector occupy more than 10% of total population.

Secondly, although Romania has a big share of the population working in agriculture sector, the agricultural labour productivity of

Romania is still very low compared to EU-28 member countries and represents only approximately 21% from the average of EU-28 in 2017. It is though encouraging that it had been on an upward trend in 2007- 2017 period. In European Union, Romania occupy the penultimate position, being followed only by Bulgaria, regarding the agricultural labour productivity.

Finally, it is very important to increase the labour productivity in agriculture, forestry and fishery because an economy can grow only when the number of employed persons increases (meaning employment increases) or when each employed person produces more and more. The latter effect is measured by the labour productivity.

Labour productivity in Romanian agriculture is one of the most important indicator of economic efficiency. For this reason, it is appropriate to increase this indicator because the ways of increasing labour productivity are means of intensifying the positive action of the various factors that influence it. Thus, the promotion of technical progress in trade, the scientific organization of the work in the whole commercial circuit, the raising of the personnel qualification and the improvement of the forms of cointegration of the commercial workers are domains comprising a wide range of measures that act on the direct factors.

## ACKNOWLEDGEMENTS

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## REFERENCES

- [1]Dewett, K.K., Singh, G., 1966, Indian Economics, Delhi, p. 66.
- [2]Dharmasiri, Lal., 2012, Measuring agricultural productivity using the Average Productivity Index (API). Sri Lanka Journal of Advanced Social Studies, 1(2).
- [3]Dovrings, F., 1967, Productivity of Labour in Agricultural Production, Agricultural Experimental

Station Bulletin, No. 726, College of Agriculture, Urbana, University of Illinois, Illinois.

[4]Eurostat Database, 2007- 2017, <https://ec.europa.eu/eurostat/data/database>, Accessed on February 5, 2019.

[5]Key Indicators of the Labour Market (KILM): 2001-2002, International Labour Organisation, Geneva, 2002, page 621.

[6]Morariu, A., 2017, Labour Productivity: Concept and Tendencies. “Ovidius” University Annals, Economic Sciences Series Volume XVII, Issue 2, pp.258.

[7]Popescu, A., 2015, Research on labour productivity in Romania's agriculture. Scientific Papers. Series "Management, Economic Engineering in Agriculture and rural development", Vol. 15(2)271-280.

[8]PricewaterhouseCoopers Management Consultants SRL. 2017. The potential of development of agriculture sector from Romania, [https://www.juridice.ro/wp-content/uploads/2017/03/Raport\\_PwC-agricultura.pdf](https://www.juridice.ro/wp-content/uploads/2017/03/Raport_PwC-agricultura.pdf), Accessed on February 6, 2019.

[9]Romania's Statistical Yearbooks, 2007-2017. National Institute for Statistics, [www.insse.ro](http://www.insse.ro), Accessed on February 7, 2019.

[10]Tofan, A., 2005, Labour Productivity in Agriculture, Scientific Annals of Alexandru Ioan Cuza University, Iasi, 441-447.

## IMPACT OF BIOMASS OF STREPTOMYCES LEVORIS CNMN-AC-01 AND SOME EXTERNAL FACTORS ON QUALITY OF COMBINED FODDER FOR RABBITS

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### Abstract

*The qualitative composition of combined fodder for rabbits plays a key role in achieving success in raising these animals, because 60-80% of the prime cost production constitutes the part of the feed. The purpose of the work was to appreciate the influence of biomass of Streptomyces levoris CNMN-Ac-01 and of some external factors on the microbiological and biochemical quality of the friable and granular combined fodder for rabbits. As a result of study of the microbiological composition of friable and granular combined fodder, it was found that the addition of Streptomyces levoris CNMN-Ac-01 biomass, the temperature and the pressure during the compaction of the combined fodder, improve the sanitary condition of the granulated fodder by reducing the amount of E. coli and Enterococcus spp. and the destruction of Aspergillum niger. The results of the biochemical analyzes of the studied fodder indicate that the elaborated fodder recipe can provide rabbits with the necessary in metabolic energy, crude protein, cellulose, carotene, calcium and phosphorus for their vital activity, and extrinsic factors (Streptomyces levoris biomass of CNMN-Ac -01, temperature and high pressure) do not significantly affect their chemical composition.*

**Key words:** biomass, granulated combined fodder, rabbits

### INTRODUCTION

Rabbit-breeding is a relatively new sub-branch of rabbit growth, which provides the population with high-quality dietary meat, beautiful fur and wool [2].

Of all mammals raised by humans, as a source of food, rabbits have the best growth rate. On the 6-th day of life, they double their body weight at birth. Approximately at 100 days, rabbits reach 2.5-3.0 kg live weight [2], [6].

Feeding rabbits is one of the main factors by which the breeder can act to achieve superior production performance and increased economic efficiency. These results are obtained by the use of fodder that contain the nutrients (proteins, fats, carbohydrates, cellulose, vitamins, minerals and water) required for the vital processes in the body, and at the same time avoid the negative effects due to the excess of one of the nutrients or the proportional imbalance between them [2], [5], [6].

Thus, the main purpose of intensive rabbit

growth is to achieve maximum productivity, while reducing expenditure, which depends directly on the quantity and quality of consumed fodder [4], [5]. Making a balanced ration is a very important task, which worldwide is solved with the so - called fodder additives. These in turn balance the ration and contribute to the more efficient food assimilation, stimulating the growth and productivity of the animals.

Lately, it has increased the interest towards the ability of preparations with beneficial micro flora to treat and prevent gastrointestinal tract diseases as well as to restore intestinal micro flora after antibiotic therapy [8].

The intensification of the study of preparations with beneficial microorganisms has been determined in recent years by the restrictions imposed on animal breeders and feed manufacturers to limit the use of antibiotics as a growth promoter. Thus, with the ban on the use of antibiotics, many farmers are worried that the action of

pathogens on farm animals may increase drastically [8], [9].

Considering the fact that *Streptomyces* are important producers of biologically active substances with large application in zootechny and agriculture [3], [7], the aim of the work was to appreciate the influence of the biomass of *Streptomyces levoris* CNMN-Ac-01 on the microbiological and biochemical qualities of combined fodder in grained and granular form for rabbits.

## MATERIALS AND METHODS

The basic research was conducted in the laboratory of Methods of Combating and Preventing Diseases and the Nutrition and Fodder Technology Laboratory of Scientific and Practical Institute of Biotechnologies in Zootechny and Veterinary Medicine, and the biomass of *S. levoris* CNMN-Ac-01 was offered by the Institute of Microbiology and Biotechnology (National Collection of Non-pathogenic Microorganisms).

Research materials served four types of fodder: friable combined fodder and control granulate and combined and granulated fodder with addition of 0.1% of biomass *Streptomyces levoris* CNMN-Ac-01.

Determination of the total amount and the species of microorganisms was performed on the nutrient media, in accordance with the usual methods [1], [10], [11].

Analyzes of the biochemical composition of the fodder included the determination of: moisture, dry substance, crude protein, crude fat, crude cellulose, metabolic energy, carotene, calcium and phosphorus.

When assessing biochemical indicators were used performing laboratory equipment of Gerhard Company.

## RESULTS AND DISCUSSIONS

Initially, *S. levoris* biomass CNMN-Ac-01a was seeded on culture media to determine TNG (total number of germs per gram of biomass). After 48 hours from sowing, were recorded  $4.3 \times 10^8$  UFC/g of biomass on the Nutrient Agar medium.

Subsequently, dry biomass of *S. levoris* CNMN-Ac-01a was included in the recipe for the preparation of the granulated fodder intended for rabbits in the experimental lot.

It was studied the microbiological composition of the combined friable fodder and the final product - granulated fodder (Table 1).

Table 1. Microbiological composition of the combined fodder before and after granulation, UFC/g

Indicators	Combined friable food		Combined granulated fodder	
	Witness	Experiment	Witness	Experiment
TNG	$7.8 \times 10^5$	$8.5 \times 10^5$	$4.6 \times 10^5$	$6.4 \times 10^5$
<i>E. coli</i>	$4.8 \times 10^5$	$4.6 \times 10^5$	$1.7 \times 10^4$	$4.0 \times 10^4$
<i>Enterococcus</i> spp.	$1.6 \times 10^4$	$1.1 \times 10^4$	$9.0 \times 10^3$	$< 10^2$
<i>Clostridia</i> spp.	$3.2 \times 10^6$	$2.3 \times 10^5$	$6.1 \times 10^5$	$2.4 \times 10^5$
<i>Lactobacteria</i> spp.	$1.4 \times 10^4$	$5.5 \times 10^4$	$1.0 \times 10^4$	$3.0 \times 10^4$
<i>Bifidobacteria</i> spp.	$4.2 \times 10^5$	$5.8 \times 10^5$	$1.0 \times 10^5$	$2.3 \times 10^5$
<i>Bacillus</i> spp.	$8.8 \times 10^5$	$1.8 \times 10^5$	$1.1 \times 10^5$	$6.2 \times 10^5$
Fungi	$8.0 \times 10^4$	$9.7 \times 10^4$	$5.3 \times 10^3$	$2.2 \times 10^5$

Source: Own calculation

According to the data in Table 1, in all types of combined fodder, TNG was  $(4.6-8.5) \times 10^5$  UFC/g, *Bacillus* spp. and *Bifidobacteria* spp. did not exceed  $10^5$  UFC/g, and the amount of *Lactobacteria* spp. oscillated within the range  $(1.0-5.5) \times 10^4$  UFC/g.

As a result of granulation process of the friable combined fodder, has diminished numerically *E. coli* and *Enterococcus* spp. and *Aspergillum niger* was not detected. The amount of *E. coli* decreased from  $4.6 \times 10^5$  UFC/g in the experimental friable combined fodder up to  $4.0 \times 10^4$  UFC/g in that experimental granulated and from  $4.8 \times 10^5$  UFC/g in witness combined friable fodder up to  $1.7 \times 10^4$  UFC/g in that control granulated.

The total amount of fungi was increased by 100 times in the experimental granulated combined fodder compared to that witness and consisted of  $2.2 \times 10^5$  UFC/g and  $5.3 \times 10^3$  UFC/g, respectively.

It was found that at sowing the samples of the granulated witness on the Nutrient agar medium increased various colonies as aspect and morphology, and at sowing the samples of experimentally granulated fodder, only colonies of *Streptomyces* have been detected, which proves that they have antagonistic action on some microorganisms (Fig. 1).



Fig. 1. Colonies on Nutrient Agar medium: a) witness granulated fodder and b) experimentally granulated fodder  
 Source: Own determination

The same legitimacy was also found and on the Sabourand environment. Both on plant medium of the Nutrient Agar and Sabourand Agar the colonies had the same form (Fig. 2).

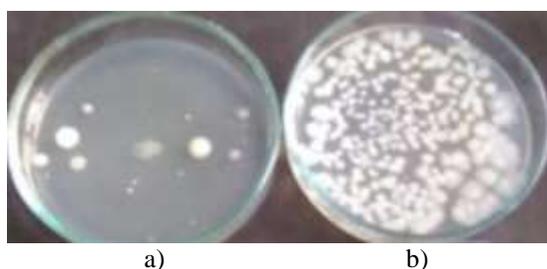


Fig. 2. Colonies on Sabourand medium: a) witness granulated fodder and b) experimental granulated fodder  
 Source: Own determination

Unlike granulated fodder in friable combined fodder, has been found a wider range of colonies, including a non-essential amount of *Aspergillus niger* (found in hay).

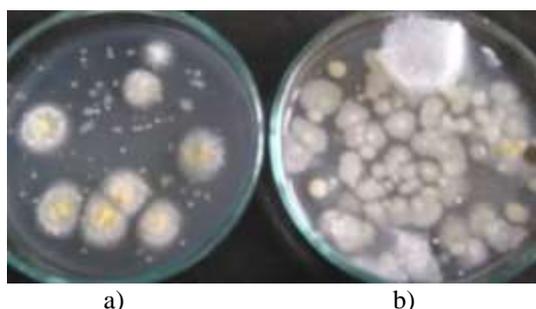


Fig. 3. Colonies on the Sabourand Agar medium: a) witness combined friable fodder b) experimental friable combined fodder  
 Source: Own determination

Analyzing Fig. 2 and 3 we can conclude that the addition of streptomycete biomass in fodder, as well as high temperature and pressure, favor the numerical reduction or destruction of some microorganisms in its composition.

Simultaneously with the microbiological study, the biochemical analysis of the combined fodder for rabbits was carried out. Thus, according to the data in Table 2 and 3, the highest humidity of 13.13% was found in the witness granulated fodder, and the minimum in the combined friable fodder with the value of 10.82%. The difference of these

Table 2. The biochemical composition of combined friable fodder for rabbits

Indices	Combined friable fodder	
	witness	experimental
Moisture %:Initial	6.64	7.38
Hidrosopic total	4.48	4.11
	10.82	11.19
Dry substances (DS),%	89.18	88.81
Azote,% :In DS	2.71	2.81
In the absolutely dry substance	2.84	2.93
With natural humidity	2.53	2.60
Crude protein,%: In DS	16.94	17.56
In the absolutely dry substance	17.73	18.32
With natural humidity	15.81	16.27
g/kg	158.15	162.64
Digestible protein,g/kg	113.87	117.10
Gross fat. %: In DS	2.47	2.57
In the absolutely dry substance	2.59	2.68
With natural humidity	2.31	2.38
g/kg	23.06	23.8
Gross cellulose. %: In DS	14.47	16.21
In the absolutely dry substance	15.15	16.91
With natural humidity,%	13.51	15.01
g/kg	135.09	150.14
Gross ash.%,: In DS	9.78	8.32
In the absolutely dry substance	10.24	8.68
With natural humidity	9.13	7.71
UN	0.72	0.72
EM, Mj/kg: In DS	10.38	10.51
With natural humidity	8.62	8.65
Caroten, mg/kg	10.50	10.00
Ca,% :In DS	2.24	1.55
P,%: In DS	0.38	0.37

Source: Own calculation.

indicators can be explained by the fact that until compressing combined friable fodder, it was moistened (according to the production technology), then granulated.

Correspondingly, the dry substance in witness combined friable fodder exceeded by 2.66% that of the witness granulated fodder.

The productive parameters of the rabbits (increase in weight gain, fecundity, prolificacy, viability, fur quality, etc.) require a certain protein level, quantitative and qualitative. At a level of 15.00-17.00% crude protein of the fodder, may satisfy the requirements of the growing rabbit [6]. According to the data in Table 3, the witness and experimental granulated fodder can

provide rabbits with a level of 18,18% crude protein and 18,23% crude protein respectively. The crude fat content of the absolutely dry substance oscillated from the minimum 2.47% in the witness combined friable fodder up to 3.12% in the witness granulated fodder.

Table 3. The biochemical composition of granulated combined fodder for rabbits

Indices	Granulated combined fodder	
	witness	experimental
Moisture %:Initial	9.77	9.58
Hidrosopic total	3.72	3.34
	13.13	12.60
Dry substances (DS),%	86.87	87.40
Azote,% :In DS	2.80	2.82
In the absolutely dry substance	2.91	2.92
With natural humidity	2.53	2.55
Crude protein,%: In DS	17.50	17.63
In the absolutely dry substance	18.18	18.23
With natural humidity	15.79	15.94
g/kg	157.90	159.41
Digestible protein,g/kg	113.69	114.78
Gross fat. %: In DS	3.12	2.83
In the absolutely dry substance	3.24	2.93
With natural humidity	2.82	2.56
g/kg	28.15	25.59
Gross cellulose. %: In DS	15.69	15.34
In the absolutely dry substance	16.30	15.87
With natural humidity,%	14.16	13.87
g/kg	141.57	138.70
Gross ash,%.: In DS	8.51	8.15
In the absolutely dry substance	8.84	8.43
With natural humidity	7.68	7.37
UN	0.71	0.72
With natural humidity	0.71	0.72
EM, Mj/kg: In DS	10.63	10.72
With natural humidity	8.52	8.62
Caroten, mg/kg	12.00	10.67
Ca,% :In DS	1.63	1.45
P,%: In DS	0.39	0.40

Source: Own calculation.

Cellulose is a weak source of energy among other sources, but it is indispensable as a stimulant for rabbit digestion [8]. It stimulates intestinal peristalsis, being practically a digestive regulator. In the granulated witness fodder was found 16.30% of crude cellulose, and in the experimentally granulated fodder - by 2.64% less.

Carotene content oscillated from 10.00 mg/kg in experimental friable combined fodder to 12.00 mg/kg in witness granulated fodder.

So, as a result of the biochemical analysis of the compound fodder, it was found that the elaborated granulated fodder recipe will provide the rabbits in the witness and experimental lot with metabolic energy, crude protein, cellulose, carotene, calcium and phosphorus necessary for the vital activity of

the animals for obtaining high quality dietetic meat.

## CONCLUSIONS

As a result of the carried out research it was found that the biomass of *Streptomyces levoris* CNMN-Ac-01, the temperature and the pressure during the compaction of the friable combined fodder improve the sanitary condition of the granulated fodder, by reducing the amount of *E. coli* and *Enterococcus* spp., and the total destruction of *Aspergillum niger*, but does not significantly affect the biochemical composition of the fodder.

## REFERENCES

- [1]Bykova, A., Vashchenko,V., 2016, Tutorial manual on general microbiology. Kharkiv, 130-142
- [2]Bura, M., 2006, Ferma, no. 2, 40.
- [3]Burteva, S., Sirbu, T., Slanina, V. *et al.*, 2008, Antimicrobial activity of streptomycetes in the soils of the central area of Moldova. *Agricultural Science*, no. 1:20-24.
- [4]Dabija, T., Macari, A., 2009, The study, which reflects the body weight of different breeds of rabbits. In: *Scientific works, USAMV "Ion Ionescu de la Brad"*. Iași, vol. 52 (14): 290-293.
- [5]Galatanu, D., 2017, Feeding Rabbits: Nutritional Requirements of the Rabbit, *Newspaper of Agriculture*.
- [6]Macovschi, B., 2014, Fodder used in feed of home rabbits. *Village world*, June 16.
- [7]Mateescu, R., Petruța, C., Grebenișan, I., Campeanu Gh., 2004, *Biotechnological Applications of Bacteria of Streptomyces and Bacillus*, 123.
- [8]Mitin, M., 2012, Increase in meat productivity due to the introduction into the diet of rabbits Irkutin, *Vestnik IrSAA*, no. 53: 88-95.
- [9]Salyakhov A., Yakmimov O., 2017, Mineral supplement in rabbit feeding. Article in issue: 2 vol.230:128-131.
- [10]The practice of determining the sensitivity of microorganisms, 2000, HIMEDIA.
- [11]Vorobiev, A. 2003, *Medical and sanitary microbiology: A manual for students. Higher medical installations*. M.: Publishing Center "Academy

## ASPECTS REGARDING THE STORAGE BEHAVIOUR OF SOME APPLE VARIETIES WHICH ARE MORE OR LESS KNOWN IN ROMANIA

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### Abstract

*The consumption of fresh apples has been and still is recommended by nutritionists, in favour of frozen, dehydrated or heat processed fruit. In the current study, we intend to present the evolution of the main physical and chemical components with nutritional value of some apple varieties, cultivated in both Europe and Romania. 6 varieties have been observed, namely: Redix, Goldrush, Florina, Generos, Topaz and Enterprise. Biometric measurements have been carried out, as well as the organoleptic assessment and physio-chemical tests: pulp firmness, soluble dry matter, titratable acidity and the content of Ascorbic acid (Vitamin C). The analysis had two storage variants: VI. Cooling Room, at  $T = 4^{\circ}\text{C}$  and  $\text{RH} = 85\%$ ; and VII. Traditional Cellar with  $T = 12-15^{\circ}\text{C}$  and  $\text{RH} = 70 - 75\%$ . In both storage conditions, after 90 days the Enterprise variety has excelled, receiving the highest score in the organoleptic assessment and has also had higher S.D.M. and Vitamin C quantities in comparison with the other varieties put under observation.*

**Key words:** firmness, rottenness, storage condition, soluble dry matter

### INTRODUCTION

Apples have played an important role in humankind's nutrition since ancient times. Furthermore, all consumers know their importance in the daily food intake through the beneficial contribution to general wellness [2][4][5]. The consumption of fresh apples has been and still is recommended by nutritionists, in favour of frozen, dehydrated or heat processed fruit.

Even if the globalisation of food commerce has reached our country as well, one should not disregard the wish of the consumer, nostalgic as he might be, to eat local products and apples that were cultivated in Romania.

Modern technologies have enabled the storage of apples for longer periods of time, depending on the storage method [6].

In the current study, we intend to present the evolution of the main physical and chemical components with nutritional value of some apple varieties cultivated in Romania, which are more or less known to the ordinary consumers, by using two storage methods.

### MATERIALS AND METHODS

The apples used for our research were harvested from the experimental orchard of the Horticultural Faculty within USAMV Bucharest, grown in pedo-climatic conditions specific to the Bucharest area in the year 2018. It has to be mentioned that this year, most of the fruit trees, especially the apple trees, were overloaded with fruit.

The varieties taken under observation were: Redix, Goldrush, Florina, Generos, Topaz and Enterprise. These are all winter apple varieties, which have good storage capacity.

This year no thinning activities were carried out in the orchard and for more than any other variety that was studied, the Goldrush variety was overloaded with fruits, which were small and had high pulp firmness.

The harvesting of the apples was performed at ripeness, in the second decade of September, when the outside temperature was  $23^{\circ}\text{C}$ .

After weighing, the apples were put into storage in 2 variants as follows:

V1 = CR (Cooling Room) at T = 4 °C and RH = 85%.

V2 =TC (Traditional Cellar) at T = 12-15°C and RH = 70 -75%.

Biometric measurements and physio-chemical tests have been carried out: pulp firmness (using the Effegi penetrometer), Soluble Dry Matter (S.D.M.), titratable acidity in malic acid and the content of Ascorbic acid (Vitamin C).

The organoleptic assessment, at the end of the storage period was also an indicator that we analysed in our research.

## RESULTS AND DISCUSSIONS

The results of the research are displayed in the tables which follow, and the data obtained represents the average, resulted from the values of the fruit which were analysed.

The physical changes studied highlight the loss in weight and the loss through fruit rotting, as well as the evolution of the pulp firmness during storage. The firmness was measured with a penetrometer and expressed in kgf/cm<sup>2</sup>.

Table 1. Biometric measurements of the apples

Variety	Average weight /unit (g)	Fruit height (mm)	Fruit diameter (mm)	Shape index
REDIX	140.14	6.2	5.9	1.05
GOLDRUSH	83.13	4.3	4.9	0.88
FLORINA	162.10	5.6	5.4	1.03
GENEROS	180.00	5.6	7.1	0.80
TOPAZ	130.00	4.8	6.8	0.70
ENTERPRISE	185.00	5.5	6.8	0.80

Source: Own determination.

Table 2. Losses during storage (90 days) in the Cooling Room

Variety	Initial firmness (kgf/cm <sup>2</sup> )	Final firmness (kgf/cm <sup>2</sup> )	Weight losses (%)	Rottenness losses (%)	Total losses (%)	Organoleptic assessment (points)
REDIX	6.4	5.5	2.15	7.02	9.17	19.66
GOLDRUSH	7.9	6.5	2.72	5.20	7.92	27.33
FLORINA	7.1	4.5	1.43	10.12	11.55	23.66
GENEROS	6.2	3.9	1.45	10.00	11.45	28.00
TOPAZ	5.6	4.7	1.65	15.30	16.95	26.66
ENTERPRISE	6.9	6.2	1.63	20.15	21.78	30.66

Source: Own determination.

Table 3. Losses during storage (90 days) in Traditional Cellar

Variety	Initial firmness (kgf/cm <sup>2</sup> )	Final firmness (kgf/cm <sup>2</sup> )	Weight losses (%)	Rottenness losses (%)	Total losses (%)	Organoleptic assessment (points)
REDIX	6.4	4.0	4.01	10.20	14.21	25.00
GOLDRUSH	7.9	6.2	4.02	5.14	9.16	22.33
FLORINA	7.1	3.7	3.73	15.02	18.75	20.33
GENEROS	6.2	3.5	5.35	25.00	30.35	20.33
TOPAZ	5.6	4.2	3.68	17.45	21.13	19.00
ENTERPRISE	6.9	5.1	3.95	22.25	26.20	28.00

Source: Own determination.

The overall losses were recorded due to the weight losses and to diseases and physiological disorders which were manifested during storage [7]. The most losses were recorded for the Generos variety – 30.35%, which was kept in Traditional Cellar,

in comparison with 11.45%, in cooling conditions (Cooling Room). The least number of losses could be observed for the Goldrush variety – 7.92% in CR and respectively 9.16% in TC.

Table 4. The main chemical characteristics of the fruits of some apple varieties in the Cooling Room

Variety	Soluble dry matter (%) initial	Soluble dry matter (%) final	Titratable acidity (%) initial	Titratable acidity (%) final	Ascorbic acid (mg/100g) initial	Ascorbic acid (mg/100g) final
REDIX	12.7	14.1	0.37	0.35	3.88	2.58
GOLDRUSH	12.4	14.8	0.48	0.45	8.28	6.65
FLORINA	13.3	13.9	0.24	0.21	6.52	5.95
GENEROS	11.2	13.1	0.40	0.40	6.76	5.05
TOPAZ	13.4	15.4	0.80	0.78	5.45	4.25
ENTERPRISE	15.3	16.6	0.72	0.71	3.44	2.64

Source: Own determination.

Table 5. The main chemical characteristics of the fruits of some apple varieties during storage in Traditional Cellar

Variety	Soluble dry matter (%) initial	Soluble dry matter (%) final	Titratable acidity (%) initial	Titratable acidity (%) final	Ascorbic acid (mg/100g) initial	Ascorbic acid (mg/100g) final
REDIX	12.7	14.7	0.37	0.34	3.88	2.05
GOLDRUSH	12.4	15.2	0.48	0.39	8.28	5.90
FLORINA	13.3	15.3	0.24	0.19	6.52	4.20
GENEROS	11.2	13.9	0.40	0.37	6.76	4.16
TOPAZ	13.4	15.8	0.80	0.75	5.45	4.20
ENTERPRISE	15.3	16.8	0.72	0.69	3.44	2.02

Source: Own determination.

As expected, the total losses were higher for all the varieties stored in the traditional way, in comparison with the Cooling Room alternative.

The firmness of the apples represents a quality guarantee during handling, transport and marketing. [3][4].

According to previous sources in the literature, bigger fruits have lower firmness than smaller fruits, because smaller fruits have more matter gathered in the cell walls per volume unity and should; therefore, have firmer tissues than bigger fruits [8].

This is the explanation for the higher values recorded in our research for the Goldrush variety, for which the average weight per fruit was 83.13g, in comparison with the other varieties that were analysed. The initial firmness was 7.9 kgf/cm<sup>2</sup> and during storage decreased to 6.5 kgf/cm<sup>2</sup> in CR and 6.2 kgf/cm<sup>2</sup> in TC.

The organoleptic assessment of the fruits stored in CR revealed the following score: the Enterprise variety – 30.66 marks as being the most appreciated and Redix – 19.66 as being the weakest as far as organoleptic parameters are taken into consideration.

After a period of 90 days of storage, small relative differences are detected with regard to

the score obtained, regardless of the storage conditions. An exception to this is the Redix and Topaz varieties.

In TC, the variety most valued by consumers was Enterprise, with 28.88 marks, and the least valued was Topaz, with 19 marks.

As shown in tables 4 and 5, the chemical changes of the main components analysed record significant quantitative variation. The soluble dry matter increased during storage for all varieties in comparison with the starting point, owing to the transformation of starch into soluble carbohydrates. The highest scores were recorded for Enterprise, 16.6% (CR) respectively 16.8% (TC), followed by Topaz with 15.4 (CR) and 15.8% (TC).

The total titratable acidity decreased in quantity during storage irrespective of the storage conditions [3]. The values were between 0.24% (Florina) and 0.80% (Topaz), at the beginning of their storage, decreasing to 0.19% (Florina) and 0.69% (Enterprise). Ascorbic acid (Vitamin C) decreases during storage, both in refrigerate conditions and in the traditional alternative. This decrease is correlated to the decrease of the total titratable acidity, since it is known from previous sources in the literature that this vitamin is stored well only in acid environments [1].

After 90 days of storage, the highest quantity of ascorbic acid was detected in the Goldrush variety – 6.65mg/100g in CR respectively 5.9 mg/100g in TC.

## CONCLUSIONS

The losses recorded during storage differ according to both the storage conditions and the variety. The varieties which did the best in both storage conditions were Goldrush and Redix.

The organoleptic assessment shows that the Enterprise variety had the best qualities in the climatic conditions of the year 2018, with a total of 30.66 marks in CR and 28.00 marks in TC, after 90 days of storage.

The content of S.D.M. was the highest for the Enterprise variety – 16.6% in CR and 16.8% in TC. The high S.D.M. levels, together with the high level of acidity determined the choice of the Enterprise as the best among the varieties taken under observation.

## REFERENCES

- [1]Beceanu D., Chira A., 2003, Tehnologia produselor horticole (Horticultural products technology), Economica Press, Bucharest, 150-153.
- [2]Bordea, M., Bordea, I., 1998. Vitaminizarea naturala a organismului si sanatatea. Colecția Vacanță și Sănătate, (Natural vitaminization of the body and health. Holiday and Health Collection). Sport-Turism Press, Bucharest, 30-32.
- [3]Chira, A., Chira, L., Delian, E., Alexe, C., 2016, Studies regarding the influence of the storage condition upon the shelf life of some apple cultivars. Scientific papers, Series B, Horticulture, vol. LX, pp.11-14.
- [4]Chira, L., Chira, A., 2017, Norme de calitate pentru produsele horticole (Quality norms for the horticultural products). Ex Terra Aurum Press, Bucharest, 56-59.
- [5]Mihaiescu, G., 1994, Fructele in alimentatie, bioterapie si cosmetica (Fruits in nutrition, biotherapy and cosmetics). Ceres Press, Bucharest, 19-22.
- [6]Niculita, P., 1998. Tehnica si tehnologia frigului in industria agroalimentara (The

cooling technics and technology in agrofood industry). E.D.P.R.A. Press, Bucharest, 58-65.

[7]Veringa, D., Niculescu, F., Mohora, A., 2018, Aspecte privind comportarea merelor din soiurile Idared si Goldrush pe durata pastrarii (Aspects regarding the behaviour of Idared and Goldrush apple varieties during storage). Hortus, no. 16., pp. 316-321.

[8]Viskelis, P., Rubinskiene, M., Sasnauskas, A., Bobinas, C., Kvikliene, N., 2011, Changes in apple fruit quality during a modified atmosphere storage. Journal of fruit and ornamental plant research. Vol 19, pp. 155-165.

## ANALYSIS OF SOME FACTORS WHICH CONTRIBUTE TO NITRO INTOXICATION OF ANIMALS

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### Abstract

*The accumulation of nitro compounds in plants depends on several factors, in particular: the doses and frequency of incorporation of organic and mineral fertilizers in the soil, the amount of nitro compounds accumulated in soil and plants, climatic conditions, the period of plant physiological development, water insufficiency, etc. All of these factors contribute to the accumulation in quantities which exceed the admissible limit concentration (ALC) of nitro compounds in plants, including fodder. The main causes which contribute to the nitro intoxication of the animals are: the non-compliance of the rules on the storage and use of nitrogen fertilizers, the lack of zoo veterinary control over the quality of the fodder which contains amounts that exceed the ALC. The most sensitive to nitro intoxication are ruminants. The degree of nitrate hazard is mainly determined by the total toxicity of all metabolites formed in the fermentation process in the multi-chamber stomach of ruminant animals. Nitro intoxication of the animals occurs as a result of the penetration of nitro compounds into the body with food and drinking water which contain nitrites and nitrates that exceed ALC. The use of feed in animal ration, fodder and water with high nitrite and nitrate content leads to acute or chronic intoxication, which affects animal health and the quality of animal products.*

**Key words:** animals, nitro compounds, nitrite, nitrate, nitro intoxication

### INTRODUCTION

The accumulation of nitro compounds (nitrites, nitrates and nitrosamines) in plants adversely affects the quality of fodder crops, which often cause intoxication in mass of animals [6]. In case of irregular incorporation of fertilizers is possible to form in the soil, plants, human and animal body the increased content of nitro-compounds, which have a more pronounced toxicity and, most important, that it exhibits stronger cancerous, mutagenic and embryo toxic action [1], [5] [7]. The most sensitive to nitro intoxication are ruminant animals, to a lesser extent – those monogastric and poultry [8]. Acute nitro intoxication of cattle leads to an increase in the percentage of death, and at chronic nitro intoxication of cows there is a decrease in milk production, increase of abortions, the birth of unviable calves, increase the sterility percentage and the concentration of nitro compounds in milk [4].

Literary sources present the results of the influence of nitro intoxication on the process of sperm genesis at breeding bulls. It is mentioned that in case when into the body of bulls within 24 hours at the same time with feed and water penetrates the amount of 0.1 grams of nitrate ions ( $\text{NO}^3$ ) per kilogram of body mass takes place an increase of the percentage of non-qualitative spermatozoa, and when into the organism penetrates a dose of 0.3 g/kg of body weight are obtained 100% of non-qualitative spermatozoa [8].

During nitro intoxication prophylaxis it is not necessary to use excessive doses of nitrogen fertilizers in the cultivation of crops; it is necessary to carry out feed quality analysis using the bio probe method, permanently to control the content of nitro compounds in the used feed; the dose of nitro compounds, taking into account their water content, must not exceed the permitted limit concentration ALC, for bulls - 0.1 g/kg, for other groups of bovine - 0.2 g/kg for sheep and horses - 0.4 g/kg for swine - 0.6 g/kg for rabbits and birds

-1.0 g/ kg of body weight [8]. If the amount of nitrate in the green feed is bigger than 0.2%, then it must be subjected to the insolubilisation process by not covering the pits for 2-3 days, it should be dried, processed into flour or left for obtaining seeds and used after diminishing the amount of nitro compounds [3], [8].

As a result of the research carried out by the collaborators of the Scientific and Practical Institute of Biotechnologies in Zootechny and Veterinary Medicine, it was found that at the incorporation in the soil under fodder crops of a high dose of mineral fertilizers, especially those with nitrogen, in case of some unfavourable climatic conditions for the physiological development of plants, excessive amounts of non-protein nitrogen (nitrates, nitrites and nitrosamines) are accumulated in them. Also, according to many researches, it was found that Moldova is a biogeochemical region with excessive accumulation of nitro compounds in groundwater and phreatic. This is explained by the intensive use of mineral fertilizers [1], [2], [7].

Taking into account the created situation regarding the pollution of the environment with nitro-compounds, it was necessary to study the factors that contribute to the nitro intoxication of animals, the methods of diagnosis, prophylaxis and treatment of this disease, and the influence of this disease on the quality of products of plant and animal origin [5].

Under favourable conditions of fermentation of fodder in the herbarium a large portion of nitrate in feed is transformed into ammonia and is used by intestinal micro organisms for protein synthesis. In some cases, nitro compounds and their disintegration products in long-term effects on the body of the animals cause health disorders, worsening the reproductive function, the birth of unviable youth, reduce of productivity and accumulation of nitro compounds in milk, organs and tissues of the animal body. In the animals' body, nitrates do not inactivate, but on the contrary, in the acid reaction they turn into nitrites, which are 10 times more toxic than nitrates. The intense transformation of

nitrates into nitrites takes place during forage putrefaction, soil fodder pollution, manure and other substances rich in nitrifying bacteria. In the summer months, when the temperatures are 30 ° C - 40 ° C, at keeping the shredded green mass, for 1.5-2.0 hours, the content of nitrites increases by 3.33 times, from 30 mg/kg till/100 mg/kg [6], [8].

It is therefore necessary to take into account that the nitrate passage into nitrite occurs during inadequate feed storage, in separate cases and during breach of the technology rules of feed preparation and use of forage.

In blood nitrite it is associated with hemoglobin; forming methemoglobin. When converting 60% to 70% of hemoglobin into methemoglobin worsens the breathing of the tissues and occurs the danger of death of animals due to oxygen deficiency [8].

## MATERIALS AND METHODS

The research was carried out within the Scientific and Practical Institute of Biotechnologies in Zootechny and Veterinary Medicine, being used as a biological material for research rabbits aged 3 months. In order to determine the influence of fodder crops with an increased content of nitro compounds on the nitro intoxication process of animals, an experiment was organized in which, according to the analogy principle, the animals were grouped in 4 lots (control lot- I and 3 experimental lots). In each lot, 8 rabbits were included (Table 1).

The duration of the experiment was 12 months. For the first 5 months in the feed ration of animals of the experimental lots was included alfalfa hay and water with increased nitrate content, and for the next 7 months the excess of nitro compounds according to the exposed doses in the experimental scheme was administered by mixing them with combine feed using potassium nitrate ( $KNO_3$ ) for obtaining required dose per kilogram of body mass (g/kg mc). Rabbits in the control lot in both the first and the second part of the experiment were fed with regular feeds in which the nitro compound content did not exceed the ALC and those in the experimental lots were fed with forage and addition of

inorganic substances, in which nitro compounds were present in the doses listed in the table.

During the experiment the rabbits were subjected to observations of the physiological state and monthly was determined the body mass and collected samples of manure for analysis.

Table 1. Scheme of the performed experiment

Lot number	Number of animals	Experimenta I conditions: nitrate dose: g/kg body weight	Investigations during the experiment
I control	8	0.10 – 0.15	Nitrites and nitrates content was determined in alfalfa samples and in rabbit organs after sacrifice
II experiment	8	2.50	
II experiment	8	3.00	
IV experiment	8	3.50	

Source: Own scheme.

In order to determine the role of nitro compounds in the nitro intoxication process of animals during the experimental period, the content of nitro compounds in the rabbit manure was determined and, after sacrifice, the content of nitro compounds was determined in tissues and organs.

## RESULTS AND DISCUSSIONS

The obtained results regarding the correlation between the amount of nitro compounds in the ration and their elimination with the manure is exposed in Table 2.

Analyzing the obtained results, it was found that at the initial stage of the experiment the amount of nitro compounds in the rabbit manure of the control and experimental lots not differ essentially. At the end of the experiment, the amount of nitrite and nitrate has essentially changed. Thus, at the end of the experiment, in manure of the rabbits in the control group, the nitrite content increased

1.64 times and in the rabbits of experimental groups II, III and IV, it increased respectively 22.62 times, 10.33 times and 19.06 times. The same legality was also found regarding the content of the nitrates, which in the manure of the rabbits in control lot increased by 1.24 times, and in the rabbits of the experimental lots II, III and IV, respectively by 12.71 times, 5.51 times and 8.36 times, compared to their content at the initial stage.

By comparing the nitrite and nitrate content results in rabbit manure, from experimental lots with those of the control lot at the end of the experiment, essential changes were noted. The nitrite and nitrate content of the rabbit manure in the II, III and IV lots exceeded those of the respective control lot by 5.44 times, 4.59 times; 5.98 times and 4.42 times, 5.77 times and 6.39 times. Thus, the elimination of nitro compounds in the rabbit body depended on the dose of the administered nitro compounds and the period of administration.

Table 2. Nitrites and nitrates content in rabbit manure in the process of nitro intoxication

Lot number	Content of nitro compounds, mg / kg			
	Initial		After 12 months	
	Nitrites	Nitrates	Nitrites	Nitrates
I	3.3±0.02	34.0±0.03*	5.4±0.02**	42.3±0.03
II	1.3±0.01*	14.7±0.02*	29.4±0.02	186.8±0.04
III	2.4±0.01	44.3±0.03***	24.8±0.01**	244.0±0.02***
IV	1.7±0.01**	31.6±0.03**	32.4±0.03*	270.1±0.04**

Note: The level of authenticity: \*P≤0.05; \*\*P≤0.01; \*\*\*P≤0.001

Source: Own determination.

In order to determine the degree of nitro intoxication of the rabbits at the end of the experiment, after sacrifice, the content of nitro compounds was determined in the tissues and organs of the animals: muscle, liver, kidney (Table 3). From the data obtained in the results of the research it was found that the value of the nitrites in the muscles, liver and kidneys ranged between 0 and 10.7 mg / kg. In the organs of the animals in the control group nitrites were not detected, whereas in

the muscles, liver and kidneys of the animals in lots II, III and IV, their quantity oscillated respectively from 1.2 mg / kg - 1.8 mg / kg, 1.6 mg/ kg - 2.8 mg / kg and 8.8 mg / kg - 10.7 mg / kg.

Table 3. Content of nitrites and nitrates in tissues and organs of rabbits after the intoxication

Content of nitro compound s mg/kg	Lot number			
	I	II	III	IV
<b>Muscle:</b>				
a) nitrites	0.0 ±0.00	1.4±0.01	1.2±0.00	1.8±0.01
b) nitrates	5.2 ±0.00	17.7±0.01	25.7±0.02 <sup>***</sup>	30.9±0.01
<b>Liver:</b>				
a) nitrites	0.0±0.00	2.8±0.00	1.6±0.01	2.4±0.01 <sup>***</sup>
b) nitrates	5.4±0.01 <sup>*</sup>	64.4±0.03	74.1±0.02	86.4±0.03
<b>Kidney:</b>				
a) nitrites	0.0 ±0.00	10.7±0.02	8.8±0.02 <sup>**</sup>	10.6±0.01
b) nitrates	7.1±0.01	157.8±0.04 <sup>***</sup>	166.0±0.05 <sup>***</sup>	177.0±0.02 <sup>**</sup>

Note: The level of authenticity: \*P≤0.05; \*\*P≤ 0.01; \*\*\*P≤0.001

Source: Own determination.

In experimental lots II, III and IV the nitrate content in the rabbit muscles exceeded respectively by 3.40 times, 4.94 times and 5.94 times that in the muscles of the animals in the control lot.

The same legality was also found in the nitrate content of animal liver in the experimental lots, where the nitrate content exceeded 11.93 times (lot II), 13.72 times (lot III) and 16.00 times (lot IV) the one in the liver of the animals of the control lot. The highest nitrate content was found in the kidneys of the animals of the experimental lots II, III and IV, where the value of nitrates exceeded ten times that of the rabbit kidneys in the control lot.

Thus, in the animals' kidneys in experimental lots II, III and IV, a quantity of nitrates was accumulated that exceeded that of the animals in the control lot, respectively by 22.22 times, 23.38 times and 24.93 times.

In the research results it was found that the nitro intoxication of animals is influenced by the dose and the period of use in nutrition of fodder and water with a high content of nitro compounds.

It was also found that the highest amount of nitro compounds was accumulated in the liver and kidney of animals that used a high dose of nitro compounds.

## CONCLUSIONS

As a result of the research it was found that some of the factors that cause the nitro intoxication of the animals are the increased doses of nitro compounds that enter in the body and the period of use of fodder with a high content of nitrites and nitrates.

Nitro compounds are accumulated in the bodies that only partially are eliminated with manure.

Some of the nitro-compounds that enter in the animal's body are accumulated in large quantities in the muscle, liver and kidney.

Chronic nitro-intoxication of animals influences negatively on the health and quality of products of animal origin.

## REFERENCES

- [1]Cremeneac, L., 2015, Study of the influence of fertilizers on the quality of fodder crops International Scientific Symposium „Achievements and Perspectives in Zootechny and Biotechnologies". Volume 44, Chisinau, 84-88.
- [2]Cremeneac, L., 2016, The evaluation of the role of the various types of fertilizers on the process of the accumulation of content of nitrates in forage crops Scientific Papers Series „Management, Economic Engineering in Agriculture and Rural Development”, Vol.16(1):115-120.
- [3]Cremeneac, L., Abramova, V., 2016, Study of the influence of the fodder, cultivated with the use of fertilizers organic and minerals, on the body mass of rabbits. Scientific Papers Series „Management, Economic Engineering in Agriculture and Rural Development”, Vol.16(3): 91-96.
- [4]Mandric, F.I., Kondyreva, M.F., Cremeneac, L.P., Slobodeniuk, N.D., 1992, Nitrointoxication of animals and its veterinary-sanitary expertise. Recommendations. Moldagroinformreclama, Chisinau, 34 .
- [5]Mandrik, F.I., Kondyreva, M.F., Yakub, G.G., Cremeneac, L. P., 1992, Pollution of the environment with nitrates, nitrites and prevention of nitrointoxication. Survey information, Chisinau, 64.
- [6]Oganisyan, S.G., Talanov, G.A., 1988, Dynamics of accumulation of nitrates in forage crops. Journal of Veterinary Medicine, No. 8.
- [7]Opopol, N.I., Dobryanskaya, E.V. 1986. Nitrates. Chisinau, pp.113.
- [8]Poloz, D.D., Polyakova, V.N., 1988. Methodical instructions. Diagnosis, prevention and treatment of farm animals with nitrite and nitrate poisoning. Moscow. Agropromizdat, 8.

## TECHNICAL, ECONOMIC AND LEGAL ASPECTS REGARDING GENETICALLY MODIFIED ORGANISMS

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### Abstract

*Genetically modified organisms have represented and represent, besides an obvious gain in scientific research, a great challenge for human communities to make the wisest decisions in achieving a fair balance between "gains" and "diversity" generated by GMOs, related to direct, indirect, immediate and delayed impacts developed on the short, medium and long term on human health and the environment. This article aims to analyse the procedure for the placing on the market of genetically modified food (feed and food) and to what extent a Member State can, in relation to European legislation, refuse / postpone the cultivation of certain genetically modified varieties on the basis of analysis impact on the environment, crops, or even has the possibility to prohibit the cultivation of these varieties.*

**Key words:** evaluation registry, feed, food, genetically modified organism, label

### INTRODUCTION

Since the beginning of the European Community, Member States have placed a particular emphasis on people's health, an aspect indissolubly linked to their nutrition. In the European legislator's view, nutrition is intrinsically linked to the choice of food, which, coupled with effective state-of-the-art protection, can be made aware in the sense that the citizen has to be able to get enough information about food which he consumes so that the "choice" is made aware of the cause. Starting from the labelling of the final product in the opposite direction, it is easy to see that the citizen must be properly informed about the legal certifications obtained by the product, the production method, the production area, the methods used, and last but not least "The Origins" of the product chosen for consumption [7].

Globally, about 30% of the crops were seeded with genetically modified maize, equivalent to 55.2 million hectares. Among the major transgenic maize producing countries are the United States, Brazil and Argentina.

Starting from the basic principles underpinning the creation of the European Community, principles which have as their foundation the guarantee of a high level of protection of human health, Member States have created a legal and administrative mechanism for managing the way in which products are placed on the market genetically modified "to guarantee on the one hand the rights and interests of European citizens by making censored administrative and jurisdictional decisions at European level and on the other hand to leave to the discretionary appreciation of the Member States the opportunity to introduce these types of products in relation to the obvious needs of the communities to maintain local biodiversity and specific ecosystems created over time" [5].

Thus, in order to protect as far as possible the natural products specific to the national ecosystems, the desire for the permanent care to protect the traditional producers and, last but not least, the consumers, the Member States have developed (especially in the circumstances of recent scientific results that do not give always gaining the cause of

GMOs) assessment systems, research and procedures designed to outline the "precautionary principle" regarding the approval of the placing on the market of these types of genetically modified products.

In addition to the endorsement procedure, Member States also monitor the impact of the cultivation of these modified varieties, monitoring which targets both crops exclusively set up with genetically modified varieties and the incidence of cases of their "accidental" coexistence with varieties originating in the same category, coexistence can lead to slippages both in terms of the protection of natural varieties and in environmental protection areas [7].

On the other hand, it should be mentioned that the precautionary principle cannot be applied abusively. In this respect, it is a good "protectionist" policy of the Member States to protect the rights of citizens operating in the area of "controlled products, which is often doubled by administrative/legislative measures to "block" the market introduction of genetically modified varieties, under different pretexts, beyond the spirit and the letter of European legislation which prevails in view of the accession treaties assumed by each state".

## MATERIALS AND METHODS

According to "Article 2 of the Treaty on the Functioning of the European Union (TFEU), the national States of the European Community" have the possibility to adopt normative acts aimed at prohibiting or restricting the cultivation of genetically modified organisms on national territory, even if they have been authorized be placed on the European market. Obviously, acts of "ban" are subject to European jurisdiction (CJEU). In any case, any judicial evaluation of the "refusal should be based on the findings of the European Food Safety Authority, specifically from the conclusions of the assessment report drawn up on the occasion of the GMO marketing authorization, as set out below". Practice has shown that almost always the refusal refers to the need for Community states to maintain and develop national

"historical" agricultural practices based on a type of production developed in habitats and ecosystems specific to a particular geographical area certain specificities [8].

On the other hand, it must be pointed out that producers, operators of genetically modified products have rights conferred by European legislation, rights that have to be protected under the same European treaties and that is why the subject of placing these types of products on the market is a certain type of the "compromise" between the new need, the idea of progress, the idea of economy and the primordial need "to guarantee the health of the environment and ecosystems created in time so necessary for the protection and welfare of the citizens and, last but not least, of their social and economic interests".

## RESULTS AND DISCUSSIONS

In a legal definition inserted in the provisions of "Law no. 247/2009 for the approval of Government Emergency Ordinance no. 43/2007 on the deliberate introduction into the environment and the placing on the market of *genetically modified organism*" that means any living organism, "with the exception of human beings, whose genetic material has been changed in a way different from the natural one, other than by crossing and/or natural recombination".

It is equally true that effective protection should primarily target the common addressees of these products, beneficiaries who should firstly, in the name of transparency, to ensure their right to accurate information about the products to be purchased. Thus, informing citizens should primarily target their food education. Education is in close and indissoluble connection with the establishment of mandatory rules for labeling GM products. "In this respect, European legislation stipulates that GMOs must be accompanied by complex labels, labels that, besides nutritional values, must necessarily include the provenance of the purchased variety being widely known that genetically modified varieties are more or less by a certain category of consumers and always origin" is reflected

in the final price of the product, it is lower than the original, unmodified genetic product. That is why the "clear" labels are meant to determine an "informed" so be it or eliminated the possibility of misleading the final recipients of the products, consumers who have the right to know exactly the methods of production and production.

It is worth mentioning in this respect the provisions of Regulation (EC) no. 1830/2003 of the European Parliament and of the Council of 22 September 2003 on the traceability and labeling of genetically modified organisms and traceability of food and feed products produced from genetically modified organisms, which sets out the terms and conditions intended to ensure that all stages the placing on the market of genetically modified organisms and foodstuffs obtained from them have been fully respected. This label must contain all the essential information and should correct the genetic modification procedures, issues mandatory under European legislative act [10].

This article aims to analyze the procedure for the placing on the market of genetically modified products (foods and feeds) and to what extent a Member State may, according to European legislation, refuse/postpone the cultivation of certain genetically modified varieties on the basis of analysis impact on the environment, crops or even have the possibility to ban the cultivation of these varieties. Approximately 14 million farmers in North America, South America, Asia, Europe, Africa and Australia cultivate transgenic plants. The world leader in the field is the USA. Over two-thirds of the food produced today in the US contains at least one ingredient derived from a genetically modified plant. The list of transgenic plant growers today includes 25 countries.

Table 1. Top 5 GMO cultivation countries

	Country	Surface (Million ha)
1	USA	701
2	Brazil	403
3	Argentina	24.4
4	India	11
5	Canada	10.8

Source: MADR 2016.

Globally, there are two attitudes about the use of new culture systems based on transgenic plants: increase in the number of species of transgenic plants and extending their assigned areas and limit or ban their cultivation.

USA, Brazil, Argentina, India, China, Canada, South Africa, Paraguay cultivate transgenic plants on millions or even tens of millions of hectares, the three countries (USA, Brazil, Argentina) are major world exporters of soy and corn.

The most popular GMO is soybean, with 79% of the total global area being biotech crops, while 70% of all cotton surfaces are sown with GMOs every year. The ranking is followed by maize and rape.

In the European Union: Spain planting transgenic corn since 1998.

France and Germany have temporarily suspended the cultivation of transgenic corn hybrids due to political reasons. Austria, Hungary, Greece and Luxembourg reject from the beginning the application system culture transgenic plants, also for political reasons, the European Commission and promotes the coexistence of three culture systems: conventional, organic and transgenic plants. In our country, the situation presented by the Ministry of Agriculture is analyzed in Table 2. EU Member States that adopt a reluctant attitude towards modern biotechnology products or reject them altogether avoid the fact that there is already a history of cultivation and consumption without any unexpected events. These events can not occur because the commercial introduction of transgenic plants is authorized only after rigorous risk assessment for the environment and the health of humans and animals that may be associated with this action. It is for the first time in the history of agriculture when the grower of a brewed plant has to provide scientific evidence that his product is safe for the environment and for consumption. Decisions on the use or prohibition of transgenic plants are, ultimately, political. Generally, the use of new technologies has increased crop yields by 5 to 50%. Farm incomes using new technologies increased between 1996 and 1818, with nearly \$ 34 billion. The use of transgenic plants in

agriculture has also had a positive impact on the environment. Globally, between 1996 and 2016, the use of transgenic plants led to a reduction in pesticide consumption of 286

million kg, equivalent to the total amount of pesticide active ingredients used over a year on arable land in the European Union [1].

Table 2. Areas cultivated with genetically modified maize MON 810 in 2012 in Romania

Genetically modified organism				Information about the authorization holder at Community level		Information on cultivator economic operator	The geographical location of the cultivation area		Size of the area authorized for cultivation (ha)	Distance from conventional/ ecological crops (m)	Information from the commercial cultivation authorized issued by MADR through DAJ
Species	The transf event	URC, (acc. to CR(EC) 65/2004	Characteristic	Name of the legal entity	No of EC Decision	Name of the legal entity	Village	County			
Gm	MON 8D Bt	MON-008 D-6	resist.to.lepid/insects	Monsanto Europe SA	Dec. 98294/CE	II Cotea Ioan	Turnu	Arad	933	min.200	authorization no. 2100/04.2012
Gm	MON 8D Bt	MON-008 D-6	resist.to.lepid/insects	Monsanto Europe SA	Dec. 98294/CE	SA Infratrea Turnu	Turnu	Arad	52	min.200	according to the authorization no.210/06.04.2012
Gm	MON 8D Bt	MON-008 D-6	resist.to.lepid/insects	Monsanto Europe SA	Dec. 98294/CE	sc AGROMLC SRL	Isurati	Braila	0	min.200	according to the authorization no.125/04.2012
Gm	MON 8D Bt	MON-008 D-6	resist.to.lepid/insects	Monsanto Europe SA	Dec. 98294/CE	sc HDLSTMLK SRL	Isurati	Braila	0	min.200	according to the authorization no.2/26.04.2012
Gm	MON 8D Bt	MON-008 D-6	resist.to.lepid/insects	Monsanto Europe SA	Dec. 98294/CE	S.C. Lamol Auru SRL	Vadani	Braila	40	min.200	according to the authorization no.3/26.04.2012
Gm	MON 8D Bt	MON-008 D-6	resist.to.lepid/insects	Monsanto Europe SA	Dec. 98294/CE	II Mosescu V. Dăre	Viziru	Braila	13	min.200	according to the authorization no.4/26.04.2012
Gm	MON 8D Bt	MON-008 D-6	resist.to.lepid/insects	Monsanto Europe SA	Dec. 98294/CE	SC LIXAND COM SRL	Isurati	Braila	5	min.200	according to the authorization no.7/10.05.2012
Gm	MON 8D Bt	MON-008 D-6	resist.to.lepid/insects	Monsanto Europe SA	Dec. 98294/CE	BYBLANAGR OSRL	Viziru	Braila	15	min.200	according to the authorization no. 915/05.2012
Gm	MON 8D Bt	MON-008 D-6	resist.to.lepid/insects	Monsanto Europe SA	Dec. 98294/CE	SC Petrosu SRL	T. Valimirescu	Braila	00672	min.200	according to the authorization no. 502.05.2012
Gm	MON 8D Bt	MON-008 D-6	resist.to.lepid/insects	Monsanto Europe SA	Dec. 98294/CE	SC D.A.Simic	Simic	Dolj	5	min.200	according to the authorization no. 1687/23.04.2012
Gm	MON 8D Bt	MON-008 D-6	resist.to.lepid/insects	Monsanto Europe SA	Dec. 98294/CE	Agro-ling SRL	Carpini	Timis	00336	min.200	according to the authorization no. 1243/7.05.2012
Gm	MON 8D Bt	MON-008 D-6	resist.to.lepid/insects	Monsanto Europe SA	Dec. 98294/CE	The Belciugatele pedagogical resort	Moura Dăneasca	Ilfov	1	min.200	according to the authorization no. 1/8.04.2012

Source: MADR, 2013.

The impact of the cultivation of these plants on the environment, assessed by means of an indicator that integrates the different effects of using a particular pesticide in a single "field value per hectare", which allows comparison of the different products between them, decreased by 15.4%.

As a result of the cultivation of glyphosate-tolerant varieties, in the period 1996-2016, the consumption of herbicides in soybean culture was reduced globally by 4.4% (the equivalent of 62 million kg) and the environmental impact assessed by the indicator mentioned above, decreased by 20.4%. In countries where farmers cultivated resistant maize of pests' attacks (Bt technology), there was a decline in total insecticide consumption by 5% (equivalent to 8.3 million kg) and a reduction in the impact of applied insecticides on the environment by 5.3%. In BT cotton

crops, total insecticide consumption decreased by 22.9% (equivalent to 128.4 million kg) and the impact of applied insecticides decreased by 24.6%.

#### Standard procedure for the authorization of a genetically modified variety.

To be placed on the market, the operator variety GMO or product containing a combination of genetically modified varieties must submit a notification to the competent authority of the Member State after verification is required to provide "the European Commission and the competent authorities in this field in Member States (through the Commission, in within 30 days of receipt)" the summary of the file based on the notification. Among the essential requirements that the notification dossier has to contain are the following: environmental risk assessment, market conditions,

environmental and human health information, a monitoring plan, a proposal for labeling *expressis verbis* the fact that the product is genetically modified.

Following the notification procedure, within 90 days, the competent authority of the national state shall draw up an assessment report to draw conclusions about the genetically modified products to be placed on the market and the conditions under which such introduction will be made. In the event of a negative response, the report will contain the conclusions that make the notification unacceptable, bearing in mind that, given the importance of the findings, it will be sent to the European Commission within maximum 105 days of receipt of the notification, which in turn will notify the Member States for 15 days. The report, once communicated, may be the subject of additional information requests, of the reasoned “objections concerning the placing on the market of genetically modified varieties [2]. Within 105 days of the release of the report, the national competent authority and the Commission may negotiate”. If the competent national authority establishes that the genetically modified product may be authorized to enter the market and in the absence of reasoned objections from the European Commission or the Member States, the competent authority shall issue the written marketing authorization. It is valid for 10 years.

As shown above, there are situations where national states may refuse to market GMOs for various reasons.

A first refusal hypothesis has been outlined above and does not involve discussions other than those aimed at censoring the report of the competent authority of the Member State where the introduction of the genetically modified variety is requested. “The second hypothesis concerns the exceptional rule provided by the provisions of art. 20 of Regulation no. 1829/2003 on genetically modified food and feed, normative act published in the Official Journal of the European Union no. 268 of 18 October 2003”[4].

The legal text indicated is to regulate the legal “status of genetically modified organisms

authorized prior to the entry into force of European Regulation no. No 1829/2003 provided that the holder of the products containing, consisting of, or produced from genetically modified organisms has been notified to the European Commission within six months after the entry into force of the new Regulation on the date of introduction of those products into the market from the European Community Framework “[4].

Products legally introduced into the European Community, other than those authorized under “the Directive no. 90/220 / EEC, Directive no. 2001/18 / EC, Directive no. 82/471 / EEC, Directive no. 70/524 / EEC, the operators of the products were obliged within 6 months from the date of application of the Regulation to notify the European Commission of the situation in which the products in question were placed on the market before the application of the act which is the common law in the matter of authorization of these products” [6].

### **Case Study**

The legal report deduced from the case was the outcome of a request made by the Consiglio di Stato (Italy), respectively application of the reference for a preliminary ruling under Article 267 TFEU in litigation worn Pioneer Hi Bred contradictory society by Ministero delle Italia SRL Agricultural and Forestry Policy's Food Forest (Italy).

The dispute has started following the preparation of the note by the Ministry of Agricultural Policies, Food and Forestry (Italy) through which the operator of GMOs on the Agricola market in Italy, Pioneer Hi Bred Italia SRL, was informed that "the adoption by the regions of the appropriate rules to ensure the coexistence of genetically modified crops with conventional and organic agriculture, the ministry could not analyze the company's request to authorize the cultivation of genetically modified maize hybrids already registered in the Common Catalog of Varieties of Agricultural Plants" [9].

According to art. 16 par. (1) lit. a) and lit. c) of Directive 2002/53/EC a Member State may be authorized upon application to prohibit on its territory or part of its territory using a variety or provide appropriate conditions for

cultivation based on certain specific of that State if it is shown that the cultivation of this variety could cause plant pest damage to the cultivation of other varieties or species or where there are good reasons other than those already mentioned or which could be evoked during the admission procedure in the national catalog of varieties in order to consider that the variety presents a risk to human health or the environment.

It is noted that although European legislation, by virtue of the precautionary principle, has established a complex authorization regime that allows all member states to make objections, consultations, proposals, even negotiations, during the pre-authorization period of the genetically modified variety, there may be situations in which, although no substantiated objections have been made during the assessment period, the placing on the market of the GMO would generate major risks incompatible with the fundamental principles that protect the life and health of citizens, environmental protection.

By virtue of their powers, in well-defined cases, in situations "where it is evident that food or feed originating in the Community or imported from another country could be a major risk to human health, animal health or the environment the European Commission may decide to suspend the placing on the market or use of food or feed or to lay down special conditions regarding the movement of such products" [7].

The same right is also granted to national States which, where the European Commission does not take urgent action to address the issue of the incidence of major-risk cases with regard to products already on the market, has the right to adopt intermediate protection measures.

Making use of this right, the Italian competent authority informed the company concerned that, in relation to its request to cultivate the MON 810 maize varieties already included in the European common catalog, it could not proceed with its application for authorization of the cultivation of genetically modified maize hybrids "until the adoption by the regions of the appropriate rules to ensure the coexistence of genetically modified crops

with conventional and organic farming, according to the MAFFP Circular [Ministry of Agricultural, Food and Forestry Policies] of 31 March 2006" [5].

Under Italian national legislation, "the cultivation of seed products is subject to authorization by act of the Minister for Agricultural and Forestry Policies, in agreement with the Minister of the Environment and the Minister of Health, adopted following the opinion of the Genetically Modified Commodities Commission, laying down measures ensure that crops resulting from seed products of genetically modified varieties do not come into contact with crops resulting from traditional seed products and do not cause biological damage to the environment, taking into account agro-ecological, environmental and pedo-climatic features.

In essence, the Italian competent authority stated that it could not proceed with the examination of the application for authorization of the cultivation of genetically modified maize hybrids already included in the Common Catalogue "pending the adoption by the regions of the appropriate rules to ensure the coexistence of genetically modified crops with conventional agriculture and according to the MAFFP Circular [Ministry of Agricultural, Food and Forestry Policies] of 31 March 2006".

It should be noted that the company has requested the renewal of the marketing authorization for MON 810 maize varieties pursuant to Article 20 (4) of Regulation 1829/2003, the exception rule from the authorization regime provided for in the normative act.

*"Solutions of the Court of Justice of the European Communities":*

"Article 26a of Directive 2001/18 does not permit a Member State to generally oppose the cultivation of such GMOs within its territory until coexistence measures are taken to avoid the accidental presence of GMOs in other crops".

"Cultivation of GMOs such as MON 810 maize varieties may not be subject to a national authorization procedure where the

use and marketing of these varieties are authorized under Article 20 of The Law"[9].

## CONCLUSIONS

Genetically modified organisms can only be placed on the market through specific procedures, procedures governed by the precautionary principle, duplicated by effective consultation mechanisms with the competent authorities of the "Member States and the European Commission". Given the importance and the major impact on the implementation of the economic and social realities, monitoring of GMOs must be done on a permanent basis, with Member States and the European Commission having at their disposal effective mechanisms to counteract any adverse effects that may develop over time, interim measures and reaching measures to prohibit the placing on the market of genetically modified products.

## REFERENCES

- [1]Ecogen, 2016, Soil ecological and economic evaluation of genetically modified crops, [www.ecogen.dk](http://www.ecogen.dk), Accessed on Jan 5, 2019.
- [2]Entransfood, 2017, European Network for the Safety of Genetically Modified Food Plants. [www.entransfood.com](http://www.entransfood.com), Accessed on Jan 5, 2019.
- [3]Marcuta, A., Simionescu, A., Tindecu, C., Marcuta, L., 2018, Relationship between sustainable development and public health. Case study Romania, Scientific Papers. Series "Management, Economic Engineering in Agriculture and Rural Development", Vol. 18(3): 251-260.
- [4]Pharma-Planta, 2017, Recombinant Pharmaceuticals from Plants for H: "alth [www.pharma-planta.org](http://www.pharma-planta.org), Accessed on Jan 5, 2019.
- [5]Popescu, A., Dinu, T.A., Stoian, E., 2018, Sorghum - An important cereal in the world, in the European Union and Romania, Scientific Papers. Series "Management, Economic Engineering in Agriculture and Rural Development", Vol. 18(4):271-284.
- [6] Research into the impact of Bt maize (Cry 3Bb1) on non-target organisms living in the soil (2005-2008), 2018, Biological Research Centre for Agriculture and Forestry (BBA) (since 2008 Julius Kuhn Institute (JKI)), Institute for Plant Protection in Field Crops and Grassland; Braunschweig SIGMEA Sustainable introduction of GMOs into European Agriculture: [sigmea.dyndns.org](http://sigmea.dyndns.org), Accessed on Jan 5, 2019.
- [7]Soare, E, Chiurciu, I, 2018, Considerations concerning the worldwide production and marketing of sunflower seeds, Scientific Papers. Series "Management, Economic Engineering in Agriculture and Rural Development", Vol. 18(3): 421-428.
- [8]The Breakdown of Bt toxins and effects on micro-organisms in soil (2005-2008) - Federal Agricultural Research Center (FAL) (since 2008 Johann Heinrich von Thunen Institute (vTI)), Institute of Agroecology; Braunschweig.
- [9]The Court of Justice, Pioneer Hi Bred Italy, Case (Chamber) in Case C-36/11 of 14 January 2011, published at [eur-lex.europa.eu](http://eur-lex.europa.eu) as of 06 September 2012.
- [10]The Romanian Academy, 2018, Position of the academic environment regarding genetically modified plants.



## TECHNICAL, ECONOMIC AND LEGAL ASPECTS REGARDING THE EVOLUTION OF AFRICAN SWINE PLAGUES IN ROMANIA

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### Abstract

*African swine plague causes great economic losses due to the catastrophic depopulation of pig farms in the areas affected by their death and slaughter, by the implementation of approved sanitary measures and trade restrictions. African swine plague is a transboundary disease that can spread rapidly from one country to another and is one of the most dangerous diseases of pigs, being included in list A of „The World Organization for Animal Health (OIE)”. In this paper we analyzed some technical aspects related to the occurrence and evolution of African swine plague in the world and in our country. Due to the extremely rapid evolution of this disease in south-eastern Europe and especially in Romania, we considered it very important to analyze the economic aspects of this virus, especially the damages produced, and to see what the applicable European and national laws African swine plague and whether these normative acts have been enforced and respected in preventing the onset and transmission of the disease.*

**Key words:** African swine plague, DNA, epidemic, legislation

### INTRODUCTION

African swine fever, also called African swine fever or „Montgomery disease, is a highly contagious and very severe febrile hemorrhagic viral disease of domestic swine and wild boar caused by a double-stranded DNA virus from the aspharvirus family propagating very rapidly in the pig population through direct or indirect contact” [2]. The disease is characterized by anatomopathology, by generalized haemorrhagic diathesis, by degenerative and necrotic injuries in different organs, and clinically in acute forms of hyperthermia (40.5-42.2°C), skin lesions (erythema, skin cyanosis, especially in the ears dyspnoea, tachypnoea, intermittent breathing, coughing, bloating of the mouth), disturbances (dyspnoea, tachypnoea, dyspnoea, bruising, bloating), Nervousness (somnia, apathy, adynamics, unstable walking, cramps, hyperexcitation, seizures, paresis and paralysis, lateral decubitus), conjunctivitis, serous nasal secretions, serum or mucopurulent or epistaxis, in pregnant sows is one of the first symptoms observed abortion. Mortality is 90-100% for overactive

and acute forms of the disease. „African swine fever causes large economic losses due to the catastrophic depopulation of pig farms in the areas affected by their death and slaughter, by the implementation of approved sanitary measures and the imposition of trade restrictions” [3]. African swine fever is a cross-border disease that can spread rapidly „from one country to another and is one of the most dangerous diseases of pigs and is included in the A list of the World Organization for Animal Health (OIE)” [4]. African swine fever is endemic in Sub-Saharan Africa where wild pigs are affected: Phacochoerus and potamochoerus, and often domestic swine. The cause of the disease is a DNA virus called African swine fever virus of the genus Asfivirus (Asfarviridae family), transmitted to Africa by ticks of the genus Ornithodoros, but the virus is easily transmitted by infected animals (domestic swine, wild boar) or indirectly through feed, water, litter, other materials, means of transport contaminated with secretions and excretions from contaminated animals or by contaminated clothing of pig breeders and veterinarians.

## MATERIALS AND METHODS

In this paper we analyzed and interpreted the data provided by „the Romanian Ministry of Agriculture and the National Sanitary Veterinary Authority”[1]. To analyze this phenomenon globally, we have used data provided by OIE. Outbreaks of African swine fever in boars and domestic swine have recently occurred in Eastern Europe (Caucasus, Ukraine, Russia, Belarus, Baltic States, Czech Republic, Hungary, Romania, Republic of Moldova), South America and the Caribbean (Dominican Republic). African swine fever arrived in China in August 2018, which is the world's largest pork producer, responsible for almost half of the world's swine population.[11] Although Bulgaria elaborated an intervention plan and took measures to prevent above mentioned fever from entering the country, including raising a border fence with Romania to prevent wild boar, the Bulgarian authorities announced that they had detected the first case of the plague from this country on 31 August 2018, on a farm near the border with Romania. More recently, the swine fever virus was identified on 13 September 2018 in the wild boar in Belgium, about ten kilometers from the border with France, and the French authorities were alerted. In the past, this disease was recorded in Western Europe (France, Spain, etc.), where it was eradicated.[13]

„Legal basis:

- Article 45 of Council Regulation (EC) No 882/2004 of the European Parliament and of the Council on official controls according to the law.
- Article 20 of Council Directive 2002/60 / EC laying down specific provisions for the control of African swine fever and amending Directive 92/119 / EEC as regards Teschen disease and African swine fever.
- Article 37 of Regulation (EU) No 652/2014 of the European Parliament and of the Council and reproductive material modifying Council Directives 98/56/ EC, 2000/29/EC”[6].

## RESULTS AND DISCUSSIONS

In the (member or candidate) countries of the European Union, between 1 January 2018 and 25 September 2018, „1,214 outbreaks of African swine plague were confirmed in domestic swine”, Table 1 [5].

Table 1. Situation of the outbreaks of African swine plague in domestic pigs in Europe

Country	Focus number
Bulgaria	1
Italy	10
Latvia	10
Lithuania	49
Poland	109
Romania	1,062
Ukraine	85

Source: SVFSA.

At the same time, 4,113 outbreaks of African swine plague from wild boar were confirmed, Table 2.

Table 2. Situation of the outbreak of African swine plague in boars in Europe

Country	Focus number
Belgium	5
Czech Republic	28
Estonia	198
Hungary	34
Italy	40
Latvia	549
Lithuania	1,233
Poland	1,941
Romania	142
Ukraine	36

Source: SVFSA.

According to data provided by SVFSA, on 01.11.2018 in Romania, African swine fever evolved in 17 counties (Sălaj, Bihor, Satu-Mare, Calarasi, Braila, Constanta, Ialomita, Galati, Ilfov, Tulcea, Buzau, Giurgiu, Dambovita, Teleorman, Maramures, Vrancea, Dolj) in 276 localities, with 1,062 outbreaks (of which 15 in commercial holdings). Also, 142 cases were recorded in wild boar. In total, 356,144 pigs affected by the disease were eliminated. First cases of African swine fever were confirmed in many countries, also in Romania at 31 July 2017 by „the Institute of

Diagnosis and Animal Health in a household from Satu-Mare”[8]. From January 1 to August 10 - 2018 - 645 cases of African swine fever in domestic swine and 30 cases of wild boar were confirmed in Romania; between 10 June and 10 July 2018, 300 outbreaks of swine plague were identified in which 268 pigs were found and 2080 pigs were sacrificed. The first cases of this severe fever in the Republic of Moldova were confirmed in September 2016 in Donduseni district (at Cernoleuca and Moșana), near the border with Ukraine; until 21.08.2018, were a total of 20 outbreaks of the disease (18 in domestic and 6 in wild pigs), of which 2 outbreaks in 2016, 10 outbreaks in 2017, 12 outbreaks in 2018. Evolution of this severe fever epidemic in pigs Domestic (red) and boar (violet) in Eastern Europe between 1 January and 23 August 2018 is shown in Fig.1.

The disease occurs in several clinical forms: overacute, acute, subacute, chronic, subclinical. Overactive form is rare and is manifested by hyperthermia ( $40.5-42.2^{\circ}\text{C}$ ) without other symptoms, the illness lasts for 1-2 days and the end is always deadly. Acute form is most common and is manifested by fever, anorexia, cutaneous and digestive haemorrhage, respiratory distress; pig death occurs in almost all cases after a week of illness [9]. A characteristic sign of African swine fever is skin cyanosis at the extremities (ears, tail, limbs) and on the abdomen. In the more moderate, subacute form, the disease lasts for 5-30 days, death occurs at 15-45 days in 30-70% of cases.

Chronic form occurs in countries where disease has evolved for a long time; pigs may have hyperthermal pockets at irregular intervals, slimming to cachexia, arthritis, tendinitis, chestiness, cutaneous necrosis, especially in the head and neck region, the disease lasts for several weeks, even on months, most animals die eventually by exhaustion, following pulmonary and digestive lesions [1]. Subclinical forms are recorded in countries where disease has been developed; pigs, although they contain the virus in the body, show no clinical sign, behaving like perfectly healthy animals, but they are carrier and excretory virus, playing a

key role in maintaining and spreading the virus.

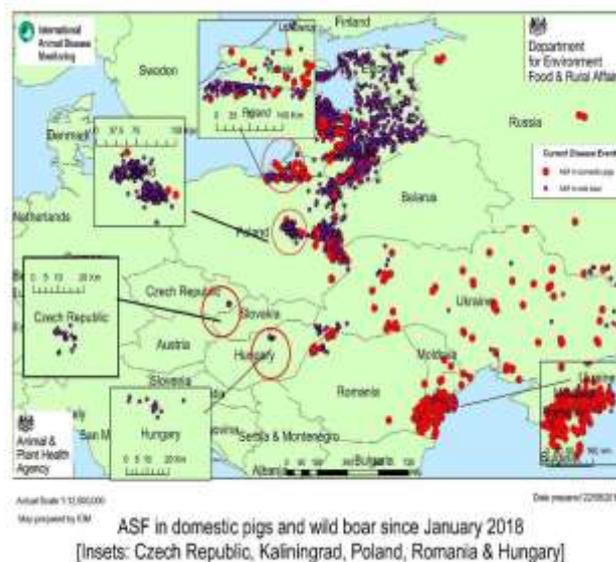


Fig.1. African Swine Fever in domestic pigs and wild boar since January 2018 (Czech Rep., Kaliningrad, Poland, Romania and Hungary).

Source: African Swine fever in Eastern Europe, Ref: VITT/1200 ASF in Eastern Europe 23 Aug. 2018, [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/735994/asf-eastern-europe-update16.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/735994/asf-eastern-europe-update16.pdf), Accessed on Jan.5, 2019.

Virus resists:

- 6-10 days in pork dejection;
- 10 weeks in corpses;
- 3-6 months in salted and smoked meat;
- 6-12 months in ticks of the *Ornithodoros* genus;
- 18 months in the blood at  $4^{\circ}\text{C}$ ;
- 6 years in frozen blood;
- Two years in frozen meat.

It doesn't exist a treatment or vaccine. „In the absence of an effective vaccine, the only way to stop the spread of the virus among pigs is to kill all the pigs from the infected areas and to establish quarantine”[11]. In order to obtain a limitation of the disease spread, it is prohibited to import pork and wild boar from infected countries.

Preventive measures:

- the holding to be fenced;
- visits to farms will be prohibited without proper disinfection;
- it is forbidden for the staff employed to hold pigs in their own household or to contact other pigs;

- to enter the holding to comply with the sanitary-veterinary rules;
- all means of transport must be rigorously disinfected;
- mandatory filtering of road filters and sanitary filters in the farm for staff;
- access to the farm is done only through filters; [7]

African swine fever does not affect people, and there is no lower risk of disease for humans, but it is a fearsome epidemic of pigs that cause significant economic losses and has a huge social and media impact. EUVET does not recommend reducing the wildlife population, as there is no evidence that wild boar is an amplifier of the current situation of African swine fever epidemic in individual households in Romania.

African swine plague should not be confused with classical swine plague (pig's cholera) caused by a pestivirus (Flaviviridae family), the symptoms of which are very similar[6].

Until January 18<sup>th</sup> – 2019 – 8,535 owners were compensated, the total payment being 251,120,910 Lei (52,922,153.38 Euro).

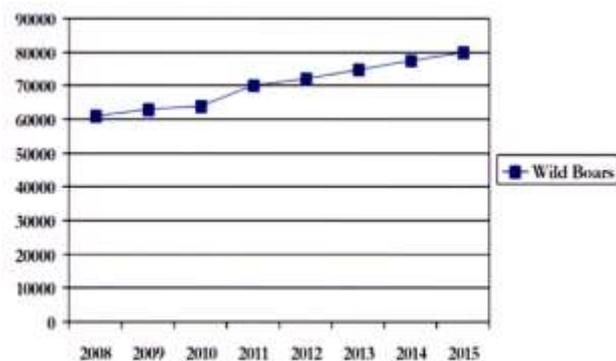


Fig.2. The evolution of the wild boar population 2008-2015,

Source MADR, 2016.

The evolution of this serious disease is constantly monitored by „specialised clinics and laboratories, and the up to date situation is analyzed daily, measures are applied and actions are taken according to circumstances” [10].

Table 3. Situation of compensation payments

Nr. Crt.	County	Number of compensated holdings	Number of affected holdings	Payments performed (LEI)
1	SATU MARE	20	20	63,260
2	BIHOR	230	230	1,077,040
3	TULCEA	1,162	1,174	46,564,960
4	BRĂILA	3,208	3,217	171,990,200
5	CONSTANTA	849	849	3,951,600
6	IALOMIȚA	2,389	2,500	6,531,000
7	GALAȚI	83	83	248,000
8	ILFOV	7	7	71,640
9	CĂLĂRAȘI	314	314	19,020,820
10	TELEORMAN	10	10	47,570
11	VRANCEA	1	1	7,000
12	GIURGIU	116	116	1,105,850
13	DOLJ	20	20	74,000
14	BUZĂU	2	2	3,300
15	ARGEȘ	1	1	2,000
16	OLT	123	125	362,670

Source: MADR, 2019.

SVFSA calls for support and understanding of citizens to comply with these measures, given the severity of the disease and the vulnerability of economic consequences generated by its occurrence. „The actions of the authorities are conjugated and undertaken to effectively manage outbreaks of disease, to stop and prevent the spread of the disease”[12].

## CONCLUSIONS

According to the SVFSA, no less than 361,132 animals have already died of the plague or preventively killed in an attempt to stop the spread of the virus in Romania. SVFSA has announced that the evolution of „this serious disease is constantly monitored by specialised clinics and laboratories, and the current situation is analyzed daily, measures are applied and actions are taken according to circumstances”[13]. Disease progression is „permanently monitored through clinical and laboratory exams, and the current Any suspicious of sick animals should be announced immediately to the veterinarian or county DSVSA in order to take measures if will be needed”[7]. In order to prevent the risks, all suspicious animals must be sacrificed and neutralized, and the owners will be compensated by the state under the

conditions laid down by law. The over 7,000 owners who were left without animals because of the plague - be they big farmers or simple households - already received damages amounting to 205,580,960 lei, or over 44 million euros. In the first stage, much of this amount was paid from the state budget, the authorities trying to recover the money from the EC. It remains to be seen whether they will succeed or not, given that more European officials have said that compensation will be paid only if authorities show that they have fulfilled their obligations according to this disease. The reports from past years of the European institutions showed the fact that the authorities did not apply all the measures in order to prevent the spread of the plague.

[12]SVFSA, 2018, Updating the situation on African Pigs' evolution. 01/11/2018  
[13]World Organization for Animal Health (OIE). African swine plague, Romania. 31/07/2017.

## REFERENCES

- [1]African Swine Fever in Romania (until 10.07.2018). National Sanitary Veterinary and Food Safety Authority of Romania. July 2018.
- [2]Beltrán-Alcrudo, D., Arias, M., Gallardo, C., Kramer, S., Penrith, M.L., 2017, African swine plague: detection and diagnosis - A manual for veterinarians. FAO Animal Production and Health Manual No. 19 Rome. Food and Agriculture Organization of the United Nations (FAO).
- [3]Daneş, D., 2012, African Pig Pest. Veterinaria, No. 7, July - September 2012.
- [4]Do it, 2011, Préparation des plan d'intervention de la peste africaine porcine. Eddité par ML Penrith, V. Guberti, K. Depner et J. Lubroth. Manuel FAO Production et santé animales No. 8. Rome.
- [5]European Commission, 2018, Animal Health and Welfare. Mission of the EU Veterinary Emergency Team (EUVET) to Romania (2-4 July 2018).
- [6]European Commission, 2018, Animal Disease Notification System: Outbreaks per Disease from 01/01/2018
- [7]European Commission. Animal Disease Notification System (ADNS)
- [8]Moga Veal, R., 2017, African swine plague. Some considerations on the history, importance, etiology, epidemiological characteristics, diagnosis, prophylaxis and control. Veterinaria, No. 27, July - September 2017.
- [9]Moga Veal, R., 2005, Viral and prion diseases of animals. Brumar Publishing House, Timișoara.
- [10]Sante/7113/2015 - Rev. 4 APPA strategy for the EU Eastern part.
- [11]Štukelj, M., Plut, J., 2018, A Review of African Swine Plague - A Disease That's Now a Big Concern in Europe. Contemporary Agriculture, Vol. 67(2):110-118.



## THE EFFECT OF SPECIAL FOLIAR FERTILISATION APPLIED ON INBRED SUNFLOWER LINES IN HYBRID SUNFLOWER SEED PRODUCTION

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### Abstract

*The paper presents some aspects concerning the influence of special foliar fertilisation on yield and concentration of nutrients in hybrid sunflower seed. This way is useful in seed production, in order to obtain seeds enriched in nutrients, especially in Mo, which caused nutritional disorders in commercial lands. According to the results, the special foliar fertilisers have significantly increased the yields and the Mo concentration in hybrid sunflower seed and have generally positive effect on N, P, K, Zn and Cu concentrations. At the same time, the use of these fertilizers has contributed to Romania's leading position in the production of sunflower seeds, as evidenced by the materials processed on the Eurostat, MADR and NIS websites.*

**Key words:** concentration of nutrients, foliar fertilisation, hybrid sunflower seed

### INTRODUCTION

Cultivated for its non saturated fatty acids, sunflower is one of the most important oilseeds crops used in human and animal feed [5]. In 2016, 68.96% of the sunflower worldwide surface was cultivated in Europe, while Romania ranked 5th among the world's top sunflower seeds producers, with 2,032,340 tonnes [6]. According to data from Eurostat, Romania is the largest cultivator and producer in the European Union, reaching in 2018 - 1,139.75 thousand ha of sunflower [7]. Developed first from the need to control the nutritional deficiencies of Mo and B in sunflower, the special foliar fertilisation method has also become a means of increasing the production of hybrid seed.

The possibility of intervention with such means is based both on international [3], [4] and national research [2], which show that besides soil conditions, climate, technology, hybrid genetic features, an important role in

the control of nutritional disorders they also have the nutrient content of the seed.

### MATERIALS AND METHODS

For the realization of the following paper, field experiments were carried out, documentary materials were studied and statistical data was used on the following sites: Eurostat, NIS and MADR. The production of sunflower seeds in Romania during the period 1970-2017 was analyzed and also, the total and average production of sunflower seeds by Macroregions and development regions in 2017, area cultivated with sunflower in Romania 2007-2017.

The field experiments were carried out in the pedo-climatic conditions at Iasi (SC Moldova-Tiganasi SA, SCDA Podul Iloaiei) and the plant test used were inbred sunflower lines in hybrid sunflower seed production (HS Rapid, HS PR 475). The treatments used were: CFF 624, CFF 624a and Folplant 231 and all the

treatments were applied three times at 1% concentrations.

The special foliar fertilisers consisting in complex compositions of mineral nutrients (N, P, K, Zn, Mo, Cu, B) and of organic substances (PAH-protein acid hydrolysate) and aimed at optimizing the mineral composition of hybrid sunflower seed in the micronutrient Mo (Table 1).

Table 1. The chemical composition of special foliar fertilisers

Specification g elements or substances/ kg of fertiliser	CFF 624	CFF 624a
N	183	217
P	62	73
K	114	96
S	21	21
Fe	0.4	0.4
Mn	0.5	0.5
Zn	0.35	0.35
Cu	0.25	0.25
Co	0.01	-
B	0.80	1.50
Mo	0.15	0.66
PAH (cm <sup>3</sup> )	88.0	102.0
pH of solution (1% concentration)	7.15	7.20
PAH-protein acid hydrolysate made from bone glue and H <sub>2</sub> SO <sub>4</sub> 4.5 n		

Source: [1]

## RESULTS AND DISCUSSIONS

Romania is the top producer and exporter of sunflower seeds in the E.U., and the demand from the European countries is rising. The production of sunflower seeds in Romania is expected to grow at the rate of 5% for the next three years.

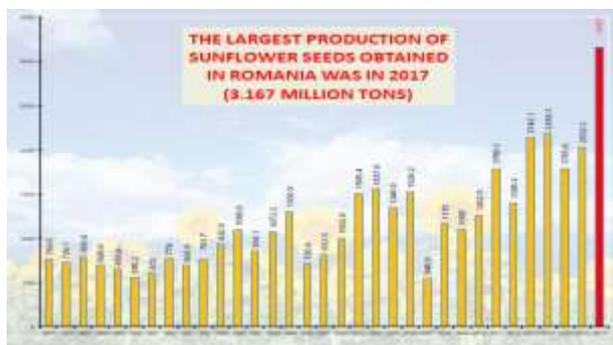


Fig. 1. Evolution of sunflower seeds production in Romania (1970-2017)

Source: MADR [8]

As shown in Fig. 1 the production of sunflower seeds has grown exponentially from 1970 when the sunflower seeds production was 769.6 thousand tons to 3,167 million tons in 2017, the growth was 415%, compared with the previous year 2016 the growth was by 55 percents. The growth of this sector was determined by the demand expressed by the industrial sector especially by the beauty and healthcare sector.

Also the production per Macroregions and Development Regions is shown in the table below.

Table 2. Production of sunflower seeds per Macroregions and Development Regions in 2017

Macroregions/ Development Regions	Production		Differences (±) year 2017, compared to 2016	
	Total - tons -	Average - kg/ha -	Total production - tons -	Average production - kg/ha -
TOTAL	3,167,743	2,917	+880,403	+962
MACROREGION ONE	169,557	2,890	+37,526	+818
NORTHWEST	138,582	2,929	+26,218	+886
CENTRE	30,975	2,725	+11,308	+465
MACROREGION TWO	1,336,609	2,987	+492,548	+1,201
NORTHEAST	385,177	2,956	+189,821	+1,482
SOUTHEAST	951,432	2,999	+302,727	+1,091
MACROREGION THREE	649,091	2,887	+172,478	+720
BUCHAREST-ILFOV	28,596	2,482	+6,816	+563
SOUTH-MUNTENIA	620,495	2,909	+165,662	+728
MACROREGION FOUR	757,486	2,833	+177,851	+790
SOUTHWEST-OLTENIA	466,272	3,155	+165,700	+1,538
WEST	291,214	2,436	+12,151	-416

Source: NIS [9]

The highest amount of sunflower seeds is produced in Macroregion two respectively in the Southeast Development Region where the quantity almost reached one million tons, followed by South-Muntenia Development Region with 620 thousand tons.

In 2017 Romanian farmers cultivated 1,030 thousand hectares with sunflower (Table 1).

Table 3. Evolution of the area cultivated with sunflower in Romania 2007-2017

Specification	UM	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Area	1,000 ha	835.9	813.9	766.1	790.8	995	1,067	1,074.6	1,001	1,000	1,016	1,030

Source: MADR [8]

The area cultivated with sunflower as shown in table 3 has seen an increase since 2007 when in Romania was cultivated 835.9 thousand ha to 1,030 thousand hectares in 2017, the increase was by 23.22 percents.

On the field, the following experiments were carried out:

- *Soil agrochemical characterisation*

The soil from experimental fields was cambic chernozem soil. Table 4 shows the main agrochemical properties of soil. From this it may be observed a high fertility level of this soil, except the IMo index which prognoses the appearance of Mo deficiency.

Table 4. Main agrochemical properties of soil, from SC Moldova-Tiganasi SA and SCDA Podul Iloaiei experimental fields

Agrochemical property	SC Moldova Tiganasi SA	SCDA Podul Iloaiei
pH	6.60	6.97
Humus,%	3.61	3.36
P <sub>AL</sub> , ppm	47.85	151
K <sub>AL</sub> , ppm	239.4	257.5
Zn, ppm	1.08	1.79
Fe, ppm	16.83	17.48
Cu, ppm	1.20	1.08
Mn, ppm	78.80	70.30
Mo, ppm	0.15	0.18
IMo	0.99	1.25

Source: [1]

- *The effect of special foliar fertilisation on yield in hybrid sunflower seed*

The experimental data concerning the effect of special foliar fertilisation on yield increases are presented in Table 5, 6 and 7.

Table 5. The agronomical effect of special foliar fertilisation on inbred sunflower lines in hybrid sunflower seed production for HS Rapid at SC Moldova-Tiganasi SA experimental field

Treatments	Yield increases		
	kg/ha	%	kg/ kg of fertiliser
Check	-	-	-
Folplant 231	339	27	22.6
CFF 624	612	48	40.8
CFF 624a	765	60	51.0
DL 5%	431		
DL 1 %	754		

Source: [1]

Thus, for HS Rapid sunflower hybrid variety the yield increases were between 10-765 kg seed/ha (2-60%) and for HS PR 475 sunflower hybrid variety the yield increases were between 246-410 kg seed/ha (21-35%). The best special foliar fertiliser was CFF 624a, which assured the yield increases for all the experimental fields (average data during three years). The obtained yield increases

were generally significantly in comparison with the check sprayed with water.

Table 6. The agronomical effect of special foliar fertilisation on inbred sunflower lines in hybrid sunflower seed production for HS Rapid at SCDA Podul Iloaiei experimental field

Treatments	Yield increases		
	kg/ha	%	kg/ kg of fertiliser
Check	-	-	-
Folplant 231	10	2	1.0
CFF 624	16	3	1.6
CFF 624a	25	4	2.5
DL 5%	41		
DL 1 %	59		

Source: [1]

Table 7. The effect of special foliar fertilisation on yield increases in hybrid sunflower seed for HS PR 475 at SC Moldova-Tiganasi SA experimental field

Treatments	Yield increases		
	kg/ha	%	kg/ kg of fertiliser
Check	-	-	-
Folplant 231	246	21	16.4
CFF 624	367	31	24.4
CFF 624a	410	35	27.3
DL 5%	84		
DL 1 %	128		

Source: [1]

- *The effect of special foliar fertilisation on mineral composition in hybrid sunflower seed*

Table 8 and 9 presents the mineral composition of seed for HS Rapid sunflower hybrid variety.

Table 8. The effect of special foliar fertilisation on the content of macronutrients in hybrid sunflower seed, HS Rapid, SCDA Podul Iloaiei

Treatments	The content of macronutrients		
	N, %	P, %	K, %
Check	2.44	0.72	0.98
Folplant 231	2.48	0.82	0.93
CFF 624	2.80	0.85	0.98
CFF 624a	2.74	0.88	1.02

Source: [1]

Table 9. The effect of special foliar fertilisation on the content of micronutrients in hybrid sunflower seed, HS Rapid, SCDA Podul Iloaiei

Treatments	The content of micronutrients		
	Zn, ppm	Mo, ppm	B, ppm
Check	60.50	0.11	13.5
Folplant 231	78.80	0.22	17.5
CFF 624	79.30	0.16	12.5
CFF 624a	72.50	0.22	14.3

Source: [1]

The results showing positive increases for macronutrients (N, P and K) and for micronutrients (Zn, Mo and B) concentrations in seeds under the influence of special foliar fertilisation.

In Table 10 and 11 are presented the mineral composition of seed for HS PR 475 sunflower hybrid variety (average data during three years). The data emphasized that the special foliar fertilisation (CFF 624 and CFF 624a) assured in comparison with the check high increases of macronutrients (N, P and K) and of micronutrients (Zn, Mo and Cu) contents in seed. The CFF 624a treatment has assured a significantly increases of Zn, Mo and Cu concentrations in seed.

Table 10. The effect of special foliar fertilisation on the content of macronutrients in hybrid sunflower seed, HS PR 475, SC Moldova-Tiganasi SA

Treatments	The content of macronutrients		
	N, %	P, %	K, %
Check	2.37	0.54	1.00
Folplant 231	2.62	0.57	1.09
CFF 624	2.57	0.58	1.05
CFF 624a	2.60	0.56	1.04

Source: [1]

The mineral compositions of hybrid sunflower seed from experimental fields have been influenced by the specific climate conditions from Iasi (high temperature and low rainfall in summer), by the genetic potential of sunflower hybrids and by the applied foliar treatments.

Table 11. The effect of special foliar fertilisation on the content of micronutrients in hybrid sunflower seed, HS PR 475, SC Moldova-Tiganasi SA

Treatments	The content of micronutrients		
	Zn, ppm	Mo, ppm	Cu, ppm
Check	35.93 c	0.15 c	16.08 b
Folplant 231	40.37 bc	0.21 c	16.70 ab
CFF 624	43.67 ab	0.29 b	16.62 ab
CFF 624a	48.31 a	0.37 a	17.41 a

Source: [1]

## CONCLUSIONS

Romania ranked 5th among the world's top sunflower seeds producers, in 2016. The highest amount of sunflower seeds is produced in the Southeast, followed by South-Muntenia Development Region.

The field experiments carried out under

pedoclimatic conditions in Iasi, have revealed:  
 - The special foliar fertilization method have been achieved significantly yield increases for HS Rapid and for HS PR 475 sunflower hybrids.

- This method can be recommended for soils with micronutrients deficiencies, especially with Mo, B and Cu.

## ACKNOWLEDGEMENTS

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## REFERENCES

- [1] Dana, D., Stefanescu, D., Dorneanu, A., Soare, M., Anton, I., Sarbu, C., Cotet, V., Bireescu, L., Istrati, E., 2006, Studies concerning on special foliar fertilisation on yield and concentration of nutrients in hybrid seed, XVIII-National Conference of Soil Science, Cluj-Napoca, 55-65.
- [2] Moraghan, T. J., Graffon, K., 1999, Seed-Zinc and the Zn-Efficiency Trait in Navy Bean, Soil Science Society of America, 63 (4), 918-922.
- [3] Peaslle, D. E., Leggett, J., 1980, Utilisation of seed zinc by Zea Mays seedling. *Comun Soil Science Plant Anal* 11 (3), 223-229.
- [4] Popescu, A., 2018, Romania's sunflower seeds production, export and import analysis of the 2007-2017 period and forecast for 2018-2022 Horizon. *Scientific Papers Series "Management, Economic Engineering in Agriculture and rural development"*, Vol. 18(4):261-270.
- [5] Soare, E., Chiurciu, I.A., 2018, Considerations concerning worldwide production and marketing of sunflower seeds. *Scientific Papers. Series "Management, Economic Engineering in Agriculture and rural development"*, Vol. 18(3): 421-428.
- [6] Eurostat Data explorer, <http://ec.europa.eu/eurostat/data/database>, Accessed on 16.01.2019
- [7] MADR, <http://www.madr.ro/culturi-de-camp/plante-tehnice/floarea-soarelui.html>, Accessed on 18.01.2019.
- [8] National Institute of Statistics (INS), Newsletter released by the NIS regarding agriculture on 11.10.2018, [www.insse.ro](http://www.insse.ro), Accessed on 18.01.2019.

## SUSTAINABLE AGRICULTURE SYSTEMS TO MITIGATE CLIMATE CHANGE EFFECTS: A BRIEF OVERVIEW

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### Abstract

*Food security, poverty and the overall sustainability of food and agricultural systems are influenced by a series of global trends. Nowadays, economic growth, population dynamics, and climate change disproportionately affect different regions. Conventional agriculture also contributes to accentuating these changes. As a result, we are faced with several challenges in the fields of food and agriculture. So, innovative systems are needed to protect and enhance the natural resource base as productivity increases. Consequently, today, but also in the future, the farming systems that counteract the negative impact of climate change must be in the attention of practitioners. Moreover, regulations in the field are necessary, and the implementation of such systems must be carried out in relation to the specificity of the geographical area. In view of the above, in the present paper, a brief overview was made on some agricultural systems aimed at counteracting the negative effects of global climate change.*

**Key words:** climate change, agroecology, agroforestry, climate-smart agriculture, conservation agriculture

### INTRODUCTION

The demand for energy and food will overtake the supply, and in the future, it is necessary to produce more food and to use more sustainable forms of energy. Emission of large amounts of carbon dioxide from the combustion of fossil fuels is one of the most important sources of greenhouse gas emissions, which results in global warming, and implicitly climate change, a global phenomenon whose impact on agricultural activities in developed countries has increased dramatically [33], [14]. Negative effects are felt on biodiversity, agriculture and, of course, on food supply [20] and besides these, there may be problems of national and international security [26]. Although climate change is a complex issue and there are many factors involved in this context, [36] highlighted that education is the key to sustainable environmental development.

Agriculture is also a determinant of global climate changes [5] and from this point of view, conventional agriculture is the one that makes a major contribution to climate change [42]. Besides this, climate change is truly one of the major challenges in terms of sustainable

resource management in agriculture [41], [46].

Food security, poverty and the overall sustainability of food and agricultural systems are influenced by a series of global trends. Economic growth, population dynamics, and climate change disproportionately affect different regions. As a result, we are faced with several challenges in the fields of food and agriculture.

Innovative systems are needed to protect and enhance the natural resource base as productivity increases. There is a need for a process of transformation geared towards "holistic" approaches such as agroecology, agroforestry, climate smart agriculture (CSA) and conservation agriculture (CA), based on both new and traditional knowledge [17].

In view of the above, a brief overview is made on some agricultural systems aimed at counteracting the negative effects of global climate change.

### MATERIALS AND METHODS

This work represents a brief original synthesis, with a general character, based on the recent publications, representative in the

field concerned, with a goal to critically analyze the existing relevant data and to identify future issues that need to be supposed to attention.

## RESULTS AND DISCUSSIONS

According to recently published results, in the middle of 2017, the world population was about 7.6 billion, and the tendency is one of continuous growth (Table 1).

Table 1. Population of the world and regions, according to the medium variant projections [45]

Region	Population (millions)			
	2017	2030	2050	2100
World	7,550	8,551	9,772	11,184
Africa	1,256	1,704	2,528	4,468
Asia	4,504	4,947	5,257	4,780
Europe	742	739	716	653
Latin America and the Caribbean	646	718	780	712
Northern America	361	395	435	499

Source: United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision. New York: United Nations.

Agriculture and applied agricultural systems are the main means of helping to successfully solve the requirements of the situation and to overcome the disturbances caused by the various foreseeable and unpredictable factors to which we are witnesses today and to which we will be exposed in the future.

### Agroecology

According to [22], agroecology consists in applying environmental concepts and principles with a view to the design and management of sustainable agroecosystems. It involves mobilizing practitioners and academics to find innovative ways to increase productivity and sustainability in agriculture, while maintaining an environment that ensures quality of life [18], [37]. Agroecology is also a part of a social movement, that is at the forefront of transforming food systems into sustainability [23]. From a social, political point of view, but also as an agricultural practice, it brings together, synthesizes and applies the knowledge of agronomy, ecology, sociology, ethno-botany

and other related sciences, with a holistic, systemic and strong ethical component, capable of generating knowledge, validate and apply appropriate strategies for the design, management and evaluation of sustainable agroecosystems [12]. Agroecology is currently focusing on food production and food systems, a vital engine for conceptualizing and implementing responsible agricultural change [19]. Agroecology should address all actors in food systems, as well as the total flow of energy and materials from their sources to production and other stages to the consumer, including the potential for return of nutrients in the field [18].

[24] announced the publication of two transformative reports prepared by the International Panel of Experts on Sustainable Food Systems (IPES-Food), called "Unravelling the Food-Health Nexus: Addressing Practices, Political Economy, and Power Relations to Build Healthier Food Systems and "Too Big to Feed: Exploring the Impacts of Mega-Fusion, Consolidation, and Concentration of Power in the Agri-Food Sector." Given that agroecology is the ecology of the entire food system, the two reports continue the activity of "IPES-Food", as a leader in the global change for the food system.

As [9], quoted by [6] mentioned, that agricultural policies on adaptation to climate change should be effective, should integrate at the same time: (i) equitable access to means of production; (ii) dissemination of technical levers to increase yields per hectare, for as many users as possible; (iii) sufficiently stable agricultural prices; (iv) an endogenous growth strategy, with the initial fostering of food sovereignty, driven by family farming.

[6] proposed an adaptable model in different agrarian contexts, based on micro agriculture and macro agriculture, two paradigms in a close interrelation. As can be seen in Figure 1, it is worth noting the connection between the two types of agriculture, with the possibility of achieving a centripetal, transparent and holistic flow of knowledge between the two food production models. Basically, based on agroecology, one can speak of a unified paradigm of sustainable food production.

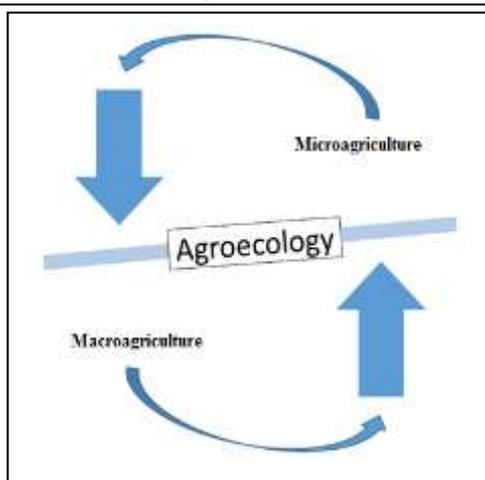


Fig.1. Interconnection between large-scale and small-scale agriculture [6].

## Agroforestry

Agroforestry deals with environmentally-friendly and economically attractive strategies for adapting and mitigating climate change, being an intensive, integrated, targeted and interactive activity, that creates favorable conditions for changing microclimate, preserving biodiversity, improving soil health and so on. As [39] emphasized, agroforestry may represent a viable trade-off between economic and environmental aspects. Most of these benefits have direct advantages, such as the dynamic agricultural adaptation option to a changing local climate [3], while contributing to global efforts to control atmospheric greenhouse gas concentrations [7], [40], [8].

Integrated land use management through agroforestry has proven to be one of the most successful ways to mitigate and adapt to climate change [32], [48]. An integrated response strategy to climate change has been implemented in North America, based on six categories of agroforestry technologies tailored to rural / urban landscape needs such as stormwater treatment and bio feed stock production (Fig. 2) [40]. The authors highlighted the potential of agroforestry to contribute to counteracting the effects of climate change, as well as adapting plants to such conditions, thanks to proper sequestration of carbon, reducing greenhouse gas emissions, increasing resistance and lowering threats, with ease of migration to more favorable conditions in highly fragmented agricultural landscapes.

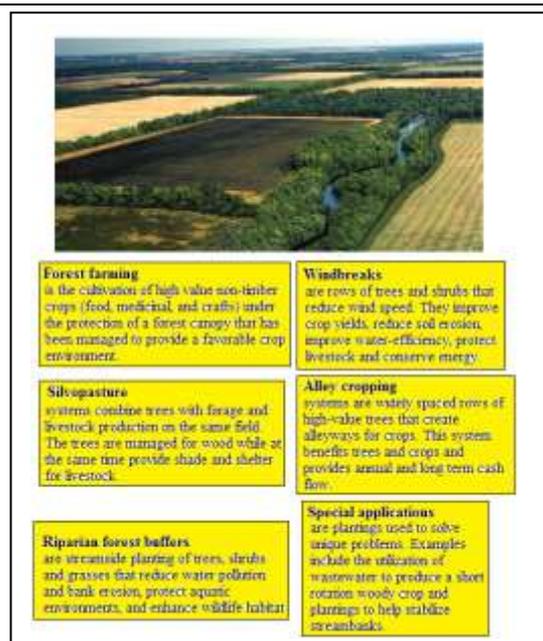


Fig.2. Six advantageous agroforestry practices in North America due to the interactive benefits from combining trees and shrubs with crops and/or livestock, to create integrated and sustainable land use systems [40].

[35] noted that agroforestry was a global solution for increasing land use efficiency, while simultaneously reducing environmental impact and economic hardship for farmers.

A recent study shows that agroforestry can be an economically efficient diversification strategy, allows for beneficial interactions between trees and crops, and a higher income diversification compared to a farm mosaic system. Moreover, as [44] mentioned, within the European Union (EU), residues from agroforestry can be a resource for the chemical industry based on bio-resources.

Agroforest systems are more beneficial alternatives to oceanic and other land-based options to mitigate climate change, due to the benefits of secondary environments, such as: helping to make food and land safe in developing countries, increasing farm incomes, restoring and maintaining biodiversity at the ground and above ground levels of corridors between protected forests such as CH<sub>4</sub> users, soil conservation and river basin retention [47].

If we are talking about the European Union, the studies conducted by Den Herder et al. [11] led to the obtaining of important data on the quantitative existence and distribution of agroforestry in the European Union, and at the

same time useful for the development of the support policies. According to the estimates using LUCAS (Land Use and Land Cover Data) [13], the total area under agroforestry in the EU 27 is about 15.4 million ha, equivalent to about 3.6% of the area and 8.8% of the utilized agricultural area.

### **„Climate-smart agriculture” (CSA)**

The CSA concept was launched by FAO [15] to draw attention to the links between food security and climate change, through the development of agriculture and the opportunities for expanding synergies in this regard. The CSA approach involves integrating the need for adaptation and mitigation potential into the planning and implementation of agricultural policies, planning and investment [29], [30].

At the same time, [21] pointed out the necessity of promoting CSA.

The Food and Climate Change Conference - held in The Hague in 2010, supported by Food and Agriculture Organizations (FAO), explained the participation of the CSA in achieving sustainable progress by combining three ways of sustainable (based on community and ecology) and the mutual approach to food safety and climate issues. The major directions were: (1) sustainable growth of agricultural productivity and a income; (2) adapting and building resistance to climate change; (3) reducing and / or eliminating greenhouse gas emissions, wherever possible.

CSA looks for potential collateral benefits, too. CSA also connects other innovations such as conservation agriculture, agroecology, agroforestry and the development of plant varieties, that are more tolerant to pests, diseases, drought, floods and salinity [16].

In the recently published book, [30] extended and formalized the concepts of CSA and presented a set of case studies that highlight the CSA's economic base for reducing vulnerability, increasing adaptability and risk management capacity.

Currently, a transition to the CSA is a mandatory task to ensure food supply for nine billion people anticipated to be by 2050. By

highlighting four strong tensions in the CSA, [43] supports the need to considerably broaden the scope of the CSA debate. To this end, an alternative "climate-wise" framework is proposed to highlight the inherent political dimensions of food and agriculture, in a time of climate change. Strategies of interest regarding the application of the CSA concept were explicitly reproduced in the synthesis paper by [2] (Table 2).

### **„Conservation agriculture” (CA)**

Conservation agriculture (CA), in line with FAO requirements, aims to conserve, improve and better utilize natural resources, through integrated management of available soil, water and biological resources, combined with external inputs. Based on the three principles: direct seeding or planting, permanent soil cover, crop rotation/diversity [31], conservation agriculture contributes to the preservation of the environment, as well as to obtain improved and sustainable agricultural production [38].

At the same time, due to the change in soil properties and processes at this level, as against to conventional agriculture, CA can affect the delivery of ecosystem services and finally, biodiversity is affected, which in turn supports many ecosystem services [34].

In Europe, in 1999, the European Conservation Agriculture Federation (ECAAF) was founded, with the aim of adopting CA in the Member States, but, given the specificity of the area, this system is not equally suitable for all European agroecosystems [28].

In synthesis prepared by [4] it is mentioned that, in the Treaty of Amsterdam in 1999, sustainable agriculture was proclaimed as an objective of the EU, even though the Conservation Agriculture has not been given special attention. However, through the Common Agricultural Policies (CAP), the EU is mindful of the principles of agriculture and rural development, according to Communication (COM-2010- 672 final) named “The CAP towards 2020. Meeting the food, natural resources and territorial challenges of the future”.

Table 2. Strategies for „Climate-smart agriculture”

1.	<b>Efficient resource management</b> across the food chain (from agriculture, transport, conservation, processing, cooking and consumption) is a means to make efficient use of energy.
2.	<b>Integrated renewable energy technologies for agricultural systems</b> From energetic point of view, for smart food systems these can be very important for several new technologies (Figure 2).
3.	<b>Availability of farmers' technical knowledge</b> Improving people's conventional environmental knowledge and their development over time could lead to different ideas and feasible options for adaptation procedures.
4.	<b>The role of institutions to improve CSA</b> , by ensuring the transfer of useful information to people and their guidance for the understanding and application of new technologies.
5.	<b>Resource conserving technologies</b> , through techniques that increase efficiency in resource management or application of inputs and consequently lead to improved yields.
6.	<b>The cultivation of genetically modified plants</b> , that are tolerant to high temperatures, drought and salinity, which reduces the risk of climate conditions.
7.	<b>Land- use management</b> , by adjusting the crop sequence in relation to sowing time, harvesting, to benefit from changing the growth period and changing the temperature and humidity levels.
8.	<b>Changing crop systems</b> , as mitigation strategies to reduce the negative effects of marked climate variations.
9.	<b>The relocation of crops</b> in different regions, given their predisposition and / or variability in relation to climate change.
10.	<b>Effective pest management, by:</b> Developing varieties resistant to diseases and pests; Integrated Pest Management (IPM), with emphasis on biological control and change of cultural practices; Adoption of alternative plant production and techniques, as well as locations that provide better resistance to pests and other stressors.
11.	<b>Efficient forecasting</b> through successful use of Information and Communication Technology (ICT).
12.	<b>Crops modeling</b> (based on simulation models), as a tool for managing risks in agriculture.
13.	<b>Integration of modeling and forecasting.</b> CERES (Crop Environment Resource Synthesis) -Wheat is often mentioned in literature and has been successfully tested in some studies.
14.	<b>GIS (Geographic Information System)</b> is used in analysis and mapping, so, it can be realized the estimation and computation of the storm course and flooding associated with hot cyclones.

Source: Adapted after [2].

In this context, through the EU 2020 strategy, the commission wanted the CAP to contribute to the Smart Growth (by increasing resource efficiency and improving competitiveness); Sustainable Growth (by maintaining the food, feed and renewable production base) and to Inclusive Growth (by unlocking economic potential in rural areas).

As can be seen in Figure 3, among the objectives proposed by the European Commission, the CAP 2020 also includes climate change, caused by the global warming and that are being witnessed across the globe. Effective control and stabilization of the effects of global warming and, implicitly, climate change require a concerted effort by global committees, good public leadership initiatives, and individual actions [1].

Therefore, conservative agriculture, through its three basic principles: a) minimal soil disturbance, b) permanent soil cover, and c) crop diversity in the form of well-balanced

and wide crop rotation, enables realization of agricultural sustainability and sustainable crop production intensification.

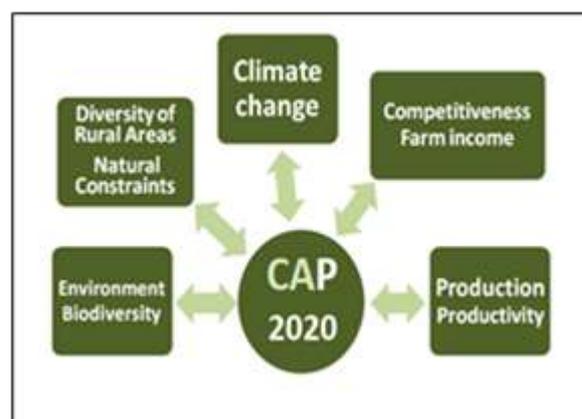


Fig.3. Main objectives to be met by the revision of the Common Agricultural Policy (CAP) [4].

Europe's lagging behind in adopting CA is caused by: 1) there is less need to consider the risks, because cost reduction is not as important as in other areas; 2) lack of

technologies for European conditions; 3) lack of adequate technology transfer; 4) lack of institutional support, conditions that have remained valid until the beginning of the 21st century [27].

As [25] noticed, a recent study carried out by European Conservation Agriculture Federation (ECAAF) shows that European farmers could remove nearly 200 million tons of CO<sub>2</sub> (the equivalent of closing 50 coal-fired power plants) from the atmosphere, by implementing conservation agriculture techniques.

## CONCLUSIONS

Considering estimates of population growth and consumption needs (agricultural output should increase by 60% by 2050), greater attention is needed to meet the food security and agricultural development objectives adapted to climate change, focusing on a change in land use, water, soil nutrients and genetic resources, possible management through intelligent farming systems to climate change [2]. Particular attention should be paid to biodiversity in agriculture, not only from the perspective of the classical paradigm, but also as an essential component of the improvement of agricultural systems [20].

Although climate change is a complex theme and there are many factors involved in this context, [36] highlight that education is the key to sustainable environmental development. Therefore, it was pointed out that for sustainability in a wider social context, the issue of education should be re-evaluated.

There is an urgent need for public funding of agroecology-based systems and research into sustainable agroecology, especially for advanced studies, in very promising areas, such as farm-based biological diversity and animal husbandry systems [10].

In the European Union, because of geographic, climatic, ecological, cultural, European traditions and policy pressures, as well as the EU programs, the future of conservation agriculture will be different, in different parts of Europe. Performance and stability performance, operating costs,

environmental policies, programs, and climate change will be the main driving forces that define the direction and expansion of the conservation agriculture in Europe [27].

We underline again that, nowadays, one of the challenges we must face is climate change, which adversely affects agricultural production, but conventional agriculture also contributes to accentuating these changes. Consequently, today, but also in the future, the agricultural systems that counteract the negative impact must be in the attention of practitioners. Moreover, regulations in the field are necessary, and the implementation of such systems must be carried out in relation to the specificity of the geographical area.

## REFERENCES

- [1]Aizebeokhai, A.P., 2009, Global warming and climate change: Realities, uncertainties and measures. *International Journal of Physical Sciences*, 4 (13): 868-879.
- [2]Amin, A., Mubeen, M., Hammad, H.M., Nasim, W., 2015, Climate Smart Agriculture: an approach for sustainable food security. *Agric. Res. Commun.*, 2(3): 13-21.
- [3]Apuri, I., Peprah, K., Thomas, G., Achana, W., 2018, Climate change adaptation through agroforestry: The case of Kassena Nankana West District, Ghana. *Environmental Development*, 28:32-41.
- [4]Basch, G., González-Sánchez, E.J., Gómez McPherson, H., Kassam, A., 2010, Opportunities for Conservation Agriculture in the EU Common Agricultural Policy 2014-2020.
- [5]Burzo, I., 2014, Modificările climatice și efectele asupra plantelor horticole. Ed. Sitech. Craiova.
- [6]Borsari, B., Espinosa, J., Hass, J., 2014, Agroecology and a vision for sustainable agriculture in spite of global climate change. *Invest. pens. crit.*, 2(5):63-79.
- [7]Calfapietra, C., Gielen, B., Karnosky, D., Ceulemans, R., Scarascia Mugnozza, G., 2018, Response and potential of agroforestry crops under global change. *Environmental Pollution*, 158:1095–1104.
- [8]Chavan, S., Newaj, R., Keerthika, A., Ram, A., Jha, A., Kumar, A., 2014, Agroforestry for Adaptation and Mitigation of Climate Change. *Popular Kheti.*, 2 (3) (July-September) 219.
- [9]Cochet, H., Ducourtieux, O., Garambois, N., 2017, Systèmes agraires et Changement climatique: Les chemins de l'adaptation; Working Paper; AgroParisTech: Paris.
- [10]DeLonge, M.S., Miles, A., Carlisle, L., 2016, Investing in the transition to sustainable agriculture. *Environmental Science and Policy*, 55:266-273.

- [11]Den Herder, M., Moreno, G., Mosquera-Losada, R.M., Palma, J.H.N., Sidiropoulou, A., Freijanes, J.J.S., Crous-Duran, J., Paulo, J.A., Tomé, M., Pantera, A., Papanastasis, V.P., Mantzanas, K., Pachana, P., Papadopoulos, A., Plieninger, T., Burgess, P.J., 2017, Current extent and stratification of agroforestry in the European Union. *Agriculture, Ecosystems & Environment*, 241:121-132.
- [12]Dussi, M.C., 2018, WORKSHOP: Agroecology and Education. Socio-ecological resilience to climate change.<http://www.ihc2018.org/en/WORKSHOPS.htm> 1.
- [13]EUROSTAT.2015. LUCAS micro data.
- [14]Fadina, A.M.R., Barjole, D., 2018, Farmers' Adaptation Strategies to Climate Change and Their Implications in the Zou Department of South Benin. *Environments*, 5 (1), 15.
- [15]FAO. 2009, Climate change and biodiversity for food and agriculture: taking systemic and second order effects into account, by M. Flitner and J. Herbeck. Commission on Genetic Resources for Food and Agriculture.
- [16]FAO, IFAD and WFP, 2013,The State of Food Insecurity in the World. The multiple dimensions of food security. Rome, FAO.
- [17]FAO. 2017. The future of food and agriculture – Trends and challenges. Rome.
- [18]Francis, C., Lieblein, G., Gliessman, S., Breland, T.A., Creamer, C., Harwood, R., Salomonsson, L., Helenius, J., Rickerl, D., Salvador, R., Wiedenhoef, M., Simmons, S., Allen, P., Altieri, M., Flora, C., Poincelot, R., 2003, Agroecology: The Ecology of Food Systems. *Journal of Sustainable Agriculture*, 22 (3): 99-118.
- [19]Francis, C.A., Wezel, A., 2015, Agroecology and Agricultural Change. *Encyclopedia. International Encyclopedia of the Social & Behavioral Sciences (Second Edition)*, 1: 484-487.
- [20]Frison, E.A., Cherfas, J., Hodgkin, T., 2011, Agricultural Biodiversity Is Essential for a Sustainable Improvement in Food and Nutrition Security. *Sustainability*, 3:238-253.
- [21]Gherghina, S., Chiru, M., 2014, Perspective românești asupra politicilor europene. Ed. Adenium.
- [22]Gliessman, S.R., Engles, E., Krieger, R., 1998, *Agroecology: Ecological Processes in Sustainable Agriculture*. CRC Press.
- [23] Gliessman, S.R., 2014, *Agroecology: The Ecology Of Sustainable Food Systems*, Second Edition. CRC Press.
- [24]Gliessman, S.R., 2018, Transforming our food systems. *Agroecology and Sustainable Food Systems*, 42: 475-476.
- [25]González-Sánchez, E.J., García, M.M., Kassam, A., Basch, G., 2017, Technical Report, July.
- [26] Karas, T.H., 2003, *Global Climate Change and International Security*. Sandia National Laboratories Albuquerque, New Mexico 87185 and Livermore, California.
- [27]Kertész, Á., Madarász, B., 2014, Conservation Agriculture in Europe. *International Soil and Water Conservation Research*, 2: 91-96.
- [28]Lahmar, R., 2010, Adoption of conservation agriculture in Europe: Lessons of the KASSA project. *Land Use Policy*, 27(1):4-10.
- [29]Lipper, L., Thornton, P., Campbell, B.M., Baedeker, T., Braimoh, A., Bwalya, M., Caron, P., Cattaneo, A., Garrity, D., Henry, K., 2014, 'Climate-smart agriculture for food security'. *Nature Climate Change*, 4: 1068.
- [30]Lipper, L., McCarthy, N., Zilberman, D., Asfaw, S., Branca G., ed. 2018, *Climate Smart Agriculture. Building Resilience to Climate Change*. Food and Agriculture Organization of United Nations. Springer.
- [31]Meena, J.P., Jha, A., 2018, Conservation agriculture for climate change resilience: A microbiological perspective, in *Microbes for Climate Resilient Agriculture*, First Edition. Edited by Prem Lal Kashyap, Alok Kumar Srivastava, Shree Prakash Tiwari and Sudheer Kumar. John Wiley & Sons.
- [32]Mosquera-Losada, M.R., Santiago-Freijanes, J.J., Rois-Díaz, M., Moreno, G., den Herder, M., Aldrey-Vázquez, A., Ferreiro-Domínguez, N., Pantera, A., Pisanelli, A., Rigueiro-Rodríguez, A., 2018, Agroforestry in Europe: A land management policy tool to combat climate change. *Land Use Policy*, 78:603-613.
- [33] Myers, S.S., Smith, M.R., Guth, S., Golden, C.D., Vaitla, B., Mueller, N.D., Dangour, A.D., Huybers, P., 2017, Climate Change and Global Food Systems: Potential Impacts on Food Security and Undernutrition. *Annual Review of Public Health*, 38:259-277.
- [34]Palm, C., Blanco-Canqui, H., DeClerck, F., Gatere, L., Grace, P., 2014, Conservation agriculture and ecosystem services: An overview. *Agriculture, Ecosystems & Environment*, 187:87-10.
- [35]Paul, C., Weber, M., Knoke, T., 2017, Agroforestry versus farm mosaic systems – Comparing land-use efficiency, economic returns and risks under climate change effects. *Sci Total Environ.*, 587–588: 22-35.
- [36]Perkins, M.K., Munguia, N., Moure-Eraso, R., Delakowitz, B., Giannette, B.F., Liu, G., Nurunnabi, M., Will, M., Velazquez, L., 2018, International perspectives on the pedagogy of climate change. *Journal of Cleaner Production*, 200:1043-1052.
- [37]Porter, P., Francis, C.A., 2017, *Agroecology: Farming Systems with Nature as Guide*. *Encyclopedia. Encyclopedia of Applied Plant Sciences (Second Edition)*, 3:9-12.
- [38]Pramanik, P., Sharma, D.K., Maly, A., 2014, Environmental Benefits of Conservation Agriculture. *Indian Farming*, 54: 26-30.
- [39]Recanati, F., Arrigoni, A., Scaccabarozzi, G., Marveggio, D., Melià, P., Dotelli, G., 2018, LCA Towards Sustainable Agriculture: The Case Study of Cupuaçu Jam From Agroforestry. *Procedia CIRP*, 69:557 – 561.
- [40]Schoeneberger, M., Bendrub. G., Gooijer, H., Soolanayakanahal, R., Sauer, T., Brandley, J., Zhan, X., Cuer, D., 2012, Branching out: agroforestry as a

climate change mitigation and adaptation for agriculture. *Journal of Soil and Water Conservation*, 67(5): 128-136.

[41]Simeon, P.O., Jijingi, H.E., Apaji, N.J., 2018, Climate change: a challenge to sustainable land resource management in agriculture and the extension of arable crops mechanization in Nigeria. *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development*, 18(3):399-406.

[42]Stabinski, D., Ching, L.L., 2012, *Ecological Agriculture, Climate Resilience and a Roadmap to Get There*. Third World Network. Penang, Malaysia.

[43]Taylor, M., 2018, Climate-smart agriculture: what is it good for? *The Journal of Peasant Studies*, 45 (1): 89-107.

[44]Thorenz, A., Wietschel, L., Stindt, D., Tuma, A., 2018, Assessment of agroforestry residue potentials for the bioeconomy in the European Union. *Journal of Cleaner Production*,176:348-359.

[45]United Nations, Department of Economic and Social Affairs, Population Division (2017). *World Population Prospects: The 2017 Revision*. New York: United Nations.

[46]Utama, G.L., Balia, R.L., 2018, Adaptation and mitigation of climate change in maintaining food security by traditional communities. *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development*,18(3):461-467.

[47]Zazai, K.G., Wani, O.A., Ali, A., Devi, M., 2018, Phytoremediation and Carbon Sequestration Potential of Agroforestry Systems: A Review. *Int.J.Curr.Microbiol.App.Sci.*,7(1): 2447-2457.

[48]Zhang, D., Du, G., Sun, Z., Bai, W., Wang, Q., Feng, L., Zheng, J., Zhang, Z., Liu, Y., Yang, S., Yang, N., Feng, C., Cai, Q., Evers, J.B., van der Werf, W., Zhang, L., 2018, Agroforestry enables high efficiency of light capture, photosynthesis and dry matter production in a semi-arid climate. *European Journal of Agronomy*, 94:1-11.

## **TYOLOGY OF REGIONS ACCORDING TO THE LEVEL OF FOOD SECURITY: METHODOLOGICAL APPROACHES AND SOLUTIONS**

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### **Abstract**

*The article deals with the problems of significant differentiation of the regions of Russia in terms of food security, which poses a threat to sustainable regional development and can lead to serious socio-political risks in the functioning of the national food system. Methodological approaches to the typology of regional agri-food systems based on a set of various criteria and indicators of food security, including independence, physical and economic accessibility of food, as well as stability of development, are proposed. It is proved that the use of criterion of food independence in the model of food security is appropriate only for development of the national food system. However, for regional agri-food systems, physical and economic accessibility of food for all population groups and stability of functioning of agri-food systems are of paramount importance. The degree of differentiation of individual RF subjects in terms of non-compliance with food safety criteria was evaluated, which made it possible to identify regions vulnerable to food security. The developed methodological and methodical provisions can serve as a basis for making management decisions in the field of food safety at the federal and regional levels.*

**Key words:** food security, agri-food system, physical and economic accessibility, import substitution, region

### **INTRODUCTION**

The fundamental vector of modern civilization development is the achievement of food security, stable food supply of the population. Food security is a priority of the agri-food policy of any state, since it means solving a whole complex of economic, social, demographic and environmental problems. The vast experience of international organizations in the field of sustainable agriculture, food security and nutrition in the world has already been accumulated. Thus, among the main provisions of the Food Security Concept, developed by the Food and Agriculture Organization of the United Nations (FAO), we can highlight the main: food security is interpreted not only as self-sufficiency in food; a country producing enough products for its needs has a comparative competitive advantage; a country must be able to import the necessary amount of food and meet the needs of its citizens for

it; governments must ensure physical and economic accessibility of safe food [17]. Food security is a multi-aspect problem. The Declaration of 2009 World Food Security Summit defines the following: "Food security exists when all people at all times have physical, social and economic access to adequate, safe and nutritious food appropriate to their diet and culinary preferences for an active and healthy lifestyle"[4]. For Russia, the problem of food security became particularly acute in the early 1990s due to the socio-economic transformation of agricultural sector, liberalization of the food market and growth of imports of agricultural products and food. Protectionist measures taken by the Government of the Russian Federation in relation to the domestic agrarian sector partially solved this problem [11]. However, given the deep territorial and social differentiation of food production and consumption, a more in-depth study of the characteristics, level, trends [12], and mechanisms to achieve food security in the

regional context is required [6].

The relevance of the research of regional problems of food security in Russia is caused, besides solving the traditional task of reducing the share of imports in food commodities, also by the following points: first, the functioning of the country's agri-food system under the sanctions regime, which necessitates the early realization of the import substitution potential by stimulating the development of leading regions [21]; second, significant regional differentiation of the subjects of the Russian Federation in the field of food supply and, therefore, heterogeneity and imbalance of the national food market; and third, the need to substantiate the priorities for improving agricultural food policy aimed at ensuring physical and economic access to food of adequate quantity and quality for all social groups in all regions of the country [13]. In this regard, the development of methodological approaches to the typology of regions on the basis of comprehensive assessment of their food security in order to justify measures to achieve it is highly actual.

International organizations constantly monitor the state of food security in all its aspects, improve the assessment methodology, and set new tasks [5]. Thus, the Report "The State of Food Safety and Nutrition in the World - 2017" marks the beginning of a new era in monitoring progress towards the world free from hunger. The designated "Goal 2" in the field of sustainable development (SDG 2) calls on countries to "eliminate hunger, ensure food security, improve nutrition and promote sustainable agricultural development" by 2030 [8]. As part of achieving SDG 2, the tasks have been identified in a number of areas - hunger, food security, nutrition, sustainable agriculture [14]. In the report two indicators of food security are given for the first time. Along with traditional for FAO indicator of hunger scale - the prevalence of malnutrition (PoU) - the report reflects the prevalence of severe food insecurity [10].

The latter was calculated on a scale of perception of lack of food security (FIES) based on data from the adult population of the whole world. FIES is a new tool to measure

people's ability to access food. The source data for FIES is collected by direct survey of the population [19].

The formation of theoretical provisions of import substitution is studied in the works of F. Liszt, who claimed that all countries embarked on the path of industrialization have passed through this stage of development. The conceptual provisions of the import substitution policy were considered in the 60-70s of the XX century by well-known representatives of neo-Keynesianism: H. Chenery, M. Bruno, A. Straug, N. Carter. Many foreign countries have put into practice their policies aimed at achieving food independence [20], primarily Latin American countries. The Argentinian economist R. Prebisch [16] contributed to the development of the theory and implementation of applied research in the field of food security.

The works of following domestic and foreign scientists are devoted to the problems of food security: A. Altukhov, A. Anfinogentova, A. Golubev, E. Krylatykh, E. Serova, N. Shagaidy, V. Uzun, I. Ushachev, P.J. Ericksen, J.S.I.Ingram, D.M.Liverman, [7], Godfray H.C., Crute I.R., Haddad L. [9], Bauer W. [1] and others.

Scientific teams of leading scientific institutions are engaged in monitoring, assessing the state of food security in Russia (ARIAPI named after Nikonov, ARSRIACE, Institute of Agrarian problems RAS, etc.).

Features of the development of food problems are highlighted in the works of Reilly M., Willenbockel D. (2010), Belaya V. [2], Hanf, J.H. (2016), Pall Z., Perekhozhuk O., Glauben T., Prehn S., Teuber R. [15].

## MATERIALS AND METHODS

Food security is considered by the authors as a complex multi-level category, which requires solving priorities at every level - the world, the country, the region. The theoretical basis of the research is the basic theories of foreign trade, including the theory of protectionism and the theory of free trade, the theory and concepts of economic growth [3] and regional policy.

At present, threats to Russia's food security are being formed both within the country and abroad. Therefore, the most important methodological approach to the research is taking into account the complex of internal and external determinants of the development of regional agri-food systems. The typology of regional agri-food systems is carried out with consideration of a number of interrelated aspects, which are characterized by a system of relevant basic quantitative and qualitative indicators (Table 1):

- food independence of the national agri-food system;
- physical availability of safe and nutritious food in sufficient quantities;
- economic accessibility of food for all social groups of population;
- stability of the functioning of the national agri-food system in a mode that is not inferior to the rate of change in the population of the country.

Table 1. Criteria and indicators of food security of the agri-food system

Aspect	Description	Indicators
Food independence	It characterizes the sufficiency of its own resources to provide the population with food in volumes that guarantee physical and economic availability of quality food products necessary for an active and healthy lifestyle.	- production of basic food per capita; - share of own production in food resources; - level of self-sufficiency of the population with basic food.
Physical access to food	It reflects the ability of the population to purchase food in volume and assortment in accordance with established rational norms of food consumption.	- per capita consumption of basic foodstuffs; - balance of the food basket (calorie content, ratio of proteins, fats and carbohydrates, compliance with recommended consumption rates).
Economic access to food	It characterizes the possibility of acquiring food products at prevailing prices in sufficient volume and assortment, provided with an appropriate level of income of the population.	- share of food expenditures in the structure of consumer spending; - proportion of the population with incomes below the subsistence minimum; - differentiation of food consumption by the population with different income levels.
Stability of functioning	It reflects the sustainability of the growth rate of the main types of food in relation to the rate of change in the population of the country.	- population growth rates; - growth rates of production of basic foodstuffs; - growth rates of consumption of basic foodstuffs.

Source: Own determination.

When typologizing the regional agri-food systems, the indicators of their development are substantiated, which allowed grouping the subjects of the Russian Federation according to the key criteria of food security and identifying the most vulnerable regions. The following analytical tools were used: the method of generalizing of statistical indicators, the method of statistical groupings, cluster analysis, correlation and regression analysis, and other methods of multivariate statistical analysis. A comparative analysis of the subjects of the Russian Federation in terms of their potential for import substitution in food markets has been carried out.

The author's method provides for an assessment of the basic conditions for the functioning of regional agri-food systems, taking into account the special features of natural climatic factors, resource endowment, development of the material and technical base, traditionally established specialization of agricultural production, established trends in the growth of

food production, volume of domestic demand with a glance to dynamics of real incomes of the population and the ability to use interchangeable products.

The typology of regional agri-food systems according to the level of food security contributes to the substantiation of the directions of agri-food policy. From the methodological point of view, the balance of interests in the development of regional and national agro-food systems implies the realization of selective state support, which involves a change in the priorities of agri-food policy from the implementation of the potential of import substitution to the formation of export potential.

## RESULTS AND DISCUSSIONS

The most important role in ensuring food security belongs to the Russian regions. It is in the regions that the zones of marketable agricultural products are formed; the reserves and stocks are created that are necessary to

achieve the strategic goal of food security. It is in many Russian regions that agriculture is one of the leading branches of the territorial economy, ensuring the sustainability of regional development. Sustainable development of the regions is impossible without reliable, uninterrupted provision of the population with food, without physical and economic access to food. It is the regions that participate in interregional exchange, form the national food market, and also act as exporters of agricultural raw materials and foodstuffs, ensuring integration into the world food economy. The summarized indicators characterizing the change

in the food security of the Russian Federation are shown in Table 2.

The analysis of the achieved level of food self-sufficiency in comparison with the target parameters provided by the Doctrine on food security in Russia as a whole has showed that this indicator in Russia is close to 100% for the most important food products. However, the share of domestic production in the total resources of meat and meat products, milk and dairy products, fish and fish products, vegetables and fruits does not meet the targets of the Doctrine.

Table 2. Indicators of food security of the Russian Federation

Indicator	2000	2005	2010	2013	2014	2015	2016	2017
Population index,%	99.6	99.5	100.02	100.2	100.2	100.2	100.2	100.2
Indices of agricultural production,%	106.2	101.6	88.7	105.8	103.5	102.6	104.8	102.4
Agricultural production per capita, thousand rubles / person	5.29	9.67	18.11	25.66	29.53	35.24	37.50	34.80
Production of meat and meat products per capita, kg	30.29	34.95	50.16	59.47	62.01	65.27	67.43	70.28
Production of milk and dairy products per capita, kg	220.61	217.65	222.92	212.50	210.51	210.15	209.52	205.37
Potato production per capita, kg	232.39	196.84	147.69	210.21	215.36	229.28	211.85	148.21
Production of vegetables per capita, kg	85.44	79.16	84.70	102.32	105.97	109.86	111.03	105.05
Consumption of meat and meat products per capita, kg	45	55	69	75	74	73	74	75
Consumption of milk and dairy products per capita, kg	215	234	247	248	244	239	236	231
Potato consumption per capita, kg	118	109	104	111	111	112	113	96
Consumption of vegetables per capita, kg	86	87	101	109	111	111	112	107
Expenditures on food in the structure of consumer spending, %	48.3	36.1	32.9	31.2	31.9	35.4	35.5	34.3
Proportion of the population with incomes below the subsistence minimum,%	29	17.8	12.5	10.8	11.2	13.3	13.4	13.2
Energy value of food per capita per day, kcal	2394	2630	2662	2626	2603	2575	2675	2980
including animal products, kcal	634	729.6	827.9	866.6	860	855	887.3	882.5
Level of self-sufficiency in meat and meat products,%	67.32	63.55	72.70	79.30	83.80	89.41	91.12	93.71
Level of self-sufficiency in milk and dairy products,%	102.61	93.01	90.25	85.68	86.28	87.93	88.78	88.90
Level of potato self-sufficiency,%	196.94	180.59	142.01	189.38	194.02	204.72	187.48	154.38
Level of self-sufficiency in vegetables,%	99.35	90.99	83.86	93.87	95.47	98.98	99.14	98.18

Source: Rosstat data.

The complexity of the problem of ensuring food security in a regional context is aggravated by the enormous size and

extremely uneven territorial development of Russia. Regions of the Russian Federation differ significantly in size and population

density, structure and level of economic development, investment and innovation potential, etc. Despite a slight decrease in differentiation of the levels of regional socio-economic development as compared with 1990s, the gap in the GRP per capita in the RF subjects is almost 20 times, which certainly affects the stability and balance of the national economy.

Such differentiation is a natural process associated with peculiarities of the natural and climatic conditions of the RF subjects, but this does not remove the requirement of ensuring the physical and economic accessibility of food in a regional context. Therefore, regional aspects of ensuring food security of Russia are ones of the essential characteristics of this category.

Table 3. Results of typology of RF subjects in terms of food security

Aspect	The level of regional development		
	High	Medium	Low
Food independence	Republic of Mordovia; Regions of Belgorod, Bryansk, Astrakhan, Kursk, Tambov	Republics of Kabardino-Balkaria, Karachai-Cherkess, Chuvash, Udmurtia; Altai Republic, Mari El Republic; Dagestan, Tatarstan, Kalmykia, Bashkortostan, Adygea; Territories of Altai, Krasnodar, Stavropol; Regions of Lipetsk, Voronezh, Penza, Pskov, Novgorod, Volgograd, Orenburg, Orel, Ryazan, Tula, Leningrad, Kurgan, Rostov, Saratov, Ulyanovsk, Omsk, Kaluga, Kirov, Nizhny Novgorod, Chelyabinsk, Tver, Vologda, Smolensk	Republics of Khakassia, Crimea, Buryatia, Tuva, North Ossetia-Alania, Sakha (Yakutiya), Ingushetia, Komi, Karelia; Jewish Autonomous region; Chechen Republic, Chukchi Autonomous district; Territories of Krasnoyarsk, Transbaikalia, Perm, Primorye, Kamchatka, Khabarovsk; Regions of Amur, Tomsk, Vladimir, Irkutsk, Tyumen, Yaroslavl, Kostroma, Kaliningrad, Novosibirsk, Sverdlovsk, Kemerovo, Samara, Ivanovo, Sakhalin, Moscow, Magadan, Arkhangelsk, Murmansk
Physical access to food	Republics of Mari El, Bashkortostan, Udmurtia, Chechen Republic; Territories of Krasnodar, Altai, Krasnoyarsk; Regions of Voronezh, Rostov-on-Don, Moscow, Astrakhan, Volgograd, Lipetsk, Kaliningrad, Tver, Novosibirsk, Omsk, Sverdlovsk, Kaluga, Novgorod, Vologda, Orel, Penza, Amur, Leningrad, Yaroslavl, Samara, Kursk, Pskov	Republics of Altai, Khakassia, Mordovia, North Ossetia-Alania, Ingushetia, Karelia, Crimea, Adygea, Komi, Chuvash; Territories of Primorye, Khabarovsk, Transbaikalia, Stavropol, Kamchatka, Perm; Regions of Kurgan, Orenburg, Bryansk, Smolensk, Tula, Kirov, Magadan, Murmansk, Vladimir, Nizhny Novgorod, Ulyanovsk, Tambov, Sakhalin, Saratov, Kemerovo, Chelyabinsk, Ryazan, Tomsk, Tyumen, Kostroma, Arkhangelsk, Ivanovo, Irkutsk	Karachai-Cherkess Republic, Republics of Kalmykia, Buryatia, Sakha (Yakutiya), Tuva; Chukchi Autonomous district, Jewish Autonomous Region
Economic access to food	Republics of Tatarstan, Khakassia, Bashkortostan, North Ossetia-Alania, Karelia, Udmurtia; Territories of Khabarovsk, Primorye, Krasnodar, Perm, Stavropol, Krasnoyarsk, Kamchatka; Chukchi Autonomous district; Regions of Belgorod, Moscow, Tambov, Nizhny Novgorod, Sakhalin, Murmansk, Sverdlovsk, Volgograd, Chelyabinsk, Voronezh, Yaroslavl, Tomsk, Tula, Novgorod, Orel, Kursk, Leningrad, Tyumen, Lipetsk, Amur, Ivanovo, Novosibirsk, Arkhangelsk, Kirov, Orenburg, Samara, Kaluga, Rostov, Kostroma	Republics of Mordovia, Mari El, Altai, Buryatia, Adygea, Komi, Sakha (Yakutiya), Chechen, Chuvash, Kabardino-Balkaria, Karachai-Cherkess; Territory of Transbaikalia; Jewish Autonomous district; Regions of Ulyanovsk, Kaliningrad, Astrakhan, Magadan, Pskov, Ryazan, Penza, Smolensk, Saratov, Bryansk, Kemerovo, Irkutsk, Omsk, Kurgan, Vologda, Vladimir, Tver	Republics of Kalmykia, Crimea, Dagestan, Tuva, Ingushetia
Stability of functioning	Republics of Tatarstan, Bashkortostan, Mordo-viya; Primorye territory, Jewish Autonomous district; Regions of Amur, Tambov, Tomsk, Pskov, Magadan, Kaluga, Tula, Orenburg, Astrakhan, Sakhalin, Novosibirsk, Kursk, Kurgan, Rostov, Ulyanovsk, Ryazan	Republics of Dagestan, Tuva, Sakha (Yakutiya), Kalmykia, Khakassia, Crimea, Adygea, Mari El, Kabardino-Balkaria, Chuvash, Udmurtia, Karachai-Cherkess, Chechen Republic; Territories of Altai, Kamchatka, Khabarovsk, Perm, Krasnodar, Stavropol; Regions of Bryansk, Lipetsk, Omsk, Saratov, Tyumen, Murmansk, Volgograd, Voronezh, Smolensk, Sverdlovsk, Samara, Chelyabinsk, Kemerovo, Orel, Tver, Irkutsk, Nizhny Novgorod, Belgorod, Ivanovo, Leningrad, Kaliningrad, Yaroslavl, Kirov, Penza; Chukchi Autonomous District	Republics of Altai, Komi, Buryatia, Karelia, North Ossetia-Alania, Ingushetia; Krasnoyarsk Territory; Regions of Moscow, Kostroma, Novgorod, Vladimir, Vologda, Arkhangelsk

Source: Own determination.

We have carried out a cluster analysis of regional agri-food systems in terms of food

security, including all of its above-mentioned aspects (Table 3).

The key indicator of food independence is the level of self-sufficiency of the population with strategically important types of foodstuffs, established as target parameters by the Doctrine of Food Security of the Russian Federation (meat, milk, vegetables, etc.). The indicator characterizing the level of self-sufficiency in

the region with basic foodstuffs is the ratio of domestic production and consumption of basic foodstuffs.

The analysis revealed a significant gap in the levels of self-sufficiency with basic foodstuffs. Figure 1 shows the subjects with minimum and maximum values of indicators.

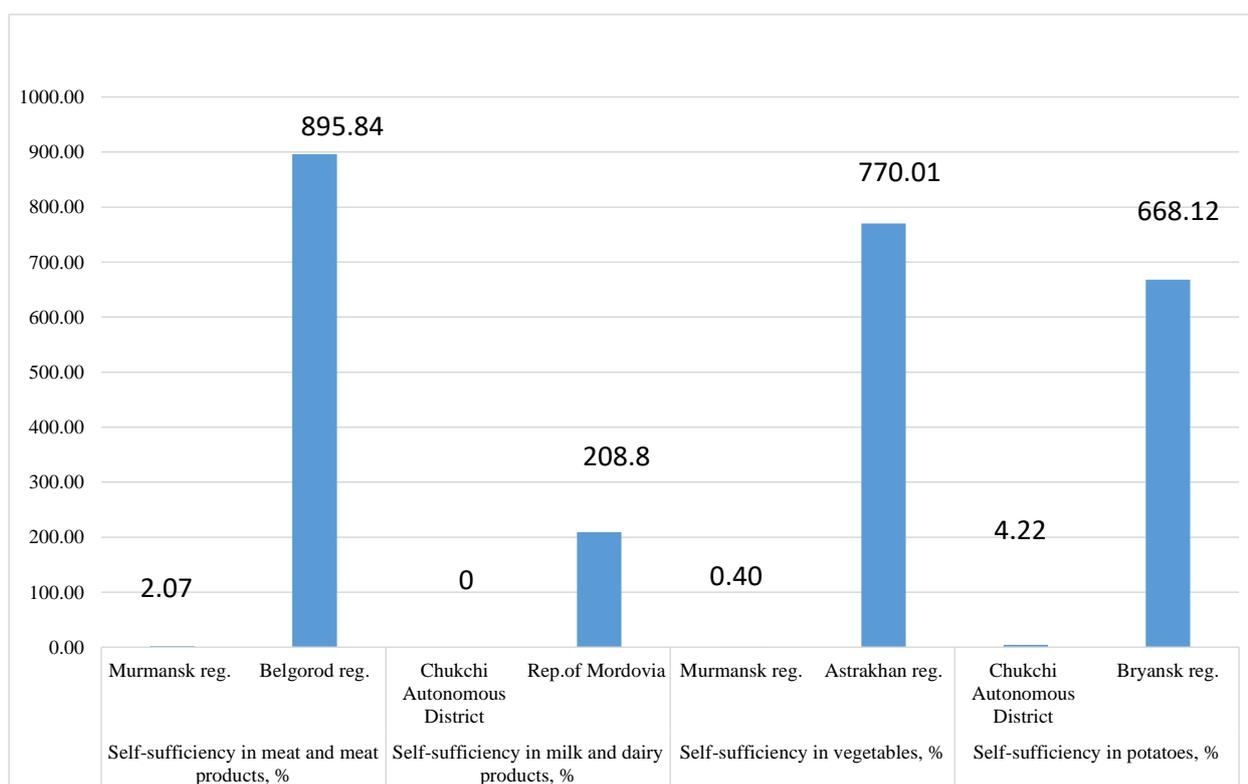


Fig.1. Minimum and maximum indicators of the level of food self-sufficiency in the regions of the Russian Federation (according to 2017 data)

Source: Own determination.

The best indicators of food self-sufficiency are demonstrated by six subjects of RF: Republic of Mordovia, regions of Belgorod, Bryansk, Astrakhan, Kursk, and Tambov. For example, the level of self-sufficiency in meat in Belgorod region is 895%, milk - 148%, vegetables - 150%, potatoes - 244%. The Republic of Mordovia is leading in self-sufficiency in milk and dairy products (208%). Astrakhan region leads in the level of self-sufficiency in vegetables - 770%, potatoes - 277%. These regions are actively involved in the interregional exchange of products of specialization, and the strategy for the development of their regional agri-food systems consists in increasing export potential

and integrating into global food chains with world-competitive products.

Low potential of self-sufficiency is typical for 36 subjects of RF, and there is a very "motley" picture - it is possible to distinguish regions with unfavorable conditions for agricultural production (Republics of Khakassia, Buryatia, Tuva, Tyumen region, Chukchi Autonomous district, etc.). According to their natural and climatic conditions and availability of land suitable for agricultural production, these subjects of RF cannot ensure the balance of the regional food market at the expense of their own resources. Another subgroup consists of industrially developed regions (Sverdlovsk, Kemerovo, Samara, Novosibirsk, etc.). A special subgroup is made

up of densely populated regions with a fairly high level of development of the food industry (Moscow region).

The remaining subjects of the Russian Federation are characterized by an average potential of self-sufficiency (regions of the North Caucasus, the Volga region, the Urals). Many of them participate in interregional exchange, for example, Tatarstan, Bashkortostan, Saratov, Volgograd, and Rostov Regions. The development strategy of regional agri-systems of this type should be aimed at further building up the capacity of import substitution, based on the growth of agricultural production, diversification of the processing industry, and they also have the opportunity to strengthen export potential. Here, of course, government support is of great importance, stimulating the development of these regional agri-food systems. Some regions included in the group with an average level of potential do not have the opportunity to fully meet the needs for food resources, as they are characterized by a high concentration of urban population (Nizhny Novgorod, Leningrad regions).

For large megacities, including Moscow and Leningrad regions, the development strategy should be based on formation of so-called "food belt", including the creation of guaranteed raw zones and organized wholesale supplies, as well as reserve fund of food, and operation of agricultural holdings with a closed production cycle etc.

The analysis showed that for many subjects of RF self-sufficiency in food is really important. Therefore, many regions consider independence as the main criterion for food security. This is reflected in regional legislation. A number of regions of the Russian Federation, along with regional programs for the development of agriculture and food market, have adopted special laws on food security. For example, such laws were adopted in the republics of Tatarstan, Bashkortostan, and the regions of Nizhny Novgorod, Samara, Saratov, and Ulyanovsk.

If the task of achieving food independence is to a certain extent solved both at the national and regional levels, then the problem of physical and economic access to food is far from being solved. The import substitution policy recently proclaimed and imposition of a food embargo did not lead to an increase in the physical and economic access to food, as evidenced by the increased differentiation in the level of consumption of basic foodstuffs.

To assess the level of physical access to food, per capita consumption of the most important types of food products, the degree of achievement of rational consumption standards and balance of the food basket (calorie ratio, the ratio of proteins, fats and carbohydrates, compliance with recommended consumption standards) were analyzed. As a result, it was revealed that most regions of the Russian Federation fell into groups with relatively high and medium levels of physical accessibility. The low level of physical availability of food is determined in Karachai-Cherkess Republic, Republics of Buryatia, Sakha (Yakutia), Tuva, Chukchi Autonomous district, Jewish Autonomous Region. However, if we consider the consumption of certain kinds of food (meat, milk, vegetables, fruits), then there remains a significant differentiation in the context of the subjects of the Russian Federation. There should be noted a significant gap in the regions of Russia in the consumption of various foods: for meat and meat products - 2.61 times, for milk and dairy products - 3.38 times, for potatoes - 4.2 times, for vegetables - 7.69 times (Fig.2).

Thus, the problem of differentiation in the level of consumption of the main products has not yet been resolved. Even taking into account national and regional features of existing consumption patterns in RF subjects, the existing gap in consumption illustrates the instability of food supply in the regions and violation of the postulates of the country's food security concept.

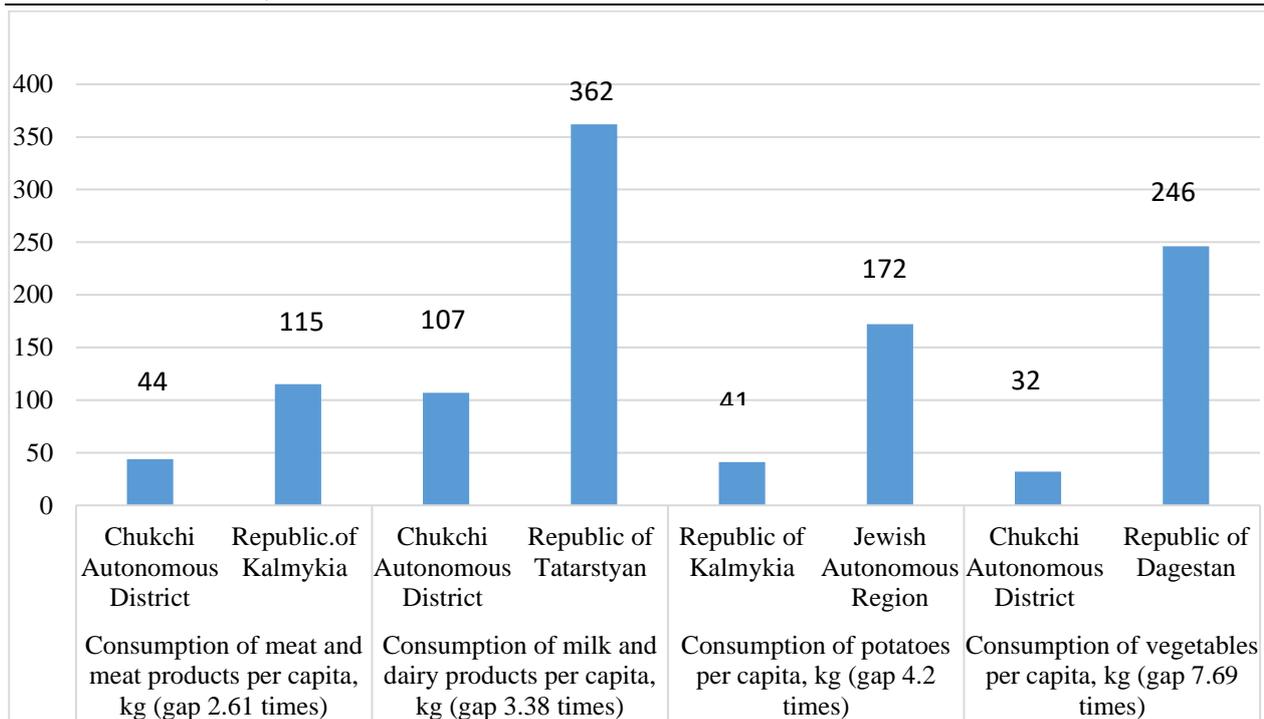


Fig. 2. Minimum and maximum values of consumption of the main types of food in the regions of the Russian Federation (according to 2017 data)  
 Source: Own determination.

To solve the problem of physical access to food, it is necessary to stimulate and support the development of regional food production, taking into account specialization and comparative competitive advantages in the territorial division of labor, development of logistics, infrastructure, and interregional exchange. An important role is played by government support of campaigns on formation of a healthy eating model. There should be noted the importance of realization of the priority project “Forming a Healthy Lifestyle”, which provides for the development and implementation of grant programs from the federal budget and extra budgetary sources to non-profit and other public organizations implementing projects in the field of promoting healthy lifestyles, proper nutrition and saving health. As well as actions with participation of food producers to inform citizens about healthy nutrition through the voluntary placement of additional marks of distinction and information on food product packaging, conducting large-scale information and communication campaigns on the formation of health-saving behavior, etc. The most important aspect of food security is ensuring the quality of nutrition, which

implies a structural balance of the “food basket”, and food safety for human health. However, this problem is far from being resolved, since the average ration of the country's population differs significantly from the rational consumption rates recommended by doctors. The energy value of food per capita per day on average in Russia is 2,980 kcal. The minimum value of this indicator was noted in the Khabarovsk Territory (2,146 kcal), and the maximum - in the Republic of Ingushetia (3,556 kcal). The proportion of animal products in the diet is of key importance in assessing the physical access to food. On average in Russia this figure was 883 kcal (29.6% of the energy value of the daily diet). Meanwhile the minimum share of products of animal origin was recorded in the Kamchatka Territory (19.9%), and the maximum - in the Republic of Ingushetia (40.1%). The most important component of food security is the economic access to food products, which depends on the level of income of the population and prices. Consumer demand was the engine of economic growth for quite a long time, but as the macroeconomic situation deteriorated in 2014–2017 it began to

act as a limiting factor. As the analysis has shown, in the last two years consumer prices for foodstuffs continue to grow in all regions. Expenditures on food in the structure of consumer spending up to 2014 were steadily declining. However, starting from 2015, there

is a growth trend from 31.2% in 2013 to 34.3% in 2017. This indicator differs more than twice by the regions of the Russian Federation: from 29.3% in the Khabarovsk Territory to 61.8% in the Republic of Ingushetia (Fig. 3).

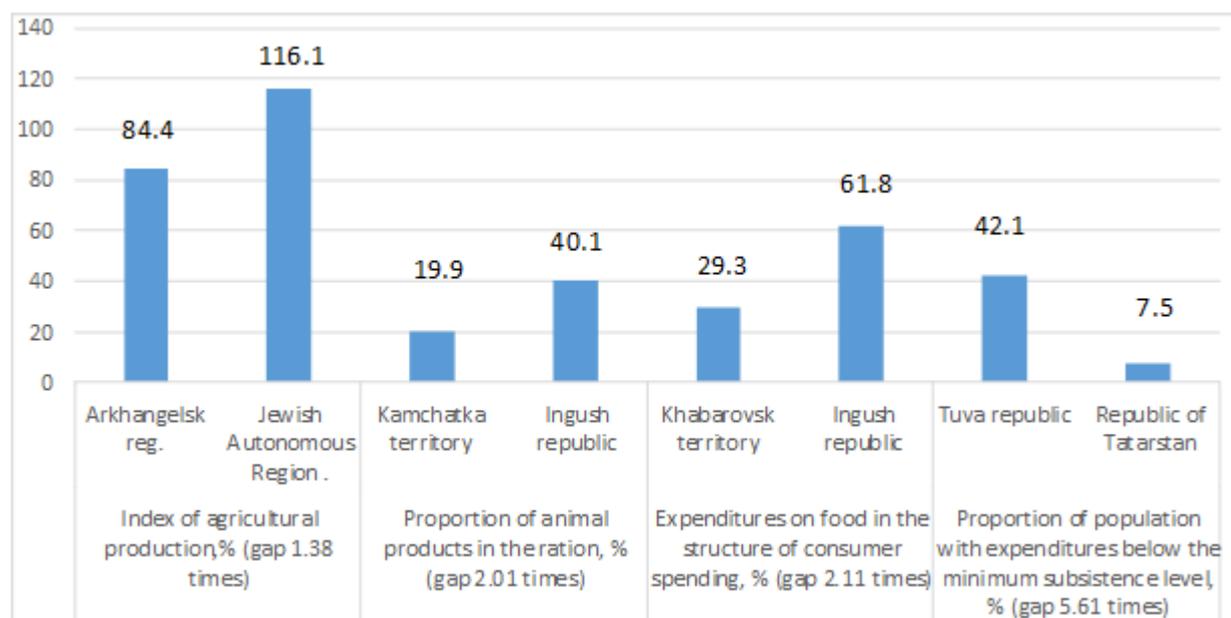


Fig.3. Maximum and minimum values of indicators characterizing physical and economic access to food in the regions of Russia (according to 2017 data)  
 Source: Own determination.

In the regions with higher income of the population, a more balanced food basket is also noted. For example, in the Republic of Bashkortostan, Nizhny Novgorod Region, there is a higher supply of food due to products of animal origin, a more rational energy value of food. In relatively poor regions, for example, in the Republic of Mari El, bread products predominate in the structure of the energy value of daily ration, while the share of valuable food products, i.e. milk and meat, is lower. Meanwhile there should be noted a significant differentiation of the quality of food: the caloric content of food in the Republic of Bashkortostan is 1.3 times higher than that in the Udmurt Republic. Thus, we can conclude: food security is not only the independence of the region from external supplies, but also the physical and economic access to food of the appropriate quantity and quality, which in turn depends on household income, logistics development,

infrastructure, and mutually beneficial regional food exchange.

One of the tools to solve the problem of the economic affordability of food is the use of direct food aid to low-income groups of the population. Back in 2014, the Government of the Russian Federation adopted the Concept for the Development of Domestic Food Aid [18]. However, in spite of the fact that in a number of regions, domestic food aid is provided through the social nutrition sector, nevertheless, this mechanism has not yet worked throughout the country. In addition, the already realized food aid in the subjects of RF does not solve the problem of economic access to food, its volume is too small, there is no consistency in the actions of the main managers of financial resources - the ministries of the social block: education, health care and social protection.

## CONCLUSIONS

The research showed that the problem of food security is complex. It must be considered at different levels of the agri-food system, which are characterized by different priorities and urgency of tasks. To achieve food security in the world, the physical and economic accessibility of food is of paramount importance due to the huge number of hungry people in the poorest countries. At the national level, taking into account various institutional conditions and political risks, the importance of achieving food independence as an important condition for ensuring sovereignty and economic security of the state should be recognized. Regional aspects of achieving food security should be considered in the context of not only food self-sufficiency, given the different specializations, natural and climatic conditions for the functioning of regional agri-food systems. The priority task is to solve the problems of economic, physical availability of food in accordance with recommended consumption norms for all social groups of the population.

The trends of regions' polarization in terms of the level of food supply have already been considered by many researchers; however, this study has revealed a number of new patterns. Thus, implementation of the import substitution policy did little to improve the physical and economic accessibility of food. The increase in the share of own food resources in value terms was largely determined not by the growth of agricultural production, an increase in sustainability and efficiency of its development, but by depreciation of the ruble. This contributed to the slowdown of processes of interregional exchange, and deformation of processes of regional specialization of the agri-food system.

A large number of the subjects under consideration provided a reliable analysis of the results obtained. This makes it possible to estimate the correctness of implemented methodical approach to identification of homogeneous types of regional agri-food

systems and justification of strategic directions of agri-food policy.

The analysis has revealed that, to a greater extent, only seven subjects of the Russian Federation meet the criteria for food security: Belgorod, Bryansk, Kaluga, Kursk, Rostov, Orenburg and Kurgan regions. The outsider regions were the republics of Kalmykia, Ingushetia, Buryatia and Tuva. Many of the remaining regions are characterized by uneven formation of all aspects of food security, which is manifested, on the one hand, in strengthening the productive capacity and activating socio-economic processes in a relatively small number of subjects, and on the other, in strengthening the destructive processes in regional agri-food systems against the background of stabilization of depressive phenomena in the regional economy.

This research on the status of food security in Russia in the context of import substitution has showed that currently one of the tasks is being solved mainly — autonomy and food independence, and the orientation towards implementation of the autarkic model of food security is predominant. It is not yet possible to state the transition of the Russian agricultural sector to an innovative model of development ensuring its sustainable development.

Summing up the research on regional differentiation of the levels of food security, it should be noted that the typology of regions determines a scientifically based approach to the formation of directions of the state agri-food policy:

- development of “growth poles” on the basis of leading regions promoting the development of agriculture, diversification of the food industry;

- development of logistics, infrastructure of food market, establishment of interregional exchange in order to increase the level of physical access to food for population of recipient regions;

- increasing real income of population, taking measures of social support for low-income strata of the population, protecting the interests of consumers on the basis of standardization and state control measures.

Implementation of these measures of agri-food policy will contribute to development of agrarian sector, based on the rational use of existing resource potential. This will allow solving the problem of sustainable provision of the population with economically available domestic food products, will improve the standard of living of population of the country, and strengthen the economic and geopolitical position of Russia in the world.

## ACKNOWLEDGMENTS

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## REFERENCES

- [1] Bauer, W., 1972, Import Substitution and Industrialization in Latin America: Experiences and Interpretations // Latin American Research Review, Vol. 7 (1):95-122.
- [2] Belaya, V., Hanf, J.H., 2016, Conflict resolution in vertical collaborations in the agri-food sector // Journal of Food Systems Dynamic, Vol.7(1):24-35.
- [3] Capanu, I., Anghelachi, C., 2000, Economic indicators for micro and macroeconomic management. Bucharest: Economic Publishing House, 256 p.
- [4] Declaration of the World Summit on Food Security. - Rome, 2009.// [http://www.fao.org/fileadmin/templates/wsfs/Sumit/Documents/Final\\_Declaration/K6050\\_Rev10\\_\\_WSFS\\_OEWG\\_\\_ru](http://www.fao.org/fileadmin/templates/wsfs/Sumit/Documents/Final_Declaration/K6050_Rev10__WSFS_OEWG__ru), Accessed on October 29, 2018
- [5] Derunova, E., Andryushenko, S., Gerchikova, E., Firsova, A., Derunov, V., 2018, Monitoring of innovative activities effectiveness in agriculture. Scientific Papers. Series "Management, Economic Engineering in Agriculture and rural development", Vol. 18(3): 89-100.
- [6] Derunova, E., Ustinova, N., Derunov, V., Semenov, A., 2016, Modeling the diversification of the market as a basis for sustainable economic growth // Economic and Social Changes: Facts, Trends, Forecast, 6(48): 91-109.
- [7] Ericksen, P.J., Ingram, J.S.I., Liverman, D.M., 2009, Food security and global environmental change emerging challenges // Environmental Science and Policy, Vol. 12, 373-377.
- [8] FAO, IFAD, UNICEF, WFP and WHO, 2017, The state of food security and nutrition in the world - 2017. Improving resilience to external influences in order to ensure peace and food security. Rome, FAO.
- [9] Godfray, H.C., Crute, I.R., Haddad, L., 2010, The future of Global food system // Philosophical Transactions of the Royal Society B: Biological Sciences/ Phil. Trans. R. Soc. 365(1554), 2769-2777.
- [10] Heller, M.C., Keoleain, G.A., 2003, Assessing the sustainability of the US food system: a life cycle perspective // Agricultural systems, Vol. 76, 1007-1041.
- [11] Kireeva, N.A., Baryshnikova, N.A., Sukhorukova, A.M., 2018, National priorities vs. economic advisability: search of Russian integration limits into the world food market, Advances in Economics, Business and Management Research, Vol. 61, 286-290.
- [12] Kuznetsov, N.I., Ukolova, N.I., Monakhov, S.V., Shikhanova, J.A., Kochegarova, O.S, 2018, Economic and mathematical research of the rural territories development in Russia, Scientific Papers. Series "Management, Economic Engineering in Agriculture and rural development", Vol. 18(3): 219-226.
- [13] Latruffe, L., Diazabakana, A., Bockstaller, C., Desjeux, Y., Finn, J., Kelly, E., Ryan, M., Uthes, S., 2016, Measurement of sustainability in agriculture: a review of indicators // Studies in Agricultural Economics 118, 123-130.
- [14] Montalbano, P., Nenci, S., Salvatici, L., 2015, Trade, value chains and food security / Food and Agricultural Organization of the United Nations, Rome, 2015.
- [15] Pall, Z., Perekhozhuk, O., Glauben, T., Prehn, S., Teuber, R., 2014, Residual demand measures of market power of Russian wheat exporters // Agricultural Economics, Vol. 45 (3):381-391.
- [16] Prebisch, R., 1950, The Economic Development of Latin America and Its Principal Problems, United Nations department of economic affairs, Lake Success, New York, 1950.ru.pdf, Accessed on December 2, 2018
- [17] Shagaida, N., Uzun, V., 2015, Food security: problems of assessment // Economic Issues.No.5, 63-78.
- [18] The concept of development of domestic food aid in the Russian Federation. Approved by order of the Government of the Russian Federation July 3, 2014.No. 1215-p // [http://www.consultant.ru/document/cons\\_doc\\_LAW\\_165323/](http://www.consultant.ru/document/cons_doc_LAW_165323/), Accessed on December 1, 2018
- [19] Transformation of our world: the 2030 Agenda for Sustainable Development. Resolution adopted by the General Assembly on September 25, 2015// <http://unctad.org/>, Accessed on December 3, 2018
- [20] Utama G.L., Balia R.L. 2018, Adaptation and mitigation of climate change in maintaining food security by traditional communities. Scientific Papers. Series "Management, Economic Engineering in Agriculture and rural development", Vol. 18(3): 461-468.
- [21] Wehrheim, P., Wobs, P., 2005, The Economic role of Russia's subsistence agriculture in the transition process // Agricultural Economics, Vol. 33(1) 91-105.



## ASSESSMENT AND RELATIONSHIPS BETWEEN PHYSICAL AND ECONOMIC ACCESSIBILITY OF FOOD: STATUS AND FORECAST

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### Abstract

*The article discusses various aspects of food security: the level of self-sufficiency, physical and economic accessibility of food. Methodical approaches to the assessment of food security are proposed: the physical availability of food through the coefficient of sufficiency of consumption of basic types of food (meat, milk, vegetables), economic affordability through the share of food costs in household expenditures. The values of various levels (permissible and critical) of food availability are substantiated. Based on the regression analysis, factors determining the physical and economic accessibility of food have been identified. The forecast of the level of achievement of the criteria of food security was fulfilled, which made it possible to estimate the timeframe and resource possibilities in terms of the main types of food. The dependence of the adequacy of consumption of basic food products to a greater degree on the increase in domestic production than on the external content of the food market has been revealed. It has been proven that physical accessibility does not always mean the economic accessibility of food. The degree of differentiation of individual subjects of the Volga Federal District of the Russian Federation on the level of economic and physical accessibility of food has been evaluated. It is concluded that there is an interconnection between various aspects of food security. The results of the study can be used to justify the priorities of the agri-food policy.*

**Key words:** food security, physical accessibility of food, economic affordability of food, self-sufficiency, agricultural and food policy

### INTRODUCTION

Among the global problems of the modern world, the food problem is most acute, since the national security, political and economic sovereignty of any state depends on its solution. As noted in the documents of the Food and Agriculture Organization of the United Nations (FAO), over the past two decades the world has made great strides in the fight against hunger and malnutrition. However, despite the progress achieved, this problem is far from being resolved. "The human, social and economic cost of hunger, food insecurity and malnutrition for society is enormous and has far-reaching consequences: reduced productivity, health problems, declining levels of well-being, impaired learning ability, incompletely revealed human potential and social and political unrest undermining development efforts " [9].

Of course, the problem of hunger for Russia is not relevant. However, low caloric intake, a high proportion of food expenditures in household expenditures, irrational consumption patterns, significant differentiation of these indicators by social groups and regions set the task of enhancing measures to solve the problem of physical and economic accessibility of food. In addition to the food security doctrine of the Russian Federation, adopted in 2010, the main components, in addition to food independence, also determine the economic and physical availability of food. However, the focus is on achieving the level of self-sufficiency in basic foodstuffs and the target parameters for achieving food independence are defined. Other aspects that relate to the physical, economic accessibility of food, food quality, although fixed, but do not have clear parameters and criteria for achieving them.

Food security as a multi-criteria category is considered in the interaction of its aspects. Achieving some aspects can reduce the level of achievement of others. This is clearly illustrated by the current policy of import substitution [16]. The decrease in the share of imports occurs against the background of a decrease in the physical and especially economic accessibility of food [13].

Therefore, an urgent task is to clarify the methodological basis for assessing the achievement of food security, which will make it possible to predict and determine the time frame and ways to achieve it to achieve it.

The purpose of the study is to systematize the factors determining food security and, above all, the physical and economic accessibility of food, develop approaches to quantify them, predict the situation with the achievement of the main parameters of food security as a multi-criteria category and justify measures to solve the most acute problems.

The problems of food security are devoted to the activities of international organizations that continuously monitor its condition in all aspects - food independence, physical and economic accessibility [8].

To ensure food security in the context of implementing sustainable development goals, FAO helps attract public and private sector investment in agri-food systems [6]. and improve efficiency, strengthen the capacity of the agri-food value chain in technical and management areas [5] access financing and increase sustainability, efficiency and inclusiveness such chains [10].

The works of domestic and foreign scientists are devoted to the problems of food security: Altukhova A. [1], Anfinogentova A. [2], Golubev A. [12], Krylatykh E. [15], Serova E., Shagaydy N., Uzuna V., Ushacheva I., Yakovenko N., P.J. Ericksen, J.S.I. Ingram, D.M. Liverman, (2009) [7] Godfray H.C., Crute I.R., Haddad L. (2010) [11] Bauer W. (1972) [3] etc. Scientific teams of leading scientific institutions are engaged in monitoring, assessing the state of food security in Russia (ARIAPI named after Nikonov, ARSRIACE [20] Institute of Agrarian problems RAS, etc.).

Features of the development of food problems are highlighted in the works of Belaya V., Hanf, J.H. (2016) [4] Pall Z., Perekhozhuk O., Glauben T., Prehn S., Teuber R. [17].

## MATERIALS AND METHODS

Quantitative and qualitative measures of food safety should be highlighted. Most often, researchers turn to the analysis of indicators characterizing the state of agricultural production. Without denying the importance of these indicators, we note that food safety is also shaped by other equally important factors: the technological level of processing and food production, the development of the trading and transport infrastructure of the food market, the income level of the population [14].

In the works of leading Russian scientists the most important problem is designated - the organization of monitoring the state of food security of the Russian Federation and the methodology for such an assessment is developed. As indicators and indicators, it is proposed to use such the level of self-sufficiency (independence) for the most important types of agricultural products, a summary indicator of food independence, the level of rational achievement, energy and nutritional value of the ration, economic accessibility) [21].

Based on this approach, which covers a wide range of indicators, the authors propose to use a comprehensive methodology that includes a limited number of indicators that reflect all aspects of food security: the level of self-sufficiency; coefficient the sufficiency of consumption by main types of food; food availability ratio. The calculations were made for the types of food that are most critical for solving the problems of food security - meat, milk, vegetables.

The coefficient the sufficiency of consumption by type of food is the ratio of the actual volume of consumption to the volume corresponding to rational norms. The proximity of the coefficient the sufficiency of consumption to 1 indicates the optimal level of consumption. And the approach of consumption to the volume established by the

medical requirements of consumption in the minimum consumer basket indicates a critical level of this indicator.

Rational food consumption standards that meet modern requirements for healthy nutrition are the average per capita values of the main food groups in kilograms per capita per year, which take into account the chemical composition and the energy value of food, provide the estimated per capita demand for nutrients and energy, as well as variety of food consumed. Rational consumption of meat and meat products - 73 kg, milk and

dairy products - 325 kg, vegetables - 140 kg [19]. The minimum marginal level of consumption adequacy ratio for Russia in 2018 was: for meat 0.75, for milk 0.9, for vegetables 0.8 (Table 1).

To identify the factors determining the physical and economic accessibility of food, the methods of statistical (regression) analysis are used, making it possible to predict the level of attainment of food safety criteria - to assess the time frame and resource capabilities in the context of "critical" food types.

Table 1. Calculation of the minimum level of consumption adequacy ratio

	Rational consumption rate, kg	Volume in the minimum consumer basket, kg			Minimum level of consumption ratio
		able-bodied population	pensioners	children	
Meat and meat products	73	58.6	54.0	44.0	0.75
Milk and dairy products	325	290	257.8	360.7	0.90
Vegetables	140	114.6	98.0	112.5	0.80

Source: Own determination.

The coefficient the sufficiency of consumption depends on the factors: import, production, consumption, export, the area under crops (or livestock), yield (or productivity).

Food availability ratio is the ratio of the cost of a consumer (food basket) to the average per capita income of a population. Food availability ratio depends on factors:

- the proportion of the population with incomes below the subsistence minimum;
- the consumer price index for food;

- population income index;
- the level of economic activity of the population.

## RESULTS AND DISCUSSIONS

It is necessary to note certain successes in solving one of the tasks of achieving food security - self-sufficiency in basic foodstuffs. The import substitution policy implemented since 2014 has led to a significant reduction in food imports.

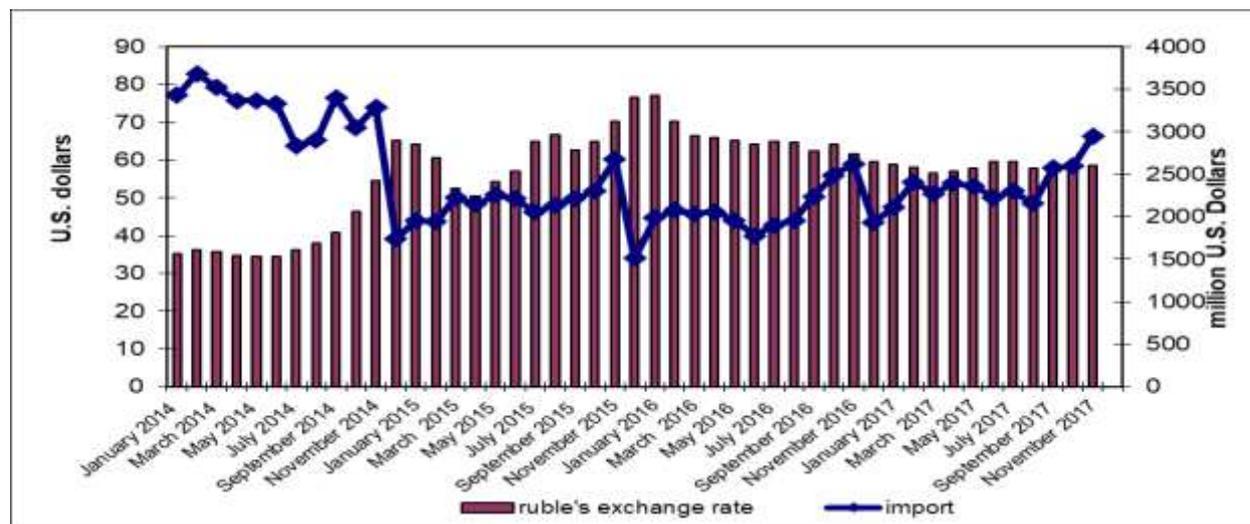


Fig. 1. The dynamics of the ruble exchange rate and the import of food and agricultural raw materials in the Russian Federation in 2014-2017

Source: Own determination.

In 2014, a clear decline in imports was evident, which was associated with the introduction of the food embargo, as well as the weakening of the ruble exchange rate against the currencies of the main trading partners [22].

By the end of 2016, there was a further, even more significant reduction in food imports due to a significant devaluation of the ruble (Fig. 1).

In 2017, imports of food and agricultural raw materials decreased by a third compared with 2013. At the same time, in 2017 compared to 2016, there is an alarming upward trend in imports in dollar terms (by 15%).

Russia continues to be a stable net importer of food and agricultural raw materials. Imports in 2017 exceeded the export almost 1.4 times (Fig. 2).

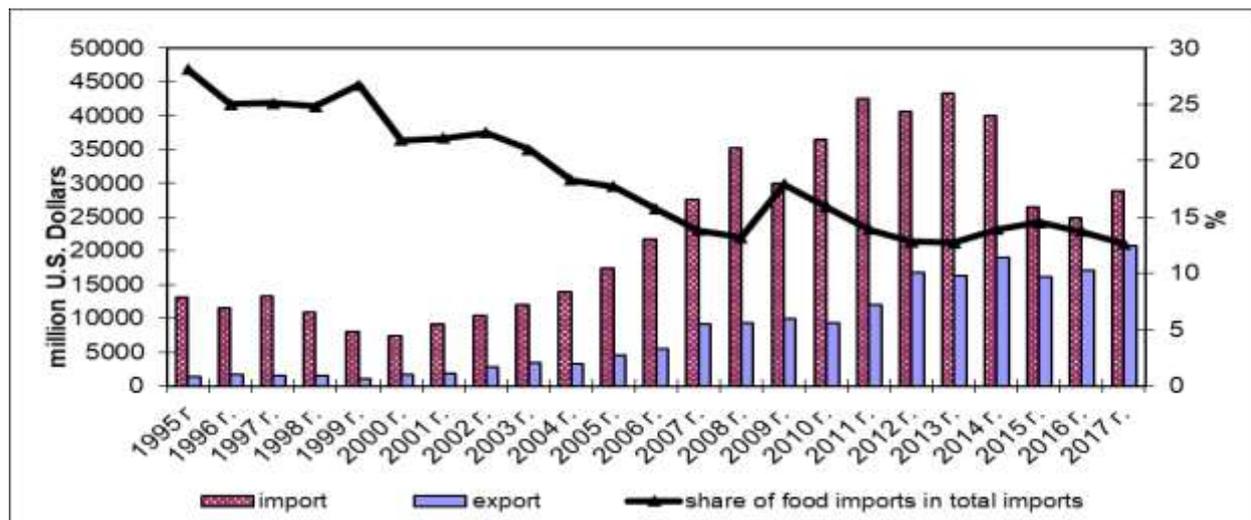


Fig. 2. Dynamics of import and export of food and agricultural raw materials in the Russian Federation in 1995-2017

Source: Own determination.

The share of domestic production of meat and meat products was in 2017 84.4% with a target determined by the Doctrine of Food Security of the Russian Federation at 85%. Almost entirely at the expense of domestic production ensured the consumption of pork, poultry meat. However, significant imports in resources for such types of products as animal butter (24%), cheeses - 27%, vegetables - almost 39%, remain.

If in achieving food independence and increasing self-sufficiency, there are traced, albeit small, positive trends, the situation with the physical and economic accessibility of food has worsened.

The structure of consumption remains inadequate for rational consumption rates. The consumption of milk and dairy products is 71% in relation to the rational rules, vegetables - 76%, fruits and berries - 59%.

The decrease in the import intensity of the agrarian sector was accompanied by a rise in

food prices and an increase in the share of food expenditures in consumer spending of the population (Fig. 3.)

An analysis of the economic affordability of food in foreign countries shows that the higher the level of development of the national food system and the more it is integrated into world economic relations, the smaller the share of food expenditure in the expenditures of the population (no more than 15%). In 2018, the share of expenditures on food in household expenditures was 30%. Food availability naturally depends on the income level of the population. Thus, the cost of food, depending on the level of average per capita disposable resources, by 10 percent (decile) groups of the population differs almost 4 times in 2018 in the first and tenth groups.

Summarizing the analysis of the achievement of food safety criteria, including its various aspects, it should be concluded that there is a

need for more in-depth research of the factors determining the interrelation and mutual

influence of such factors as own production, imports, production resources.

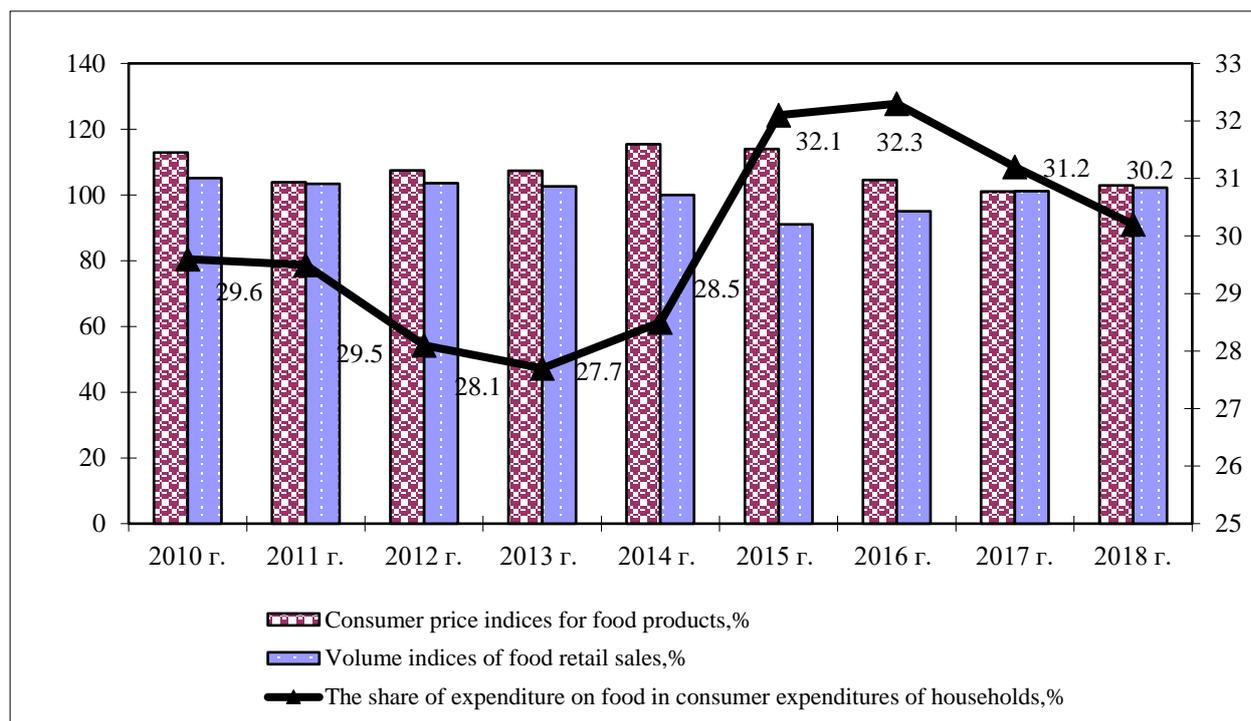


Fig. 3. The dynamics of food prices, retail sales of food products and the share of food expenditures in household consumption expenditures

Source: Own determination.

For this purpose, calculations of the coefficient of sufficiency and availability of food were made using the example of the regions of the Volga Federal District (VFD) of the Russian Federation.

In terms of its development indicators, the VFD agrarian sector is close to the average Russian values. Many regions of the Volga Federal District are characterized by a fairly high level of development of agriculture and food industries. This enables their integration into the national and world food market. At the same time, the VFD regions are significantly differentiated by the standard of living of the population. Against the background of the more prosperous subjects of the Volga Federal District (the Republic of Tatarstan and the Nizhny Novgorod region), the Republic of Mari El, Mordovia, Chuvashia and the Saratov region look more backward.

Data to predict the adequacy of consumption of meat and meat products are given in Table 2.

If, in Russia as a whole, the consumption adequacy ratio is evidence of a completely satisfactory picture, then in the PFD as a whole, as well as in a number of regions (Perm Krai, Kirov, Saratov, and Ulyanovsk Regions), this indicator is lower than one, which indicates an insufficient level meat consumption and meat products. However, the volume of meat consumption does not reach a critical level (0.75) and exceeds the minimum volume provided by the consumer basket.

The application of the regression analysis method to the initial data presented in the table allowed us to obtain the following relationship:

$$\text{Meat} = 1.03 + 0.0014 * X1 - 0.0029 * X2 + 0.0001 * X3 - 0.0007 * X4 - 0.0006 * X5 + 0.0046 * X6,$$

where:

Kmyas. - the coefficient of sufficiency of consumption of meat and meat products;  
 X1- production of meat and meat products per capita, kg;

X2 - the share of import and import in meat resources,%;  
 X3 - cattle livestock per 1000 people. population, heads;  
 X4 - the number of pigs per 1000 people. population, heads;  
 X5 - the number of sheep and goats per 1000 people. population, heads;

X6 - feed consumption per 1 kg of cattle weight gain, feed units.  
 The analysis of the obtained dependence showed that the adequacy of meat consumption is largely determined by the level of its domestic production.

Table 2. Data to predict the adequacy of consumption of meat and meat products

Regions	Sufficiency ratio of meat consumption	Production of meat and meat products per capita, kg	Share of import and import in meat resources,%	Livestock per 1,000 people. population, heads			Feed consumption per 1 kg of cattle weight gain, unit
				Cattle	Pigs	Sheep and goats	
Russian Federation	1.027	70.3	10.4	124.6	157.2	166.1	14.43
Volga Federal District	0.986	70.4	31.8	173.22	120.20	98.88	14.33
Rep. of Bashkortostan	1.068	65.9	22.9	252.97	115.11	201.86	17.16
Mari El Republic	1.301	294.7	5.0	111.02	373.92	55.38	11.71
The Rep. of Mordovia	1.068	265.9	18.0	266.20	444.14	54.48	15.01
Republic of Tatarstan	1.110	84.0	23.3	264.06	118.40	91.69	14.02
Udmurt Republic	0.959	76.9	17.3	227.65	147.65	51.06	11.91
Chuvash Republic	0.932	68.8	30.9	156.48	115.61	136.24	11.08
Perm region	0.863	27.2	59.2	90.94	52.14	29.95	13.18
Kirov region	0.918	42.6	47.7	186.60	152.12	32.72	11.41
Nizhny Novgorod Region	1.096	32.6	55.5	80.34	52.55	22.15	15.96
Orenburg region	0.959	72.2	27.5	285.71	142.30	165.72	17.74
Penza region	1.027	163.8	21.6	124.61	152.08	80.30	14.50
Samara region	0.904	35.2	48.5	71.36	52.33	45.98	18.86
Saratov region	0.808	49.7	42.1	171.37	114.21	228.64	16.52
Ulyanovsk region	0.863	34.0	50.4	94.71	167.61	64.48	13.53

Source: Own determination.

At the same time, an increase in the share of imports in meat resources negatively affects the availability of this product. The ruble, which sharply depreciated during this period, made imported products low-margin for processors and the HoReCa segment, which led to a decrease in its consumption. One should also take into account the fact that the prices of imported raw meat from those countries that fell under the embargo were, as a rule, lower than from the countries that ultimately remained in the list of importers. In this regard, a higher share of imports in the resources of meat and meat products indirectly affects the level of consumption. A

further possible reduction in the share of imports in the resources of meat and meat products will not have a significant impact on domestic consumption, since, unlike in previous years, it will not lead to price increases, given the increase in competition between domestic producers of poultry meat and pork.

Thus, the achievement of the criteria for the adequacy of the consumption of meat and meat products, taking into account the rational and actually established structure of consumption of meat products, is due to the growth of domestic production of beef. This circumstance should be taken into account

when justifying the priority directions of development of the meat-and-food subcomplex of Russia, to which should be included the increase in the number of cattle (cattle), the optimization of feeding rations. The level of sufficiency in meat consumption is most sensitive to the growth of the cattle population (Table 3). Growth in the number of pigs is less significant due to the relatively high rates of industry development and saturation of the domestic market in recent years, and sheep and goats due to the

insignificant share in the structure of consumed meat products.

The analysis revealed that to ensure full sufficiency of meat consumption for the population of the Volga Federal District, an additional production growth will be required in the amount of 296.4 thousand tons, which will be 14% compared to 2017. With the current growth rates of meat production (livestock and poultry in slaughter weight) in 1.8% per year it will require more than 7 years.

Table 3. Analysis of the sensitivity of the adequacy of meat consumption

	Production of meat and meat products per capita, kg	Share of import and import in meat resources, %	Livestock per 1,000 people. population, heads			Feed consumption per 1 kg of cattle weight gain, unit
			Cattle	pigs	Sheep and goats	
Regression coefficient	0.0014	-0.0029	0.0001	-0.0007	-0.0006	0.0046
Elasticity coefficient	0.1053	-0.0981	0.0216	-0.1102	-0.0543	0.0672

Source: Own determination.

An equally important problem is the achievement of the physical availability of milk and dairy products for the population

[18]. Data to predict the adequacy of the consumption of milk and dairy products are presented in Table 4.

Table 4. Data to predict the adequacy of the consumption of milk and dairy products

Regions	The ratio of the consumption of milk	Production of milk and dairy products per capita, kg	The share of import and import in the resources of milk, %	The number of cows per 1,000 people. population, heads	Feed consumption per 1 quintal of milk, feed units
Russian Federation	0.711	205.6	18.7	54.2	1.05
Volga Federal District	0.818	315.54	16.50	69.31	1.06
Republic of Bashkortostan	0.923	395.76	2.30	97.60	1.16
Mari El Republic	0.732	250.50	13.40	45.28	1.04
The Republic of Mordovia	0.769	520.02	3.90	94.06	1.01
Republic of Tatarstan	1.114	469.42	8.40	91.16	1.15
Udmurt Republic	0.818	503.32	10.90	88.85	0.98
Chuvash Republic	0.778	336.81	13.60	71.20	0.98
Perm region	0.708	183.64	41.30	38.99	1.04
Kirov region	0.815	497.22	4.30	73.92	0.88
Nizhny Novgorod Region	0.723	185.62	38.30	34.95	1.12
Orenburg region	0.932	355.88	5.10	123.14	1.08
Penza region	0.615	256.07	13.60	53.20	0.95
Samara region	0.748	141.78	47.40	33.69	1.06
Saratov region	0.711	287.16	14.20	76.93	1.28
Ulyanovsk region	0.628	159.86	28.80	37.06	0.82

Source: Own determination

As can be seen from the table, the level of sufficiency of consumption for milk and dairy products in both Russia and the PFD regions is generally lower than one, and 11 regions of the PFD reach a critical value (0.9). Compared to the consumption of meat and meat products, the situation with the consumption of milk and dairy products is characterized as more acute.

The application of the regression analysis method to the initial data presented in the table allowed us to obtain the following relationship:

$$Q_{mol.} = 0.102 + 0.0005 * X1 + 0.0035 * X2 + 0.0026 * X3 + 0.278 * X4,$$

where:

$Q_{mol.}$  - the coefficient of sufficiency of

consumption of milk and dairy products;  
 $X1$  - milk production per capita, kg;  
 $X2$  - the proportion of import and import in milk resources,%;  
 $X3$  is the number of cows per 1,000 people. population, heads;  
 $X4$  - feed consumption per 1 kg of milk, feed units

The level of sufficiency of consumption of milk and dairy products is also the most sensitive to the increase in milk production, which, in turn, depends on the number of cows and the technology used for the production of milk. The factor of growth in imports in milk resources, although it can affect the sufficiency of milk consumption, has a sensitivity of 2.5 lower than the growth factor of its own production (Table 5).

Table 5. Analysis of the sensitivity of the adequacy of milk consumption

	Production of milk and dairy products per capita, kg	Share of import and import in milk resources,%	The number of cows per 1,000 people. population, heads	Feed consumption per 1 kg of milk, feed units
Regression coefficient	0.0005	0.0035	0.00265	0.2781
Elasticity coefficient	0.1953	0.0786	0.2305	0.367

Source: Own determination.

In order to ensure the required level of sufficiency in the consumption of milk and dairy products, the volume of domestic production of milk must be increased to 11,035 thousand tons, or by 18%. However, the achievement of such indicators looks problematic against the background of declining livestock of cows (1.1% in PFD for 2017) and taking into account the current growth rates of milk production (1% in PFD in 2017). Extrapolation of the dynamics of milk production indicates that this will require more than 17 years. The way out of this situation can be an increase in the growth rate of the livestock of cows, an increase in productivity, the introduction of innovative technologies in the dairy-food subcomplex.

Dairy products and vegetables are the only categories whose consumption in Russia is lower than rational norms. A significant problem is the unbalanced diet of Russians, in particular, the low proportion of fruits and vegetables. In 2017, the consumption of

vegetables by residents of the Russian Federation was 107 kg, while the recommended rate was 140 kg. Data to predict the adequacy of vegetable consumption is presented in Table 6.

In almost all regions of the Volga Federal District, the coefficient of sufficiency of consumption is below the minimum level (0.8). The analysis showed a high level of differentiation of per capita production of vegetables, even within the VFD. Thus, the production of vegetables in the Orenburg region in 2017 exceeded the level of the Perm Territory by almost 8 times. The share of areas occupied by vegetable crops, rarely exceeds 1% in the structure of the sown areas of the Volga Federal district regions.

The application of the regression analysis method to the initial data presented in the table allowed us to obtain the following relationship:

$$Cove. = 0.19 + 0.0013 * X1 + 0.126 * X2 - 0.0007 * X3 + 0.0014 * X4 - 0.0006 * X5,$$

where:

Cove. - the coefficient of sufficiency of consumption of vegetables;  
 X1- production of vegetables per capita, kg;  
 X2 - the proportion of the sown area of vegetables,%;

X3 is the specific weight of import and import in resources of vegetables,%;  
 X4 - yield of vegetables, kg / ha;  
 X5 - application of mineral fertilizers per 100% of nutrients, kg.

Table 6. Data for predicting the adequacy of vegetable consumption

Regions	Sufficiency ratio of vegetable consumption	Production of vegetables per capita, kg	The proportion of sown area of vegetables,%	The share of import and import in the resources of vegetables, %	The yield of vegetables. centers per hectare	Application of mineral fertilizers per 100% nutrients, kg
Russian Federation	0.764	105.1	0.668	8.1	241	55
Volga Federal District	0.736	115.1	0.409	10.2	253	32.1
Republic of Bashkortostan	0.543	74.0	0.356	14.2	210	25.9
Mari El Republic	0.950	152.8	1.231	1.7	294	19.7
The Republic of Mordovia	0.629	111.1	0.684	3.4	159	68.1
Republic of Tatarstan	0.707	88.0	0.327	18.6	287	64.6
Udmurt Republic	0.807	89.1	0.415	4.2	319	19.9
Chuvash Republic	0.764	98.5	0.738	12.1	288	38.3
Perm region	0.721	52.5	0.650	17.8	293	17
Kirov region	0.757	60.3	0.281	26.4	314	27.6
Nizhny Novgorod Region	0.607	61.8	0.600	12.6	284	41.3
Orenburg Region	1.121	408.5	0.144	4.3	284	2.5
Penza region	0.679	121.5	0.500	1.6	230	63.2
Samara region	0.829	92.4	0.573	9.2	249	23.9
Saratov region	0.750	193.4	0.415	5.6	216	9.9
Ulyanovsk region	0.779	118.2	0.516	10.1	258	33.8

Source: Own determination.

Studies have shown that to achieve even the minimum sufficiency limit for vegetable consumption, it is necessary to increase their production in the Volga Federal District by 1,512.4 thousand tons (by 44% compared to the level of 2017). Providing such growth in the current situation in the vegetable subcomplex will require about 13 years. The sensitivity analysis of the level of sufficiency of vegetable consumption (Table 7) revealed that the main factor in increasing production volumes is the yield of vegetables.

It should be noted that the vegetable production market in Russia is formed mainly due to domestic production. The level of self-sufficiency in vegetables was 93.7%. Thus, we can draw the following conclusion. Ensuring the sufficient accuracy of consumption of such products as meat and meat products, milk and dairy products, vegetables directly depends on the increase in domestic production. However, the long period required to achieve the target indicators for the development of its own production

does not allow completely abandoning food imports. It should be noted that the availability of physical availability or sufficiency of consumption does not always mean the economic affordability of food.

According to the authors, the coefficient of food accessibility can be estimated as a share

of food expenditures in household consumption expenditures. The availability of food depends on factors: the share of the population with incomes below the subsistence minimum, the consumer price index for food, the income index of the population.

Table 7. Analysis of the sensitivity of the adequacy of consumption of vegetables

	Production of vegetables per capita, kg	The proportion of the sown area of vegetables,%	The share of imports and imports in the resources of vegetables,%	The yield of vegetables, centers per hectare	Application of mineral fertilizers per 100% nutrients, kg
Regression coefficient	0.0013	0.126	-0.0007	0.0014	-0.0006
Elasticity coefficient	0.2034	0.0867	-0.0096	0.4963	-0.0279

Source: Own determination.

To assess the impact of the sectoral structure of the regional economy, it is proposed to

include in the system of indicators the share of agriculture in GRP (Table 8).

Table 8. Data to predict the availability of food

Regions	The coefficient of availability (the share of food costs),%	Index of per capita income,%	Population with incomes below the subsistence minimum,%	The share of agricultural products in the GRP,%	Consumer price index for food products,%
Russian Federation	34.3	97.85	13.2	5.2	101.1
Volga Federal District	34.2	99.37	13.3	8.3	100.3
Republic of Bashkortostan	34.5	98.92	12.3	10.4	100.6
Mari El Republic	36.1	98.19	22.1	19.4	100.3
The Republic of Mordovia	41.4	97.97	18.6	20.2	100.5
Republic of Tatarstan	29.7	102.82	7.4	7.8	101.3
Udmurt Republic	30.9	99.82	12.2	6.8	100.0
Chuvash Republic	39.3	99.92	18.5	13.7	99.1
Perm region	31.4	99.13	14.9	3.3	100.2
Kirov region	35.2	98.81	15.7	16.4	99.9
Nizhny Novgorod Region	32.3	99.58	9.9	5.5	100.4
Orenburg region	32.2	97.12	14.6	8.8	100.7
Penza region	40.4	97.34	14.0	13.3	100.6
Samara region	34.4	99.30	13.4	4.5	99.5
Saratov region	43.9	97.91	16.8	15.0	99.0
Ulyanovsk region	39.0	97.20	14.9	10.9	101.4

Source: Own determination.

As a negative trend, it should be noted that the pace of growth in food prices is higher than the growth rate of incomes of the population. The most favorable situation in the Volga Federal District has developed only in

Tatarstan, where income growth (102.82%) outpaces price growth (101.3%). The same region demonstrates the best indicator of the economic affordability of food products: the share of food expenditures in the cost

structure is 29.7%. The differentiation of this indicator by regions of the Volga Federal District is significant - the gap between the limit values is about 1.5 (as in the Saratov region, the population spends almost 44% on food).

The application of the regression analysis method to the initial data presented in the table allowed us to obtain the following relationship:

$$Dost = 105,998 - 0,296 * X1 + 0,0074 * X2 + 0,3016 * X3 - 0,6628 * X4,$$

where:

Dost - the coefficient of availability (the share of food costs in the cost),%;

X1 is the index of per capita income,%;

X2 - population with incomes below the subsistence minimum,%;

X3 is the specific weight of agriculture in GRP,%;

X4 - consumer price index for food products,%.

As can be seen from Table 9, the per capita income index is more influenced by the availability of food. The growth of average per capita incomes of only 1% will lead to a reduction in the cost of food in the structure of household consumption expenditures by 0.82%.

Table 9. Analysis of the sensitivity of food availability

	Index of per capita income,%	Population with incomes below the subsistence minimum,%	The share of agricultural products in the GRP,%	Consumer price index for food products,%
The coefficient of pair correlation with food availability	0.5472	0.61434	0.69292	0.34635
Regression coefficient	-0.296	0.0074	0.3016	-0.6628
Elasticity coefficient	-0.8206	0.00302	0.0926	-1.8634

Source: Own determination

The analysis revealed the following pattern: in regions with a relatively high level of agricultural development and, accordingly, with a high proportion of agricultural products in GRP, the economic accessibility of food is lower. This can be explained by lower wages in the agricultural sector. Paradoxically, food availability depends on the consumer price index for food: a rise in the price index leads to a decrease in the share of food expenditures in the expenditure structure. This is due to the switching of consumer demand (especially among low-income groups of the population) to cheaper and lower-quality food, which represents a significant threat to the achievement of food security.

Studies have shown that the development of regional agro-food systems does not always ensure the achievement of all the criteria for food security, including the physical and economic accessibility of food. Thus, the Republic of Tatarstan is characterized by a

high level of physical and economic accessibility (Fig. 4).

For a number of subjects of the Volga Federal District, against the background of relatively low physical availability of food, high economic affordability was recorded (Perm Territory, Nizhny Novgorod and Samara Regions, the Republic of Bashkortostan, etc.). The application of the regression analysis method allowed us to reveal the interrelation between the indicators of physical and economic accessibility of food and to establish that with a reduction of 1 percentage point the share of food expenditure in the household expenditure structure increases the food consumption sufficiency ratio by 0.945.

Bringing the level of consumption of basic foodstuffs (meat, milk, vegetables) to the level recommended by rational food consumption standards will require a significant reduction in poverty and a corresponding reduction in the share of food expenditures in the household expenditure structure.

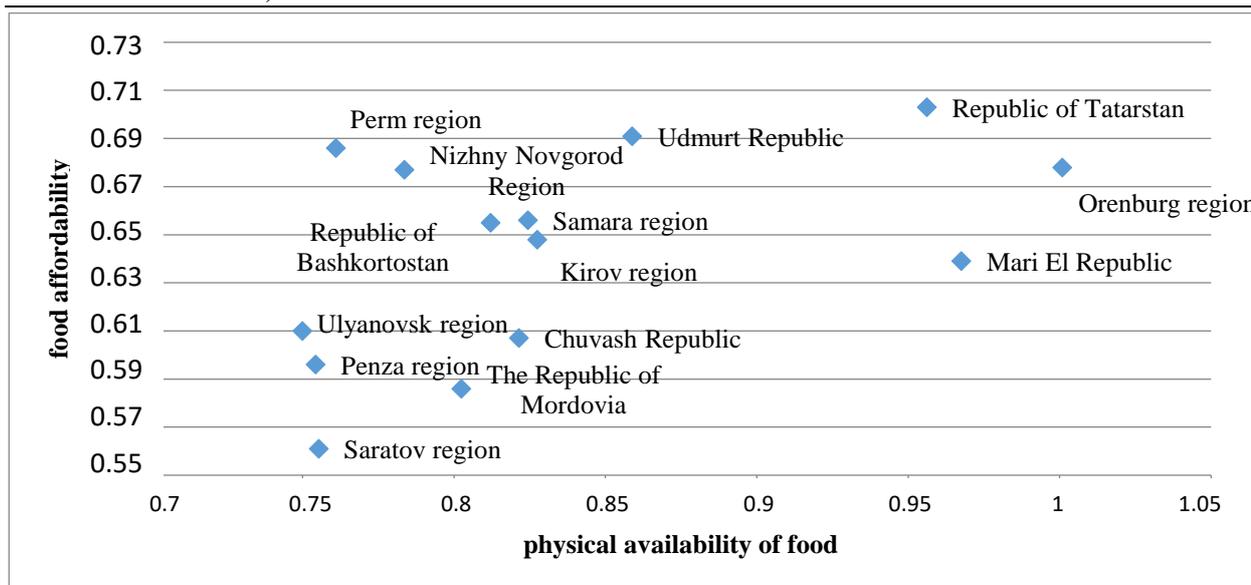


Fig. 4. Grouping of regions of the Volga Federal District by components of food security  
 Source: Own determination.

If in 2017, on average, in the regions of the Volga Federal District, the share of food expenditures was 34.2%, then the decrease of this indicator is 17 pp. will improve the physical availability of food in accordance with modern requirements of healthy nutrition.

## CONCLUSIONS

The study revealed the complex nature of food safety issues. Achieving food security involves achieving both physical and economic accessibility of food.

To identify the factors that determine the physical and economic accessibility of food products, we used regression analysis methods that allowed us to predict the level of attainment of food safety criteria — assess time frames and resource opportunities in terms of “critical” food types.

The analysis showed that physical accessibility or the level of adequacy of consumption depends on a number of factors: import (import) of food, production volumes, level of consumption of main types of food, factors of resource potential (area under crops, livestock, yield, productivity).

The calculations show that ensuring the adequacy of consumption of such products as meat and meat products, milk and dairy products, vegetables directly depends on the increase in domestic production. However, the

long period required to achieve the target indicators of the development of its own production does not allow completely to abandon food imports. It should be noted that the availability of physical availability or sufficiency of consumption does not always mean the economic affordability of food.

The economic affordability of food is estimated on the basis of the calculation of the ratio of food availability — the ratio of the cost of a consumer (food basket) to the average per capita income of the population. The food availability ratio depends on a system of factors: poverty level, price dynamics, and consumer incomes.

The study revealed a significant differentiation of the regions of the Volga Federal District: in terms of the physical availability of food, the difference between the maximum and minimum levels is 33%; on economic affordability respectively 25%. Solving the problem of the economic accessibility of food depends largely on the state’s social policy, which provides for an increase in the quality of life of the population and a reduction in the level of poverty. For this, it is necessary to improve the mechanisms of targeted social protection of the population, including the provision of direct food aid, the implementation of measures to protect against inflation, the development of social contracting practices,

which will increase the real disposable income of the population.

It is important to ensure a reduction in the proportion of the population with incomes below the pro-subsistence minimum. This is impossible without an increase in real incomes of the population, which can be facilitated by a set of measures: the use of a progressive tax scale; introduction of a system of inter-sectoral wage regulation. The optimal level of sufficiency of consumption and economic availability of food for the population can be achieved through joint efforts of the state and business.

Taking into account the identified interrelations, the key areas of agro-food policy in the Volga Federal District should be: stimulating the growth of own production through the use of innovative technologies in meat and dairy cattle breeding; Overcoming the trends in the decline of livestock of cattle and increasing its productivity, developing production technologies, storage, processing, wholesale and retail trade in food, ensuring stable and even consumption for all social groups of the population in volumes that meet scientifically based medical standards.

The implementation of these areas of agricultural and food policy will contribute to the development of the agrarian sector, based on the rational use of existing resource potential. This will make it possible to solve the problem of the stable provision of the population with economically accessible food products of domestic production, raise the standard of living of the population of the country, strengthen the economic and geopolitical position of Russia in the world.

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## REFERENCES

- [1]Altukhov, A., Semin, A., 2018, Increasing interstate integration in the agro-industrial complex of the EAEU Countries, *European Research Studies Journal*. Volume XXI. Issue 2., pp. 753-771.
- [2]Anfinogentova, A.A., Dudin, M.N., Lyasnikov, N.V., Protsenko, O.D., 2017, Methodology for assessing the quality of the activities of agricultural enterprises based on an environmentally responsible approach, *Economy of the region*. 2017., Vol. 2., pp. 579-590.
- [3]Bauer, W., 1972, Import Substitution and Industrialization in Latin America: Experiences and Interpretations, *Latin American Research Review*, Vol. 7 (1):95-122.
- [4]Belaya, V., Hanf, J.H., 2016, Conflict resolution in vertical collaborations in the agri-food sector, *Journal of Food Systems Dynamic*, Vol.7(1):24-35.
- [5]Derunova, E., Andryushenko, S., Gerchikova, E., Firsova, A., Derunov, V., 2018, Monitoring of innovative activities effectiveness in agriculture. *Scientific Papers. Series "Management, Economic Engineering in Agriculture and rural development"*, Vol. 18(3): 89-100.
- [6]Derunova, E., Semenov, A., Balash, O., Firsova, A., 2016, The Mechanisms of Demand Formation in the High-Tech Products Market, *International Journal of Economics and Financial*, 6 (1):96-102.
- [7]Ericksen, P.J., Ingram, J.S.I., Liverman, D.M., 2009, Food security and global environmental change emerging challenges, *Environmental Science and Policy*, Vol. 12, 373-377.
- [8]FAO, IFAD, UNICEF, WFP, WHO, 2017, The state of food security and nutrition in the world - 2017. Improving resilience to external influences in order to ensure peace and food security. Rome, FAO.
- [9]FAO's strategic work to ensure the inclusiveness and efficiency of food systems, <http://www.fao.org/about/what-we-do/so4/ru/>, Accessed on February 1, 2019.
- [10]FAO's strategic work to help fight hunger and malnutrition. Eradicating hunger, fighting food insecurity and malnutrition during the current generation, <http://www.fao.org/home/en/>, Accessed on February3, 2019.
- [11]Godfray, H.C., Crute, I.R., Haddad, L., 2010, The future of Global food system, *Philosophical Transactions of the Royal Society B: Biological Sciences/ Phil. Trans. R. Soc.* 365(1554), 2769-2777.
- [12]Golubev, A.V., 2017, New trends in the development of the agrarian economy of Russia, *Economics of agricultural and processing enterprises*. 2017, No. 3, pp. 8–12.
- [13]Kireeva, N. A., Prushchak, O. V., Sukhorukova, A. M., 2018, Agro-food system of the region: evolution, problems, prospects of development. Saratov: Saratov socio-economic Institute (branch) of Plekhanov Russian University of Economics.
- [14]Kireeva, N.A., Baryshnikova, N.A., Sukhorukova, A.M., 2018, National priorities vs. economic advisability: search of Russian integration limits into

- the world food market, *Advances in Economics, Business and Management Research*, Vol. 61, 286-290.
- [15]Krylatykh, E. N., Belova, T. N., 2018, Russian grain exports in the context of the formation of regional economic policy, *Economy of the region*. No 14(3), pp. 778-790.
- [16]Kuznetsov, N.I., Ukolova, N.V., Monakhov, S.V., Shikhanova, Ju. A., 2017, Provisions for effective development of regional agricultural systems in Russia's economy, *Journal of Advanced Research in Law and Economics*, VIII (2(24)):490-495.
- [17]Pall, Z., Perekhozhuk, O., Glauben, T., Prehn, S., Teuber, R., 2014, Residual demand measures of market power of Russian wheat exporters, *Agricultural Economics*, Vol. 45 (3):381–391.
- [18]Popescu Agatha, 2016, The milk market concentration and competition thresholds in Romania, *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development*, Vol.16(2):247-253.
- [19]Recommendations for rational food consumption standards that meet modern requirements for healthy nutrition (approved by the order of the Ministry of Health of the Russian Federation dated August 19, 2016 No. 614 ), GARANT.RU: <http://www.garant.ru/products/ipo/prime/doc/71385784/#ixzz5aa80BWgj/>, Accessed on February 3, 2019.
- [20]Sandu, I.S., Veselovsky, M. Ya., Fedotov, A.V., Semenova, E.I., Doshchanova, A.I., 2015, Methodological aspects of social and economic efficiency of the regional activities. *Journal of Advanced Research in Law and Economics*, № 6(3), 650-659.
- [21]Shagayda, N.I., Uzun, V.Ya., 2015, Food security in Russia: monitoring, trends, threats. RANEPА, M.
- [22]Yakovenko, N. A., 2016, Competitive potential of the agri-food complex of Russia as a basis for ensuring the country's food security, *Economics and Management*. No. 10 (132):4-12.

## ASSESSMENT OF THE SYSTEM OF ALLOCATION OF SUBVENTIONS AND SUBSIDIES AND THEIR IMPACT ON THE DEVELOPMENT OF RURAL TERRITORIES

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### **Abstract**

*It was found that a rapid decrease in the population, monopolization of agricultural and other production in rural areas leads to a decrease in local budget revenues, which makes it impossible to maintain its own infrastructure at the proper level. It is proved that rational, aimed at the economic development allocation of subventions and subsidies, their distribution among rural communities, and the most important areas of funding will solve this problem. In view of this, the system of distribution of subventions and subsidies funds of the Ukrainian government for local budgets between the UTCs budgets and expenditure purposes (only UAH 1 billion or 2.8% of the total funds is spent on the development of UTCs) is analysed. It is substantiated that the system of allocation of subventions and subsidies and their distribution among rural communities have a positive impact on the change of indicators of sustainable development of rural territories. We propose a methodology for calculating the necessary level of average annual growth of the community budget in order to reach the current level of expenditures by own revenues. Taking into account the results obtained, it is found that for most communities budget revenues have to grow 6.9-10.0% annually, the financing of programs of economic development of the UTCs will require a significant increase, which will allow communities to achieve economic growth.*

**Key words:** *subventions, subsidies, rural areas, sustainable development indicators, local budgets, economic development programs, local self-government*

### **INTRODUCTION**

Nowadays the process of decentralization and associated formation of united territorial communities in rural areas is continuing in Ukraine. Undoubtedly, the priority in the implementation of decentralization of power is given to the redistribution of most powers in the management of finance and natural resources within the territories of territorial communities. Local community social and technical infrastructure management is transferred to the communities of rural areas, so they have to finance the construction and maintenance of this infrastructure in an appropriate condition. In other words: more power freedom – more financial responsibility. The goal of decentralization is

to create the right preconditions for the formation of self-sufficient communities. 876 united territorial communities were already formed (stand 10.01.2019) [9].

The overall dynamics of the formation of united territorial communities in 2015-2018 is generally stable and amounts to more than 200 UTCs per year on average. This process is set up in 2015, which resulted in the creation of 159 UTCs, and in 2016 another 207 was added. In order to more effectively assess different aspects of community development, we chose some communities, which have been formed in 2015-2016, as statistics for them is available for longer period (2016-2018).

The Government of Ukraine presents processes of decentralization of power and the

formation of united territorial communities, that is, the unification (consolidation) of existing village, settlement and city councils as a single process. There is a denial: legally it is worth dividing these processes. After all, financial and fiscal decentralization and the expansion of managerial powers, in our opinion, are crucial components of the reform and in no way depend on the process of uniting communities from the legal point of view. This is confirmed by the fact that amendments to the Budget and Land Codes of Ukraine, other laws are equally valid for both UTC and village, settlement and city councils. However, a rapid decline in the population of rural regions, monopolization of agricultural and other production leads to a decline in local budget revenues. It is a pity, but under such circumstances it is impossible to maintain its own infrastructure at the proper level. The reality of the situation has prompted the Cabinet of Ministers of Ukraine (CMU) to determine the procedure for granting subventions to the newly formed UTCs for the development of infrastructure within the territories of newly formed communities (Cabinet of Ministers of Ukraine Resolution № 200 of 16.03.2016 was adopted) [3].

This decision is intended to stimulate the process of community consolidation, since the subventions provided by the Government of Ukraine will serve as a significant replenishment of the community budget. However, subventions are distributed among communities in pre-determined amounts, but community funding can only be provided for the implementation of specific projects or can be used only with specific purpose.

**The purpose of our case study** is to provide a general analysis of the allocation system of subventions and subsidies, their distribution among rural communities, and the most important areas of financing, and then determine if they have a positive impact on the change of indicators of sustainable development of rural areas, and to calculate, according to the method proposed by us, the necessary average annual level growth of the community budget in order to reach the

current level of expenditures by own revenues.

In the process of studying the existing experience, we have **reviewed the literature** on rural development and analysed the main factors contributing to the development of the rural territories.

Hohol T. (2011) in her work is studying the multifunctional development of rural areas, which concludes the need to avoid a dominance of employment of rural areas inhabitants in the agricultural sector [5]

Malik M. and Pulim V. (2009) in their study of the development of rural areas come to the conclusion that it is necessary to build a concept of development around the development of entrepreneurship and strengthening the role of local self-government [6].

John Bryden (2011) in his work defines the main indicators of the development of rural territories used in the European Union, describes their evolution and analyses their effectiveness [2].

## MATERIALS AND METHODS

During this study, we used the data of state statistical reporting, legislative acts, materials of other scientific studies, tangent to the chosen direction of research. In particular, materials for monitoring the process of decentralization of power and local self-government reform, which is being carried out by the Ministry of Regional Development, Construction, Housing and Communal Services of Ukraine [9]. This monitoring is a unique source of statistical data, on the basis of which a large amount of information concerning the process of decentralization of power can be analysed.

We have acquainted in detail with the practice of subvention distribution system and its influence on the formation and development of the infrastructure of the united territorial communities in 2016-2017, carried out by the office of financial and economic analysis of the Verkhovna Rada of Ukraine [11]. The effectiveness of the study was influenced by the information on the assessment of financial sufficiency of 366 UTCs in 2017, carried out

with the support of the program "U-LEAD with Europe" [8].

In the worked-out materials the importance and necessity of allocating subventions for the formation of the UTC infrastructure and its economic development is indicated.

Based on this, we have analysed the system of distribution of funds between UTCs in the framework of providing subventions, the effectiveness of their use and use of other types of financial assistance to communities, which is transferred from the state budget, as well as the share of these subsidies in the community budget.

For this purpose, the following indexes are selected for our calculations: UTC area, UTC population, community budget, share of subsidized funds (including subventions), own budget revenues, expenditures per inhabitant. The goal is to calculate the necessary growth level of own budget revenues for the next 5 years in order to achieve self-sufficiency, in other words to cover the current level of expenditures by own revenues. In our analysis we paid attention to the communities that are trying to fill local budgets by themselves, so the growing ones, and depressive ones. An important aspect in the analysis is to determine whether there is a possibility of using subventions and other subsidies for development, rather than for maintenance.

In order to calculate the necessary level of growth of own budget revenues for the next 5 years in the community, we determine the share of subsidies in its budget, which are received through state funding programs of the UTCs, and accordingly are not protected by legislative requirements (such as road funds) and we calculate the rate of compound interest, as we know a value of budget revenues (with the exception of subventive and subsidized funds received under the programs of the Cabinet of Ministers of Ukraine), the current level of budget expenditures, which we want to achieve in defined period of time. This value must be achieved within 5 years. That is why the inverse formula for calculating a compound interest is used. We propose to calculate the necessary annual growth of the budget revenues using to the following formula:

$$i = \sqrt[n]{\frac{B'}{B}} - 1 \quad (1)$$

where:

$i$  – average annual growth of own budget revenues;

$B'$  – necessary amount of own budget revenues at the end of the period (current budget expenditures);

$B$  – existing level of own budget revenues;

$n$  – number of years;

The size of the subventions and other subsidies provided to each community in accordance with the Resolution of the Cabinet of Ministers of Ukraine № 200 of 16.03.2016 is determined by the following formula:

$$V' = Vx\left(\frac{X'}{X} + \frac{Y'}{Y}\right)/2 \quad (2)$$

where:

$V'$  – volume of subventions of the united territorial community;

$V$  – total amount of subventions distributed between UTCs;

$X'$  – number of inhabitants in rural united territorial community;

$X$  – number of inhabitants in all rural united territorial communities;

$Y'$  – area of territory of the united territorial community;

$Y$  – area of territory of all united territorial communities [3].

That is, subventions and other subsidies for rural areas are allocated according to the size and number of populations of the united territorial communities established in rural areas.

## RESULTS AND DISCUSSIONS

Based on the achievements of Ukrainian and European scholars, we have identified the most important indicators of local self-government development in Ukraine and their financial strength. For the formation of a list of indicators in particular the works of John Bryden were also used, as they are marked by the depth of research and informativity. We believe that the defining indicators of rural development are:

- Multifunctionality and diversification of production;
- Business activity growth;
- availability of programs to support the initiatives of the local people;
- availability of jobs;
- social and environmental safety;
- social and technical infrastructure;
- autonomy (financial, energy production, water supply...);
- tourism development in the region (community).

To improve these indicators, both local self-government bodies and the government of Ukraine should wisely use the available programs of financing the development of united territorial communities.

The Cabinet of Ministers of Ukraine, through a system of subventions and subsidies, provides funds for development of the united territorial communities. The total amount of financing planned by the Cabinet of Ministers is ₴35.45 bln (€1.10 bln) [9]. We used the exchange ratio of 32,14 ₴/€ (UAH/EUR) as an average ration in 2018 based of statistical data of National Bank of Ukraine [10]. The distribution of these funds accordingly to funding programs and, the purpose of funds is shown in Fig.1.

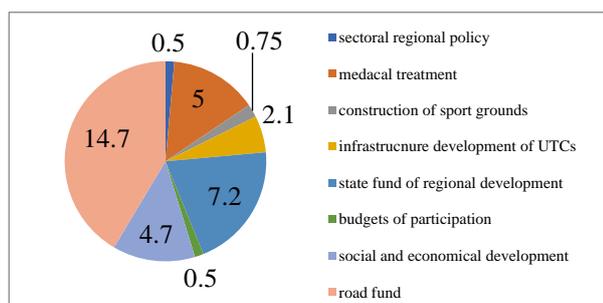


Fig.1. Distribution of funds of the state budget according to the programs of state financing (purpose), UAH bln.

Source: Ministry of Regional Development, Construction, Housing and Communal Services of Ukraine (stand 10.01.2019).

It should be noted that the funds allocated from the road fund are protected by the law of Ukraine "On sources of financing of roads of Ukraine", so they have to be transferred to the local budgets and therefore, when estimating the potential growth of the budget for a certain period, will not be considered as additional

financing, which must be compensated by an increase in communities own budget revenues [12]. The vast majority of other local budget expenditures, which are covered by government subventions and subsidies according to the goals of reform, should in the long run be covered by own revenues of local budgets.

Analysing the available statistical information, we noticed that the growth of subventions and subsidies total volume is not proportional to the growth of the number of formed united territorial communities in terms of years. For example, let's take a look at the volume dynamics of the subvention for the development of the UTCs infrastructure for 2016-2019 (Fig. 2), as well as the dynamics of the growth of the number of united territorial communities (Fig. 3). Data for 2019 is a forecast of CMU [9].

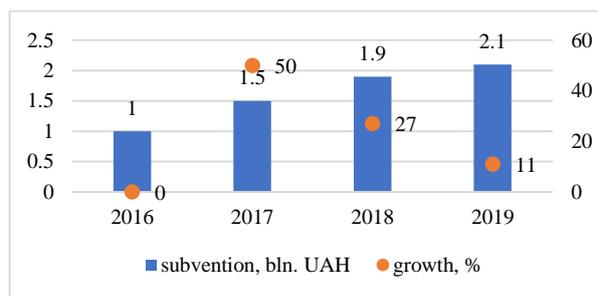


Fig.2. Volume dynamics of the subvention for the development of the UTCs infrastructure for 2016-2019  
 Source: Ministry of Regional Development, Construction, Housing and Communal Services of Ukraine (stand 10.01.2019).

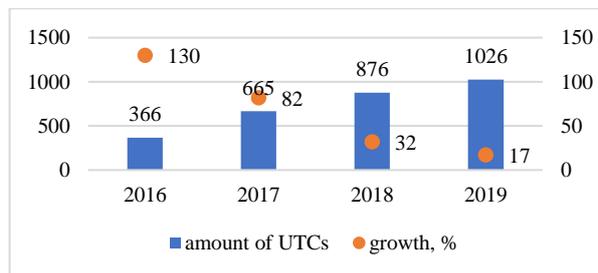


Fig.3. Dynamics of the growth of the number of united territorial communities for 2016-2019  
 Source: Ministry of Regional Development, Construction, Housing and Communal Services of Ukraine (stand 10.01.2019).

The increase in the number of UTCs exceeds the increase of the subventions volume. It means that the amount of the subventions for the development of UTCs infrastructure per community decreases each year, namely

decreasing from €2.73 mln. in 2016 to €2.05 mln. in 2019 (forecast). Taking into account the recently registered draft law of Ukraine number 8,213 we can see, that after 2019 and within the next five years the size of the state subvention for the formation of the infrastructure of the UTC will decrease annually for five years. Other subventions and subsidies from the state budget will suffer the same fate [4]. That is why we decided to calculate for the necessary annual growth of the UTCs budgets, which will allow to bring its own revenues to the level of current expenses in five years. It is important to note that budget transfers from the road fund will be taken into account as community own

revenues. The subsidy for roads construction and maintenance is about 42% of the total amount of subventions and subsidies transferred to local budgets.

The results of our calculations are given in Table 1. Communities are given and this study was selected on the following criteria:

- not more than one community from each oblast;
- formed in 2015 or 2016;
- rural communities with an administrative centre in one of the villages of the community;
- population from 3 to 15 thousand people (to increase representativeness and to avoid extreme values).

Table 1. Assessment of Necessary budget revenues annual growth of selected communities

United territorial community name and oblast name	Area of UTC, km <sup>2</sup>	Population, thousand	Density, people/ km <sup>2</sup>	Community budget, mln. UAH	Community budget per citizen, ths. UAH	Subventions and subsidies		Road fund (~42%), mln. UAH	Community budget without subventions and subsidies (excluding road fund)		Budget without subventions and subsidies per citizen, ths. UAH	Necessary budget revenues annual growth, %
						mln. UAH	%		mln. UAH	%		
						Sokolivska UTC Kirovohradska obl.	214.4		6.2	29		
Bilokorovytska UTC Zhytomyrska obl.	110.1	6.0	54	37.0	6.2	20.1	54.3	8.4	25.3	68.5	4.2	7.9
Ozernianska UTC Ternopil'ska obl.	126.8	6.3	50	38.2	6.1	24	62.8	10.1	24.3	63.6	3.9	9.5
Rozsoshanska UTC Khmelnytska obl.	147.9	5.0	34	53.0	10.6	10.5	19.8	4.4	46.9	88.5	9.4	2.5
Velykokopaniyska UTC Kherson'ska obl.	112.9	7.1	63	60.0	8.5	37.0	61.5	15.5	38.5	64.2	5.4	9.3
Zymnivska UTC Volyn'ska obl.	175.0	5.4	31	44.8	8.3	24.4	54.4	10.2	30.6	68.4	5.7	7.9
Krasnosil'ska UTC Odeska obl.	246.6	11.0	45	123.3	11.2	41.5	33.7	17.4	99.2	80.5	9.0	4.4
Velykokuchuriv'ska UTC Chernivetska obl.	103.1	13.8	134	80.7	5.8	52.8	65.4	22.2	50.1	62.1	3.6	10.0
Shakhiv'ska UTC Donetsk obl.	231.8	3.0	13	62.4	20.8	9.8	15.7	4.1	56.7	90.9	18.9	1.9
Prybuzhaniv'ska UTC Mykolaiiv'ska obl.	363.6	8.1	22	56.7	7.0	27.7	48.9	11.6	40.6	71.7	5.0	6.9

Source: Ministry of Regional Development, Construction, Housing and Communal Services of Ukraine (Stand 01.02.2018), Ministry of Finance of Ukraine, state budget portal (Stand 03.02.2018) and calculations of authors.

In most of the communities selected for analysis, the budget for a single local resident is at a low level and amounts 6 to 11 thousand UAH. The level of subsidization of

communities varies considerably and ranges from 15 to 65%. This discrepancy is explained by the fact that on the territory of Shakhiv'ska and Rozsoshanska communities there are

enterprises that have been operating since the Soviet era and, accordingly, the subsidization of the budgets of these communities is 15 and 20%. The budgets of eight other communities are subsidized by 1/3-2/3, or an average of 51%, that is, they are able to cover only about a half of their expenditures on their own.

But the main goal of our calculations is to determine the necessary annual increase in budget revenues in order to reach a self-sufficient level in five years. Of the total number of communities, Shakhivska, Rozsoshanska, Sokolivska and Krasnosilka require an average annual growth of budget revenues of 1.9-4.4%, which in Ukrainian

realities is rather stagnant than rapid development, therefore, this situation is not a big economic challenge for them. As for other communities, the average annual growth expected for them is 6,9-10,0%, so they need a truly stable high growth of the domestic economy.

The next step was to analyse budget expenditures of the selected UTCs in order to assess how they use their available resources and whether they are aimed at improving the rural development indicators identified in this article. Average expenditures of budgets of selected 10 UTCs in percent are shown on Fig. 4.

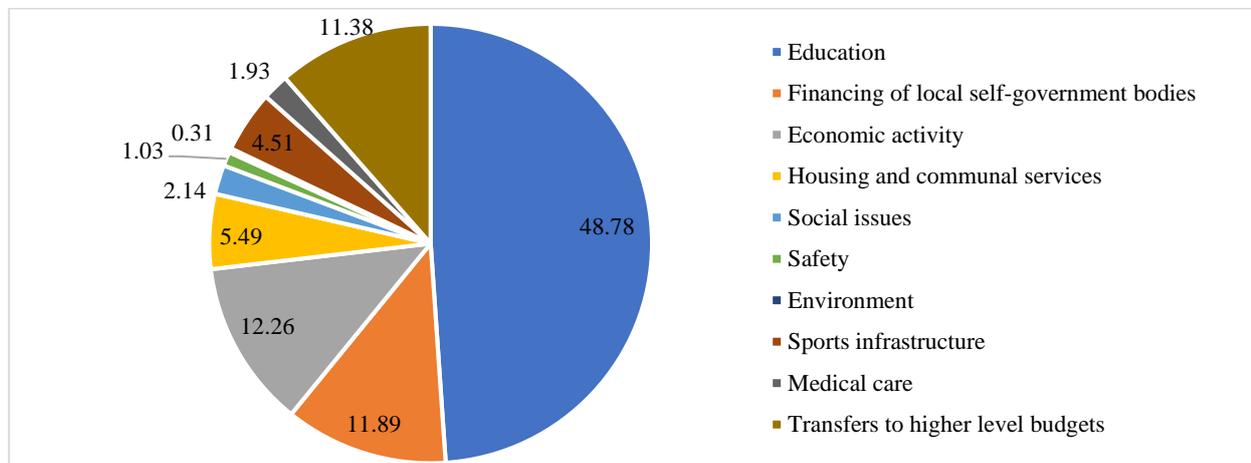


Fig.4. Average expenditures of budgets of selected 10 UTCs in percent  
 Source: Ministry of Finance of Ukraine, state budget portal (Stand 03.02.2018) and calculations of authors

In all communities, except Rozsoshanska, educational expenditures (kindergartens and schools) have the biggest share, which is an average of 48.78%. The subvention for educational expenditures at the moment is quite a significant part of the subventions and subsidies, because before the implementation of the decentralization reform educational activities financing was carried out from the state budget and therefore, without additional support, most of the communities are not able to independently fund kindergartens and schools for the time being. The cost of own economic activity is on average 12.26%, all the other expenses are aimed essentially at maintaining the social and technical infrastructure of the UTCs [7].

It should be noted that the deficit of the budget of the communities is directly proportional to the share of expenditures on

education and financing of local self-government bodies and is inversely proportional to the share of expenses for own economic activity. Transfers to higher level budgets mainly relates to health, safety and environmental measures that are co-funded by several communities through a higher level budgets. That is why these expenditure items have such a low share (Fig. 4).

Consequently, measures that would contribute to the improvement of rural development indicators are practically not implemented, therefore hoping for economic development and growth of budget revenues for communities is useless. Communities are not able to independently finance measures to diversify production on their territory, there are no funds for business development, lack of skills in attracting investors, and therefore it is difficult to create new jobs. There are also no

opportunities for funding local people's initiatives and training local administrators.

According to Article 64 of the current Budget Code of Ukraine, the vast majority of local budget revenues are personal income tax, a single tax for entrepreneurs, payments for land and other real estate, excise taxes (fuel, alcohol, tobacco products) and corporate income tax [1].

That is why these measures should be financed from the state budget of Ukraine, as they will promote economic growth, entrepreneurship development and increase of workplaces, and in the long run also to the growth of population, which will lead to an increase in revenues to local budgets.

Fig. 1 shows the distribution of funds provided by the CMU to local budgets in the form of subventions and subsidies. We note that only 1 bln. UAH. (2.8%) of the total amount of 35.45 bln UAH is used for implementation of these measures (this is insignificant volume and is financed only by the residual principle). Although for the subvention aimed at social and economic development 4.7 bln. UAH is allocated, it is almost entirely spent on the maintenance of social infrastructure.

Thus, public funds are mainly aimed at building and maintaining existing social and technical infrastructure of communities (covering local budget holes) and almost do not promote diversification of production, creation of points of economic growth, development of entrepreneurship, increase of workplaces, training of local population and realization of their initiatives.

## CONCLUSIONS

As a result of our study, we analysed the system of distribution of funds, which are used as subventions and subsidies of the Ukrainian government between the budgets of the UTCs, as well as by their purpose. Only 1 bln. UAH or 2.8% of total funds is spent on the development of UTCs. Taking into account the results of our calculations, according to which most communities need to increase their budget revenues by 6.9-10.0% annually, financing of programs of economic

development of UTCs must be substantially increased. It is really necessary to direct the funds of the state budget directly to the development of the UTCs, and not to their maintenance, which cannot lead to active economic development.

## REFERENCES

- [1] Budget Code of Ukraine, 2010, Available at: <https://zakon.rada.gov.ua/laws/show/2456-17> Accessed 04.02.2019
- [2] Bryden, J., 2011, Rural Development Indicators and Diversity in the European Union, [https://www.researchgate.net/profile/John\\_Bryden3/publication/228865950\\_Rural\\_Development\\_Indicators\\_and\\_Diversity\\_in\\_the\\_European\\_Union/links/0046352f9d1cef2cb8000000/Rural-Development-Indicators-and-Diversity-in-the-European-Union.pdf](https://www.researchgate.net/profile/John_Bryden3/publication/228865950_Rural_Development_Indicators_and_Diversity_in_the_European_Union/links/0046352f9d1cef2cb8000000/Rural-Development-Indicators-and-Diversity-in-the-European-Union.pdf), Accessed on 02.02.2019.
- [3] Cabinet of Ministers of Ukraine, Resolution № 200 of 16.03.2016 "Some issues of subvention from the state budget to local budgets for the formation of the infrastructure of the united territorial communities", 2016, <https://zakon.rada.gov.ua/laws/show/200-2016-п>, Accessed on 03.02.2019.
- [4] Draft Law on Amendments to Article 10 of the Law of Ukraine "On Voluntary Association of Territorial Communities" on the financial support of the state of voluntary association of territorial communities of villages, settlements, cities, 2019, [http://w1.c1.rada.gov.ua/pls/zweb2/webproc4\\_1?pf3511=63767](http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?pf3511=63767), Accessed on 04.02.2019.
- [5] Hohol, T., 2011, Multifunctional development of rural territories – a strategic goal of the state regional policy, Public Administration: Theory and Practice, Vol. 1, <http://www.academy.gov.ua/ej/ej13/txts/Gogol.pdf>, Accessed on 02.02.2019
- [6] Malik, M., Pulim, V., 2009, Conceptual framework for the development of rural areas, Available at: <http://vadyba.asu.lt/8/156.pdf>, Accessed 02.02.2019
- [7] Ministry of Finance of Ukraine, 2019, State budget web-portal, <https://openbudget.gov.ua/local-budget> Accessed on 04.02.2019.
- [8] Ministry of Regional Development, Construction, Housing and Communal Services of Ukraine, 2018, assessment of financial sufficiency of 366 UTCs in 2017, [https://decentralization.gov.ua/uploads/library/file/177/Буклет\\_-\\_Рейтинг\\_фін.\\_спром\\_366\\_ОТГ\\_за\\_2017.pdf](https://decentralization.gov.ua/uploads/library/file/177/Буклет_-_Рейтинг_фін._спром_366_ОТГ_за_2017.pdf), Accessed on 03.02.2019
- [9] Ministry of Regional Development, Construction, Housing and Communal Services of Ukraine, 2019, Monitoring of the process of decentralization of power and reform of local self-government, Available at: <https://storage.decentralization.gov.ua/uploads/library/file/359/10.01.2019.pdf>, Accessed 03.02.2019

[10]National Bank of Ukraine, 2019, Currency statistics,

[https://bank.gov.ua/control/uk/publish/article?art\\_id=65162&cat\\_id=36674](https://bank.gov.ua/control/uk/publish/article?art_id=65162&cat_id=36674), Accessed on 04.02.2019

[11]Office of financial and economic analysis of the Verkhovna Rada of Ukraine, 2017, Analysis of the distribution of the subvention on the formation of the infrastrucnure of the united territorial communities in 2016-2017, Available at: <https://feao.org.ua/wp-content/uploads/2015/11/2017-12-21-subvenciyi-infrastruktury-2016-2017.pdf>, Accessed 03.02.2019

[12]The law of Ukraine "On sources of financing of roads of Ukraine", 1991,

<https://zakon.rada.gov.ua/laws/show/1562-12/ed20180101>, Accessed on 04.02.2019

## THE IMPORTANCE OF CUCUMBER CULTURE IN THE VEGETABLE SECTOR IN 2012-2017

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### Abstract

*Cucumber is a plant belonging to the Cucurbitaceae family, including pumpkin, melon and green pumpkin. Due to the increasing demand on the domestic market, the area under cucumber (protected areas) for fresh consumption has increased significantly over the last 5 years, but nevertheless in the last two years this product has experienced a trade deficit in terms of the trade balance. The high price of the imported cucumbers compared to the exported ones shows that Romania is forced to import at this price because it fails to ensure the needs of the domestic market, especially during the off season.*

**Key words:** cucumbers, cucumber crop, cucumber surfaces

### INTRODUCTION

*Cucumis sativus* (*Cucumis sativus*) is a vegetable plant belonging to the Cucurbitaceae family, which includes other vegetables such as melon (yellow and red), but also pumpkin and zucchini. [1] [3]

Cucumber comes from India and it was also introduced in other parts of the world, like Europe, by Greeks and Romans. [7] [14]

The mode of growth consists in hanging the treadle or various supporting structures. The fruit has an elongated cylindrical shape with a length between 10 and 60 centimetres, being used both fresh and pickled. [2] [5]

Cucumber is rooted in the ground, and with the help of supports, they are wrapped, and if the plant does not benefit from support, it extends along the ground. [13] [15]

At present, there are varieties of cucumbers that produce vegetables without seeds and without being pollinated, but degrade the quality of the variety. Also most of the cucumber varieties resemble and require pollination. [11].

Cucumber is one of the vegetables that has a very low calories content, without fat or cholesterol, and which has many benefits for the body. [4] [6]

Table 1. Nutritional values for 100 grams of cucumber

Active principle	Nutrient value	Percent DRD (recommended daily dose)
Energy	15 Kcal	<1%
Carbohydrates	3.63 g	3%
Protein	0.65 g	1%
Total fat	0.11 g	0.5%
Cholesterol	0 mg	0%
Dietary fiber	0.5 g	1%
<b>Vitamins</b>		
Folic acid	7 µg	2%
Niacin	0.098 mg	<1%
Pantothenic acid	0.259 mg	5%
Pyridoxine (B6)	0.040 mg	3%
Riboflavin	0.033 mg	3%
Thiamine	0.027 mg	2%
Vitamin C	2.8 mg	4.5%
Vitamin A	105 IU	3.5%
Vitamin K	16.4 µg	13.6%
<b>Electrolytes</b>		
Sodium	2 mg	0%
Potassium	147 mg	3%
<b>Minerals</b>		
Calcium	16 mg	1.6%
Copper	0.045 mg	5%
Iron	0.28 mg	3.5%
Magnesium	13 mg	3%
Manganese	0.079 mg	3.5%
Zinc	0.20 mg	2%
Phosphorus	24 mg	3%
Selenium	0 mcg	0%
<b>Phytonutrients</b>		
Beta-carotene	45 mcg	–
Lutein-zeaxanthin	23 mcg	–
Alfa-carotene	30 mcg	–
Beta-cryptoxanthin	26 mcg	–

Source: USDA - US National Nutrient Data Base.

Cucumber is a culture of particular economic importance since in 2017 the value of imports amounted to 18.4 million euros, while the value of exports was 15.8 million euros. [9, 10].

## MATERIALS AND METHODS

The survey is based on the statistical data collected by the National Institute of Statistics, Eurostat and TradeMap, which will determine the evolutions recorded by areas, outputs, average outputs, prices, imports and exports using absolute indicators (with fixed base and in chain), relative (dynamics index, dynamics and absolute value of a percentage of the change rate) and averages (average level, change of absolute mean and average dynamics index) presented below.

Absolute indicators are the absolute changes, so that absolute changes mean the abatement increase or decrease from time to time, expressed in the same unit of measure as that of the analyzed variable.

The abolished changes may be:

-with the fixed base, using the formula:

$$\Delta t / t-1 = y_t - y_{t-1} \quad (1)$$

-with chain / mobile basis, using formula:

$$\Delta t / t-1 = y_t - y_{t-1} \quad (2)$$

Relative indicators are represented by:

-The dynamics index shows how many times the variable has decreased or increased from one unit of time to another; this indicator can be calculated with a fixed base:

$$I_t / 1 = y_{t1} / y_1 * 100 \quad (3)$$

or a chain base:

$$I_t / t-1 = y_{t1} / y_{t-1} * 100 \quad (4)$$

-Dynamics measure percentage changes from time to time; like the afore mentioned indicators, it can be calculated with a fixed base:

$$R_t = I_{t1} * 100 - 100 \quad (5)$$

or mobile:

$$R_t / t-1 = I_t / t-1 * 100 - 100 \quad (6)$$

-The absolute value of a percentage of the

change rate will be expressed in the unit of measure of the analyzed variable and shows the absolute measure of the change per unit, a percentage of the rate of change; fixed base:

$$A_t / 1 = y_1 / 100 \quad (7)$$

and with chain base:

$$A_t / t-1 = y_{t-1} / 100 \quad (8)$$

The average indicators are represented by:

-average level:

$$y = (\sum y_t) / n \quad (9)$$

where n = the number of terms of the chronological series;

-the absolute mean change showing how many units changed the average phenomenon that has been analyzed between two successive moments or intervals; is calculated by the following formula:

$$\Delta = (\sum \Delta t / t-1) / (n-1) = (Y_n - y_1) / (n-1) \quad (10)$$

-The average dynamics index that shows how many times or as many as the average phenomenon analyzed within the time horizon of the chronological series has averaged and will be calculated using the following formula:

$$I = \sqrt{(I_{1t} / (t-1))} = \sqrt{(n-1 \ \& \ n / 1)} \quad (11)$$

The average rhythm of dynamics will be expressed as a percentage of the phenomenon analyzed, averaged from time to time and calculated with the formula:

$$R = (I-1) * 10 \quad (12)$$

## RESULTS AND DISCUSSIONS

The most significant areas planted with cucumbers are Turkey (36 thousand hectares), Poland (9.19 thousand hectares) and Spain (7.48 thousand hectares). Romania ranks 4th place, ahead of Serbia with 4.48 thousand hectares. It should be noted that the general trend is to decrease the areas cultivated with

cucumbers in the field, to the detriment of their cultivation in protected areas, where the most significant increase was registered in Poland, over 43% compared to 2012.

Regarding the absolute base-based changes we can see that the area cultivated with cucumbers decreased significantly compared to the base year, where the most marked change is registered in 2017, the area decreasing by over 2.2 thousand hectares (Table 2).

Analyzing the dynamics of the field cultivated with cucumbers in the field, reporting each year to the previous year, we can see that absolute changes with a base in a chain

register an oscillating trend of the cultivated area. The most significant decrease is recorded in 2017 compared to 2016, where the area decreases by 1.22 thousand hectares, representing a decrease of over 20%. At the opposite end of the year, there is an increase of the area in 2014 compared to 2013, with 120 hectares (Table 2).

From the point of view of the absolute value of a percentage of the rate of change we can state that the result shows that the increase by 1% of the area of cucumbers cultivated in the field in any year compared to 2012 is equivalent to an absolute increase of 66.9 hectares (Table 2).

Table 2. Dynamics of field cultivated with cucumbers in the ground during 2012-2017 in Romania

Year	Cucumber in the ground thousands of hectares	Dynamics index		Dynamic rhythm (%)		The absolute value of a percentage of the change rate	
		with fixed base	with chain base	with fixed base	with chain base	with fixed base	with chain base
		$I_t/1=y_t1/y_1$	$1=y_t1/y_{t-1}$	$R_t=I_t1*100-100$	$R_t/t-1=I_t/t-1*100-100$	$A_t/1=y_1/100$	$A_t/t-1=y_t-1/100$
2012	6.69	-	-	-	-	0.0669	-
2013	6.32	0.9447	0.9447	-5.5306	-5.5306		-0.0037
2014	6.44	0.9626	1.0190	-3.7369	1.8987		0.0012
2015	5.73	0.8565	0.8898	-14.3498	-11.0248		-0.0071
2016	5.70	0.8520	0.9948	-14.7982	-0.5236		-0.0003
2017	4.48	0.6697	0.7860	-33.0344	-21.4035		-0.0122

Source: Eurostat data processing, accessed 20.11.2018 [8].

Analyzing the average dynamics index, we can state that the area cultivated with cucumbers in the ground shows an absolute value of 0.1116 in the period 2012-2017 (Table 2).

Regarding the production of cucumbers

cultivated in the field, Romania is advanced by countries such as Turkey, Spain or Poland, especially their higher yields of 50.8 t/ha, 84.8 t/ha and 49.1 t/ha, compared with the average annual production of Romania, of 17.8 t/ha (2017).

Table 3. Dynamics of production obtained with cucumbers in the field during 2012-2017 in Romania

Year	Cucumber in the ground thousands of tons	Dynamics index		Dynamic rhythm (%)		The absolute value of a percentage of the change rate	
		with chain base	with fixed base	with chain base	with fixed base	with chain base	with chain base
		$I_t/1=y_t1/y_1$	$1=y_t1/y_{t-1}$	$R_t=I_t1*100-100$	$R_t/t-1=I_t/t-1*100-100$	$A_t/1=y_1/100$	$A_t/t-1=y_t-1/100$
2012	102.54	-	-	-	-	1.0254	-
2013	103.76	1.0119	1.0119	1.1898	1.1898		0.0122
2014	115.31	1.1245	1.1113	12.4537	11.1315		0.1155
2015	102.47	0.9993	0.8886	-0.0683	-11.1352		-0.1284
2016	88.75	0.8655	0.8661	-13.4484	-13.3893		-0.1372
2017	79.87	0.7789	0.8999	-22.1084	-10.0056		-0.0888

Source: Eurostat data processing, accessed 20.11.2018 [8].

From the point of view of absolute changes with a fixed base, we can see that the production of cucumbers in the field shows a downward trend compared to the reference

year, with the exception of 2013 and 2014 with outputs of over 103 thousand tons and respectively 115 thousand tons (Table 3). Analyzing the yield of cucumber yields in the

field reporting each year the previous year, we can see that absolute base chain changes register increases until 2014, after which they keep a downward trend until 2017. The most significant increase is recorded in 2014 compared to 2013, where production increases by 11.55 thousand tons and the most pronounced decrease is recorded in 2017 as compared to 2016, with a decrease of 8.88 hectares, representing a decrease of production by more than 10 % (Table 3).

Analyzing the average dynamics index, we can state that the yield obtained with

cucumbers in the field shows an absolute value of 0.1298 in the period 2012-2017 (Table 3).

And with regard to the area cultivated with cucumbers in protected areas, Romania occupies the 4th position among countries in Europe, after countries such as Turkey (8 thousand hectares), Spain (6.75 thousand hectares) and Poland (1.72 thousand hectares), while Romania's area cultivated with cucumbers in protected areas at the level of 2017 was 1.22 thousand hectares.

Table 4. Dynamics of the area planted with cucumbers in protected areas during 2012-2017 in Romania

Year	Cucumber in protected areas thousands of hectares	Dynamics index		Dynamic rhythm (%)		The absolute value of a percentage of the change rate	
		with chain base	with fixed base	with chain base	with fixed base	with chain base	with fixed base
		$I_t/I_{t-1}=y_t/y_{t-1}$	$I_t/y_{t-1}$	$R_t=I_t \cdot 100-100$	$R_t/t-1=I_t/t-1 \cdot 100-100$	$A_t/1=y_t/100$	$A_t/t-1=y_t-1/100$
2012	1.09	-	-	-	-	0.0109	-
2013	1.12	1.0275	1.0275	2.7523	2.7523		0.0003
2014	1.24	1.1376	1.1071	13.7615	10.7143		0.0012
2015	1.23	1.1284	0.9919	12.8440	-0.8065		-0.0001
2016	1.22	1.1193	0.9919	11.9266	-0.8130		-0.0001
2017	1.22	1.1193	1.0000	11.9266	0.0000		0

Source: Eurostat data processing, accessed 20.11.2018 [8].

Regarding the absolute base-based changes, it is noted that the area cultivated with cucumbers in protected areas shows significant increases over the base year, so that the most significant change is registered in 2014 as compared to 2012 when the area cultivated with cucumbers in protected areas increased by approximately 150 hectares compared to the reference year (Table 4).

Analyzing the dynamics of the cucumber-growing area in protected areas reporting each year the previous year, we can notice that absolute base chain modifications register surface increases until 2014, after which a decreasing trend is maintained. The most significant increase is recorded in 2014 as compared to 2013, where the area increased by 120 hectares, representing a 10.7% increase. At the opposite end, the most pronounced decrease is recorded in 2016 as compared to 2015, when the area decreased by about 10 hectares (Table 4).

The absolute value of a percentage of the change rate that we can state that the result

shows that the increase by 1% of the area cultivated with cucumbers in any year compared to 2012 is equivalent to an absolute increase of 10.9 hectares (Table 4).

From the point of view of changes in fixed-absolute changes, we can see that the production obtained with protected cucumbers has increased significantly compared to the base year, so the only period in which a decrease is recorded is in 2013, when production decreased by 2.26 thousand tons, representing a decrease of the production by 6.3% (Table 5).

Regarding the dynamics of the production of cucumbers in protected space, it is observed that absolute changes with chain base register oscillating values. The most significant decline is recorded in 2016 as compared to 2015, when cucumber production decreased by 7%, and the most significant increase is recorded in 2017 as compared to 2016, showing an increase of about 12% compared to the reference year (Table 5).

Table 5. Dynamics of production obtained with cucumbers in protected areas during 2012-2017 in Romania

Year	Cucumber in protected areas thousands of tons	Dynamics index		Dynamic rhythm (%)		The absolute value of a percentage of the change rate	
		with chain base	with fixed base	with chain base	with chain base	with fixed base	with fixed base
		$I_t/I_{t-1}=y_t/y_{t-1}$	$I_t/y_{t-1}$	$R_t=I_t*100-100$	$R_t/I_{t-1}=I_t/I_{t-1}*100-100$	$A_t/I_{t-1}=y_t/y_{t-1}/100$	$A_t/I_{t-1}=y_t/y_{t-1}/100$
2012	35.95	-	-	-	-	0.3595	-
2013	33.69	0.9371	0.9371	-6.2865	-6.2865		-0.0226
2014	44.62	1.2412	1.3244	24.1168	32.4429		0.1093
2015	56.97	1.5847	1.2768	58.4701	27.6782		0.1235
2016	52.98	1.4737	0.9300	47.3713	-7.0037		-0.0399
2017	59.41	1.6526	1.1214	65.2573	12.1367		0.0643

Source: Eurostat data processing, accessed 20.11.2018 [8].

From the point of view of the absolute value of a percentage of the change rate we can state that the result shows that the 1% increase in the production of cucumbers cultivated in

protected space in any year compared to 2012 is equivalent to an absolute increase of 359.5 tons (Table 5).

Table 6. Dynamics of the sale price of cucumbers during 2012-2017 in Romania

Year	Cucumbers euro / 100 kg	Dynamics index		Dynamic rhythm (%)		The absolute value of a percentage of the change rate	
		with chain base	with fixed base	with chain base	with chain base	with fixed base	with chain base
		$I_t/I_{t-1}=y_t/y_{t-1}$	$I_t/y_{t-1}$	$R_t=I_t*100-100$	$R_t/I_{t-1}=I_t/I_{t-1}*100-100$	$A_t/I_{t-1}=y_t/y_{t-1}/100$	$A_t/I_{t-1}=y_t/y_{t-1}/100$
2012	62.12	-	-	-	-	0.6212	-
2013	53.63	0.8633	0.8633	-13.6671	-13.6671		-0.0849
2014	48.38	0.7788	0.9021	-22.1185	-9.7893		-0.0525
2015	52.64	0.8474	1.0881	-15.2608	8.8053		0.0426
2016	45.65	0.7349	0.8672	-26.5132	-13.2789		-0.0699
2017	80.55	1.2967	1.7645	29.6684	76.4513		0.3490

Source: Eurostat data processing, accessed 20.11.2018 [8].

With regard to absolute base-based changes, it can be noted that the sales price of cucumbers is oscillating to the reference year where the only increase compared to the reference year was registered in 2017 when the cucumber price increased with approximately 23% compared to the reference year (Table 6).

Taking into account the dynamics of cucumbers' sales price reporting each year to the previous one, it is noted that the absolute values with the base chain register the most pronounced increase in 2017 compared to 2016. The most significant decrease in the sales price was registered in the year 2013 compared to 2012, is approximately 14% (Table 6).

From the point of view of the absolute value of a percentage of the change rate we can state that the result shows that the 1% increase in the sales price of cucumbers in any year compared to 2012 is equivalent to an absolute increase of 0.66212 euro/100 kg (Table 6).

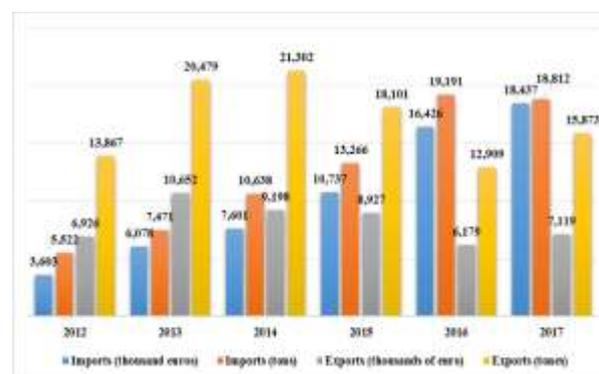


Fig 1. Evolution of imports and exports of cucumbers in Romania during 2012-2017

Source: TradeMap database, accessed 22.11.2018 [16].

Imports of cucumbers in terms of value show an upward trend, as in 2012 their value was 3.6 million, while in 2017 they exceeded the value of 18.4 million, thus increasing 5 times (Figure 1).

While the evolution of imports shows an upward trend, the value of exports shows an oscillating trend, determined by the total flow of cucumbers, fluctuating, which affected their sales price. It should also be noted that

since 2015, the value of cucumber imports exceeds that of exports (EUR 10.7 million imports compared to EUR 8.9 million exports) (Figure 1).

## CONCLUSIONS

Cucumbers are of particular economic importance, as evidenced by the value of imports and exports made in 2017, which amounted to EUR 7.1 million and EUR 18.4 million respectively. While the area cultivated with cucumbers in the field has a downward trend, in terms of their production in protected areas, there is an upward trend, due in particular to the multiple benefits of cultivating cucumbers (and vegetables in general in this type of system), from getting richer productions, reducing dependence on weather conditions, and ensuring cucumber requirements, including over-season satisfying demand.

The yields obtained with cucumbers in the field are mainly influenced by the area under cultivation and the recorded yields, which are much lower than in other European countries (Spain - 85 t/ha, Poland 49 t/ha, compared to Romania 18 t/ha). In the case of the production of cucumbers in protected areas there is a significant difference in the production recorded by other states in Europe compared to Romania, so in Turkey or Spain, the average annual production in 2017 was 137 t/ha, respectively 91 t/ha, while in Romania the annual average production was about 49 t/ha, due mainly to the cultivation technology, but also to the fact that a large part of the vegetable production areas in these countries is represented by the greenhouse, and not the sun, with productivity differences being significantly higher in the case of greenhouse.

At the level of 2017, Romania imported EUR 18.4 million, mainly from countries like Greece (5.3 million), Turkey (4.2 million) or Spain (3.4 million) and exported only 7.1 million euros to countries like Germany (3.9 million), Hungary (1.2 million) or Poland (1.2 million).

It should be noted that at the level of 2017 the price of one tonne of imported cucumbers

amounted to EUR 980, while the price of exported cucumbers amounted to EUR 448 ton, with a significant difference due to the fact that the import of the product is carried out during the off-season, when the price of cucumbers is high (also being grown in protected areas whose production costs are higher), while the production of cucumbers exported is predominantly the field production used with preponderance towards industrialization.

It is very important to continue encouraging vegetable producers and other products (other than tomatoes) and, in conjunction with this aid, to support investments in the creation of protected areas and, in particular, protected areas as being more advantageous from several points such as greenhouses, to the detriment of sunscreens, thus preventing the situation found in 2017 when the production of tomatoes grown in solariums was affected by the adverse weather conditions that led to their partial or total destruction.

## REFERENCES

- [1] Budică, C., 2005, Research on Organizing the Vegetable Market in the Supply Area of Bucharest, PhD Thesis, Bucharest, pp. 130-135.
- [2] Butnariu, H. Indrea, D., Petrescu, C., Savițchi, P., Chilon, P., Ciofu, R., Popescu, V., Radu, Gr., Stan, N., 1992, Vegetable Culture, Didactic and Pedagogical Publishing, R.A., Bucharest, pp. 81-82.
- [3] Ceausescu, I., Balasa, M., Voican, V., Savițchi, P., Radu, Gr., Stan, N., 1984, General and Special Vegetables, Didactic and Pedagogical Publishing House, Bucharest, pp. 102-103.
- [4] Ciofu, R., Stan, N., Popescu, V., Chilon, P., Apahidean, S., Horgis, A., Berar, V., Lauer, K.F., Atanasiu, N., Legumiculture Treaty, Ceres Publishing House, Bucharest, pp. 170-176.
- [5] Drăghici E., 2002, Vegetable growing, Granada Publishing House, Bucharest, pp. 60-61.
- [6] Dumitrescu, M., Scurtu, I., Stoian, L., Glăman, G., 1998, Vegetable Production, Artprint, Bucharest, pp. 15-16.
- [7] Dumitrescu, M. *et al.*, 1977, Technology of seed production and planting material for vegetable plants. Ceres Publishing House, Bucharest, pp. 42.
- [8] Eurostat database, Accessed 23.11.2018.
- [9] Indrea, D. Apahidean, A. S., Apahidean, M., Măniuțiu, D., Ganea, R., 2004, Vegetable Culture, Ceres Publishing House, Bucharest, pp. 49.
- [10] Indrea, D., Apahidean, A. S., Apahidean, M., Măniuțiu, D., Sima, R., 2012, Vegetable Culture, Ceres Publishing House, Bucharest, pp. 56.

[11]Indrea, D., Apahidean, A.S., 2012, Vegetable Cultivator' Guide, 2nd Ed., Ceres Publishing House, Bucharest, pp. 83.

[12] INSSE database, [www.innsse.ro](http://www.innsse.ro), Accessed 23.11.2018.

[13]Ivaşcu, G.-L., 2011, Study on Agro-Food Consumption in Timiș County, Ph.D. thesis, Timișoara, pp. 123.

[14]Mariod, A. A., Mirghani, M. E., S.,Hussein, I. H., 2017, Unconventional oilseeds and oil sources, Chapter 16. Cucumis sativus, cucumbers, Academic Press, pp. 69-71.

[15]Renner, S.S., Schaefer, H., Kocian, A., 2007, Phylogenetics of Cucumis (Cucurbitaceae), BMC Evolutionary Biology, pp. 89.

[16]Trademap database, Accessed 23.11.2018.

[17]USDA, the US National Nutrient Data Base, <https://www.ars.usda.gov/northeast-area/beltsville-md-bhnrc/beltsville-human-nutrition-research-center/nutrient-data-laboratory/docs/usda-national-nutrient-database-for-standard-reference/>, Accessed 23.11.2018.



## DEVELOPMENT OF THE STATE SUPPORT FOR AGRICULTURAL CONSUMER COOPERATIVES: CASE STUDY OF THE TOMSK REGION

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### Abstract

*The implementation of state programs for agricultural support provides for the development of agricultural cooperation in the regions as the basis for the rural territory development. Taking the latest global trends into account, only organizations that produce high-quality, organic food can become the basis of agricultural cooperation capable of giving an efficient impetus to the territory development – not single organizations, but rather a system of agricultural consumer cooperatives (ACCs) that provide storage, processing and marketing of finished products in cooperation with the small-scale agricultural sector (private subsidiary farming (PSF) and family (farm) enterprises F(F)E), as well as agricultural organizations that are the main producers of raw materials with modern qualified management, the support of local authorities, regional and federal authorities. In reality, most of the rural population, small and medium-sized organizations are not ready for new investments because they have no own funds but only old loans. Beginning farmers also lack sufficient funds for their further development, even with the help of a selective state support represented as Novice Farmers and Family Farms grants, as well as subsidies for technical equipment. This requires new mechanisms and methods of the state support for the creation and operation of ACCs, as well as intensive involvement of non-agricultural businesses with competences in commerce, logistics, marketing and other skills not typical for agricultural producers in the agricultural cooperation system on the basis of grant support for investment projects.*

**Key words:** agriculture, state support, consumer cooperatives, development program, subsidies

### INTRODUCTION

Most of the small and medium agricultural producers are not ready for new investments in the modern realities due to the high debt load and the lack of own funds [6]. The development of the state support for ACCs will allow to solve the problems of small forms of management in terms of logistics, business planning, engineering, and sale of finished products. Agricultural cooperation through the combination of efforts and resources is one of the main ways of ensuring expanded production in the countryside, selling agricultural products, and thus ensuring decent living standards for the rural population [3, 14].

The factors of the emergence of new areas in the development of the state support for agricultural cooperation have been the following [12, 20]:

- lack of interest from large and medium agricultural producers in cooperating with small farms,
- unpreparedness of small agents to increase the production of agricultural raw materials (products) due to the fact that the main added value (and profit) will go not to them (labor resources) but to the capital: intermediaries, processors, and trade. The solution to this problem is to change the existing commodity supply chains (own processing, own sales, etc.) and the structure of the distribution of value added [17]. This requires merges – farmers on their own will not be able to resist large farms,
- imbalance of the state support: 70 % of the budget funds allocated for various support programs are provided to large agricultural producers, and
- creation of separate cooperatives only partially solves the problem of the

cooperation development [18]. The solution is possible only if a multilevel agricultural cooperation system emerges [5].

## MATERIALS AND METHODS

The goal of the study is the development and scientific substantiation of theoretical and methodological provisions and practical recommendations for the development of the state support for ACCs in the region.

The object of the study is a system of economic, organizational and managerial relations between the state and ACCs.

The subject of the study includes the trends, conditions and factors influencing the development of the state support for ACCs.

The object of observation is state and municipal authorities and ACCs.

The fundamental principles of economic theory, scientific papers on the problem under study, and regulations of the Russian Federation, including the Tomsk region, served as the theoretical and methodological basis of the study. The data from the Federal State Statistics Service of the Russian Federation, including the Tomsk Region, materials from the Department for Social and Economic Development of Villages in the Tomsk region, planning documents and reports of ACCs, as well as special, reference, and other literature were used in this study.

The theoretical significance of this paper is to clarify the idea of the state support for ACCs in the region, the concept and tools for its implementation. The practical significance of the dissertation research lies in the fact that the obtained results can underlie the federal and regional programs for the development of the state support for the agricultural cooperation system. The following methods were used in the work: monographic, analytical, abstract logical, computational constructive, and economic mathematical.

## RESULTS AND DISCUSSIONS

The algorithm of the state support for the creation and operation of ACCs on the basis of the Regional Center for Agribusiness Engineering in the Tomsk region has been

developed and tested. Its main functions are to provide financial support to cooperatives through consulting centers, training centers for agribusiness, and municipal business support centers in the formation of competences in cooperative creation, business planning and engineering, marketing and sales, and management of investment project and production systems. Forty-two first level ACCs, or 80 % of the total number, had been established in the Tomsk region by 2017 and are operating according to this scheme.

The mechanism of grant support for ACCs has been improved and tested, according to which they are supported by grants of up to 40 mln rubles for the logistics support of production in the amount of 60 % of the total project amount. The remaining 40 % can be own funds, funds of a private investor, investment, or a preferential loan from the state-owned Joint-Stock Company TomskAgroInvest at 5.25 % per annum with the option to repay the debt with the cooperative production, or a preferential loan from a commercial bank or credit unions with a subsidized interest rate. The grant is provided if there is a business plan ordered at the Regional Center for Agribusiness Engineering in the Tomsk region, a business plan for 3 years ahead, and a commitment to operate for at least 5 years after receiving a grant, an expenditure plan, and a commitment to create at least one new permanent job per every 3 mln rubles of subsidies.

The prospects for the state support of ACCs in the Tomsk region are defined in the Program of Developing the Regional System of Agricultural Consumer Cooperation in the Tomsk region for 2017 – 2020, developed by the authors. The implementation of legislative, organizational, property, and financial support measures, information and consultation measures, measures aimed at arranging sales channels for products, as well as education, training and retraining of personnel, developed by the authors, will require the funding of 1,085 mln rubles from budgets of all levels and extrabudgetary sources by 2020. The number of agricultural cooperatives in the region will amount to 70

by 2020, while the annual growth of revenue of agricultural producers will be 15 %.

**Analysis of the ACC development**

In total, there were 52 agricultural cooperatives in the Tomsk region by the beginning of 2017, of which 23 were

processing cooperatives, 8 – supply and marketing cooperatives, 21 – credit cooperatives, and 80 % of them were created on the basis of state financial and consulting support (Table 1) [11].

Table 1. Indicators of the ACC development in the Tomsk region as of early 2017

Indicator	Number
Number of ACCs	52
Share of operating ACCs in the total number of registered cooperatives, %	80
Share of ACCs that received support from the state (consulting, educational, etc.), %	25
Number of ACCs that received financial support from organizations from the support infrastructure for small and medium-sized businesses	7
Share of ACCs that received state and financial support and continued their activities for 3 years from the date of receipt of such support, %	80
Number of organizations from the support infrastructure for small and medium-sized businesses that provide priority support to ACCs	5
Increase in the number of members of ACCs, %	8
Share of agricultural producers involved in the activities of ACCs, %	15
Increase in revenue from sales of ACCs, % to the previous year	10
Growth of profitability of agricultural producers that are members of ACCs, % to the previous year	10

Source: compiled by the authors.

Sixteen new first level cooperatives had been created in the region in 2014 – 2016, 7 of them became winners of the "Development of agricultural cooperation" competition, received grants totaling 64 mln rubles, and raised more than 70 mln rubles additionally to develop their cooperatives [2, 9].

26.5 mln rubles were allocated for the grant support for agricultural cooperatives from the regional and federal budgets in 2015, 37 mln rubles – in 2016, and 49 mln rubles – in 2017 [7, 10].

**Algorithm of the state support for the creation and operation of ACCs**

The cooperative creation should not occur "from below" or "from above", but rather with the help of a certain coordinator of all actions of agricultural producers, who will manage the entire process of the ACC creation [1, 8]. The Center for Innovative Development of Agribusiness in the Tomsk region was created with the participation of the authors and the financial assistance of the Ministry of Economic Development of the Russian Federation and the Fund for the Support of Small and Medium-Sized Businesses of the authorities of the Tomsk region. This Center is funded as follows: 74 % of the total amount

of funding is provided by the Ministry of Economic Development of the Russian Federation for the provision of services to cooperatives, and 26 % is provided by the government of the Tomsk region to finance the current activities of the Center. With the participation of the authors, the Regional Center for Agribusiness Engineering in the Tomsk region was created on its basis to help small and medium-sized businesses in agriculture form competences in business planning and engineering, marketing and sales, management of investment projects, and production systems.

PSF, F(F)E, individuals, and legal entities develop agricultural production within one village, urban-type settlement, district, or a group of such objects, uniting into ACCs and forming the first level of the agricultural cooperation system – first level ACCs.

Based on the activities of the Regional Center for Agribusiness Engineering in the Tomsk region, we have developed an algorithm of the state support for the creation of a first level ACC and its operation (Figure 1).

The Regional Center for Agribusiness Engineering in the Tomsk region searches for consulting centers, training centers for

agribusiness, and municipal entrepreneurship support centers for conducting training seminars in municipal districts. The educational process begins with the heads of administrations (heads of districts, heads of rural settlements). Separately, the existing entrepreneurs and then residents of the

settlements gather for the training – those who would like to become a member of the cooperative. As a result, two different-age training groups are formed to be taught basics of creating and operating a cooperative by business trainers employed by the Regional Center for Agribusiness Engineering.

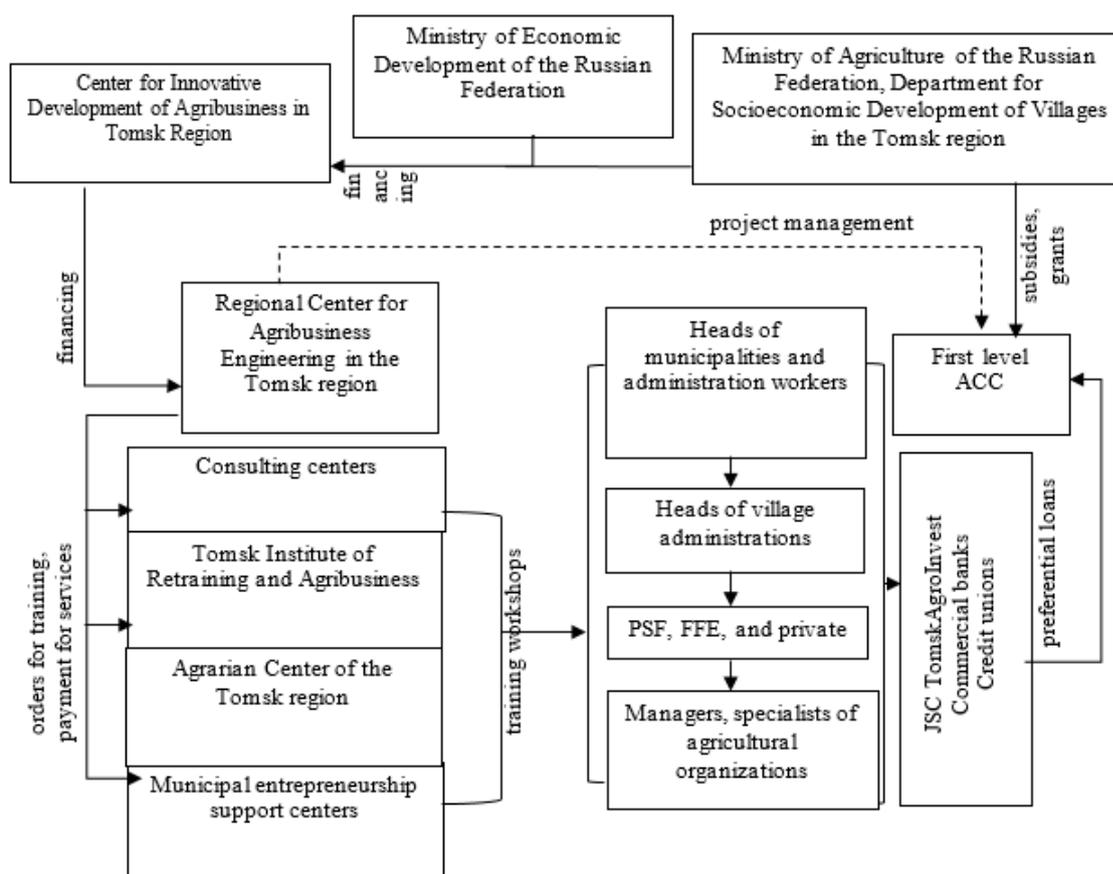


Fig. 1. Algorithm of the state support for the creation and operation of ACCs of the first level  
 Source: compiled by the authors.

The functions of the Regional Center for Agribusiness Engineering in the Tomsk region include management of cooperative projects, which includes the development of business plans, marketing research, and technological support for the created ACCs by consultancy centers.

These services are provided to cooperatives under the following conditions: the first service (for example, a business plan) is provided free of charge, then the ACC pays 5 % of the second order, 10 % of the third order, 15 % of the fourth order, and 20 % of the fifth order. The Regional Center for Agribusiness Engineering in the Tomsk

region carries out a quality check of all services provided by outside organizations, which improves their quality and validity [13].

The first level ACC has the right to claim all measures of the state support provided by federal and regional authorities (subsidies, grants), as well as the support provided by the state-owned JSC TomskAgroInvest in investments or a preferential loan [15].

As such, the algorithm proposed by the authors for creating and operating the first level ACC with the state support sets the motion vector for agricultural entrepreneurs

and executive authorities in the Tomsk region to achieve the goals of the ACC development.  
**Improved mechanism of the state grant support for ACCs in the Tomsk region**  
 Aside from the existing measures of the state support for agricultural producers stipulated

by the current legislation, the authors improved and tested the mechanism of grant support for ACCs, according to which the ACC obtains support as a grant for the logistics production support (Figure 2).

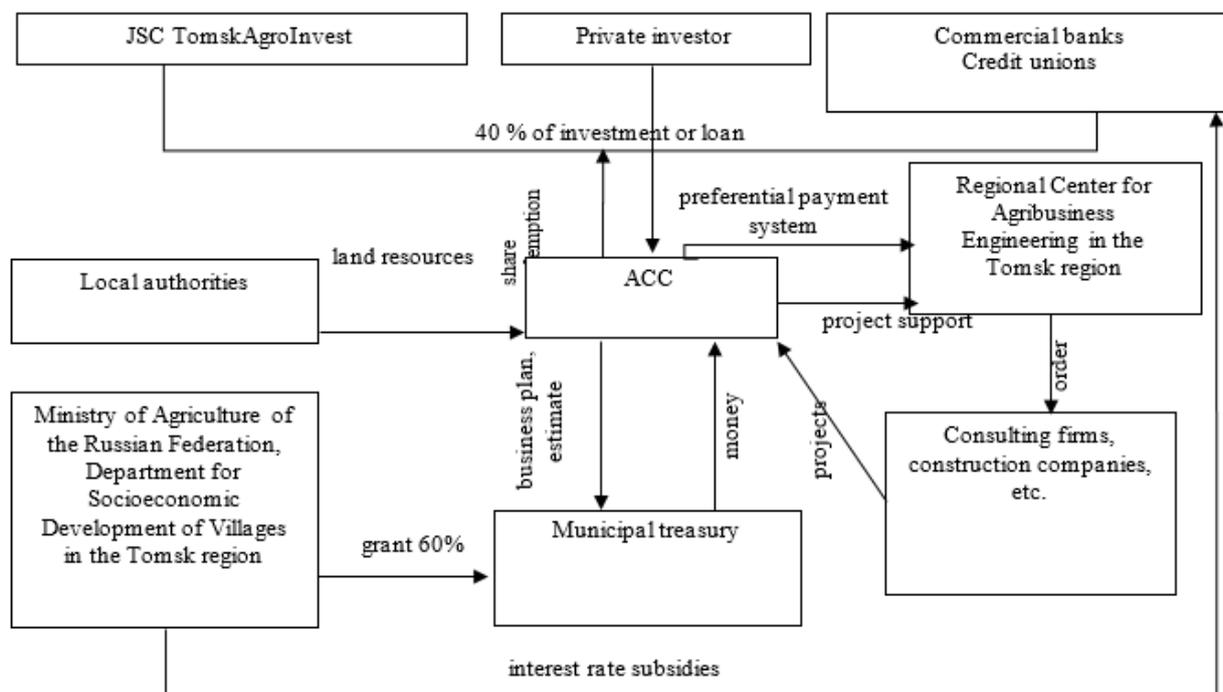


Fig. 2. Mechanism of state grant support for the development of ACCs in the Tomsk region  
 Source: compiled by the authors.

After one year of operation, the established cooperative can apply for a grant of up to 40 mln rubles. The grant amount is not more than 60 % of the total project amount. The ACC can get the remaining 40 % of investments using the following options:

(i) From a private investor. The private investor interested in increasing the supply of agricultural products (raw materials) for the own production or trade is involved in the project. The project is introduced for a tender, and in case of win, the further financial scheme is as follows: the private investor invests 40 % required for the project, becomes a shareholder of the cooperative, and sells its shares to the members of the cooperative after the production launch, keeping the least of voting rights. At the same time, members of the cooperative acquire a share worth 2,500 rubles by buying shares in the amount of 1,000 rubles (1,000 rubles from a private

investor + 1,500 rubles from the state investment in the form of a grant).

(ii) From the funding of JSC TomskAgroInvest, which, like the private investor in the previous case, becomes a shareholder of the cooperative.

(iii) From a preferential loan taken from JSC TomskAgroInvest:

-JSC TomskAgroInvest takes a loan from JSC Rosselkhozbank at a rate of 12.65 % with a subsidy of refinancing rate plus 3 %;

-the cooperative submits an application for a loan and a business plan to JSC TomskAgroInvest;

-the cooperative provides mortgage property or a guarantee from the Guarantee Fund of the Tomsk region to JSC TomskAgroInvest. The cost of the guarantee is reduced for agricultural cooperatives and their members (shareholders). It is 0.5 % per annum of the amount of the provided guarantee, and is paid

as a lump sum for the entire period, or 1 % per annum of the amount of the guarantee, and is paid annually in equal parts. The Guarantee Fund of the Tomsk region sets a quota for guarantees to agricultural cooperatives and their members (shareholders) in the amount of not less than 15 % of the total volume of the issued guarantees;

-JSC TomskAgroInvest provides a loan to the cooperative at 5.25 % per annum, the loan term is 1 year;

-the cooperative must pay a 4 % interest rate immediately, and the remaining 1.25 % during the year. The interest is paid only in cash, and the loan principal can be paid with agricultural products or money.

(iv) From a preferential loan from a commercial bank or credit unions at an interest rate of 5 %.

(v) From the own funds.

The grant funds (60 % of the value of the entire project) to the cooperative are transferred only through the treasury and only after the cooperative has provided estimates of all necessary expenses and a business plan. The ACC can get a grant only if there is a business plan implemented with the assistance of the Regional Center for Agribusiness Engineering of the Tomsk region, an operational and financial plan for 3 years ahead, and a commitment to operate for at least 5 years after receiving the grant, an expenditure plan indicating the names of the purchased property, works, services rendered, their quantity, price, sources of financing (subsidies, own funds).

The business project must be implemented within 18 months, and it should involve the creation of new jobs – at least one new permanent job for every 3 mln rubles of subsidies in the year when the grant is received. Cooperatives participating in the tender should combine at least 10 agricultural producers as members, and the share of the products purchased from shareholders should be at least 50 %. All assets acquired through subsidies must be in the indivisible fund of the ACC.

The grant is provided according to the decision of the competition commission of the

Department of Socioeconomic Development of Villages in the Tomsk region for the selection of cooperatives receiving grants. The commission is chaired by the Head of the Department of Socioeconomic Development of Villages, includes specialists from the Department, as well as the regional Veterinary Administration, the trade union of agribusiness, the Agrarian Center of the Tomsk region, the Center for Innovative Development of the Agribusiness of the Tomsk region, and the administrations of municipalities.

Seven ACCs from Kolpashevsky, Shegarsky, Bakcharsky, Molchanovsky, Tomsky, and Pervomaisky districts claimed regional grants in 2017, 4 of which received grants in the amount of 4.2 to 17.8 mln rubles.

It must be noted that a total of 49 mln rubles were allocated from the regional and federal budgets for grant support of agricultural cooperatives in 2017, 39.6 mln rubles – in 2016, and 26.5 mln rubles – in 2015.

#### **Use of the mechanism of the state grant support for ACCs in the Tomsk region**

ACPC Monastyrsky from the Molchanovsky district, engaged in the processing and marketing of agricultural products, namely raw milk obtained from the cooperative members and the local population, can be given as an example of the successful implementation of the mechanism developed by the authors in the Tomsk region.

A grant in the amount of 4.2 mln rubles was received for the development of the logistics support of the ACPC to implement the project for milk processing. The own funds in the amount of 700 thous. rubles were also invested in the project, along with the borrowed funds with the interest rate compensation in the amount of 2,100 thous. rubles from JSC Rosselkhozbank. Table 2 presents the prospective financial and economic indicators of the cooperative through to 2020.

The revenue growth from the sale of processed products in ACPC Monastyrsky from 2016 to 2020 will amount to 81.8 %. This will contribute to an increase in the sales volume of milk, kefir and sour cream by 81.8 % as well.

At the same time, due to a gradual reduction in the production cost, there will be an increase in the profits from sales almost 2.5 times, up to 10,492 thous. rubles in 2020. The increase in the return on sales will amount to 9.6 percentage points, up to 36.2 %.

Table 2. Estimation of the main financial and economic indicators of ACPC Monastyrsky

Indicators	Year							2020/ 2016, %
	2014	2015	2016	2017	2018	2019	2020	
Proceeds from sales, thous. Rubles	5,843	6,784	15,939	20,286	24,633	28,980	28,980	181.8
Sales volume, kg								
Milk	-	-	285,120	362,880	440,640	518,400	518,400	181.8
Kefir	-	-	99,000	126,000	153,000	180,000	180,000	181.8
Sour cream	-	-	11,880	15,120	18,360	21,600	21,600	181.8
State support (grant), thous. Rubles	-	-	4,200	-	-	-	-	
Profit from sales, thous. Rubles	537	973	4,233	6,280	8,386	10,492	10,492	247.9
Return on sales, %	9.2	14.3	26.6	31.0	34.0	36.2	36.2	-

Source: compiled by the authors.

### Prospects for the state support for ACCs in the Tomsk region

The creation of a regional system of agricultural cooperation should be regulated and controlled through the implementation of the Program for the Development of ACCs in the Tomsk region for 2017 – 2020 (hereinafter – the Program).

The goal of the Program is to develop an efficient multilevel system of agricultural cooperation in the Tomsk region, securing competitiveness of the participants in the cooperation.

Tasks of the program are the following:

- high-quality development (improvement) of the infrastructure system for supporting agricultural cooperation,
- improving the competitiveness of small businesses in the agricultural market through the access of agricultural producers to modern technologies of storage, processing and marketing of these products,
- increasing the number of ACCs in various areas of activity and an increase in the share of the operating cooperatives,
- full and high-quality provision of services to agricultural producers and the rural population,

-increasing the profitability of agricultural producers and the rural population,

-increasing the employment rate for the rural population in small businesses, including in PSFs,

-changing the dynamics of rural residents' migration from negative to positive.

The implementation of this program is possible with a combination of state support measures (Figure 3).

*Legislative measures* [4, 19]:

- simplified taxation system,
- patent system of taxation,
- zero tax rate,
- property support,
- land support, and
- reduction of administrative barriers.

*Financial support:*

- Guarantee fund of the Tomsk region,
- provision of microloans to ACCs,
- provision of subsidies to ACCs,
- provision of subsidies for reimbursement of costs under a leasing agreement, and
- grant for the development of the logistics support of ACCs.

*Organizational support measures:*

-noncommercial partnership Center for Innovative Development of Agribusiness in the Tomsk region,  
 -Regional Center for Agribusiness Engineering in the Tomsk region,

-Agrarian Center of the Tomsk region,  
 -Fund for Support and Development of Small and Medium-Sized Businesses of the Tomsk region, and  
 -municipal business development centers.

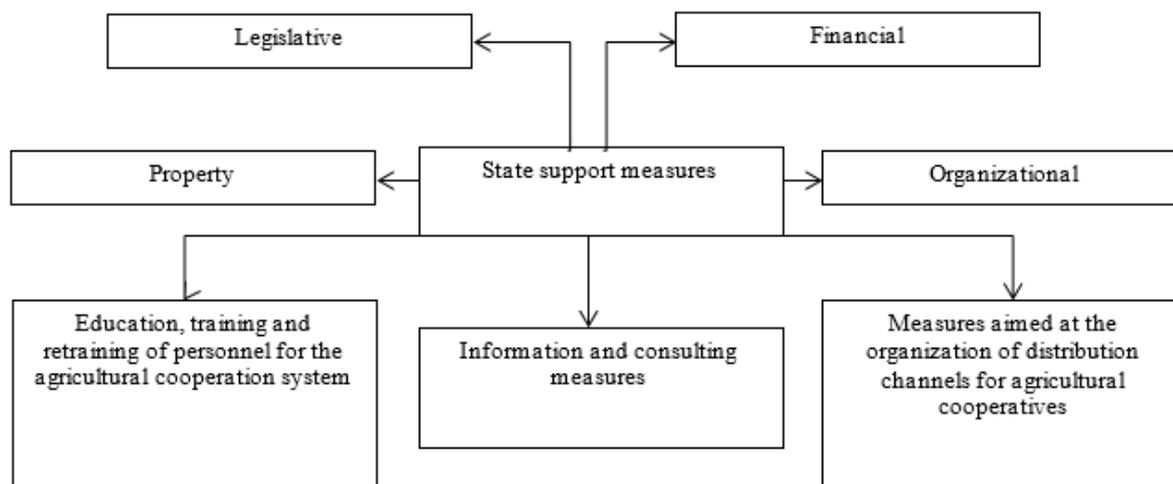


Fig. 3. State support measures for the development of ACCs in the Tomsk region  
 Source: compiled by the authors.

*Property support measures:*

-centers of collective use (access) to specialized equipment for processing of agricultural products,  
 -agroindustrial parks, and  
 -agroindustrial business incubators.

*Information and consulting activities [7, 16]:*

-information system for ACCs, and  
 -increase in the prestige of agricultural cooperation.

*Education, training and retraining of personnel for the system of agricultural cooperation:*

-personnel support of the agribusiness, and  
 -formation of the educational system.

*Measures aimed at the organization of distribution channels for ACC products:*

-regional information resources,  
 -exhibition fairs and trading places in municipal and district markets for agricultural producers, and  
 -independent trading network of ACCs.

**Implementation of the Program for the ACC Development in the Tomsk region for 2017 – 2020**

Implementation of the above measures will allow the Tomsk region to achieve the Program indicators by 2020 (Table 3).

The number of ACCs in the region will increase by 27 % over 4 years, and will amount to 70 by 2020. 60 % of all cooperatives will receive the state support by 2020, and at least 85 % of them will continue their activities after receiving support.

The agricultural cooperation infrastructure in the Tomsk region will develop: the number of organizations forming the support infrastructure for small and medium-sized businesses that provide priority support to agricultural cooperatives will increase 1.5 times, up to 9.

The revenue from the sale of products by ACCs will grow by 10 % per year in 2017 – 2018, but in 2019 – 2020 it will be as much as 15 %.

The profitability of agricultural producers that are members of ACCs will increase at a respective pace.

Table 3. Sources and volumes of financing and the expected results of the implementation of the Program of the ACC Development in the Tomsk region for 2017 – 2020

Indicators	Year			
	2017	2018	2019	2020
Program funding, total, mln rubles, of which:	107.4	282.2	329.2	366.2
federal budget (grants)	40.2	40.2	40.2	40.2
regional budget (grants)	8.2	40.0	50.0	60.0
regional budget (funding of other measures, except for grants)	10.0	12.0	14.0	16.0
extrabudgetary sources	49	190	225	250
Number of ACCs	55	60	65	70
Share of ACCs that received support from the state, %	33	40	50	60
Number of ACCs that received financial support from organizations that form the support infrastructure for small rural businesses	4	6	8	10
Number of ACCs that received support from the state	80	80	82	85
Number of organizations that form the support infrastructure for small rural businesses providing priority support to ACCs	6	7	8	9
Share of operating ACCs in the total number of agricultural cooperatives registered in the Tomsk region, %	85	86	87	88
Increase in the number of members of ACCs, % relative to 2016	10	20	30	40
Share of small businesses in the rural economy involved in the ACC operation, % relative to 2016	4	6	8	15
Increase in revenue from product sales by ACCs, % relative to 2016	10	20	35	45
Annual profitability growth of agricultural producers that are members of ACCs, p.p.	10	10	15	15

Source: compiled by the authors.

## CONCLUSIONS

(i) In order to shape and develop ACCs, the authors have developed and tested an algorithm of the state support for their creation and operation in the Tomsk region. The main role in the creation and maintenance of these cooperatives is assigned to the Regional Center for Agribusiness Engineering in the Tomsk region established on the basis of the Center for Support of Small and Medium-Sized Businesses of the Tomsk region. Its main functions are to provide financial support to cooperatives through consulting centers, training centers for agribusiness, and municipal business support centers in the formation of competences in cooperative creation, business planning and engineering, marketing and sales, and management of investment project and production systems. Sixteen new first level cooperatives were created in the Tomsk region in 2014 – 2016, 7 of them became winners of the "Development of agricultural cooperation" competition, received grants totaling 64 mln rubles, and raised more than

70 mln rubles additionally to develop their cooperatives.

(ii) The mechanism of grant support for ACCs improved by the authors is based on the provision of a grant to the ACC in the amount of 60 % of the total project amount up to 40 mln rubles for the logistics support of production on terms of co-financing the remaining 40 % from the own or borrowed funds. This could be private investor's funds, an investment or a preferential loan from the state-owned JSC TomskAgroInvest at 5.25 % per annum with the option to repay the debt with the cooperative production, or a preferential loan from a commercial bank or credit unions with a subsidized interest rate. The investor sells its shares to the members of the cooperative after the production launch, keeping the least of voting rights. At the same time, members of the cooperative acquire a share worth 2,500 rubles by buying shares in the amount of 1,000 rubles: 1,000 rubles from a private investor + 1,500 rubles from the state investment in the form of a grant.

(iii) The grant is provided if there is a business plan ordered at the Regional Center for

Agribusiness Engineering in the Tomsk region, a financial and operational plan for 3 years ahead, and a commitment to operate for at least 5 years after receiving a grant, as well as an expenditure plan. The business project must be implemented within 18 months, and it should involve the creation of new jobs – at least one new permanent job for every 3 mln rubles of subsidies in the year when the grant is received. Cooperatives participating in the tender should combine at least 10 agricultural producers as members, and the share of the products purchased from shareholders should be at least 50 %. All assets acquired through subsidies must be in the indivisible fund of the ACC. 26.5 mln rubles were allocated for the grant support for agricultural cooperatives from the regional and federal budgets in 2015, 39.6 mln rubles – in 2016, and 49 mln rubles – in 2017.

(iv) The authors have developed the Program for the Development of ACCs in the Tomsk region for 2017 – 2020, including the set of legislative, organizational, property, and financial support measures, information and consultation measures, measures aimed at arranging sales channels for products, as well as education, training and retraining of personnel. Their implementation will require financing from budgets of all levels in the amount of 371 mln rubles, and 714 mln rubles from extrabudgetary sources by 2020. The number of ACCs in the region will increase by 27 % in 4 years and amount to 70 by 2020, and the members of cooperatives will increase by 40 %. 60 % of all cooperatives will receive the state support by 2020, and at least 85 % of them will continue their operation after receiving support. Annual growth in revenue and profitability of agricultural producers will be at least 15 %.

## REFERENCES

- [1] Antsiferova, O.Yu., 2011, Innovatsionnoye razvitiye kooperatsionnykh i integratsionnykh protsessov pri formirovaniy mekhanizma ustoychivosti agrarnogo sektora ekonomiki [Innovation-driven growth of cooperation and integration processes in the formation of the sustainability mechanism in the agricultural sector of the economy], *International Agricultural Journal*, 1, 13 – 14.
- [2] Belkina, E., 2006, Selskokhozyaystvennyye proizvodstvennyye kooperativy v molochnom komplekse Stavropolya [Agricultural production cooperatives in the dairy complex of Stavropol], *Economics of Agriculture in Russia*, 1, 28.
- [3] Bogdanov, S.N., 2015, Razvitiye selskoy kreditnoy kooperatsii v kontekste institutsionalnykh preobrazovaniy agrotterritoriy [Development of rural credit cooperation in the context of institutional transformations of agricultural territories], *Modern problems of science and education*, 2(2), 435.
- [4] Enina, D.V., 2016, Razvitiye selskokhozyaystvennoy potrebitelskoy kooperatsii v molochnoproduktovom podkomplekse [Development of agricultural consumer cooperation in the dairy product subcomplex of agribusiness], *Voronezh*.
- [5] Getmanchuk, A.V., 2012, Selskokhozyaystvennaya kooperatsiya Rossii: predposylki i usloviya razvitiya v regionakh [Agricultural cooperation in Russia: prerequisites and conditions for development in regions], *International Technical and Economic Journal*, 2, 5 – 11.
- [6] Glukhov, Yu.V., 2010, Organizatsionno-ekonomicheskiy mekhanizm razvitiya kooperatsii v selskom khozyaystve [Organizational economic mechanism for the cooperation development in agriculture], *Saransk*, p. 4.
- [7] Kulikov, I., 2012, Selskokhozyaystvennaya kooperatsiya v Rossii: ternistyy put vozrozhdeniya [Agricultural cooperation in Russia: thorny path of rebirth], *Bulletin of the Institute of Economics of the Russian Academy of Sciences*, 5, 82 – 93.
- [8] Kundius, V.A., Kashirskikh, P.A., 2014, Kooperativy sobstvennikov selskokhozyaystvennykh mashin v perspektivakh razvitiya outsorsinga agrarnogo biznesa [Cooperatives of owners of agricultural machines in the prospects for the development of outsourcing agricultural business], *Agrofood policy of Russia*, 4(16), 52 – 56.
- [9] Murtaeva, A.V., 2012, Selskokhozyaystvennaya kooperatsiya kak put povysheniya effektivnosti proizvodstva krestyanskikh (fermerskikh) khozyaystv [Agricultural cooperation as a way to improve the production efficiency of personal (farmer) farms], *Economy and Entrepreneurship*, 6(29), 288 – 291.
- [10] Pakhomchik, S.A., Krotkov, N.A., 2016, Razvitiye selskokhozyaystvennoy kooperatsii v Rossiyskoy Federatsii posle vykhoda Zakona "O selskokhozyaystvennoy kooperatsii" [Development of agricultural cooperation in the Russian Federation after the adoption of the Law "On Agricultural Cooperation"], *Economy, labor, management in agriculture*, 2, 34 – 37.
- [11] Pechenkina, V.V., 2013, Selskokhozyaystvennaya kooperatsiya v sovremennykh usloviyakh [Agricultural cooperation in modern conditions], *Economics of Agriculture in Russia*, 10, 51 – 57.
- [12] Polunin, G.A., Krylov, V.S., Tkach, A.V., Starchenko, V.M., Zaika, S.B., 2011, Perspektivnyye modeli kooperatsii [Promising models of cooperation], *Agribusiness: Economics, Management*, 9, 31 – 39.

[13]Pudovikov, A.S., 2012, Povysheniye ekonomicheskoy effektivnosti selskokhozyaystvennoy sbytovoy kooperatsii v zernovom podkomplekse Kurganskoy oblasti [Improving the economic efficiency of agricultural sales cooperation in the grain subcomplex of the Kurgan region], Chelyabinsk.

[14]Rudoy, E.V., Stasiulis, M.V., Samokhvalova, A.A., Vyshegurov, M.S., Iakimova, L.A., 2016, Development of agrofood market in the southern part of Siberia by means of regional and food relations, International Journal of Applied Business and Economic Research, 14(9), 5875 – 5890.

[15]Stadnik, A.T., Shelkovnikov, S.A., Rudoy, Y.V., Matveev, D.M., Maniehovich, G.M., 2015, Increasing efficiency of breeding dairy cattle in agricultural organizations of the Russian Federation, Asian Social Science, 11(8), 201 – 206.

[16]Volobueva, T.A., 2015, Kooperatsiya i integratsiya malykh form khozyaystvovaniya v agrarnom sektore ekonomiki [Cooperation and integration of small businesses in the agrarian sector of the economy], Economic analysis: theory and practice, 35(434), 14 – 21.

[17]Zeleneva, I.P., 2011, Selkokhozyaystvennaya potrebitelskaya kooperatsiya kak faktor ustoychivogo razvitiya agrarnogo biznesa [Agricultural consumer cooperation as a factor of sustainable agrarian business development], European Journal of Social Sciences, 2(5), 344 – 350.

[18]Zeleneva, I.P., 2011, K voprosu o razvitiy kooperatsionnykh protsessov v sovremennykh usloviyakh [On the development of cooperation processes in modern conditions], Bulletin of the Altai State Agrarian University, 11(85), 111 – 113.

[19]Zeleneva, I.P., 2016, Selskokhozyaystvennaya potrebitelskaya kooperatsiya v usloviyakh innovatsionnogo razvitiya APK Volgogradskoy oblasti [Agricultural consumer cooperation in the conditions of innovation-driven growth of agribusiness in the Volgograd region], in: Strategic guidelines for the innovation-driven growth of agribusiness in the modern economic conditions: proceedings of the international research-to-practice conference, Volgograd State Agrarian University, Volgograd, pp. 194 – 199.

[20]Zhichkin, K.A., Guseinov, F.M., Esipov, A.V., 2013, Selskokhozyaystvennaya kreditnaya kooperatsiya kak faktor razvitiya lichnykh podsobnykh khozyaystv [Agricultural credit cooperation as a factor in the development of private farms], Bulletin of the Samara State Agricultural Academy, 2, 28 – 32.



## CURRENT PROFILE OF PEFC CHAIN OF CUSTODY CERTIFIED COMPANIES IN ROMANIA

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### Abstract

*PEFC is one of the most common certification schemes in forestry worldwide. The aim of this paper was to highlight the profile of the PEFC Chain of Custody certified companies from Romania. Data available in December 2018 on the official website of PEFC were taken into consideration. Until present, 43 PEFC CoC certified companies were recorded in Romania, more than half holding an individual certificate. The certified companies are located in fifteen counties plus Bucharest, one quarter of them being based in the capital city. 60% of the valid CoC certificates in Romania were issued only by two certification bodies. As regards the product category, the number of the companies involved in paper-related activities is almost equal with the companies acting in wood industry. Even though Romania is a country well known for its forest resources and its wood industry, PEFC certification is not very well represented. But, by taking into account that PEFC national certification system was endorsed in mid-summer 2018, it might happen very soon that PEFC (both FM and CoC) will gain more interest in Romania.*

**Key words:** Chain of Custody, Romania, forest certification, PEFC, wood industry

### INTRODUCTION

According to recent statistics, every year approximately 3,000 million cubic meters of wood are harvested worldwide, more than half being used in industry [18]. This high quantity is mainly generated by the growing world population that is putting a higher pressure on the main resources [3], including wood.

In the last twenty-thirty years, environmental issues gain an increasing attention from the general public, including the trade flows at international level [4], [27]. It is also the case of forestry sector which is confronted with diverse customer needs [8], such as fire wood or roundwood used in industry. In this context, the management of forest companies should take into consideration the opinions of stakeholders, including the customers.

In order to fulfill the above-mentioned requirements, more and more agencies,

companies and enterprises both from forest management sector and wood industry adopted several types of certification initiatives in order to implement specific measures regarding the management of the forests and the producing of certain wood-base products [16].

As a general definition, forest certification is regarded as a set of procedures aimed at assessing the quality of forest management and timber harvesting according to specific standards. In forestry, there are two main levels, namely the evaluation of the quality of the management of a forest land (*i.e.* forest management certification, known as FM) and the tracking of wood products from forests to the market (*i.e.* chain of custody certification, known as CoC) [1], [6], [13], [15]. In other words, forest certification represents perhaps the main instrument that is defining the sustainable development in forestry [17].

Worldwide, numerous forest certification schemes were developed in the last years, Programme for the Endorsement of Forest Certification (PEFC) and Forest Stewardship Council (FSC) being the most common ones [9], [14], [19]. Nowadays, it is estimated that almost 10% of the world's forests are PEFC or FSC certified [26]. At a global level, Europe recorded the highest number of the PEFC chain of custody certificates, while the highest area of PEFC certified forests is located in North America [5], [10].

Both certification schemes, that were launched in 1993 (FSC) and 1998 (PEFC) [22], [28], respectively, include minimum management requirements and specific criteria that are defining the principles of sustainable forest management [7], [20].

If FSC certification scheme was designed as a global standard, PEFC is more regarded as an umbrella organisation for the national standards [14]. PEFC was created by several representatives of wood industry and forest owners and managers across Europe [21] in order to provide a certification tool also for small forest areas that are in generally in private ownership. For example, in Italy, several cork oak forests of twenty, forty or more hectares were certified [23].

The two certification schemes provide important benefits to forest owners, forest managers and companies active in wood industry, however the implementation of CoC standard involves some costs which represent in most of the cases a real problem [11], [25]. Even if nowadays, big companies have very complex supply chains, meaning that they have to deal with long and complicated chains of custody, thanks to the benefits provided by the information and communication technology the work of the managers simplifies [12].

In Romania, in December 2018, there were around 2.7 million hectares of FSC certified forests [10], most of them being managed by the National Forest Administrator ROMSILVA, which is the main forest administrator across the country, being responsible for 3.2 million hectares of state-owned forests [2].

The history of PEFC in Romania started in 2015, when a group of NGOs and academia representatives developed the first PEFC standard. The national PEFC standard was debated for two years and in August 2017, PEFC International endorsed it. Until now, there is no PEFC certified forest in Romania, but only PEFC CoC certificates issued by several certification bodies (CBs).

The aim of this paper was to highlight the profile of the PEFC CoC certified companies in Romania.

## MATERIALS AND METHODS

Data regarding the PEFC certified companies in Romania were centralized from official PEFC website [24]. The companies with valid Chain of Custody (CoC) certificates at the end of 2018 (December, 31) were taken into account.

## RESULTS AND DISCUSSIONS

In total, 43 PEFC CoC certified companies were recorded in Romania in December 2018. In most of the cases, these companies trade products with PEFC labels from other countries. More than half (56%) hold an individual certificate, only four companies having a multi-site certificate (Fig. 1).

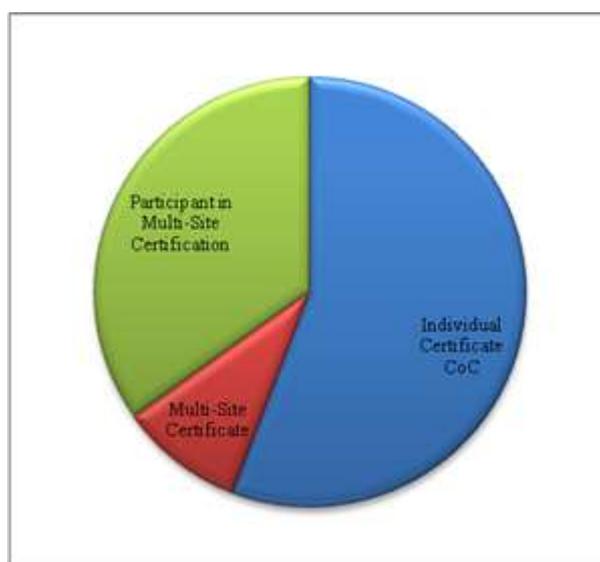


Fig. 1. Type of certification of the PEFC CoC certified companies in Romania

Source: PEFC [24], <https://www.pefc.org/find-certified/certified-certificates>

The PEFC CoC certified companies from Romania are based in 15 counties plus Bucharest, one quarter of them being located in the capital city (Fig. 2)

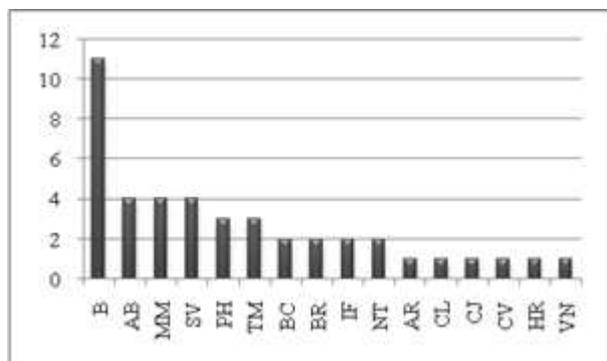


Fig. 2. Distribution of PEFC certified companies per county

Source: PEFC [24], <https://www.pefc.org/find-certified/certified-certificates>

60% of the valid CoC certificates in Romania were issued only by two certification bodies, namely SGS Société Générale de Surveillance SA (SGS), based in Switzerland, and Soil Association Certification Limited (SA), based in United Kingdom, respectively (Fig. 3). These two certification bodies have also the most FSC certified companies, SA being the CB that issued the first FSC certificate in Romania.

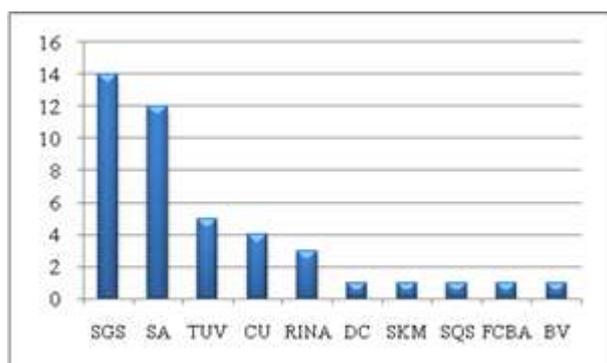


Fig. 3. Certification bodies present in Romania

Source: PEFC [24], <https://www.pefc.org/find-certified/certified-certificates>

The list of the certification bodies is completed by TÜV SÜD Czech (TUV), Control Union Certifications (CU), Rina Services (RINA), DIN CERTCO (DC), DNV GL Business Assurance Sweden AB (SKM), Swiss Association for Quality and Management Systems (SQS), Technological

Institute (FCBA) and Bureau Veritas Certification France (BV), respectively.

As regards the product category, the number of the companies involved in paper-related activities is almost equal with the companies acting in wood industry. In the case of two companies, there was no information available on the official website of PEFC.

## CONCLUSIONS

Even if Romania is a country well known for its forest resources and its wood industry, PEFC CoC certification is not very well represented. But, by taking into account that PEFC national certification system was endorsed in mid-summer 2018, it might happen very soon that PEFC (both FM and CoC) will gain more interest in Romania. Perhaps that the most interested will be the small forest owners and the small companies that will supply certified material to biggest ones and/or to other countries worldwide. Another opportunity will be for the local specialists who would want to conduct field and office audits regarding the implementation of the PEFC standards across the country.

Last but not least, it is expected that by increasing the number of PEFC certificates the confidence of the consumers in the companies that are active in Romania will increase, no matter of their capital.

## REFERENCES

- [1]Bowler, K., Castka, P., Balzarova, M., 2017, Understanding Firms' Approaches to Voluntary Certification: Evidence from Multiple Case Studies in FSC Certification, *Journal of Business Ethics* 145: 441-456.
- [2] Enescu, C.M., 2018, How many people are needed to manage a forest in Europe and in Romania? *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development* 18(3): 123-126.
- [3] Eriksson, M., Samuelson, L., Jägrud, L., Mattsson, E., Celander, T., Malmer, A., Bengtsson, K., Johansson, O., Schaaf, N., Svending, O., Tengberg, A., 2018, Water, Forests, People: The Swedish Experience in Building Resilient Landscapes, *Environmental Management* 62: 45-57.
- [4]Garcia-Montiel, E., Cubbage, F., Rojo-Alboreca, A., Lujan-Álvarez, C., Montiel-Antuna, E., Corral-

- Rivas, J.J., 2017, An Analysis of Non-State and State Approaches for Forest Certification in Mexico, 8(8), 290, doi:10.3390/f8080290.
- [5]Garrett, R.D., Levy, S., Carlson, K.M., Gardner, T.A., Godar, J., Clapp, J., Dauvergne, P., Heilmayr, R., le Polain de Waroux, Y., Ayre, B., Barr, R., Dovre, B., Gibbs, H.K., Hall, S., Lake, S., Milder, J.C., Rausch, L.L., Rivero, R., Rueda, X., Sarsfield, R., Soares-Filho, B., Villoria, N., 2019, Criteria for effective zero-deforestation commitments, *Global Environmental Change* 54: 135-147.
- [6]Gilani, H.R., Kozak, R.A., Innes, J.L., 2018, A Change Management Model for the Adoption of Chain of Custody Certification in the British Columbia Value-added Wood Products Sector, *Journal of Change Management* 18(3): 240-256.
- [7]Guan, Z., Xu, Y., Gong, P., Cao, J., 2018, The impact of international efforts to reduce illegal logging on the global trade in wood products, *International Wood Products Journal* 9(1): 28-38.
- [8]Halaj, D., Sedliačiková, M., Malá, D., 2018, Customer Behavior on the Slovakian Roundwood Market: A Case Study, *BioResources* 13(3): 6003-6020.
- [9]Hălălișan, A.F., Abrudan, I.V., Popa, B., 2018, Forest Management Certification in Romania: Motivations and Perceptions, *Forests* 9, 425, doi:10.3390/f9070425.
- [10]Ilie, A., Apăfăian, A., Puicea, D.R.E., Enescu, C.M., 2018, Latest trends in the evolution of PEFC certification, *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development* 18(3): 179-182.
- [11]Klarić, K., Greger, K., Klarić, M., Andrić, T., Hitka, M., Kropivšek, J., 2016, An Exploratory Assessment of FSC Chain of Custody Certification Benefits in Croatian Wood Industry, *DRVNA INDUSTRIJA* 67(3): 241-248.
- [12]Konovalenko, I., Ludwig, A., 2019, Event processing in supply chain management – The status quo and research outlook, *Computers in Industry* 105: 229-249.
- [13]Lukashevich, V., Shegelman, I., Vasilyev, A., Lukashevich, M., 2016, Forest certification in Russia: development, current state and problems, *Lesnicky časopis - Forestry Journal* 62: 48-55.
- [14]Maesano, M., Ottaviano, M., Lidestav, G., Lasserre, B., Matteucci, G., Mugnozza, G.S., Marchetti, M., 2018, Forest certification map of Europe, *iForest Biogeosciences and Forestry* 11: 526-533.
- [15]Majer, S., Wurster, S., Moosmann, D., Ladu, L., Sumfleth, B., Thrän, D., 2018, Gaps and Research Demand for Sustainability Certification and Standardisation in a Sustainable Bio-Based Economy in the EU, *Sustainability* 10(7), 2455.
- [16]Maryudi, A., Nawir, A.A., Sumardanto, P., Sekartaji, D.A., Soraya, E., Yuwono, T., Siswoko, B.D., Mulyana, B., Supriyatno, N., 2017, Beyond good wood: Exploring strategies for small-scale forest growers and enterprises to benefit from legal and sustainable certification in Indonesia, *Journal of Agriculture and Rural Development in the Tropics and Subtropics* 118(1): 17-29.
- [17]Mikulková, A., Hájek, M., Štěpánková, M., Ševčík, M., 2015, Forest certification as a tool to support sustainable development in forest management, *Journal of Forest Science* 61(8): 359-368.
- [18]Oprea, A.M., Borlea, G.F., Dronca, D., 2018, Oak species – providing renewable and sustainable raw materials, enriching the ecosystems services and fulfilling the social demands. Case-study – Western Romania, *Scientific Papers. Series E. Land Reclamation, Earth Observation & Surveying, Environmental Engineering* 7: 225-233.
- [19]Paluš, H., Parobek, J., Šulek, R., Lichy, J., Šálka, J., 2018, Understanding Sustainable Forest Management Certification in Slovakia: Forest Owners' Perception on Expectations, Benefits and Problems, *Sustainability* 10(7), 2470.
- [20]Paluš, H., Parobek, J., Vlosky, R.P., Motik, D., Oblak, L., Jošt, M., Glavonjić, B., Dudík, R., Wanat, L., 2018, The status of chain-of-custody certification in the countries of Central and South Europe, *European Journal of Wood and Wood Products* 76: 699-710.
- [21]Panico, T., Pagnani, T., Caracciolo, F., 2018, Intention to Purchase Sustainable Wood Products: An Empirical Analysis of the Determinants, *International Journal on Food System Dynamics* 9(4): 342-353.
- [22]Perera, P., Vlosky, R.P., 2006, A History of Forest Certification, *Louisiana Forest Products Development Center Working Paper* 71.
- [23]Pollastrini, M., Chiavetta, U., Cutini, A., Casula, A., Maltoni, S., Dettori, S., Corona, P., 2018, Indicators for the assessment and certification of cork oak management sustainability in Italy, *iForest - Biogeosciences and Forestry*, Vol. 11(5):668-674.
- [24]PEFC Find Certified 2018. <https://www.pefc.org/find-certified/certified-certificates>, Accessed December 31, 2018.
- [25]Ratnasingam, J., Ark, C.K., Latib, H.A., Subramaniam, H., Khoo, A., 2018, Innovation in the Malaysian Furniture Industry: Drivers and Challenges, *BioResources* 13(3): 5254-5270.
- [26]Sen, G., Genc, A., 2018, Perceptions and expectations on forest management certification of foresters in state forest enterprises: a case study in Turkey, *Applied Ecology and Environmental Research* 16(1): 867-891.
- [27]Vlosky, R., Tasdemir, C., Gazo, R., Cassens, D., 2015, The U.S. value-added wood product sector and certification over time: 2001, 2007 & 2014, *Intercathedra* 31(2): 110-116.
- [28]Wibowo, A., Giessen, L., 2018, From voluntary private to mandatory state governance in Indonesian forest certification: Reclaiming authority by bureaucracies, *Forest and Society* 2(1): 28-46.

## A STUDY ON SOME DIFFERENT PARAMETERS AFFECTING THE ABRASIVE PEELING MACHINE PERFORMANCE

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### *Abstract*

*Potato varieties (Hermes and Lady Rosetta) harvested from different type of soil (clay and sandy) were vital factors have deep effect in peeling processes addition to potato condition (freshly harvested and stored in a refrigerator for 3 months at a temperature ranges between +7 and +10 C° and relative humidity ranges between 90% and 95%) were used. The main objective of this research studies on the factors affecting for abrasive peeling machine performance. The measurements and indicators such as physical properties of potato, the peeling efficiency, peel losses, and emery work time were tested. The results showed that when used stored potato tubers the peeling efficiency decreased by average 16.1 % with using stored potato tubers , the peel losses of potatoes during peeling process decreased by average 16.95 % with using stored potato tubers. Fresh potato tubers showed the decreased in peel efficiency from 96.8 to 52.3 % after 2000 hours from working time, while with using stored potatoes the peel efficiency more decreased from 93 to 54.8 % after 2000 hours of working time .Also fresh potato tubers showed the decreased in peel percent from 2.0 to 0.85 % after 2000 hours from working time, while with using stored potatoes the peel losses of potatoes more decreased from 1.85 to 0.77 % after 2000 hours of working time .*

*Key words:* potatoes, fresh, storing, peeling process

### INTRODUCTION

Peeling is one of the integral parts of a food processing, and the majority of agricultural crops need to be peeled in order to remove peels at the initial stage of food processing [4] To achieve the ideal peeling conditions using physical and mechanical properties of the product and used a new methods to improvement of current peeling methods [5] The goals of optimum peeling operation are minimizing product losses, minimizing energy and chemical usage and minimizing the environmental pollution. Peeling operation can be grouped under following categories: manual peeling using knife or blade, mechanical peeling using abrasive devices with drums, rollers, knives or blades and milling cutters, chemical peeling, enzymatic peeling, and thermal peeling [6]. Abrasive peeling was carried out for different types of vegetables with an abrasive peeler. This is simply a drum with a rough inner surface and a motor. After the vegetables are put inside the drum, the inlet is covered, and the drum is

allowed to rotate for a short time. This method is more suitable for root vegetables than fruits, because the latter are usually rather soft. Sweet potato is usually peeled by this method [2]. The mechanical peeler for potato peeling a power operated batch type was developed. The machine contains a drum rotates and removes peel from potatoes by abrasion. The inside peeling drum there are protrusions on the inside surface and Moreover, also a water spraying unit to clean the potatoes and at once peels were removed from the drum. The machine capacity was 100 kg/h with a peeling efficiency and peel losses of 78 % and 6 % respectively [7]. Potato peeling processes face a numerous problems of time consuming and became inefficient during weekly breakdown maintenance. It is very important for food process industry as well as domestic point of view. Mechanization of processing operations will no doubt play a pivotal role in removing the negative attributes of the traditional processing techniques and promote timely

large scale production with desired quality [8].

The performance of the production line and modifying the potato peeler leads to maximize the peeling efficiency by 3.1 %, minimize the mechanical destruction of potato tubers during the peeling process by 32.7 %, minimize the peeling time per one batch by 17.7 % Which led to maximize the productivity of the peeling device by 21.9 % and minimize the amount of needed water consumption for peeling by 17.6 % , also the quality of the final product was improved as the oil content percentage was decreased by 2.4% . [1].

Many factors have effect on the machine peeling efficiency such as the physical characteristics of the potato varieties. Potato source from different locations during different seasons. The objective of this study was to minimize peeling losses and maximize the peeling efficiency addition to evaluate the impact of the durability emery paper and working time

## MATERIALS AND METHODS

The experiments were carried out in small factory for making potato chips to investigate the effect of fresh and storing potato tubers at refrigerators on the performance of the abrasive peeling machine of potatoes. Different varieties of potato (hermes and lady rosetta) harvested from soil type (clay and sandy). Two different cases (freshly harvested and stored in a refrigerator for 3 months) Potato treatments were coded as showing in Table 1.

### The Peeling machine

In peeling process peels are removed from the skin of the tubers by friction in the presence of water using heat and control patch peeler Model BP

The peeling machine have peeling drum was covered with emery paper to detach peel from potatoes by abrasion. The water spraying unit washes potatoes and simultaneously peel is removed from the drum through the perforation along with the flow of water.

### Measuring physical properties of potato tubers [3]

**Shape index:** Shape index of the measured samples was calculated using the following formula:

$$\text{Shape index} = \frac{L}{\sqrt{D T}}$$

**Volume of potato tubers:** The volume of potato tubers as follows:

$$V_{cal} = (\pi / 6) (L D T).$$

where:  $V_{cal}$  = calculated volume of individual tuber,  $\text{mm}^3$ .

**The geometric mean diameter (Dg):** The geometric mean diameter was calculated by using the following equation:

$$Dg = (LDT)^{0.333}$$

**Sphericity:** Sphericity of the tuber was determined by the following formula:

$$\text{Sphericity} = (Dg / L) \times 100$$

where, Dg is the geometric mean diameter of the tuber.

**Surface area (A):** Surface area was determined by the following formula:

$$A = \pi Dg^2$$

### Peeling process measurements

**The peeling efficiency** was determined by using the following formula [7]:

$$\text{Peeling efficiency} = \frac{F1 - F2}{F1} * 100\%$$

F1 = fraction of peel in raw potatoes and

F2= fraction of peel in peeled potatoes

Actual Peel remove, %: were determined by using the following formula [9] stander skin percent=2.2%

$$\text{Actual Peel remove, \%} = \frac{W_r - W_p}{W_r} * 100, \%$$

where:  $W_r$  = weight of washed potato tubers and  $W_p$  = weight of peeled potatoes in kg.

Table 1. The coded potato samples were used

Treatments	HCF	HCS	HSF	HSS	LCF	LCS	LSF	LSS
Varieties	Hermes	Hermes	Hermes	Hermes	Lady R.	Lady R	Lady R.	Lady R
Soil type	Clay	Clay	Sandy	Sandy	Clay	Clay	Sandy	Sandy
Conditions	Fresh	Stored	Fresh	Stored	Fresh	Stored	Fresh	Stored

Source: Based on the data from the factory.

Table 2. The properties of potato varieties used in the experiment

Measurement	Treatments							
	HCF	HCS	HSF	HSS	LCF	LCS	LSF	LSS
Length ,mm	94.87	87.47	93.34	91.83	79.47	74.39	83.83	76.56
Width, mm	53.33	51.31	64.00	62.66	62.69	63.98	72.51	69.97
Thickness, mm	44.62	42.95	56.09	49.05	60.98	57.45	62.32	59.89
Dg, mm	60.37	57.09	67.50	63.77	66.13	63.06	72.05	66.87
Shape index	1.98	1.92	1.69	1.85	1.32	1.30	1.26	1.22
Sphericity	63.77	66.424	74.30	74.02	84.46	87.77	86.34	90.64
Surface area	11737.63	10707.35	14695.29	13569.31	14319.91	12924.66	17143.77	14718.04
Volume	124749.91	111072.48	173961.12	162378.91	169391.44	144481.74	225795.62	179125.89

Source: Results based on the data from the factory.

## RESULTS AND DISCUSSIONS

### Peeling efficiency

The data in Fig (1) shows the effect of treatments on the peeling efficiency. It shows that the peeling efficiency decreased by using the variety Hermes stored three months harvested from clay soil, peeling efficiency decreased by 16.1 %, storing causing by change in potato tuber structure and physical properties. While the maximum peeling efficiency were 93% with HCF and HSF treatments.

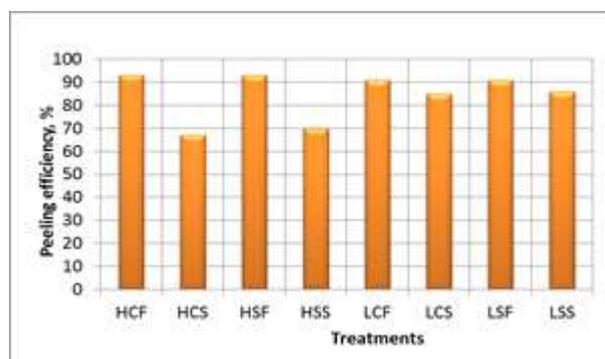


Fig.1. Effect of potato tubers treatments on peeling efficiency.

Source: Results based on the data from the factory.

### Peel of potato

The data in Fig (2) showing the effect of potato tubers treatments on the peel remove

percent, during peeling process potato skin remove by emery paper, the maximum peel percent were 2.08 and 2.03 % with LCF and LSF treatments this results nearest of 2.2% with ideals peel percent, while the minimum peel percent were 1.38 and 1.41 % with HSS and HCS treatments

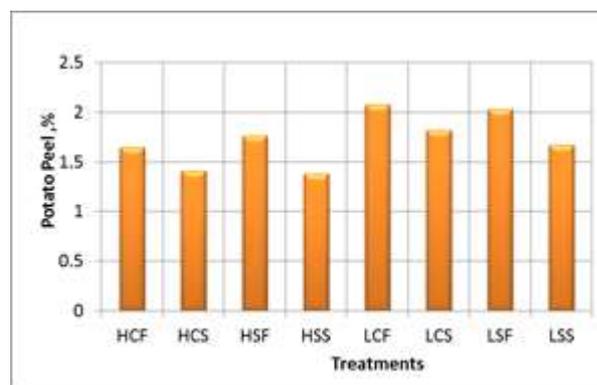


Fig.2. Effect of potato tubers fresh and storing on peel losses

Source: Results based on the data from the factory.

### Peeling productivity

The data in Fig 3 and 4 showing the effect of potato tubers treatments on the peeling productivity and actual amount of peel remove during peeling process potato, the maximum peeling productivity reach to 3,600kg/h. and 90kg/h. with LSC treatment

and minimum productivity were 1,800 kg/h. with 45 kg/h. at HSS and HCS.

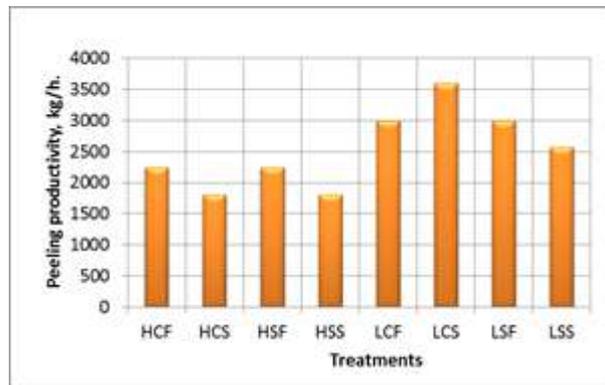


Fig.3. Effect of potato tubers treatments on peeling productivity

Source: Results based on the data from the factory.

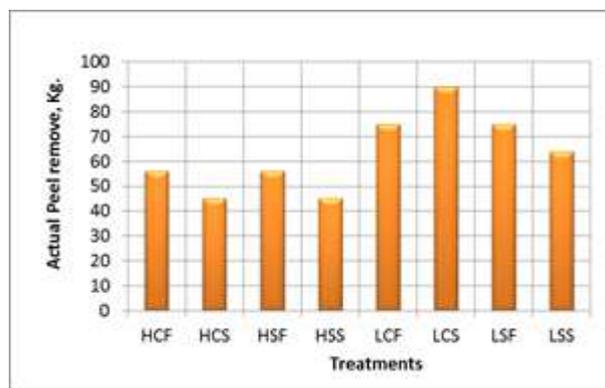


Fig.4. Effect of potato tubers on actual remove peel amount

Source: Results based on the data from the factory.

### Relationship between peeler work time and peeling efficiency

The results in Figure 5 show the relationship between peeler working time and the peeling efficiency. It shows that the peeling efficiency affected by the work time of the potato peeler before the emery wears out and needed to be changed. At treatment HCF the peeling efficiency decreased from 96.8 to 52.30% during operating time start from 400 to 2,000 h. for peeling machine. The same trend for all treatments but at LSS treatment the scored the minimum results for peeling efficiency. The peeling efficiency decreased at HCF to 64.1% after 1,600 hours with fresh case potatoes harvested from clay soil. But with using stored potatoes the peeling efficiency decreased at HCS to 59.2 % after 1,600 hours.

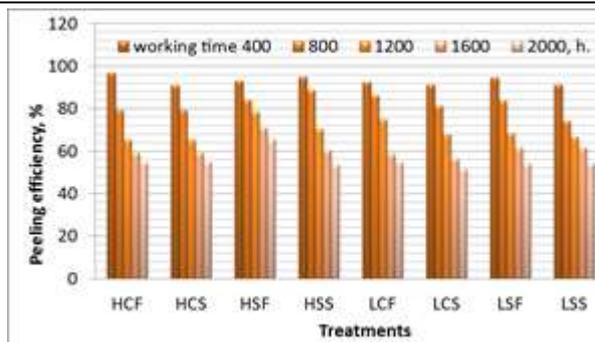


Fig.5. Relationship between emery working time and peeling efficiency

Source: Results based on the data from the factory.

### Relationship between peeler working time and peel remove percent

The results in Figure 6 showing the relationship between peeler working time and the peel remove percent. It shows that the peel remove percent affected by the working time of the potato peeler. At treatment HCF the peeling efficiency decreased from 1.95 to 0.85% during operating time start from 400 to 2,000, h. for peeling machine. The same trend for all treatments but at HSF treatment the scored the minimum results were 0.65% for peeling efficiency. The peel remove decreased at HCF to 0.89 % after 1,600 hours with fresh case potatoes harvested from clay soil. But with using stored potatoes the peel remove decreased at HCS to 0.90 % after 1,600 hours.

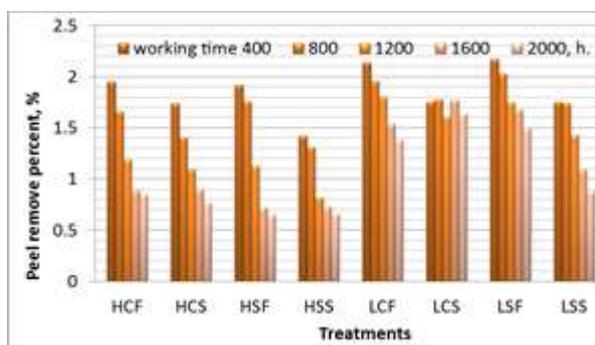


Fig.6. Relationship between peeler working time and peel remove percent

Source: Results based on the data from the factory.

### CONCLUSIONS

The experimental clear relation between the potato production conditions such as different varieties of potato (Hermes and Lady Rosetta), which harvested from different soil

type (sand and clay) using freshly and stored in potato production line. The performance of the abrasive peeling machine of potatoes varied by using freshly harvested potato tubers and stored in refrigerators the peeling efficiency decreased by average 16.1 % with using stored potato tubers , the peel losses of potatoes during peeling process decreased by average 16.95 % with using stored potato tubers.

## REFERENCES

- [1]Fouda, T., Derbala, A., Darwesh, M., Elkhodarey, M., 2017, Improving the performance of potato chips production line. MISR J. Ag. Eng., 34 (2): 911 – 924.
- [2]Lin, S.B., 1995, Development of Cottage Food Processing Enterprises in Rural Taiwan. Food Industry Research and Development Institute, Hsinchu, Taiwan, Work Report 114, pp. 1-6.
- [3]Mohsenin, N.N., 1986, Physical Properties of Plant and Animal Materials. Gordon and Breach Science Publishers, 20–89.
- [4]O’Beirne, D., Gleeson, E., Auty, M., Jordan, K., 2014, Effects of processing and storage variables on penetration and survival of Escherichia coli O157:H7 in fresh-cut packaged carrots. Food Control, 40:71–77.
- [5]Ohwovoriole, E. N., Oboli, S., Mgbeke, A.C.C., 1988, Studies and preliminary design for a cassava tuber peeling machine. Transaction of the ASAE, 380-385.
- [6]Radhakrishnaiah Setty, G., Vijayalakshmi, M., Usha Devi, A., 1993, Methods for peeling fruits and vegetables: a critical evaluation. J Food Sci Technol (India) 30:155–162.
- [7]Singh, K.K., Shukla, B.D., 1995, Abrasive peeling of potatoes. J. of Food Eng., 26:431–442.
- [8]Talodhikar, V.P., Gorantiwar, V.S., Dhole, L.P., 2017, Mechanization & Development of potato peeling machine: A Review International Journal of Engineering and Innovative Technology (IJEIT) Volume 6, Issue 9. pp:38-41.
- [9]Willard, M. J., 1971, A grading system of peeled potatoes. Proc. 21st Nat. Potato Util. Conf., July 28.



## ECOLOGICAL AND ECONOMIC ASSESSMENT OF THE POTENTIAL OF AGRICULTURAL LAND

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### Abstract

*Improved methodological approach to the environmental and economic assessment of the potential of agricultural land which is based on the use of an integral index, which sufficiently characterizes the properties, functions and possibilities of using land resources in agricultural production. The integral index of the potential of agricultural land was proposed to be calculated as the average value of the normalized indicators of agroclimatic potential, soil bonitet and regulatory and monetary assessment of land. This approach allows us to determine in the future the objective level and efficiency of using the potential of agricultural land both at the level of territories and economic entities. An environmental-economic assessment of the potential of agricultural land in the Kiev region. On the basis of theoretical and methodological approaches, an assessment was made of the effectiveness of the use of the potential of agricultural land in the districts of the Kiev region. The proposed approach provided for comparing the cost estimates of the theoretical and actual productivity of land resources in agriculture, calculated on an integral score of the potential of agricultural land. The evaluation results indicate that the level of use of the potential of agricultural land varies from 31.8 to 293.8 %. It was found that eight districts of the region use the potential of agricultural land at a low level, and in most areas the actual figures exceed the theoretical one by 1-2 times.*

**Key words:** ecological and economic assessment, potential, agricultural land, integral indicator.

### INTRODUCTION

Agriculture is one of the branches of the economy of Ukraine, where involvement in the production of land resources is one of the determining factors for its development. However, now, due to the introduction of intensive production technologies in the agrarian sphere, the condition of the lands used for farming is deteriorating. The soil cover undergoes degradation, loses its resistance to destruction, its ability to restore the properties and reproduction of fertility decreases. To solve these problems, the integrated analysis of land potential and the development of ways to improve the effectiveness of its use are of great importance. The solution of this issue is particularly acute in the modern conditions of market economy. Therefore, an objective assessment of the potential of agricultural

land and the efficiency of its use should serve as a basis for substantiating the directions for improving all the main elements of the ecological and economic mechanism of land use.

Also, there is a need to revise some methodological approaches to study the process of restoring potential. As can be seen from the above, the potential of agricultural land is a complex multi-factor category, which currently does not have a single unambiguous interpretation and assessment methodology. We believe that the assessment of the potential of land resources should be considered as a whole, both the economic and the resource and production potential.

Along with this, as a result, of market transformations in the sphere of land relations, the conditions for the use of the potential of agricultural lands changed dramatically, resulting in a deterioration of their ecological

and economic characteristics. Therefore, there is a need to revise the theoretical and methodological foundations and substantiate the system of measures to preserve the productivity of land in the conditions of market relations. Issues of ecological and economic support for assessing the use of land potential in agriculture also remain insufficiently studied. In general, the lack of an integrated approach to solving these environmental and economic problems in the field of using the potential of agricultural land and determine the relevance of the topic of the research.

## MATERIALS AND METHODS

Ecological and economic assessment of the potential of agricultural land and the level of effectiveness of its use were carried out on the example of districts of the Kiev region of Ukraine.

The informational basis of the study consists of domestic and international laws and regulations in the field of land relations, land use economics, environmental protection, materials and reports of the State Statistics Service of Ukraine, State Agency of Land Resources of Ukraine, Ministry of Agrarian Policy and Food of Ukraine, Ministry of Ecology and Natural Resources of Ukraine State Enterprise "Institute of Soil Protection of Ukraine", State University "Kiev Research and Design Institute of Land Management", and also guidelines academic institutions, information from Internet resources, materials own research and other sources of literature on the problems of research.

It was proved that along with traditional indicators of agricultural land use efficiency (the ratio of production and financial activity results in terms of value or in kind to a unit of land resources used), it is advisable to use an indicator of the level of their potential realization, comprehensively reflect the achieved level and possible reserves for increasing agricultural production. Improved methodological approach to the environmental and economic assessment of the potential of agricultural land provides for the use of an integral index, which is

characterized by indicators of agroclimatic potential, bonitet and regulatory and monetary assessment of land. The integral index of the ecological and economic assessment of the potential of agricultural land ( $I_p$ ) is calculated as the average of the normalized values of the above indicators:

$$I_p = \frac{\sum_{j=1}^n \hat{x}_{ij}}{n} \times 100, \quad (1)$$

where  $x_{ij}$  – normalized value  $j$ -th indicator for  $i$ -th district;  
 $n$  – the number of indicators used in the calculation.

The normalized values are calculated by the formula:

$$\hat{x}_{ij} = \frac{x_{ij} - x_j^{\min}}{x_j^{\max} - x_j^{\min}}, \quad (2)$$

where  $x_{ij}$  – the value of the  $j$ -th indicator for the  $i$ -th district;

$x_j^{\min}$  – minimum value of  $j$ -th indicator;

$x_j^{\max}$  – maximum value of  $j$ -th indicator.

It is proposed to distinguish between two levels of determining the potential of agricultural land: 1) territorial and 2) business entities. Ecological and economic assessment of the potential of agricultural land at the territorial level involves taking into account the possible volume of production per unit area, depending on the natural properties of these lands. At the level of individual agricultural land uses, the ecological-economic assessment of potential should be carried out taking into account the internal specialization of various forms of management.

## RESULTS AND DISCUSSIONS

In the economy of agriculture, the rational use of land resources is of particular importance, because obtaining high-quality products in the required quantity is due precisely to the qualitative condition of the land, the nature and conditions of its use. The land is an important productive force, without which the

process of agricultural production is impossible. This implies the importance of taking into account its productive characteristics, since any individual land plot is characterized by a combination of spatial, soil, quality and other properties, is its potential. It is revealed that in the scientific literature today the concepts of "resource", "economic", "production", "economic" potentials are identified. However, with respect to land, where the potential is a complex multifactor category, these types are interrelated, therefore, the assessment of the potential of land resources should be considered as a combination of these potentials. It was established that, on the one hand, the potential of agricultural land characterizes their properties and quality, and on the other, it is the basis for assessing the efficiency of land use based on the determination of the level of realization of this potential. Despite this, the potential of agricultural land should be considered as a set of properties and functions of land resources and the possibilities of obtaining the maximum level of efficiency from their use in agricultural activities in order to meet the needs of society and preserve the natural environment [2; 6].

This interpretation of the concept of potential of agricultural land makes it possible to consider it not only as a scientific category, but at the same time to understand its practical value for agricultural producers, as well as society as a whole.

Considering that the level of realization of current and potential opportunities directly affects the achievement of the operational, tactical and strategic goals of an agricultural enterprise, an objective need arises in determining its quality, i.e. assessment of the potential of agricultural land [1]. Moreover, the main characteristic of the potential in the process of such an assessment should be its value for achieving these goals. It is advisable to characterize the potential of an enterprise not by one indicator, but by their totality, and depending on the nature of the indicator itself, apply either a value, or a real, or any other, for example, heuristic estimate. The methodological basis for determining the

potential is the ratio of the result with the resources expended to achieve these potential values. At the same time, indicators assessing the level of utilization of the elements of the potential should enable a comparative assessment of both the effectiveness of the use of various elements of the potential of one enterprise and various production systems [7]. The concept of valuation seems to be the most universal and methodological justified, since it takes into account all the necessary requirements for the potential as an object of assessment. The initial prerequisite for valuation is that an enterprise as an object is characterized by a certain level of potential, can be a source of income and an object of a market transaction [4; 5].

Data analysis shows that Ukraine has a significant potential for land resources in agriculture: 71.03%, or 42.74 million hectares – agricultural land, in the structure of which agricultural land – 97.5%, of which 78.3% is arable land.

A positive tendency towards an increase in the efficiency of land use, characterized by an increase in the volume of gross output (over the past 15 years, gross crop production increased by 189.5%), crop yields, and their gross yield, has been revealed. However, an increase in the acreage of maize, sunflower and rape while reducing the proportion of cereals negatively affects the quality characteristics of the soil, against the background of non-compliance with scientifically based crop rotations and not using soil protection agents leads to its depletion and loss of fertility. The result of such changes is the reduction of humus in the soil for the period 1991–2017. From 3.3 to 3.1%, which eventually leads to a decrease in crop yields. And all the above-mentioned positive changes are achieved only through the use of new intensive technologies and new high-yielding varieties of crops, and by no means contribute to the preservation and reproduction of the natural (potential) fertility of lands. It is revealed that at present due to over-plowing the deficient balance of nutrients, insufficient application of organic, mineral fertilizers, ameliorants, pollution, etc. The soils of Ukraine are degrading (the annual

increase in eroded lands amounts to 80–90 thousand hectares). The same problems exist at the regional level, in particular in the Kiev region.

In the structure of the land fund of Kiev region in 2017 compared to 2005 there were changes – the share of farmland decreased from 64.2 to 59.0%, that is, their total area decreased by 148.9 thousand hectares, or by 8.2% due to the loss of arable land and hayfields, which turned out to be unproductive or flooded lands. It is determined that the quality and potential of land resources of the Kiev region rather

uneven. Climatic zoning of the Kiev region. causes a significant difference in levels of bonitet by district. So, better fertility agricultural land located within the Southern Polissya, less fertile – in the northern part of the Forest-Steppe and the worst – within the North-Western Polissya.

The results obtained on the basis of our proposed methodological approach to the environmental and economic assessment of the potential of agricultural land in the administrative districts of the Kiev region are given in Table 1.

Table 1. Ecological and economic assessment of the potential of agricultural land areas of Kiev region

Region	Agroclimatic potential, ball	Bonitet of the soil, ball	Normative-monetary land valuation thousand UAH	Integral index, ball
Baryshevsky	7.1	48	11.7	49.0
Bila Tserkva	7.4	59	35.7	91.1
Boguslavsky	7.2	52	34.6	82.5
Borispolsky	6.3	40	11.7	35.2
Borodyansky	4.2	27	9.9	2.7
Brovarsky	5.0	27	13.3	14.9
Vasylkivsky	5.2	60	34.6	68.9
Vyshhorodsky	5.0	29	13.3	16.4
Volodarsky	7.4	58	35.7	90.4
Zgurovsky	4.0	60	22.1	40.9
Ivankivsky	4.8	26	9.9	7.8
Kagarlyk	5.7	68	34.6	79.7
Kiev Svyatoshinsky	5.0	32	18.6	25.5
Makarivsky	5.7	30	18.6	30.9
Myronivsky	5.7	63	34.6	76.0
Obukhovsky	5.0	62	34.6	68.4
Pereyaslav-Khmelnytsky	5.3	55	22.1	50.0
Polissky	4.9	28	9.9	10.3
Rokitnyansky	7.4	69	35.7	98.5
Skvirsky	7.4	63	35.7	94.1
Stavyshchensky	7.3	62	35.7	92.4
Taraschansky	7.3	60	35.7	90.9
Tetyevsky	7.3	71	35.7	99.0
Fastovsky	7.4	53	18.6	64.6
Yagotinsky	4.0	66	10.7	30.7

Source: Calculated by the author according to the Institute of Soil Conservation of Ukraine, the Ukrainian Hydrometeorological Center and the State Service of Ukraine on geodesy, cartography and cadaster.

The basis for calculating indicators of the use of the potential of agricultural land of the Kiev region. It is proposed to consider the gross crop production per 1 ha of agricultural land in comparable prices of 2010 (Table 2). Using correlation and regression analysis revealed a positive relationship between these indicators (correlation coefficient – 0.52).

The data Table. 2 indicate that the level of agricultural production per ball-hectare of the potential of agricultural land of the Kiev region ranges from 37.5 UAH / ball-hectare – in Volodarsky region to 476.5 – in Brovarsky. However, high potential is not always the key to an effective result. For example, in Tetyevsky region, according to a high rate of

bonitet and integrated assessment, only UAH 47.4 is made per 1 hectare potential of agricultural land.

It is proved that the efficiency of land use should be determined, first of all, not by the volume of land area received per unit, but by the level of realization of the potential of the land as a basic resource of agricultural production. Therefore, based on the theoretical approaches of Plotnyk [7] to assess the potential of agricultural land on the basis of the natural potential of the soil and the agrosoil potential of natural and effective fertility and research Hulinchuk [3] on the potential efficiency of agricultural production

is proposed to determine the theoretical level of gross agricultural output per unit area of agricultural land ( $VP_t$ ):

$$VP_t = \sum_{j \in k} V_k P_{jk} S_{jk}, \quad (3)$$

where  $S_{jk}$  – the area of agricultural land of the  $j$ -th species with  $k$ -th type of their intended use;

$P_{jk}$  – productivity of agricultural land of the  $j$ -th type at  $k$ -th type of their intended use;

$C_k$  – cost estimation of the products obtained in the  $k$ -th type of targeted use of agricultural land.

Table 2. The efficiency of use of agricultural land areas of the Kiev region per unit of their potential

Region	Gross output of crop production for 2012–2017 at constant prices in 2010, UAH/ha	Integral index of agricultural land potential	Production of crop production UAH / hectare, in terms of:			
			1 ball integral assessment	thousand UAH normative monetary valuation	1 ball of the bonitet	1 ball climatic potential
2	3	4	5	6	7	8
Baryshevsky	4,111.1	49.0	83.9	351.4	85.6	579.0
Bila Tserkva	4,603.8	91.1	50.5	129.0	78.0	622.1
Boguslavsky	4,150.9	82.5	50.3	120.0	79.8	576.5
Borispolsky	3,533.1	35.2	100.2	302.0	88.3	560.8
Borodyansky	990.5	2.7	366.7	100.1	36.7	235.8
Brovarsky	7,117.4	14.9	476.5	535.1	263.6	1,423.5
Vasylkivsky	4,231.9	68.9	61.5	122.3	70.5	813.8
Vyshhorodsky	3,900.0	16.4	237.5	293.2	134.5	780.0
Volodarsky	3,391.9	90.4	37.5	95.0	58.5	458.4
Zgurovsky	4,661.0	40.9	113.8	210.9	77.7	1,165.2
Ivankivsky	601.2	7.8	76.7	60.7	23.1	125.3
Kagarlyk	4,950.5	79.7	62.1	143.1	72.8	868.5
K. Svyatoshinsky	1,657.0	25.5	65.0	89.1	51.8	331.4
Makarivsky	1,938.9	30.9	62.8	104.2	64.6	340.2
Myronivsky	4,267.5	76.0	56.2	123.3	67.7	748.7
Obukhovsky	3,456.3	68.4	50.5	99.9	55.7	691.3
Pereyaslav-Khmelnytsky	3,909.3	50.0	78.2	176.9	71.1	737.6
Polissky	1,123.3	10.3	109.0	113.5	40.1	229.2
Rokitnyansky	4,861.5	98.5	49.3	136.2	70.5	657.0
Skvirsky	5,731.5	94.1	60.9	160.5	91.0	774.5
Stavyshchensky	4,439.2	92.4	48.1	124.3	71.6	608.1
Taraschansky	4,469.9	90.9	49.2	125.2	74.5	612.3
Tetyevsky	4,692.8	99.0	47.4	131.5	66.1	642.9
Fastovsky	5,018.0	64.6	77.7	269.8	94.7	678.1
Yagotinsky	5,010.8	30.7	163.4	468.3	75.9	1,252.7

Source: calculated by the author according to the State Institute of Soil Protection of Ukraine, the Ukrainian Hydrometeorological Center and the State Statistics Service of Ukraine.

In order to determine the effectiveness of the use of the potential of agricultural land, we

propose to compare the indicator of the theoretical level of gross crop production with the actual data of this indicator per 1 point of the integral index of the potential of agricultural land calculated by the author's methodology (Table 3).

Table 3. The level of effectiveness of the use of the potential of agricultural land in the regions of Kiev region

Region	Volume of gross crop production per 1 ball of integral estimation, UAH		Level of potential use, %
	Actually	Theoretically	
Baryshevsky	4.11	2.96	138.7
Bila Tserkva	4.60	3.70	124.6
Boguslavsky	4.15	3.21	129.5
Borispolsky	3.53	2.92	121.2
Borodyansky	0.99	2.43	40.7
Brovarsky	7.12	2.42	293.8
Vasylkivsky	4.23	3.59	118.0
Vyshhorodsky	3.90	2.63	148.0
Volodarsky	3.39	4.14	82.0
Zgurovsky	4.66	3.37	138.2
Ivankivsky	0.60	1.89	31.8
Kagarlyk	4.95	4.38	113.0
K. Svyatoshinsky	1.66	3.05	54.4
Makarivsky	1.94	2.33	83.2
Myronivsky	4.27	3.75	113.8
Obukhovsky	3.46	3.97	87.1
P.-Khmelnitsky	3.91	3.09	126.6
Polissky	1.12	2.02	55.7
Rokitnyansky	4.86	5.74	84.7
Skvirsky	5.73	3.42	167.5
Stavyschensky	4.44	4.11	107.9
Taraschansky	4.47	3.85	116.2
Tetyevsky	4.69	3.91	119.9
Fastovsky	5.02	3.34	150.1
Yagotinsky	5.01	3.27	153.4

Source: author's calculations.

The highest level of use of the potential of agricultural land is observed in Brovary region – 293.8%. The next 16 regions demonstrate a rather high level of potential use from 107.9 to 167.5%. Such indicators of the level of performance, which exceed the theoretical values of the efficiency of the use of the potential of agricultural land, prove that this is due to the introduction of intensive technologies and not the natural (potential) fertility of lands. This fact in turn provokes a loss of soil fertility their degradation and pollution. However 8 regions currently use

insufficiently the potential of agricultural land the worst being Ivankovsky. Borodyansky and Kiev-Svyatoshynsky.

## CONCLUSIONS

Thus, on the basis of an improved methodological approach to the environmental and economic assessment of the potential of agricultural land, an analysis of the integral index of this indicator has been carried out, has shown the practical ability of this approach at the regional level. It turned out that the majority of areas with high potential of agricultural land had a low indicator of output per 1 hectare.

The proposed approach provided for comparing the cost estimates of the theoretical and actual productivity of land resources in agriculture, calculated on the integral score of the potential of agricultural land.

In general, the problem of rational use of the potential of agricultural land depends on many factors. This raises the need for an integrated approach to the organization of an effective system of using the potential of land in modern conditions of economic activity.

## REFERENCES

- [1]Berezin, O.V., Plotnyk, O.D., 2012, Ekonomichnyj potentsial ahrarnykh pidpryemstv: mekhanizmy formuvannya ta rozvytku [The economic potential of agricultural enterprises: the mechanisms of formation and development]. Poltava: InterHrafika, p. 17-25.
- [2]De Olde, E.M., Moller, H., Marchand, F., McDowell, R.W., MacLeod, C.J., Sautier, M., Halloy, S., Barber, A., Bengé, J., Bockstaller, C., Bokkers, E.A.M., de Boer, I.J.M., Legun, K.A., Le Quellec, I., Merfield, C., Oudshoorn, F.W., Reid, J., Schader, C., Szymanski, E., Sørensen, C.A.G., Whitehead, J., Manhire, J., 2017, When experts disagree: the need to rethink indicator selection for assessing sustainability of agriculture. *Environment, Development and Sustainability*, 19(4), p. 1327-1342.
- [3]Hulinchuk, R.M., 2015, Metodichni osnovy otsiniuvannya potentsialu zemel' sil'skohospodars'koho pryznachennia [Methodical framework for assessing the potential of agricultural land]. *Balanced Nature Using*, 2: 107–113.
- [4]Lup, A., Miron, L., Alim, I.D., 2016, Management of land resource, agricultural production and food security. *Scientific Papers. Series "Management, Economic Engineering in Agriculture and rural development"*, 16(2), 219-228.

[5]Manos, B., Papathanasiou, J., Bournaris, T., Voudouris K., 2010, A multicriteria model for planning agricultural regions within a context of groundwater rational management. *Journal of Environmental Management*, 91: 1593-1600.

[6]Meyer-Aurich, A., Zander, P, Werner, A., Reinhold, R., 1998, Agricultural land use strategies appropriate to nature conservation goals and environmental protection. *Landscape and Urban Planning*, 41: 119-127.

[7]Plotnyk, O.D., 2012, Osoblyvosti strukturyzatsii ekonomichnoho potentsialu ahrarnykh pidpryemstv [Features of structuring the economic potential of agricultural enterprises]. *Technological audit and production reserves*, 1 (3): 43–48.



## PRODUCTIVITY AND RESOURCE USE EFFICIENCY AMONG BENEFICIARIES OF E - WALLET INPUT DISTRIBUTION SYSTEM COMPONENT OF GROWTH ENHANCEMENT SUPPORT SCHEME (GESS) IN ADAMAWA STATE, NIGERIA

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### Abstract

Nigeria is fundamentally an agricultural country, at least 71% of Nigerian workforce is engaged in agriculture and over 90% of Nigerian agricultural output comes from small holder farmers most of whom dwell in remote rural and sometimes hard to reach areas. It is in these rural areas that over 60% of the over 180 million Nigerian population live and work. Despite all these abundant human and natural resources, Nigeria is still unable to feed her citizens due to low productivity which could be attributed to low fertilizer use, low improved seed utilization and low government expenditure on agriculture. The success of any agricultural revolution is not only on access of farmers to modern agricultural inputs, especially fertilizer and seeds but efficient allocation of resources. The study was conducted to examine Productivity and Resource Use Efficiency among Beneficiaries of E-Wallet Input Distribution System Component of Growth Enhancement Support Scheme (GESS) in Adamawa State Nigeria where data on 315 beneficiaries were collected and analyzed using descriptive and inferential statistics. Result of the socio-economic analysis revealed that respondents were small scale farmers who were young with mean family size of five people and with mean experience of 7 years. Production function analysis showed that the Cobb-Douglas functional form was selected as the lead equation and showed that the coefficient of multiple determination ( $R^2$ ) of 0.7781 implied that about 77.81% of the variations in total output of respondents were explained by production factors included in the model. The overall model is significant at 1% level as shown by the magnitude of the F-statistics. Return to scale (RTS) was 1.45 showing increasing return to scale on the production surface (rational zone of production). The estimated coefficients for seeds, fertilizers, herbicides, farm size and hired labour were positive and statistically significant at 1% level. Marginal analysis of input utilization among respondents revealed that fertilizers, farm size and hired labour were over utilized while seeds and herbicides were underutilized. This shows that beneficiaries of the E wallet system are not efficient in their production. The study recommended the need for government to increase extension support services for farmers, consistent and sustainable policies to encourage production in the country.

**Key words:** production function, resource use efficiency, electronic wallet, beneficiaries, Nigeria

### INTRODUCTION

The Growth Enhancement Support Scheme (GESS) is a Federal government initiation to actualize the Agricultural Transformation Agenda (ATA) which was aimed at subsidizing the costs of major agricultural inputs such as fertilizer, seeds, seedlings, and agro-chemicals for farmers [3]. One of the requirements of the GESS is the national farmers' registration exercise, where farmers' data are captured in to the ministry's central

data bank. The GESS is hinged on the use of technology to enhance effective distribution of various farm inputs, especially fertilizers, to farmers. This is in line with government vision of making agriculture the cornerstone of Nigeria's economy. GESS started in May 2012, and has registered about 14 million farmers (4 million in 2012 and 10 million in 2013) throughout the federation for direct redemption of farm inputs through the Electronic wallet, E-wallet system. Under the scheme, registered farmers receive 50%

subsidy on their farm inputs from Federal Government with the support of the State government. With this system, farmers receive SMS alerts on their mobile phones and proceed to the nearest agro-dealers to redeem the inputs with 50% value of the inputs price putting an end to the age-long queue by farmers only to secure a bag of fertilizer for a group [6].

E-wallet (Electronic wallet) refers to an electronic device that allows an individual to make electronic commerce transactions. This can include purchasing items on-line with the use of a computer or using a Smartphone to purchase items at a store or away from where one is. Digital wallets are made not just for basic financial transactions but also to authenticate the holders' credentials. For example, digital wallet could potentially verify the age of the customer who may want to purchase inputs such as fertilizer, seeds or agro-chemicals. A digital wallet has both software and an information component. The software provides security and encryption for the personal information and for the actual transaction.

The use of e-wallet for agricultural inputs distribution was adopted in Nigeria in 2012 as the first country in Africa to develop the e-wallet system for input delivery to farmers [3]. It was an initiative of the Federal Ministry of Agriculture to better the delivery of farm inputs such as fertilizer, seeds and agro-chemicals among other agricultural inputs delivered to farmers. The initiative was one of the most effective ways of reaching real farmers with government subsidies and other supports there by evading the hijacking influence of the fertilizer cartel in Nigeria. This is because in the past the cartel has made it impossible for such benefits to be tapped in to by the real farmers especially those at the grass roots. One direct way in which agricultural input subsidies can provide social protection to the poor is by targeting the poor with very high subsidies to ensure that they are able to access production inputs [5,9].

Federal Government of Nigeria has decided to reach farmers directly using the Global System of mobile telephones which allows the Federal Ministry of Agriculture to send

electronic vouchers to farmers to buy seeds and fertilizers. The Government developed a system whereby no body signs fertilizer contract anymore. This therefore proves a fact that Information and Communication Technologies (ICTs) have brought to the fore new ways of doing things. This also brought to the fore the realization of the need to integrate ICTs to be effectively used in agriculture development as facilitating tools to boost its impact to the lives of farmers. ICTS have become an increasingly powerful tool for improving the delivery of basic services and enhancing local development opportunities [7].

Nigeria is fundamentally an agricultural country, at least 71% of Nigerian workforce is engaged in agriculture and over 90% of Nigerian agricultural output comes from small holder farmers most of whom dwell in remote rural and sometimes hard to reach areas. It is in these rural areas that over 60% of the over 180 million Nigerian population live and work [8]. Despite all these abundant human and natural resources, Nigeria is still unable to feed her citizens. The reasons for the low productivity in the country could be attributed to low fertilizer use, low improved seed utilization and low government expenditure on agriculture. International Fertilizer Development Centre (IFDC) revealed that average fertilizer use in Nigeria is just 13 kg/ha compared to a world average of 100 kg/ha and 150 kg/ha for Asia. Also, percentage of farmers who had access to improved seeds has been recorded to be very low in Nigeria as only five per cent of farmers accessed seeds compared to twenty five per cent in East Africa and sixty per cent in Asia [2].

"Efficiency is the optimal productivity of resources in production process. Production is the ratio between output and input. Also efficiency is a significant concept in production economics. When resources are constrained and prospects of adopting better technologies are competitive. Efficiency studies helps in understanding the existing performance and opportunities to improve the production performance of a particular enterprise under consideration. Earlier studies

on efficiency have revealed that it is possible to increase the productivity of farms without actually increasing the inputs" [11]. The role of efficiency in increasing agricultural output had been recognized by researchers.

The success of any agricultural revolution is not only on access of farmers to modern agricultural inputs, especially fertilizer and seeds but efficient allocation of resources. Six years after the introduction of the initiative, are beneficiaries efficient in the use of inputs leading to higher productivity prompting the need to conduct a study on Productivity and Resource Use Efficiency among Beneficiaries of E-Wallet Input Distribution System Component of Growth Enhancement Support Scheme (GESS) in Adamawa State Nigeria. The specific objectives are to describe the socio-economic characteristics of the beneficiaries and examine resource use efficiency among respondents.

## MATERIALS AND METHODS

### The Study Area

The study was carried out in the four Agricultural Development Zones of Adamawa State, namely Mubi, Gombi, Mayo-Belwa and Guyuk respectively. Adamawa State lies between latitude 7°28' N and 10° 55' N of the Equator and longitude 11° 30' E and 13° 45' E of the Greenwich Meridian. The study area has a population of about 3,168,101 people National Population Commission [12] Adamawa State has a land mass of about 36,917 km<sup>2</sup>. The mean annual rainfall ranges from 700 mm in the North West to 1,600 mm in the South East. The mean annual rainfall is less than 1,000 mm in the Central and North Western part of the State. The State is characterized with mean temperature of 26.7°C to 27.8°C. The area lies within the guinea savannah climatic zone of Nigeria with distinct dry and rainy seasons. The rainy season commences in April and ends in October, while the dry season starts in November and ends in April.

Major occupation in the State includes farming, cattle rearing, fishing, trading and civil service. Adamawa State is bordered to the East by Republic of Cameroon, to the

North by Borno State, to the West by Gombe State and Taraba State to the South [1].

### Source of Data and Sampling Procedure

Primary data was used for this study, which was collected using interview schedule to obtain data from the respondents. List of beneficiaries of E- wallet in all the redemption centres across the ADP zones was obtained and the sample size for this study was determined using Yamane (1976) formula:

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

where n = sample size, N = total population  
 e = margin of error disturbance.

Given that N = 52,476 and e is assumed to be 5%. Then sample size,

$$n = 52,476 / (1 + 52,476(0.05)^2)$$

$$n = \text{Sample Size} = 399.$$

Random and proportionate sampling technique was then used in selecting respondents for the Study (Table 1).

Out of this number, 315 respondents provided the required information and were used for analysis.

Table 1. Selection of Respondents for the Study

ADP Zones	Number of Redemption Centres	Registered Farmers	Number of Farmers sampled
Gombi	6	8,199	62
Guyuk	12	14,148	108
Mayo Belwa	17	21,318	162
Mubi	10	8,811	67
<b>Total</b>	<b>45</b>	<b>52,476</b>	<b>399</b>

Source: ADADP (2017).

### Methods of Data Analysis

Descriptive statistics and inferential statistics were used to achieve the objectives of the study. The descriptive statistics which employed the use of mean, frequencies, tables and percentages were used to achieve objective i.

Of the inferential statistics used was the production function analysis. This was used to actualize objective ii (resource use efficiency). Four functional forms (Linear, Semi log, Exponential and Double log) were tried to

select the best fit based on economic, econometric and statistical criteria.

The Double log functional form gave the best fit and is explicitly stated as follows:

$$\ln Y = \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + \mu$$

where:

Y = output of the ith respondent (grain equivalent)

X<sub>1</sub> = quantity of seed (grain equivalent)

X<sub>2</sub> = fertilizers (kg),

X<sub>3</sub> = herbicides (litres),

X<sub>4</sub> = farm size (hectares),

X<sub>5</sub> = hired labour (SMD),

X<sub>6</sub> = family labour (SMD) and

μ = error term. β<sub>0</sub>, β<sub>1</sub>,..... β<sub>6</sub> coefficients that were determined.

The marginal analysis of input utilization was used to estimate the efficiency of resources used (objective iii) it will be determined by computing the ratio between the marginal value product and marginal factor cost of variable inputs. The ratio for determining the efficiency use was calculated as follows.

$$R = MVP/MFC$$

where: MVP = Marginal Value product of each input, MFC = Marginal factor cost of input r = Efficiency ratio. The MVP is defined as the product of the Marginal Physical Product (MPP) and the unit price of output (P). The MFC of input can either be taken as the market unit price or geometric mean value of the input costs, or depreciation of durable assets. When r = 1 efficiency in resource use r > 1 under-utilization of resources and r < 1 over-utilization of resources.

## RESULTS AND DISCUSSIONS

Table 2. Summary statistics of Socio-economic characteristics of Respondents (N=315)

Variable	Mean	Standard deviation	Minimum	Maximum
Age	31.5	5.16063	20	64
Family size	5.393333	2.501897	1	17
Experience	6.893333	2.937809	2	16
Farm size	1.7926	1.052991	1	5.5
Output	1557.21	1028.933	691.5	3,534.6

Source: Data Analysis, 2018.

## Socio-economic Characteristics of Respondents

Summary of socio-economic variables of respondents (Table 2) revealed that the mean age of the farmers was 32 years which showed that the farmers are relatively young. The preponderance of younger farmers in agriculture production is a positive signal with increasing productivity and likely increase in hectares of land under production. This result is in accord with the previous studies that food production in Adamawa State are by younger farmers as the result of lack of industries that could provide white collar jobs to young and active population [13].

Family sizes of farmers provide sources of labour for production especially in African agriculture that is not mechanized. As shown in Table 2, the minimum and maximum family sizes were 1 and 17. The mean family size of respondents was five people with a standard deviation of 2.501897 which is a reflection of the fact that many of the farmers were married. Large family size of respondents could be used as a vital source of labour for food production and other productive activities. Large family size can put pressures on family heads in devising means of obtaining income to meet family needs. The mean farm size was 1.7926 hectares with a standard deviation of 1.052991 (Table 2) and imply that farmers operated at different levels of farm sizes which tend to affect their production levels. This result indicates that majority of the farmers are small holders. The result is line with several studies conducted which showed that small scale farmers in Nigeria are major producers of food and cash crops [11]. Years of farming experience have been reported to provide a measure of managerial ability among farmers in Nigeria.

The mean farming experience was 7 years with standard deviation of 2.937809.

This implies that the farming experience varied significantly among the farmers. The result showed that respondents were majorly new entrants to farming business.

### Productivity and Resource Use Efficiency Analysis

Efficiency of Resource use among respondents was examined using the production function analysis. Out of the four functional forms tried, Cobb - Douglas functional form was selected as the lead equation based on statistical, economic and econometric criteria.

Table 3. Results of Diagnostic statistics

Diagnostic Variable	Value
Ramsey RESET test	0.530 (Prob > F = 0.0014)NS
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity	Chi <sup>2</sup> (1) = 0.82 ( Prob > chi <sup>2</sup> = 0.3662)Ns
Variance inflation Factors	
Seeds(grain equivalent )	1.53
Fertilizers(kilogramme)	1.31
Herbicides ( litres )	1.23
Farm size ( hectare)	1.23
Hired labour ( SMD)	1.17
Family labour( SMD)	1.11
Mean VIF	1.26

Source: Output from STATA 11, 2018 Ns = Not significant.

The result of diagnostic statistics is presented in Table 3 and revealed that there were no estimation error (Ramsey RESET test) and no heteroskedasticity (Breusch-Pagan / Cook-

Weisberg test) were not statistically significant.

The variance inflation factors (VIF) showed no multicollinearity as all the variables were within the acceptable threshold levels of not more ten (10).

The Cobb-Douglas function (Table 4) showed that the coefficient of multiple determination (R<sup>2</sup>) of 0.7781 implied that about 77.81% of the variations in total output of respondents were explained by production factors included in the model.

The overall model is significant at 1% level as shown by the magnitude of the F-statistics. Coefficients of the variables are their corresponding elasticities as is the case with Double log functional form. All the coefficients are positively signed and in conformity with apriori.

Return to scale (RTS) was 1.45 showing increasing return to scale on the production surface (rational zone of production).

The estimated coefficients for seeds (X<sub>1</sub>), fertilizers (X<sub>2</sub>), herbicide(X<sub>3</sub>), farm size (X<sub>4</sub>) and hired labour (X<sub>5</sub>) were positive and statistically significant at 1% level.

The uses of fertilizers and agrochemicals have been found to increase output of crops in Nigeria. The significant relationship between output of respondents and seeds, fertilizers and herbicides agreed with the findings of Umaru [14] who reported that seeds, fertilizers and herbicides are critical inputs that increase farmers' productivity in Nigeria.

Table 4. Production function Result for Beneficiaries of E-Wallet

Variable	Parameter	Coefficient	Standard error	t- values
Constant	β <sub>0</sub>	2.511101	0.1371436	18.31***
Ln seeds	X <sub>1</sub>	0.4584587	0.0536736	8.54***
Ln fertilizers	X <sub>2</sub>	0.1276967	0.0416118	3.07***
Ln herbicide	X <sub>3</sub>	0.3031969	0.0403722	7.51***
Ln farm size	X <sub>4</sub>	0.392205	0.0596050	6.58***
Ln hired labour	X <sub>5</sub>	0.1444916	0.0481384	3.00***
Ln family labour	X <sub>6</sub>	0.0241052	0.0264539	0.91
RTS		1.45		
R <sup>2</sup>		0.7781		
Adjusted R <sup>2</sup>		0.7690		
F-value		62.87594621		
Error of the estimate		0.23468		

Source: Data Analysis, 2018, \*\*\* Significant at 1% level of probability.

Farm size is important in technology adoption and improved productivity among small scale farmers who are the bulk producers of food in Nigeria [4].

### Respondents' Marginal Analysis of Input Utilization

Marginal analysis of input utilization among respondents (Table 5) revealed that fertilizers, farm size and hired labour were over utilized

while seeds and herbicides were underutilized. This shows that beneficiaries of the E wallet system are not efficient in their production as regards the five important resources that were used in this analysis. The result is similar to the findings of Jongur [10] who reported inefficient utilization of resources among Masakwa (sorghum) farmers in Adamawa State.

Table 5. Result of Marginal analysis of input utilization of Respondents

Resources	MPP	MVP	MFC	MVP/MFC	Remarks
Seeds	41.70	34544.50	1250	2.84	Underutilization
Fertilizers	1.26	107.10	3500	0.041	Over utilization
Herbicide	34.05	2894.25	1850	1.56	Underutilization
Farm size	4.82	409.70	1500	0.27	Over utilization
Hired Labor	11.13	946.05	2570	0.38	Over utilization

Source: Data Analysis 2018.

## CONCLUSIONS

Respondents were young with mean family size of five people with mean experience years and mostly small scale farmers. Fertilizers, herbicides, farm size and hired labour were positive and statistically significant at 1% level and increased output of farmers. Marginal analysis of input utilization among respondents revealed that fertilizers, farm size and hired labour were over utilized while seeds and herbicides were underutilized. Beneficiaries of the E wallet system are not efficient in their production. There is the need for the three tiers of government to increase extension support services for farmers, consistent and sustainable policies to encourage production in the country.

## REFERENCES

[1]Adebayo, E. F., Onu, J.I., 1999, Economics of Rice Production in Yola North and South Local Government Areas. Nigeria Journal of Tropical Agriculture 1:15-20.  
 [2]Agricultural Transformation Agenda ATA, 2012, Federal Capital Territory Abuja, Nigeria Pp 13, 21, 23.  
 [3]Daily Trust, 2013, Nigeria: E-wallet Apprehension Grips Farmers as Rain sets in. Retrieved on 15<sup>th</sup> January 2014.  
 [4]Dire, B., Onu, J.I., Jongur, A.A.U., Ndaghu, A.A., Giroh, D.Y., 2016, Awareness on the Use of Information and Communication Technologies(ICTs) among Agricultural Extension Agents in North Eastern Nigeria. Scientific Papers. Series "Management,

Economic Engineering in Agriculture and Rural Development" 16(1):128 – 139.

[5]Dorward, A. R., 2009, Rethinking Agricultural Input Subsidy Programmes in a Changing World. (Paper prepared for FAO).

[6]Federal Ministry of Agriculture, 2013, Federal Capital Territory Abuja, Nigeria.

[7]Gurstein, M., 2003, Effective use: A Community Information Strategy beyond the Digital Divide, [http://firstmonday.org/issues8\\_12/Gurstein/index.html](http://firstmonday.org/issues8_12/Gurstein/index.html), <https://firstmonday.org/article/view/1107/1027>, Accessed Oct.10, 2018.

[8]Gushibet, S.T., 2012, Economic Growth and Development; an Appraisal. Nigeria Journal of Policy and Strategy 17(1): 111-130.

[9]Heeks, R., 2008, ICT4D 2.0: The Next Phase of Applying ICT for International Development, <http://www.nixdell.com/classes/Tech-for-the-underserved/heels-ictd2.pdf>, Accessed Oct.10, 2018.

[10]Jongur, A.A.U., 2008, Profitability Analysis and Management Practices of Masakwa Farmers in Yola North LGA of Adamawa state, Nigeria: Global Journal of Agricultural Sciences 7 (2):177-182.

[11]Maurice, D.C, Joseph, M., Garba, A., 2015, Analysis of Technical Inefficiency in Rice based Cropping patterns among Small scale Farmers in Selected Local Government Areas of Adamawa State, Nigeria. ATBU Journal of Science, Technology and Education (JOSTE)3(1): 1-13.

[12]National Population commission, NPC2006, National Population commission Census of the Federal Republic of Nigeria.

[13]Panny, Y. M., Giroh, D.Y., 2017, Determinants of Youth Participation in Food Crops Production in Song Local Government Area Adamawa State, Nigeria. Scientific Papers. Series "Management, Economic Engineering in Agriculture and Rural Development" 17(3):427- 430.

[14]Umaru, I.I., 2016, Productivity and Resource Allocation among Small Scale Irrigation Crop Farmers in Taraba and Gombe States, Nigeria. Unpublished Doctoral thesis, Department of Agricultural Economics and Extension, Modibbo Adama University of Technology Yola, Nigeria.



## FACTORS AFFECTING CONSUMER'S BEHAVIOUR ON PURCHASING AND CONSUMPTION OF FOOD PRODUCTS

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### **Abstract**

*Study of consumer's behaviour is important in developing marketing strategy. Consumer behaviour refers to the attitude that the consumer shows during the search, purchase and consumption of a certain product. According to literatures, correlated factors such as; economic, cultural, and psychological factors mostly affect the decision of the consumers whether to accept or reject a food product in the market. The purpose of this paper is to identify the main factors that affect consumer behaviour during the purchase and consumption of an existing food product in the market. The recent study shows many significant differences of the purchasing and consumption attitude between undergraduate and foundation degree students. Consumers have become more dependent on their own preferences by observing sensual attributes of the foodstuffs. Moreover, complete understanding of these identified factors is essential in order to develop an effective marketing strategy.*

**Key words:** consumer's behaviour, food consumption, purchasing behaviour

### **INTRODUCTION**

Increase in globalization, leads food market industries in getting more complex and competitive situation [13]. At the present time, food sector is entitled as one of the major important sectors in global economy and it brought serious attention to the most of institutions and authorities [20]. Despite of the recognition being an important sector, businesses that operates in line with the food industry still faces major problems [30], mainly in terms of competing their products in the market [31]. Since in marketing, consumers are considered as the king, each and every institution desires to intensify their marketing range and income by satisfying the needs of their customers [38]. Widening market capabilities includes psychological observation of the target and potential market individualities in consuming a certain goods. Consumer approach towards foods is influenced by several aspects, which prejudice the costumer's preferences and their decision whether to accept or reject produced goods [24]. Consumer behaviour means the procedure of the costumers making a decision

concerning the product of his choice whether to purchase and acquire an existing product or not [18]. Customer's attitude towards a certain product has always been affected by several factors such as cultural, lifestyle, psychological and economic factors [3]. Study of consumers behaviour are mainly used in developing marketing strategies which requires knowledge of the customers tastes and preferences [18][36]. The purpose of this research is to identify the major factors influencing the attitude of the consumers in buying and consumption of a certain food product.

#### ***Consumers' Behaviour***

Consumer behaviour refers to the attitude that the consumer shows during the search, purchase and consumption of a certain product [36][40]. In today's generation, globalization plays a big role on the continuous growth in food sector [5]. Developing countries started to adapt the concept of digital revolution in production of goods. This concept enables much effective ways on product customization, services and much efficient strategies than older marketing tools [29]. However, while development in

food sector increases, consumer's attitudes and perception towards food products are also evolving.

Most of the companies conduct a consumer behaviour study to improve and develop their marketing strategy [25]. One of the common concepts of conducting strategic marketing analysis is observing the economic status or demographic characteristics of the consumers (ages, gender, level of education, economic stability, etc.) [40][32]. Thru this, the organization could determine the characteristics of their target customer. There are plenty of researchers who used demographic analysis in developing their marketing strategy. Generally, aside from indicating the characteristics of an individual customer, demographic study also shows the ability of the customers to buy a certain product [1]. The consumer's level in the economy could slightly influence their behaviour of consumption. For example, lower generating income individual or family, basically will be more concern of the price of a certain product, while consumers with higher income are more on the quality and less sensitive on the price of the goods [41]. However, regardless of the amount of income of every individual or household, it can be considered that the price of the food products directly affects their purchasing practices [28]. In addition, an individual or family with higher quality of life has more probability of demanding more trusted product in terms of quality, health and hygiene [39].

Marketers could manipulate the behaviour of the buyers but they don't have complete control on it [11]. Other factors which affect the behaviour of the food consumers are based on cultural aspects [14][21]. In modern society, cultural aspects and consumption have substantial connection [2]. Cultural factors include; ethics, tradition, belief, customs, language and etc. that are conveyed from generation to generation. Culture is the vital identity of an individual or group of people that differentiates it from other groups in the society. This factor does not just give impact to the behaviour of the customers, yet it also put limitations on the choice of purchase of the consumers. For example, you

can't expect to sell a ton of pork meat in a group of society with a huge number of Muslims. Anyanwu (1993) observes that Muslims do not eat meat from pork; many marketing strategists have tried to change this behaviour but failed. Culture has put limitation on the choice of consumers and it's hardly unchangeable [12].

Aside from cultural traditions, consumer's buying practices can also be affected by some correlated factors such as, product appearance, flavour or taste, nutritional value, food preferences, convenience and food suitability [6]. In addition perception, motivation, learning and attitudes of the consumers also have an impact on how they react towards a food product. These features are often called as psychological factors [19]. Among these, perception and motivation are the most important norms. Motivation means the level of urgency in which an individual seeks satisfaction [35]. The higher the level of necessity of the person, the higher the possibility of him/her buying a certain product. When we talk about perception, it is all about the senses of a person he uses towards a certain product. A human being, considerably has more than five senses, (i.e. taste, smell, touch, hearing and sight) there are also sense of direction and sense of balance [6][11]. Basically, these are the basis of the customer in purchasing a certain food product. Needs and preferences of the customers are basically the main reason why today's consumers are considered to be "the king" in marketing. Simply because, innovation of a product are mainly based on the needs and the preferences of the customers. Vision also serves a huge role in capturing the interest and attention of the consumers as well as setting the consumer's expectation from an existing product [16][37]. Strategists used colour relatively to packaging process in order to catch immediately the attention of the buyers [27].

Over the last decades, the consumers are being more conscious already towards food product in the market. Aside from the characteristics of the products used to satisfy their preferences, they are also concern of the benefits they can get after consumption.

They've become more knowledgeable about the products in the market. Buyers are worrying about the qualities in terms of health and safety of food because of the crisis they encounter during consumption of a certain product [15]. Food being one of the basic needs of human being, health and safety are one of the most important factors that affect human behaviour towards available food products in the market. Especially in developing countries which are believed to becoming more industrialize. Nowadays, processed foods are largely occupying more space on the market [38]. This means food products with doubtful backgrounds and class (quality) has been submerged in the market [4]. Several years have passed; the numbers of consumers shifting on organically produced food products are increasing [10]. Organic foods are expected to be safer, healthier and tastier to consume than the conventional foods or processed foods on the market [26][34]. It is necessary to completely understand the mentioned factors above in order to improve marketing method referring to consumers' behaviour [7].

## MATERIALS AND METHODS

This study was carried out at Uludag University. Uludag University is the seventh largest university in the country. It accommodates 74,822 students 42,917 of whom undergraduate, in 14 faculties, 4 institutes, and 15 vocational schools.

The computation was as follows:

$$n = (t^2[1+(0.02)(b-1)]pq)/E^2,$$

where n is the sample size, t is the significance level (assumed to be 95%), p is the probability of the situation being searched (assumed to be 50%), q is the probability of the situation not being searched (1 - p), and d is the accepted error (assumed to be 5%). If b is equal to 1, the equation 1 is transformed into the following equation:

$$n = (t^2 * pq) / E^2$$

Using the formula:

$$n = (t^2 * pq) / E^2 =$$

$$[(1.96)^2 * (0.50 * 0.50)] / (0.05)^2 = 384$$

Hence, the minimum sample size is 384. For this study, 440 participants were used in order to reach the reasonable results. The survey is the most used method in socio-economic research, being the most popular and sometimes identified with the sociological research itself.

## RESULTS AND DISCUSSIONS

Survey has been conducted with a total of 440 respondents who are all students. Among the respondents, 45% were female students and 55% were male. About 300 students have associate degree programs and 140 have undergraduate degree programs. Majority of associate degree students are in the 17-19 age groups, the majority of undergraduate students are between the ages of 20-22 years old.

Table 1. Demographic Characteristics of the Respondents

DEMOGRAPHIC	Total	%	Foundation degree (Vocational School)	%	Undergraduate	%	
Gender	Female	198	45%	140	46.7%	82	41.4%
	Male	242	55%	160	53.3%	58	58.6%
	<b>Total</b>	<b>440</b>	<b>100%</b>	<b>300</b>	<b>100%</b>	<b>140</b>	<b>100%</b>
Age	17-19	210	47.7%	210	140	-	-
	20-22	150	34.1%	84	56	66	27.1
	23-25	54	12.3%	6	4	48	34.3
	26-31	26	5.9%	-	-	26	18.6
	<b>Total</b>	<b>440</b>	<b>100%</b>	<b>300</b>	<b>100%</b>	<b>140</b>	<b>100%</b>
Income	<500	90	20.5%	90	30%	-	-
	501-750	220	50%	182	60.7%	38	27.1
	751-1000	76	17.3%	24	8%	52	37.1
	1001-1250	30	6.8%	4	1.3%	26	18.6
	1251+	24	5.4%	-	-	24	17.2
<b>Total</b>	<b>440</b>	<b>100%</b>	<b>300</b>	<b>100%</b>	<b>140</b>	<b>100%</b>	

Source: Own calculation.

Within the scope of the research, the students were group according to their monthly income and computed by percentage. As a result, 20.5% of the respondents belong to the group of <500 TL/month earners and there are only associate degree students in this group. While, majority of the respondents from associate degree students belong to the group of 501-750 TL/month earners with 60.1% and only 27.1 % coming from under graduate students. Meanwhile, the majority of the undergraduate students earn 751-1,000TL per month with 37.1% in ratio and the rest from them earns more than 1,000TL per month.

As a results show, the undergraduate students has higher monthly income than that of the associate degree students. It is thought that this factor may affect the purchasing and consumption attitude of the respondents toward food products. Thru that, it will be examine whether this aspect has significant impact on how the two different groups react upon purchasing and consuming a food product.

**Consumption and purchasing preferences of food products**

The researcher used five Likert’s scale to determine the food purchasing and consumption attitude of the respondents. Then, the internal consistency of the questions on the scale was validated by calculating the value of alpha. It was determined that the value of alpha is equal to 0.779 or ( $\alpha = 0.779$ ) and this number indicates that the scale is reliable and acceptable. According to this, there is no finding of any factor that negatively affects the internal consistency of the statements that contain the criteria and consumer behaviours of the respondents in the survey concerning the purchase of food products.

Within the scope of the research, the student participants of the study were asked about the criteria that serve as an important factor which influence their decisions on purchasing and consuming food products. The results of the scale are shown in table 2.

Base on the results, it has been identified that the first concern of the student participants in buying and consuming a certain product is the quality of the foodstuffs. 87.3% of the respondents agreed with this criterion. The price got the least amount of rate with only 49.5% and 30% of disagreement as the most important factor to influencing the consumers’ purchasing behaviour. Nutritional value got the second highest rate with 75.4% and “brand” got 66.4% of vote. However, when the responses collected from the students are examined separately in terms of their educational status, it is observed that the respondents with an associate degree level pointed out the nutritional value as the most important criterion, while the majority of the undergraduate students chose the quality of

the food as the most significant factor upon acquiring or consuming a certain food product.

Table 2. Consumer Preferences towards Food Products  
F-Foundation Degree  
U-Undergraduate Degree

Important Aspect	Strongly disagree %	Disagree %	No idea %	Agree %	Strongly agree %	F	U	MEAN Total
Brand of the food	12.7%	11.4%	9.5%	50.0%	16.4%	3.39	3.61	3.46
Quality of the food	2.7%	5.9%	4.1%	47.3%	40.0%	3.98	4.54	4.16
Price of the food	10.0%	20.0%	20.5%	25.9%	23.6%	3.54	2.88	3.33
Nutrient of the food	1.8%	4.5%	18.2%	45.9%	29.5%	4.07	3.74	3.97

Source: Own calculation.

In addition, undergraduate students having higher income than the associate degree students, these results clearly indicate that demographic factors of the consumers such as level of income and educational status vary upon purchasing a food product. In other words, the customers with a higher income are more likely to demand higher quality of food products than those with lower income [17]. Many researchers also stated that demographic factors serve as an important variable in determining the purchasing behaviour of the customers [10][23][33][40].

Table 3. Value of t and p

		Mean	Standard Deviation	t value	Sig
Brand on the food	Foundation	3.39	1.31	-1.255	0.211
	Undergraduate	3.61	1.13		
Quality of the food	Foundation	3.98	1.05	-4.252	0.000*
	Undergraduate	4.54	0.50		
Price of the food	Foundation	3.54	1.30	3.555	0.000*
	Undergraduate	2.88	1.20		
Nutrient of the food	Foundation	4.07	0.95	2.544	0.012*
	Undergraduate	3.74	0.77		

\*p<0.05

Source: Own calculation.

Base on the table 3, the students who participated in the study found the quality of the product as the most important criteria when buying a food product. As a result of the T-tests, it is observed that there is a significant difference in determining the importance of the quality (p=0.00<0.05), price (p=0.00<0.05) and nutritional value (p=0.00<0.05). The study of Uçar et al. (2012) also concluded that quality and price shows

significant difference if we talk about educational level of the respondents [39]. According to Nowicki & Sikora (2015), sensual features, nutritional value and price of the food product are the most significant factors determining the attitude of the consumers in the marketplace [24]. Meanwhile, one important finding of the current study is that there is no significant

difference between the respondents regarding the importance of the brand in the food products.

Within the scope of the research, students were asked about their preference and the importance of these features when purchasing food items. The results obtained are shown in Table 4.

Table 4. Specifications when Purchasing Food Products  
 (f) Foundatin Degree – Vocational School – 2 years in university  
 (u) Undergraduate – Faculty

Specifications	Strongly Disagree			Disagree			No Idea			Agree			Strongly Agree		
	F	U	%	F	U	%	F	U	%	F	U	%	F	U	%
Quality	8	-	1.8	42	-	9.5	-	-	-	126	58	41.8	124	88	46.9
Taste & Flavour	-	-	-	4	0	0.9	-	-	-	102	42	32.7	194	98	66.4
Nutrition	-	-	-	18	16	7.7	20	4	5.5	136	80	49.1	126	40	37.7
Food integrands	-	-	-	40	6	10.5	30	14	10.0	98	72	38.6	132	48	40.9
Price	14	4	4.1	34	20	12.3	12	8	4.5	128	84	48.2	112	24	30.9
Label information	8	6	3.2	48	18	15.0	24	18	9.5	138	78	49.1	82	20	23.2
Food Security	-	-	-	10	6	3.6	16	8	5.5	90	48	31.4	184	78	59.5
Food Processing & hygiene	-	-	-	10	-	2.3	16	14	6.8	96	40	30.9	178	86	60.0
Brand Name	30	8	8.6	46	20	15.0	34	8	9.5	122	90	48.3	68	14	18.6
Date of Production & Expiration	-	-	-	6	-	1.4	10	-	2.3	38	18	12.7	246	122	83.6
Pure and Natural Food	4	-	0.9	44	4	10.9	24	32	12.7	116	72	42.8	112	32	32.7
Freshness	-	-	-	8	6	3.2	4	-	0.9	90	62	34.5	198	72	61.4
Design and Type of packaging	40	16	12.7	84	44	29.1	18	6	5.5	104	62	37.7	54	12	15.0
Packaging material	38	6	10.0	56	18	16.8	42	30	16.4	112	54	37.7	52	32	19.1
Product advertising	80	28	24.5	74	46	27.3	46	8	12.3	68	52	27.3	32	6	8.6
Promotion	14	12	5.9	24	28	11.8	18	20	8.6	104	50	35.0	140	30	38.7

Source: Own calculation.

As shown in Table 4, 83.6% of the respondents found the production and expiration date very important. Base on the students, the rates of food processing and hygiene, taste and flavour and freshness are high; and there is none of the respondents think of these criteria as not important at all. The percentage of those who think that product advertising has a greater impact on food purchasing than the other criteria has a minimum proportion in the results of the research. There are 8.6% who find product advertisement as important factor and 24.5% think of this criterion as not important at all. Meanwhile, 16.4% of the respondents are undecided in the importance of packaging

material in purchasing food product. This ratio has the highest rate among the other criteria that belong to undecided group in the study.

However, about 99.1% stated that they “Agree” and “Strongly agree” of the taste and preferences of the food product being the most important. All of the undergraduate students have agreed that taste & preference are important specification that influences their purchasing behaviour, while out of 300 associate students 296 also chose to agree. These finding clearly indicates that sensual characteristics of the food product is the first criterion that the customer observes upon purchasing food product.

Table 5 shows different criteria that the respondents give importance on purchasing food items. As a result of T-tests, quality ( $p=0.00<0.05$ ) and promotion ( $p=0.00<0.05$ ) criteria, shows difference among associate and undergraduate students.

Table 5. Properties and Importance of Purchasing Food

	Education level	Mean	Standard Deviation	t value	Sig
Quality	Foundation	4.05	1.11	-4.171	0.000*
	Undergraduate	4.63	0.49		
Taste & Flavour	Foundation	4.62	0.56	-1.036	0.301
	Undergraduate	4.70	0.46		
Nutrition	Foundation	4.23	0.82	1.679	0.095
	Undergraduate	4.03	0.88		
Food integrands	Foundation	4.07	1.04	-0.602	0.548*
	Undergraduate	4.16	0.77		
Label information	Foundation	3.79	1.09	1.061	0.290
	Undergraduate	3.63	1.02		
Food Security	Foundation	4.49	0.75	0.717	0.474
	Undergraduate	4.41	0.79		
Food Processing & hygiene	Foundation	4.47	0.75	0.390	0.697
	Undergraduate	4.51	0.68		
Brand Name	Foundation	3.51	1.27	0.453	0.651
	Undergraduate	3.59	1.04		
Date of Production & Expiration	Foundation	4.75	0.62	-1.588	0.114
	Undergraduate	4.87	0.34		
Pure and Natural Food	Foundation	3.96	1.08	0.120	0.905
	Undergraduate	3.94	0.76		
Freshness	Foundation	4.59	0.65	1.686	0.093
	Undergraduate	4.443	0.71		
Design and Type of packaging	Foundation	3.16	1.36	0.459	0.646
	Undergraduate	3.07	1.25		
Packaging material	Foundation	3.28	1.30	-1.938	0.054
	Undergraduate	3.63	1.11		
Product advertising	Foundation	2.66	1.36	0.354	0.723
	Undergraduate	2.73	1.27		
Promotion	Foundation	4.11	1.12	4.082	0.000*
	Undergraduate	3.41	1.27		

\* $p<0.05$

Source: Own calculation.

When we look at the means, it is seen that the date of production and expiration criterion is first in terms of importance. While, for the students with associate degree, the least important criterion is the advertisement of the product and the packaging material is the lowest for undergraduate degree students.

Although some consumers are sometimes not checking the indicated expiration date on the label of the product [8], Lorenz, Hartmann, & Simons (2015) stated that consumers habitually discard eatable goods with alterations in visual, sensual appearance, or product which passed the expiration date already [22].

The respondents were asked about the regularity or frequency of their consumption of different food product. The results are shown in the table 6.

Base on the result of the T-test, the frequency of consumption of white meat products ( $p=0.00<0.05$ ) and red meat ( $p=0.00<0.05$ )

were significantly different among associate degree and undergraduate students. Also, the consumption of milk and dairy products ( $p=0,006<0.05$ ), frozen foods ( $p=0,007<0.05$ ) and flour Foods ( $p=0,035<0.05$ ) shows difference according to educational status.

Table 6. Distribution of respondents' opinion on organic products information accessibility depending on age

	Education level	Mean	Standard Deviation	t value	Sig
Vegetables	Foundation	4.05	1.11	-4.171	0.000*
	Undergraduate	4.63	0.49		
Fruits	Foundation	4.62	0.56	-1.036	0.301
	Undergraduate	4.70	0.46		
White Meat	Foundation	4.23	0.82	1.679	0.095
	Undergraduate	4.03	0.88		
Red Meat	Foundation	4.07	1.04	-0.602	0.548*
	Undergraduate	4.16	0.77		
Dairy Products	Foundation	3.79	1.09	1.061	0.290
	Undergraduate	3.63	1.02		
Dry Legumes	Foundation	4.49	0.75	0.717	0.474
	Undergraduate	4.41	0.79		
Frozen	Foundation	4.47	0.75	-0.390	0.697
	Undergraduate	4.51	0.68		
Bakery Products	Foundation	3.51	1.27	-0.453	0.651
	Undergraduate	3.59	1.04		
Others	Foundation	4.75	0.62	-1.588	0.114
	Undergraduate	4.87	0.34		

\* $p<0.05$

Source: Own calculation

Table 6 shows that vegetable is the most frequently consumed. The food that receives lowest consumption is frozen products; followed by the red meat products. When the means are observed, the most frequently consumed food by the undergraduate students is white meat products, while the most common food consumed by undergraduate students is vegetables. Both groups have the same results of least consumed food which is the bakery products. Jabir Ali, Sanjeev Kapoor, Jana Kiraman Moorthy (2010) concluded that fruits and vegetables are frequently purchased due to their perishable nature [3].

## CONCLUSIONS

The recent study concluded that the respondents which have higher income are more conscious of the quality of the food that they purchase and those who have lower

income are more focus on the nutritional value. Consumer behaviour attitude measurement statements revealed a number of significant differences between associate degree student and undergraduate students. In analysing the data obtained using t-test, it is observed that there is a significant difference in determining the importance the quality ( $p=0.00<0.05$ ), price ( $p=0.00<0.05$ ) and nutritional value ( $p=0.00<0.05$ ) as well as the promotion ( $p=0.00<0.05$ ) criteria. The study also indicates that that taste & preference are important specification in determining the purchasing and consumption behaviour of the food consumers. However, one of the important results of this research is that today's food consumers are getting more attentive of the food product durability by checking the expiration date of the food products. Earlier than these years, marketers could easily manipulate the consumers attitude using the old marketing tools of advertising, promotion, elegant packaging and another aspects provided by the product innovators. However, the recent study concluded that today's consumers are harder to please using these old marketing tools. In fact, consumers have now started emphasizing more on their own preferences by observing the sensual characteristics of the product.

In marketing, consumers are considered as the king. In which companies or any organization's main goal is to identify the needs of their customers and give them satisfaction. In order to have effective and efficient marketing strategy, complete understanding of consumer's behaviour in consumption and buying a certain product is a significant approach.

## REFERENCES

- [1]Abdullahi Farah, A., Zainalabidin, M., Ismail, A. L., 2011, The influence of socio-demographic factors and product attributes on attitudes toward purchasing special rice among Malaysian consumers. *International Food Research Journal*, 18(3): 1135–1142.
- [2]Akpan, S. J., 2016, The Influence of Cultural Factors on Consumer Buying Behaviour (A Case Study of Pork). *British Journal of Marketing Studies*, 4(6): 44–57.
- [3]Ali, J., Kapoor, S., Moorthy, J., 2010, Buying behaviour of consumers for food products in an emerging economy. *British Food Journal*, 112(2): 109–124.
- [4]Alibabić, V., Jokić, S., Mujić, I., Rudić, D., Bajramović, M., Jukić, H., 2011, Attitudes, behaviors, and Perception of consumers' from Northwestern Bosnia and Herzegovina toward food products on the market. *Procedia - Social and Behavioral Sciences*, 15, 2932–2937.
- [5]Antić, Z., Bogetić, S., 2015, Food Industry Workers Attitudes on the Importance of Factors Affecting Foodstuff Quality Management. *Journal of Engineering Management and Competitiveness (Jemc)*, 5(1): 29–39.
- [6]Blanck, H. M., Yaroch, A. L., Atienza, A. A., Yi, S. L., Zhang, J., Mâsse, L. C., 2009, Factors influencing lunchtime food choices among working Americans. *Health Education and Behavior*, 36(2): 289–301.
- [7]Burcea, D., Dona, I., 2015, Study Regarding the Evolution of Food Consumption of Romania During 2007-2013, From the Perspective of Food Security Insurance and Export Availability Growth. *Scientific Papers: Management, Economic Engineering in Agriculture & Rural Development*, 15(2): 45–52.
- [8]Chassy, B. M., 2010, Food safety risks and consumer health. *New Biotechnology*, 27(5): 534–544.
- [9]Colson, G., Rousu, M. C., 2013, What do consumer surveys and experiments reveal and conceal about consumer preferences for genetically modified foods? *GM Crops & Food*, 4(3): 158–165.
- [10]Dinu, T.A., Stoian E., Micu, M.M., Condei, R., Niculae, I., 2014, Study Regarding Consumption Of Organic Products in Romania. *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development*, 14(2): 113–118.
- [11]Durmaz, Y., 2014a, The impact of psychological factors on consumer buying behavior and an empirical application in Turkey. *Asian Social Science*, 10(6): 194–204.
- [12]Durmaz, Y., 2014b, The Influence of Cultural Factors on Consumer Buying Behaviour and an Application in Turkey Dr. *Journal of Social Science Research*, 3(2): 256–263.
- [13]Gupta, K. B., 2009, Consumer Behaviour for Food Products in India. *International Food and Agribusiness Management Association*, 1, 1–13.
- [14]Hema Patil, M., BBakkappa, D., 2012, The Influence of Culture On Cosmetics Consumer Behaviour, 3(4): 41–47.
- [15]Kar, P., Meena, H. R., Patnaik, N. M., 2018, Factors Influencing Consumers Purchase Intention towards Organic and Cloned Animal Food Products. *Int.J.Curr.Microbiol.App.Sci*, 7(1): 1–9.
- [16]Kauppinen-Räsänen, H., Luomala, H. T., 2010, Exploring consumers' product-specific colour meanings. *Qualitative Market Research*, 13(3): 287–308.
- [17]Koç, B., Ceylan, M., 2009, Consumer-awareness and information sources on food safety: A case study of Eastern Turkey. *Nutrition and Food Science*, 39(6): 643–654.

- [18]Laoviwat, P., Suppapanya, P., Yousapronpaiboon, K., 2014, A Study of Demographics Influencing on Consumer Behavior and Attitude towards Brand Equity of Optical Business in Thailand. *International Journal of Trade, Economics and Finance*, 5(4): 347–350.
- [19]Lautiainen, T., 2015, Factors affecting consumers' buying decision in the selection of a coffee brand (Bachelor's thesis).
- [20]Lehmann, R. J., Reiche, R., Schiefer, G., 2012, Future internet and the agri-food sector: State-of-the-art in literature and research. *Computers and Electronics in Agriculture*, 89: 158–174.
- [21]Lichev, G. T., Tsenov, D. A., 2017, Psychological Factors in Determining Consumer Behaviour. *Eastern Academic Journal*, (1): 2367–73848.
- [22]Lorenz, B. A., Hartmann, M., Simons, J., 2015, Impacts from region-of-origin labeling on consumer product perception and purchasing intention - Causal relationships in a TPB based model. *Food Quality and Preference*, 45, 149–157.
- [23]Nejati, M., Moghaddam, P. P., 2013, The effect of hedonic and utilitarian values on satisfaction and behavioural intentions for dining in fast-casual restaurants in Iran. *British Food Journal*, 115(11): 1583–1596.
- [24]Nowicki, P., Sikora, T., 2015, Consumer behaviour at the food market, (2012).
- [25]Oke, A. O., Kamolshotiros, P., Popoola, O. Y., Ajagbe, M. A., Olujobi, O. J., 2016, International Review of Management and Marketing Consumer Behavior towards Decision Making and Loyalty to Particular Brands. *International Review of Management and Marketing*, 6(S4): 5–6.
- [26]Olson, E. L., 2017, The rationalization and persistence of organic food beliefs in the face of contrary evidence. *Journal of Cleaner Production*, 140(October): 1007–1013.
- [27]Orquin, J. L., Mueller Loose, S., 2013, Attention and choice: A review on eye movements in decision making. *Acta Psychologica*, 144(1): 190–206.
- [28]Peterson, S. L., Dodd, K. M., Kim, K., Roth, S. L., 2010, Food cost perceptions and food purchasing practices of uninsured, low-income, rural adults. *Journal of Hunger and Environmental Nutrition*, 5(1): 41–55.
- [29]Pettigrew, J., Schein, A. M., Rosenfield, E. H. R., Pettigrew, R., 2008, Chapter – Ii Review of Literature. *Administrative Science Quarterly Journal of Management Studies*, 24(26): 579–581.
- [30]Pinna, C., Galati, F., Rossi, M., Saidy, C., Harik, R., Terzi, S., 2018, Effect of product lifecycle management on new product development performances: Evidence from the food industry. *Computers in Industry*, 100(August 2017): 184–195.
- [31]Pinna, C., Plo, L., Robin, V., Girard, P., Terzi, S., 2017, An approach to improve implementation of PLM solution in food industry - case study of Poult Group. *International Journal of Product Lifecycle Management*, 10(2): 151.
- [32]Pirvutoiu, I., Popescu, A., 2013, Research on Consumer Behaviour in Bucharest Poultry Meat Market. *Animal Science and Biotechnologies*, 46(1): 389–396.
- [33]Poornima, S., Ramakrishna, S., Shivakumar, K., 2013, Consumption Pattern of Fastfoods among young adults Attending Medicine OPD at Mimsh, Mandya City, Karnataka, India. *Indian J. Prev. Soc. Med*, 44:(1–2).
- [34]Prakash, G., Singh, P. K., Yadav, R., 2018, Application of consumer style inventory (CSI) to predict young Indian consumer's intention to purchase organic food products. *Food Quality and Preference*, 68, 90–97.
- [35]Ramya, N., Ali, D. S. M., 2016, Factors affecting consumer buying behavior. *International Journal of Applied Research*, 2(1 0): 76–80.
- [36]Rani, P., 2014, Factors influencing consumer behaviour. *Excellent Publishers Journal*, 52–61.
- [37]Spence, C., 2016, Multisensory Packaging Design: Color, Shape, Texture, Sound, and Smell. Integrating the Packaging and Product Experience in Food and Beverages: A Road-Map to Consumer Satisfaction, (December 2016), 1–22.
- [38]Srinivasan, K., Nirmala, R., 2014, A Study on Consumer Behavior towards Instant Food Products (With Special References to Kanchipuram Town). *IOSR Journal of Business and Management*, 16(11): 17-21.
- [39]Uçar, A., Özdoğan, Y., Özçelik, A. Ö., 2012, Consumer Attitudes toward Food Consumption and Purchase in Turkey. *Ecology of Food and Nutrition*, 51(6): 492–504.
- [40]Vilčeková, L., Sabo, M., 2013, The influence of demographic factors on attitudes toward brands and brand buying behavior of Slovak consumers. *International Journal of Education and Research*, 1(11): 1–10.
- [41]Zhao, R., Geng, Y., Liu, Y., Tao, X., Xue, B., 2018, Consumers' perception, purchase intention, and willingness to pay for carbon-labeled products: A case study of Chengdu in China. *Journal of Cleaner Production*, 171, 1664–1671.

## STRUCTURE OF INVESTMENT COSTS OF DAIRY SHEEP BREEDING FARMS IN BULGARIA

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### *Abstract*

*The purpose of the research was to analyze the structure of the investment costs for the establishment of dairy sheep breeding farms in Bulgaria, as well as to explore some indicators, characterizing the activity of the farms under this study. The data were collected by visiting and questioning the owners of 5 sheep farms and on the basis of own calculations. The structure of the investment costs of the dairy sheep farms was explored. The amount of investments per 1 ewe in each farm was also calculated. Average milk yield, age of inclusion in the main flock of ewes and rams, average number of lactations of ewes, average number of years of using rams and prolificacy were analyzed. Although we couldn't prove it statistically, we saw a tendency for reduction of the investment costs per 1 ewe with an increase in the number of animals in the main flock. The largest share of the investments occupied the purchase of animals, followed by the land purchase and the expenses for agricultural buildings. The interviewed farmers bought predominantly used tractors and other agricultural machinery, mainly because of their lower prices. The ewes in the five farms were inseminated naturally. They were kept in renovated old buildings. During the summer season, the animals grazed on pastures; concentrated fodder as a supplement was used in only one of the farms. The farmers used their agricultural lands mainly to produce meadow hay and alfalfa occasionally wheat and barley. The average milk yield in the farms ranged from 80 to 170 liters per year. These large ranges of variation were due both to the raised sheep breeds and to the specifics farms' activities. Nulliparous ewes and rams were included in the main flock at 12-18 months of age. The sheep remained in the main flock on average of 6 lactations with a variation from 5 to 8 lactations. The rams were used on average for 2 years with variations from 1 to 4 years. Prolificacy in the farms ranged from 100 to 154%.*

**Key words:** dairy sheep breeding; investment costs; milk yield; prolificacy; Bulgaria

### INTRODUCTION

Over the last 30 years, sheep husbandry in Bulgaria has undergone dramatic changes. Pursuant to FAO data in 1990, sheep number was 8,130,305 and in 2017 it fell to 1,360,087 [12]. Also the priority of the sector has changed - from the finewool production to the dairy direction. In Bulgaria, sheep in the dairy sector account for 70–75% of the total sheep number and the most widely represented breed is Bulgarian Dairy Synthetic Population (also named Synthetic Population Bulgarian Milk (SPBM), registered in 2005 [10]. The developed crossbreeding schemes for creation of SPBM involved East Friesian and Awassi breeds, as sire breeds and local breeds, as dame breeds. For the last 10 years, there is an interest from the sheep farmers to introduce sheep from world famous milk breeds – Awassi, Assaf, Lacaune.

Average milk yield and prolificacy of the SPBM breed vary in accordance to the number of lactation and lambing [4], [9]. The reported mean for the milk production of the flock at first lactation is 88.07 l, 94.4 l at second, and 100.04 l at third; the mean fecundity varies from 1.2 to 1.7 [4].

Searching for alternatives for raising farm income is essential to redeem investment costs. The performance of livestock sector (including dairy sheep husbandry) in Bulgaria can be improved by new technologies' implementation, which can help the sector to become a competitive one [2].

It has been established [1] that with a suitable reproductive model the net income of the holding can be increased. A number of authors are studying the economic effectiveness of raising SPBM breed in different regions of Bulgaria [6], [7] as well as the economic outcomes of raising local sheep breeds [11].

Investments in a dairy sheep farm in Serbia with 200 ewes in the main flock, were calculated and it was found that Pay back of return on investment was 4.2 years with Internal rate of return of 20% [8]. In our previous research [3], we were calculated different categories of cash flows and some indicators for effectiveness assessment of a dairy sheep breeding farm in Bulgaria with 300 ewes in the main flock and we found out that the Discounted payback was 10 years.

The purpose of the research was to analyze the structure of the investment costs for the establishment of dairy sheep breeding farms in Bulgaria, as well as to explore some indicators, characterizing the activity of the farms under this study.

## MATERIALS AND METHODS

The paper examined the structure of the investment costs of 5 dairy sheep farms in Bulgaria. The amount of investments per 1 ewe for each farm was also calculated.

The data were collected by visiting and questioning the owners of the sheep farms, as well as on the basis of our own estimations. The ewes' number in the farms was respectively: 26 ewes, 83, 90, 314 and 325. Average milk yield, age of inclusion in the main flock of ewes and rams, average number of lactations, average number of years of using rams and prolificacy were analyzed. Prolificacy was calculated as a ratio between the number of lambs born for one year and the number of ewes, multiplied by 100.

The farms raised the following sheep breeds: Synthetic Population Bulgarian Milk (SPBM), Sofia sheep (local sheep breed, not endangered from extinction), Stara Zagora sheep (endangered from extinction) and local crosses. The ewes from the five farms were inseminated naturally, artificial insemination was not applied. The farms' buildings were renovated. During the summer season, the animals grazed on pastures, which are important source for the production of ruminants' forages [5]. Concentrated fodder as a supplement was used in only one of the farms (the holding with 26 ewes), which recorded the highest average milk yield

among the analyzed farms. In the winter season, each farm had adopted its own combination of rough and concentrated forages for feeding the sheep. Only 1 farm did not manage land and therefore did not produce feed for the sheep. Four of the farms received subsidies for the animals and three farms - for the lands they managed.

## RESULTS AND DISCUSSIONS

Figure 1 shows the investments in EUR per 1 ewe in the main flock. The largest value of this indicator had the farm holding with 26 ewes (1,396 EURO), and the smallest - the farm with 325 ewes (200 EUR).

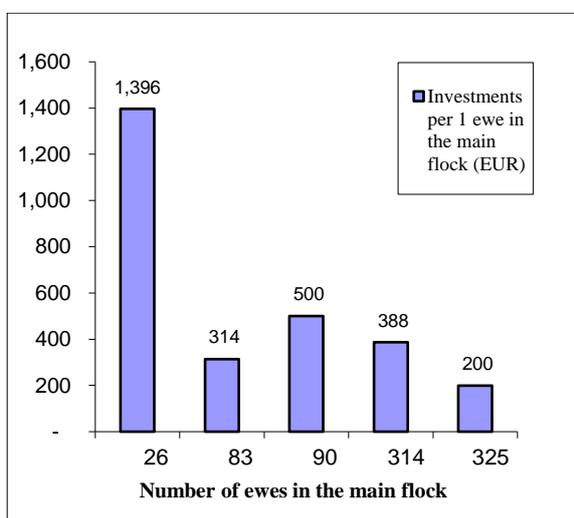


Fig. 1. Investments per 1 ewe in the main flock (EUR)  
Source: Data collected from questionnaires and own estimates

Investments per 1 ewe in the smallest farm were almost 7 times higher than these in the farm with 325 ewes. The indicator was 314 EUR for the farm with 83 ewes, ie. the value was close to that for the farm with 314 ewes (388 EUR). On the other hand, in the farm with 90 ewes, the indicator was 1.6 times higher than that for the farm with 83 ewes, although the two farms had almost the same number of animals in the main flock.

Investments per 1 ewe varied widely, depending on the farms' specific characteristics. Although we couldn't prove it statistically, we saw a tendency for reduction of the investment costs per 1 ewe with an

increase in the number of animals in the main flock.

Table 1 shows the mean, standard deviation, minimum and maximum of the shares of the respective investment cost.

Table 1. Structure of investments in dairy sheep breeding farms

Investments	Mean	Minimum	Standard deviation
		Maximum	
Farm buildings (%)	24.80	5 / 47	16.10
Agricultural lands (%)	25.00	0 / 73	28.13
Animals (%)	26.00	8 / 46	13.77
Agricultural machinery (%)	11.20	0 / 22	10.43
Milking equipment (%)	0.40	0 / 2	0.89
Inventory (%)	8.60	0 / 28	12.10
Vehicles (%)	3.80	1 / 8	2.59

Source: Data collected from questionnaires and own estimates

In terms of the mean percent for each category of investment cost, the largest share took the purchase of animals (ewes, rams and lambs) - 26% (with variations from 8 to 46%), followed by the expenditures for agricultural lands (arable land and pastures) - 25% (from 0 to 73%) and the purchase of farm buildings - 24.8% (from 5 to 47%). The share of agricultural machinery (tractors, mowers, balers) was 11.2% with variations from 0 to 22%. The milking equipment took a mean value of 0.40%. Machine milking with a sheep milking bucket was practiced only in the farm with 325 ewes, in other farms the animals were milked manually. The mean percent of inventory (hay cutters, forage grinders, plows, seed drills, cultivators, disc harrows, brush cutters and other) was 8.60%. The mean percentage of vehicles was 3.80%, varying from 1 to 8%.

The studied sheep farmers used their agricultural lands mainly to produce meadow hay and alfalfa, occasionally wheat and barley. Alfalfa was given to sheep in fresh (faded) form during the summer and in the

form of hay during the winter. From the wheat and barley, besides grain (concentrated fodder), straw was also produced, which was used as a rough forage and for animal bedding.

Farmers reported that the purchase price per animal varied according to breed and age: 75-100 EUR for SPBM sheep and 100-150 EUR for a lamb from the Stara Zagora sheep breed. The studied farmers were found to buy predominantly used tractors and other agricultural machinery, mainly because of their lower prices. Farmers said they had bought tractors at prices of 2,500-4,000 EUR per tractor; a baler for 1,750 EUR; a mower for 1,050 EUR; a forage grinder for 150-300 EUR; a hay cutter for 75-100 EUR; a sheep milking bucket - 675 EUR.

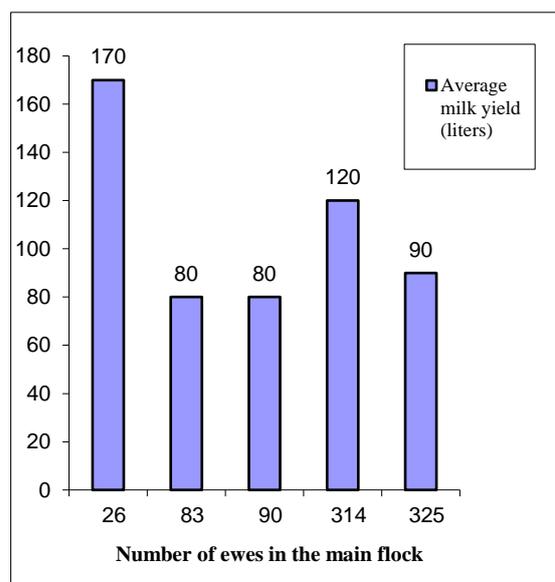


Fig. 2. Average milk yield, realized in the dairy sheep farms

Source: Data collected from questionnaires and own estimates

The average milk yield of ewes from the 5 farms varied widely from 80 to 170 liters per year (fig. 2). Highest milk productivity (170 liters) was reached in the farm with 26 ewes, where SPBM breed was raised. The high milk productivity of this farm, according to us, was due not only to the sheep breed, but also to the individual attendance for each animal. The individual attendance was partly due to the small number of sheep, kept on the farm. The lowest milk productivity had the farms with

83 and 90 ewes in the main flock. In the farm with 83 ewes, SPBM breed was raised, and in the farm with 90 ewes, the animals were from the Stara Zagora sheep breed. In the farm with 314 ewes, the sheep were from SPBM breed and from Sofia sheep breed. Local crosses were bred as well. In the largest farm (325 ewes) the animals were from local crosses and from the SPBM breed.

These large ranges of variation in average quantities of milk yield on a farm level were due both to the raised sheep breeds and to the specifics farms' activities.

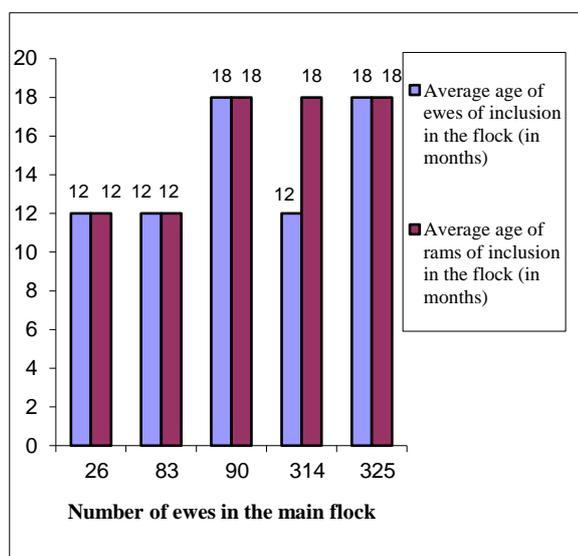


Fig. 3. Average age of inclusion in the main flock  
 Source: Data collected from questionnaires and own estimates

Nulliparous ewes are included in the main flock after their first insemination, and rams - after reaching sexual maturity. In the analyzed farms, rams and nulliparous ewes were included in the main flock at 12-18 months of age (fig. 3). The ewes from the farms with 26, 83 and 314 ewes were included in the main flock earlier than the other two farms. Only in farms with 26 and 83 ewes, the rams were included at 12 months of age. The age of inclusion of rams and nulliparous ewes in the main flock is an important indicator, because the animals begin to return the invested resources for their rearing (labor, fodder, medication, services, buildings) after their inclusion in the main flock. They return the investments in the form of animal production (sheep milk, wool and lambs) and in the form

of meat, skin, or money when they are culled or sold.

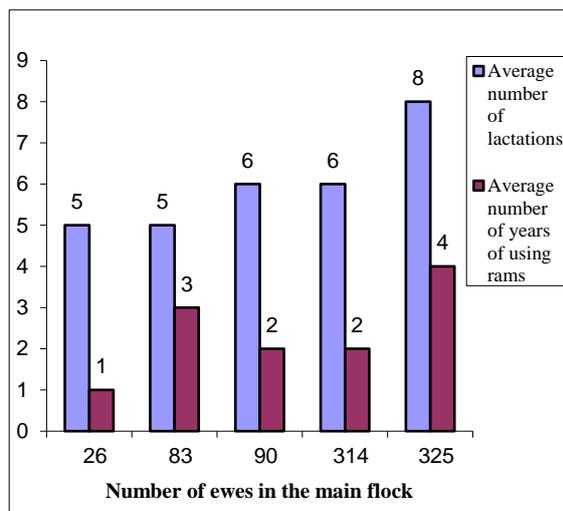


Fig. 4. Average number of lactations and average number of years of using rams  
 Source: Data collected from questionnaires and own estimates

According to fig. 4, the ewes remained in the main flock for 6 lactations on average with variations from 5 to 8. The rams were used for 2 years with variations from 1 to 4 years.

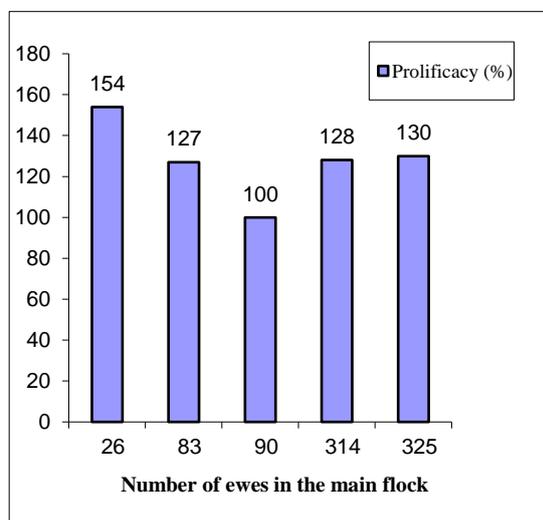


Fig. 5. Prolificacy, realized in the dairy sheep farms  
 Source: Data collected from questionnaires and own estimates

Prolificacy ranged from 100 to 154%, with the highest value in the farm with 26 ewes (fig. 5). The lowest percent was observed in the farm with 90 ewes, which was probably due primarily to the raised breed (Stara Zagora sheep). The other three dairy farms had similar prolificacy rates (127-130%).

## CONCLUSIONS

Investments per 1 ewe in the main flock varied widely, depending on the farms' specific characteristics. Although we couldn't prove it statistically, we saw a tendency for reduction of the investment costs per 1 ewe with an increase in the number of animals in the main flock. The largest share of the investments occupied the purchase of animals, followed by the land purchase and the expenses for agricultural buildings. The interviewed farmers bought predominantly used tractors and other agricultural machinery, mainly because of their lower prices. The ewes in the five farms were inseminated naturally. They were kept in renovated old buildings. During the summer season, the animals grazed on pastures; concentrated fodder as a supplement was used in only one of the farms. The farmers used their agricultural lands mainly to produce meadow hay and alfalfa occasionally wheat and barley. The average milk yield in the farms ranged from 80 to 170 liters per year. These large ranges of variation were due both to the reared sheep breeds and to the specifics farms' activities. Nulliparous ewes and rams were included in the main flock at 12-18 months of age. The ewes remained in the main flock on average of 6 lactations with variation from 5 to 8 lactations. The rams were bred on average for 2 years with variations from 1 to 4 years. Prolificacy in the farms ranged from 100 to 154%.

## REFERENCES

- [1] Bonev, G., Kostadinova, N., 2011, Economic analyse for sheep reproduction model. *Bulgarian Journal of Agricultural Economics and Management*, 56, 6/2011, p. 23-28.
- [2] Harizanova-Bartos, H., Dimitrova, A., 2018, Perspectives and barriers in the implementation of innovations in Bulgarian agriculture. *Scientific Papers Series "Management, Economic Engineering in Agriculture and Rural Development"* Vol. 18/2018, Issue 4, p.143 -149.
- [3] Harizanova-Metodieva, Ts., Metodiev, N., 2014, Effectiveness of dairy sheep breeding in Bulgaria. *J. of International Scientific Publications: Agriculture and Food*, Vol. 2, 330-337.
- [4] Ivanova, T., Metodiev, N., Raicheva, E., 2013, Effect of the genealogic line on milk production and prolificacy of the ewes from Synthetic Population Bulgarian Milk. *Bulgarian Journal of Agricultural Science*, 19 (No 1):158-162.
- [5] Ivanova, T. V., Lutskanov, P. I., Kalev, R. Y., Bozhanska, T. I., Iliev, M. N., Gajdarska, V. M., 2018, Influence of grassland composition and climate conditions on the productivity of Aberdeen-Angus calves. *Animal breeding and genetics*, Vol. 55, 61–70.
- [6] Mihailova – Toneva, M., 2016, Economic assessment of the efficiency in the production of sheep products from the Synthetic Population Bulgarian Milk. *Bulgarian Journal of Animal Husbandry*, LIII, 3-6, 46 - 51.
- [7] Slavova, St, Stancheva, N., Laleva, S., Popova, Y., Slavova, P., 2015, Economic efficiency in the sheep flock of Bulgarian Synthetic Population for Milk, raised in the experimental base - state enterprise to the Agricultural Institute – Shumen, situated in the village of Tsarev Brod. *Bulgarian Journal of Animal Husbandry*, LII, 5/2015, p. 90 - 97.
- [8] Sredojević, Z., Popović, N., 2014, Sheep farming-pastures-sustainability: an economic model of sheep farm for rural areas in Serbia. *International Scientific Conference „Sustainable agriculture and rural development in terms of the Republic of Serbia strategic goals realization within the Danube region. Rural development and (un)limited resources“*, 5-6 June 2014, Belgrade, the Republic of Serbia, MPRA Paper No. 58558, p. 1006 - 1023. [https://mpra.ub.uni-muenchen.de/58558/.](https://mpra.ub.uni-muenchen.de/58558/), Accessed on Jan.10, 2019.
- [9] Stancheva, N., Dimitrova, I., Georgieva S. 2014. Biological fertility and milk yield in Bulgarian Dairy Synthetic Population sheep according to breeding line. *Agricultural Science and Technology*, Vol. 6(1): 17-20.
- [10] Stancheva, N., Krastanov, J., Angelova, T., Kalaydzhiev, G., Yordanova, D., 2018, Suckling period and milk productivity of the sheep from Bulgarian Dairy Synthetic Population. *Macedonian Journal of Animal Science*, Vol. 8 (1):11–17.
- [11] Staykova, G., Iliev, M., Slavova, S., 2017, Assessment of the economical effect in rearing and preserving the Local Karnobat Sheep Breed in Institute of Agriculture – Karnobat. *Bulgarian Journal of Animal Husbandry*, LIV, 3/2017, p. 16 - 24.
- [12] [www.fao.org](http://www.fao.org), Accessed on Jan 10, 2019.



## IMPLEMENTATION OF THE CONCEPT AGRICULTURE OF PRECISION A WAY TO IMPROVE THE MANAGEMENT OF AGRICULTURAL ENTERPRISES

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### *Abstract*

*The present study is part of the research area, which aims at the necessity and opportunity of adopting at the agricultural enterprise level geospatial and informational technologies, in order to practice an optimal management of terrain, machinery and input acquisition, taking into account the specific natural variation of environmental conditions. The paper briefly presents a series of particularities regarding the use of geospatial and informational technology in the process of taking, storing, analysing and processing spatially distributed information through a computerized process aiming to optimize the agricultural technologies.*

**Key words:** *agricultural, geospatial and informational technologies, optimal management of terrain, optimize the agricultural technologies*

### INTRODUCTION

Globally, geospatial and informational technology is increasingly present in technological processes in agriculture, which calls for a responsive reaction from the management of agricultural enterprises in Romania. Adoption of these technologies is a good thing because it allows the agricultural field to integrate into the most processed fields of human activity together with agricultural technologies as a natural step in the knowledge-based economy [4]. The moment of adopting geospatial and informational technologies in agriculture will mark the entry into a new stage of agricultural management and decision-making at the level of agricultural enterprise, generating the emergence of a new concept called agriculture of precision. The interest in this concept is growing, which makes us, when referring to precision farming, to understand the following: the most advanced form of agriculture that has the fundamental purpose of optimizing the use of soil, water and chemical inputs on local specific basis, for obtaining high production of high quality, optimizing economic profits, integrating

environmental protection, increasing the sustainability of agricultural systems [8]; knowing the spatial and temporal variation of soil productivity parameters, continuous variability monitoring and its management through different technologies (Variable Rate Technology - VRT) according to local specific conditions [9]; a systemic approach of the biological, ecological and socio-economic factors involved, with spatial and temporal components as characteristics, and emerging as a necessity to increase the efficiency of the quantity of fertilizers and pesticides under economic, legislative and environmental protection pressure, to increase the profit, and control of agricultural systems [7] and [10]; the use of geospatial and informational technologies for the acquisition, storage, analysis and processing of an impressive amount of data and information, along with the promotion of best agricultural practices for the management of the agricultural enterprise [1]; increasing agricultural production through the efficient use of nutrients under the conditions of the protection of the agricultural environment [5]; regulating inputs into the agricultural system (seeds, fertilizers, pesticides) in such a way as

to distribute the exact amount where and when exactly needed [3].

## MATERIALS AND METHODS

The need for an efficient management, the complex climatic, technological, economic, and biological changes that have recently occurred at the level of agro-systems impose a continuous and accurate knowledge of the growing production resources and the vegetation state in cultures. In this respect, the present paper presents particularities regarding the continuous monitoring of these parameters for a real-time reporting of changes and vulnerabilities in agroecosystems, in order to adopt efficient strategies for preserving the economic sustainability of agricultural holdings. The case study is carried out on the field of SC Agri-Trade Oravița SRL, located in the S-V of the country, in Caraș-Severin county, at a distance of 30 km from Oravița, on the territory of Grădinari, Răcășdia, Ciclova Română and Ciuchici. The methodology used by SC Agri-Trade Oravița SRL is represented by space technologies for monitoring the production and vegetation growth resources such as drones and photogrammetry, GPS (Global Positioning System) and GIS (Informational Geographic System).

## RESULTS AND DISCUSSIONS

The structure of crops at AC Agri Trade Oravița SRL is specific to the phytotechnical agroecosystem and is mainly based on the production of cereals and oilseeds, with the largest spread of wheat, then corn and rape, sunflower, soybean, peas, oats and lucerne, in a 4-year crop on an area of 4,540 ha. Within the society, there are concerns about improving the natural fertility of the land and minimizing chemical imputations as a result of the promotion of lucerne and pea crops (still on small areas) and the implementation of the concept of precision farming. The implementation of the precision agriculture concept at SC Agri Trade Oravița SRL takes place on a large scale through the usage of drones and GPS (Global Positioning System) for spectral monitoring of the state of vegetation of agricultural crops. Thus, an accurate assessment is achieved by the acquisition of detailed, up-to-date and well-

located, field-based data and information, their analysis and interpretation in order to optimize inputs taking into account the state of the crops and the degree of soil supply in each relatively homogeneous area of the terrain [6,11,2]. We have opted for the image as a mean of identifying the factors that influence plant development, as it faithfully indicates this and can easily be done by air using the drones. Taking aerial photos using the drone is based on its ability to fly after a determined and spatially framed scheme. For small surfaces (up to 20 ha) the DJI Phantom 4 drone (photo 1) was used, and for larger surfaces (even for 450 ha) the bi-ax airplane type drone (photo 2) with an electric motor made by a group of Romanian engineers.



Photo 1. Photography DJI Phantom 4 (original photo)



Photo 2. Drone airplane type bi-ax (original photo)

The DJI Phantom 4 is not just a simple drone, this is the complete solution for professional aerial photography and films designed to deliver 4K quality images with incredible details. The Quadcopter has many features that make it easy to navigate, photoshoot and film, offering easy and intuitive use. The flights we made were carried at a height of 50m, according to a pre-established flight plan. The flight planning begins with selecting a land area by dragging a polygon onto a Google Earth or Map support (photo 3). The application calculates automatically,

depending on the flight height, the time interval between the photos and the distances between the routes of the drone, so that the resulting photos overlap to 40%. This creates the premises for obtaining an orthophotomap and a mathematical model of the relief. It is important for the accuracy and precision of the coordinates of the photograms to be marked with distinct and visible signs (photo 4) of four terrestrial points in the selected area and the registration of their geographic coordinates with a GPS receiver.



Photo 3. Preparing the flight scheme (original photo)



Photo. 4 Marking of distinct signs (original photo)

These registered geographical coordinates and the visible signs in the photograms will be used in the georeferencing of the orthophotomap (photo 5), obtained in tiff, dxf, shp, etc format. This orthophotomap, resulted from the aggregation of all the photograms, is georeferenced and represents the information support for topographic measurements, appreciations of plant density and health, quality of agricultural works such as sowing, applying the herbicide, etc. Some mistakes can be observed, such as maize

sowing (photo 6), or the destruction of crops from different causes (by animals grazing). In the process of construction of the orthophotomap one can see how each photo is positioned according to the geographic coordinates assigned by the GPS to the drone, recorded at the moment the camera is triggered (photo 7).



Photo 5. Obtaining the terrain orthophotomap (original photo)



Photo 6. Appreciating the state of crops (original photo)

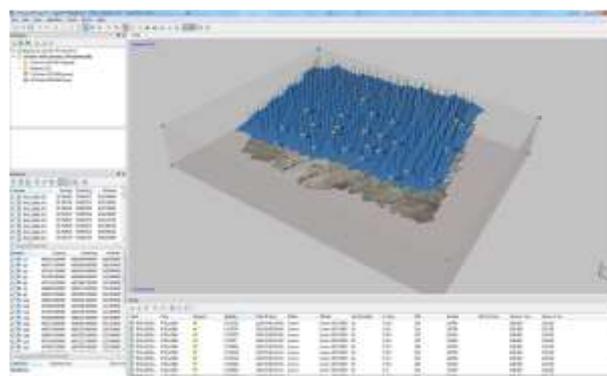


Photo 7. The process of construction of the orthophotomap (original photo)

After obtaining the cloud of points, the georeferenced orthophotomap and the mathematical model of the field are generated (photo 8).

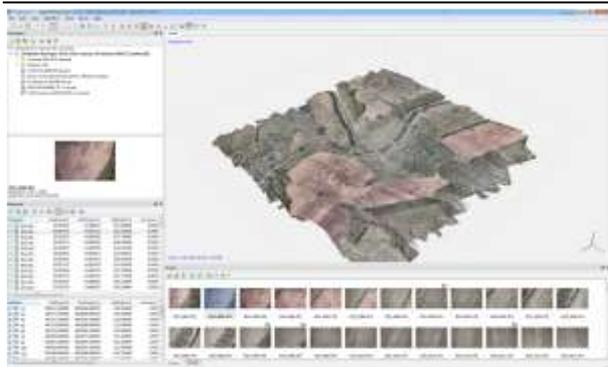


Photo 8. Obtaining the orthophotomap (original photo)

The camera takes pictures of the vegetation on the RGB and near infrared (NIR) wave spectrum, that are subsequently processed by a specialized software (photo 9).

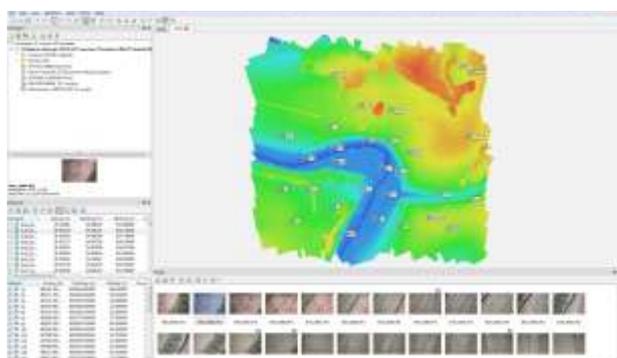


Photo 9. Images of vegetation on the RGB and near infrared (NIR) wave spectrum (original photo)

Their concatenation generates reflection maps of the investigated surfaces and contributes to the calculation of vegetation parameters, representing their distribution in the field.

The interpretation of the obtained results allowed the development of a management specific for the analyzed area and the optimization of the resources, respectively the agroecosystem sustainability.

## CONCLUSIONS

The concept of the agriculture of precision provides the premises for increasing productivity, reducing production costs and minimizing negative environmental impacts. SC Agri-Trade Oravița SRL uses space technologies to monitor the production growth and the vegetation state resources such as drones and photogrammetry, GPS (Global Positioning System) and GIS (Informational Geographical System). The implementation of

the precision agriculture concept at SC Agri Trade Oravița SRL manages an accurate assessment of the resources of growing production and of vegetation state of crops by acquiring detailed and up-to-date data and information on the field, analyzing and interpreting them to optimize inputs, taking into account the state of the crops and the degree of soil supply in each relatively homogeneous area of the terrain.

Continuous monitoring of the production growing resources and of the vegetation state of crops for real-time reporting of changes and vulnerabilities in agroecosystems, contributes to the development of a performant management tailored to the specificity of the analyzed area.

## REFERENCES

- [1]Anisi, M.H., Abdul-Sallam, G., Abdullah, A.H., 2015. A survey of wireless sensor network approaches and their energy consumption for monitoring farm fields in precision agriculture. In: Precision Agriculture. 2015, 16(2):216-238.
- [2]Baret, F., Weiss, M., Troufleau, D., Prévot, L., Combal, B., 2000, Maximum Information Exploitation for Canopy Characterization by Remote Sensing. *Asp. Appl. Biol.*, 2000, 60:71-82.
- [3]Dumitrascu, A., 2015, The Sustainable Development in the Field of Phytosanitary Treatments. The impact of the socio-economic and technologic transformations at national, european and global level; <https://ssrn.com/abstract=2671283>, Accessed on December 10, 2018.
- [4]Duzineanu, M., 2013, Top geospatial and informational technologies, ergonomized, used in multidisciplinary agricultural engineering. The works of the 8th edition of the Annual Conference of ASTR, p. 137-143.
- [5]Hedley, C., 2015, The role of precision agriculture for improved nutrient management on farms. In: *Journal of the Science of Food & Agriculture*. 2015, 95(1):12-19.
- [6]Moran, M.S., Inoue, Y., Barnes, E.M., 1997, Opportunities and Limitations for Image-Based Remote Sensing in Precision Crop Management. *Remote Sens. Environ.*, 1997, 61:319-346.
- [7]Olteanu, G., Olteanu, I.M., Olteanu, I., 2002, The agriculture of precision – a new concept in researching and practicing of agriculture, in: *Priorities of scientific research in the field of crops*, Ed. Ceres, București, 99-110.
- [8]Olteanu, G., Puiu, I., Bekö, A., Ghinea, A., 2012, The agriculture of precision – a way for improving the production of potato, in: *Scientific communication session 45 years of research and development*:

tradition, continuity and future for Romanians agriculture, the National Institute for Research Development for Potato and Sugar Beet in Brasov, 2012.

[9]Puiu, I., Olteanu, G., 2012, Perspectives in modernisation of the cultivating technologies for patato, Patato in Romania, 21(1).

[10]Puiu, I., 2014, Study of potato production according to spatial diversity of resources, Doctoral thesis, University of Agricultural Sciences and Veterinary Medicine Cluj Napoca, Faculty of Agriculture, 2014.

[11]Stafford, J.V., 2000, Implementing Precision Agriculture in the 21st Century. J. Agr. Eng. Res., 2000, 76(3):267-275.



## PASTORAL ARRANGEMENT - VECTOR OF MANAGEMENT FOR SUSTAINABLE GRASSLAND EXPLOITATION

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### *Abstract*

*The present study starts from the premise that the grassland is an essential element for sustainable development systems due to its impact on animal fodder and animal welfare, but also on the maintenance of humus content in soil and of the micro-fauna, diseases and pests by interrupting their biological cycles, land lacking vegetation as a result of their grassing. It is important that these influences to be positive, which is why the functional structure of the meadows should not be disturbed by the inappropriate exploitation. For this purpose, at the level of institutions, key local factors, enterprises etc., it is necessary to adopt a specific management in which the manner of valorisation of meadows is established by pastoral arrangements under the law (GD 1064 11/12/2013). Concretely, the paper briefly presents the main elements of the realization of a pastoral arrangement in the commune of Bazna, Sibiu County.*

**Key words:** agricultural, grassland, pastoral arrangement, sustainable development systems, specific management

### INTRODUCTION

The grassland is a "area of land occupied with grassy vegetation" [10], consisting of "herbaceous plant species belonging to several botanical families" [4], which from the point of view of the ecological and physiological classification, are part of the "herbaceous terrestrial communities" [5]. The debate on climate change caused by the greenhouse effect poses grassland as an important carbon deposit by storing it in greater quantity than the arable land [2,3]. The grassland is the vegetable resource that can be transformed into the most valuable and most efficient fodder for animal growth. It is therefore the basic component of sustainable farming systems, contributing fundamentally for fodder, animal welfare, the introduction of a significant amount of organic matter into the soil, maintaining humus content in the soil, microfauna maintenance, interruption of biological cycles for diseases and pests and consolidating the lands lacking vegetation [9]. It is obvious the multifunctional character of the meadows, a long debated concept, whose dimensions include the extreme diversity of

the products obtained in agriculture and which give sense to the profession of farmer [6]. In this context, there is a common trend at the global level to promote sustainable farming systems and to valorify separately the multiple functions of agriculture [1]. The sustainability of grassland multifunctionality is a major concern of specialists and is based on an integrated management of grass vegetation. This approach is strongly influenced by a series of features that define grasslands, such as the spreading area (with impact on the diversity of static conditions generally characterized by areas unfit for other cultures) and human activity. In support of this approach, the competent forums intervene with a series of legislative measures that create a technical, organizational and economic framework favorable to the sustainability of the multifunctional character of the meadows. For our country, taking into account the not very favorable status of permanent meadows with a rather pronounced level of degradation due to their invasion of mounds, worthless vegetation, the presence of erosion and landslides, the European Union Council Regulation (EC) no. 1782 of 2003

enforce a special attention to the Romanian pastoral heritage as follows: maintaining the existing area on 1 January 2007; ensuring a minimum level of maintenance; avoiding the spread of unwanted vegetation. In this regard, in order to reduce or eliminate the process of degradation of permanent meadows, in our country the legislative framework was created by HG 1064/11.12.2013 on the application of the methodological norms for the application of the conditions of OUG 34/2013 on the organization, management and exploitation of permanent meadows and for changing and completing the Land Fund Law no. 18/1991. It is stipulated that the management of the meadows is established by pastoral arrangements according to the law [7].

## MATERIALS AND METHODS

The pastoral arrangement is a complex work which addresses the elements of the pastoral economy and highlights the specific measures to improve the meadows in order to achieve the technical and scientific documentation necessary for the elaboration of the prospective plans in accordance with the real possibilities of the meadow. The purpose of the present study is the purpose of the pastoral arrangement and refers to the time and space regulation of the rational valorisation of grassland productions in the commune of Bazna, Sibiu County, taking into account the static conditions, the agricultural and environmental measures, the improvement and maintenance of biodiversity and the protection of the environment. The objectives are to list the meadows belonging to a territorial administrative unit, to study their characteristics, and to elaborate a documentation useful for the planning process of the specific works to the proposed goal. Organizationally, the present study is based on grounding elements regarding the territorial administrative and organizational situation, the organization of the territory, the geographic and climatic characteristics, the vegetation and the setting up framework, and is finalized with the organization, improvement, endowment and use of the meadows including the parcel description. We

emphasize that the sustainable valorisation of grassland productions is a major problem also for many specialists [8].

## RESULTS AND DISCUSSIONS

The meadows under the study belong from an administrative point of view to the Bazna commune located in the north of Sibiu County, in a hilly region at an average altitude of 320 m. The legal holder of the analyzed meadows is the Bazna Local Council. The respective grassland areas have been registered since 2003 and have a total of 866 ha with the following structure (Table 1).

Table 1. The structure of grasslands in Bazna commune.

Location		Category of use			Area (ha)
		meadow	hayfield	unproductive	
UAT Bazna	Village Bazna	149.68			149.68
	Village Boian	389.40		2.29	391.69
	Village Velt	324.63			324.63
TOTAL					866.00

Source: documents of the Bazna district

The present study highlights the particularities of the rational valorisation of grasslands in the commune of Bazna, having as a case study the meadow called the Bazna's Thorns, constituted as a body, which group the land 46 in the surface area of 47.06 ha. The meadow is exploited by grazing. The grazing time is 160 days and the number of grazing cycles is 3. The state of the meadow shows that it has not been adequately maintained in the sense that it has a large percentage of lacks (20%) and wooden vegetation cover (20%), but preserves the premises of a good productive potential by the presence of a high percentage of plants from the Fabaceae Family (30%) and the lack of mole mounds. The analyzed meadow is formed on two soil categories: deep with medium texture, moderately acid, mesobasic, with brown humifere of poor natural fertility; deep with medium to fine texture, slightly alkaline, carbonated, saturated in low to moderate natural fertility bases, belonging to quality classes II, III. The ground water is at depths between 3 and 5 m, and over 5 m on the mountainsides. The climate is

temperate with mild oceanic influences with riverside and valley topo-climates with impact on the temperature and precipitation which favor the temperature inversions, mist frequency and aisle currents. The average annual air temperature is between +8°C ÷ +8.4°C, the multiannual average is + 8.2°C, the average values of relative air humidity for the typical months of the year are 88-92% for January and 77-80% for July. The average annual sum of atmospheric precipitation rises to 650-700 mm, and the dominant direction of air mass movement is from NW sector, followed by NE and N. From the point of view of the natural conditions that characterize the area or the vegetation floor the analysed meadow is geobotanic framed in the immoral area (of the oak forests) the sub-area of the mesophilic oak forests. The main plant species that make up the grass carpet of the grasslands analyzed are: *Lolium perene* (12%), *Festuca sulcata* (12%), *Brachipodium pinnatum* (2%), *Agrostis tenuis* (2%), *Puccinella distans* (2%); *Trifolium repens* (25%), *Medicago falcata* (3%), *Trifolium pratense* (2%); *Cichorium intybus* (3%), *Urtica dioica* (3%), *Alchillea millefolium* (3%), *Carium carvi* (3%), *Plantago lanceolata* (1%), *Mentha longifolia* (1%), *Ononis spinosa* (1%); *Carduus acanthoides* (2%), *Sambucus aebulus* (2%), *Euphorbia cyparissias* (1%). The invading wooden species are: *Crataegus monogyna* (10%), *Prunus spinosa* (5%), *Rosa canina* (5%). A degree of vegetation coverage of 80% was identified and the presence of landslides, respectively, the degradation of the grass carpet by 20%. The identified vegetation data allowed the calculation of the pastoral value (Table 2), for which we used the gravimetric method as a floristic method (the actual weighing of the plant species (G) harvested by mowing on 1 square meter in several rehearsals according to the variation of the grass carpet, followed by their expression in percentages).

Based on the data obtained using the calculation formula:

$$VP = \sum PC(\%) * IC / 5,$$

where:

VP is pastoral value indicator (0-100), the PC is the percentage of participation in the grass carpet of a species, and IC is the index of fodder quality.

The determination of the animal load of the analyzed meadow was based on the total grass production (Pt) on grazing cycles and on the determination of the coefficient of grass usage (Cf). Total grass production was determined by mowing and weighing on sites of 2 square meters and got the amount of 21,000 kg. green mass at ha.

Table 2. Calculation of Pastoral Value of the Bazna's Thorns meadow

Species	%PC	IC	PC*IC
<b>Poaceae</b>	<b>30</b>		
<i>Lolium perene</i>	12	5	60
<i>Festuca sulcata</i>	12	2	24
<i>Brachipodium pinnatum</i>	2	1	2
<i>Agrostis tenuis</i>	2	3	6
<i>Puccinella distans</i>	2	3	6
<b>Fabaceae</b>	<b>30</b>		
<i>Trifolium repens</i>	25	4	100
<i>Medicago falcata</i>	3	4	12
<i>Trifolium pratense</i>	2	4	8
<b>Other families</b>	<b>20</b>		
<i>Cichorium intybus</i>	3	1	3
<i>Urtica dioica</i>	3	0	0
<i>Alchillea millefolium</i>	3	2	6
<i>Carium carvi</i>	3	2	6
<i>Plantago lanceolata</i>	1	2	2
<i>Mentha longifolia</i>	1	0	0
<i>Ononis spinosa</i>	1	0	0
<i>Carduus acanthoides</i>	2	0	0
<i>Sambucus aebulus</i>	2	0	0
<i>Euphorbia cyparissias</i>	1	0	0
<b>Wooden species</b>	<b>20</b>		
<i>Crataegus monogyna</i>	10	0	0
<i>Prunus spinosa</i>	5	0	0
<i>Rosa canina</i>	5	0	0
<b>TOTAL</b>	<b>100</b>	<b>x</b>	<b>235</b>
<b>Pastoral value</b>	<b>x</b>	<b>x</b>	<b>47</b>
<b>Assessment of VP</b>	<b>Medium-Good</b>		

Source: own determinations.

The coefficient of utilization expressed in percentage was determined by mowing and weighing of the unconsumed residues (Rn), which weighed 3,500 kg/ha) per 10 square meters and reporting it to the total production by the formula:

$$Cf(\%) = [(Pt(\text{kg/ha}) - Rn(\text{kg/ha})) / Pt(\text{kg/ha})] * 100.$$

The resulting coefficient of utilization is:

$$Cf(\%) = [(21,000 - 3,500) / 21,000] * 100 = 83.34.$$

Further, we proceeded to establish of the meadow load, regarding the daily grass requirement for each animal head, in our case the dairy cows (Nz) and the number of grazing days (Zp) using the formula:

$$I_p (\text{head/ha}) = P_t * C_f / N_z * Z_p * 100.$$

For the analyzed meadow, knowing that it belongs to the mesophilic oak forests sub-area at the altitude of 300 m, according to the formula, results the following meadow load:

$$I_p = 2100 * 83.34 / 65 * 160 * 100 = 1.68 \text{ cows per ha (UVM/ha)}.$$

The data obtained allow the total meadow load (IAP) to be calculated as the product between the meadow area (ha) and the meadow load (Ip), so that:

$$IAP = 47.06 * 1.68 = 79.06 \text{ no. of heads (UVM)}.$$

The analyzed meadow did not benefit from ameliorative works over the last 5 years, making it possible to increase the grazing capacity by improving the use coefficient according to the literature on the application of specific measures for improvement [9], which results in a meadow load of up to 3.69 UVM / ha and a total meadow load of up to 173.65 cows (UVM). The description of the analysed grassland vegetation and the appreciation of the pastoral value as a medium to good, requires the implementation of improvement works that are the object of the pastoral arrangement and contribute to the adoption of a specific management oriented to the integrated management of the resulting grass carpet. The pastoral arrangement will include a logical succession of analytical and time-labeled ameliorative works such as: removal of wooden vegetation and of harmful and toxic plants; stopping the landslides and the degradation of the grass carpet through specific works, taking into account the causes that have caused them; restoring the grass carpet by overseeding; improving the floristic composition by self-fertilization and natural and chemical fertilization in accordance with

the code of good agricultural practices; practicing a rational grazing considering the productivity and durability of the grass carpet; the endowment of the grassland with drinking water through drilling works, water supply, and the construction of drinking places for animals according to the standards.

## CONCLUSIONS

The meadow represents the basic component of sustainable farming systems, contributing fundamentally to the fodder provision and animal welfare. The regulation in time and space of the rational valorisation of meadows productions in the commune of Bazna, Sibiu County, taking into account the static conditions, agricultural-environmental measures, improvement and maintenance of biodiversity and environmental protection, ensures the sustainability of the meadow agroecosystem. The rational utilization of the meadows in Bazna commune, having as a case study the meadow called Bazna's Thorns, highlights the particularities of the regulation and insurence of the meadow agroecosystem sustainability. The state of the meadow shows that it was not properly maintained, which enforce the introduction of a specific management, specific to regulate the sustainable valorisation of the production of the analyzed meadows. The description of the grassland vegetation analyzed and the appreciation of the pastoral value as a medium to good, requires the implementation of improvement works that are the object of the pastoral arrangement and contribute to the adoption of a specific management oriented to the integrated management of the resulting grass carpet.

## REFERENCES

- [1]Beranger, C., 2002, La multifonctionnalité des prairies: les acquis et les interrogations du 19e Congrès Européen des Herbages, Fourrages,171.
- [2]Bogdan (Pleșa) Anca-Dorina, 2012, Cercetări privind folosirea și menținerea păjiștilor montane cu low-input. Research concerning the use and maintenance of the low-input mountain meadows). Teză de doctorat, (Ph.D.Thesis) Universitatea de Științe Agricole și Medicină Veterinară Cluj-Napoca.

[3]Brown, L., 2001, Eco-economia, București, Editura Tehnică, (Eco-Economy, Bucharest, Engineering Publishing), p.86, 89, 91.

[4]Dragomir, N., 2005, Pajiști și plante furajere tehnologii de cultivare. Editura Eurobit, Timișoara, (Meadows and forage crops- Cultivation technologies. Eurobit Publishing House, Timisoara). p.6.

[5]Elleberg, H., Mueller Dombois, D., 1967, A key to Raunkiaer plant life forms with revised subdivisions. Ber. Geobot. Inst. Eidg. Tech. Hochschule Rubel. 37. 56-73.

[6]Hervieu, B., 2002, La multifonctionnalité: un cadre conceptuel pour une nouvelle organisation de la recherche sur les herbages et les systèmes d'élevage, Fourrages,171, p. 219-226

[7]HG 1064/2013 privind aprobarea Normelor metodologice pentru aplicarea prevederilor OUG 34/2013 privind organizarea, administrarea si exploatarea pajistilor permanente si pentru modificarea si completarea Legii fondului funciar nr. 18/1991.

[8]Iagaru, P., Marcuta, L., Marcuta, A., Iagaru, R., 2017, Sustainable management for grassland agroecosystem resources. Scientific Papers: Management, Economic Engineering in Agriculture & Rural Development, 17(4):161-166.

[9]Marușca T., Mocanu, V., Has, E.C., Tod, M.A., Andreoiu, A.C., Dragos, M. M., Blaj, V., Ene, T.A., Silistru, D., Ichim, E., Zevedei, P.M., Constnatescu, C. S., Tod, S.V., 2014. Ghid de întocmire a amenajamentelor pastorale. Editura Capolovoro, (Guide for setting up the pastoral improvement management, Capolovoro Publishing House), Brașov, p.7.

[10]Rotar, I., Carlier, L., 2005, Cultura pajiștilor. Editura Risoprint, (Mewdows Cropping, Risoprint Publishing House), Cluj-Napoca, p 12.



## COMPARING AN EFFICIENCY OF ERODED SOILS RESTORATION IN NORTH-WESTERN UKRAINIAN POLISSYA

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### Abstract

*Presented prospects about restoration of sod-podsolic and sod-carbonate soils possessing light granulometric composition (texture) regarding local processes of wind erosion. Agricultural efficiency of crops growing in conditions of Polissya (West forest zone) has been determined. It has been investigated that growing of red clover («Trifolium pratense» Lat.) on such territories in spite of fertilizers input creates stable crops cover, decreases the deflation processes spread and results in obtaining seeds and harvesting green biomass in nearest future. It has been found that after 5 years of perennial growing these territories regain profitable qualities. Comparing different plans of agro technical activities on such areas showed that one of the most viable and practically proved variants is to harvest crop together with mineral and organic fertilizers input in first years of restoration. As the particular example the components of farming practices in the form of mineral fertilizer input and overseeding grasses payback are used to obtain both the environmental and economic benefits of applied operations.*

**Key words:** efficiency, restoration, fertilizer, perennial, calculation.

### INTRODUCTION

Wind erosion processes occur in Ukraine in different ways - both in quantitative terms and forms, depending on the nature of local climatic conditions, soil types, etc. Thus, in case of Polissya conditions (forest region in north-western part of country) structureless sandy loam or sandy clay soils particles provoke moving as a part of air-dust flow that cripple a surface of drained organic soils and incorporate them in process of saltation. Moreover, dust storms in Polissya occur at speeds of 6-10 m/s, recurring often up to 3-4 times in decade – that is fleeting and aggravating the situation with significant soil deterioration and air dusting [3]. For Polissya with the same probability the occurrence of dust storms at speeds matching 5-10 m/s coincides with the data for the southern steppes of Ukraine [6]. During the last 20-30 years in the Polissya region local centers of recurring manifestation for deflationary processes were observed and characterized by

a small size of eroded areas but with tendency to develop and spread further due to the tree belts remoteness and erosion control measures lack on these lands. Until recently the study on manifestation of wind erosion processes in the Polissya had been considered controversial because some scientists described this region as historically inherent with excess moisture, excessive rainfall and distribution of natural herbaceous vegetation and forests [10]. The gradual reduction of forest areas of Polissya together with the involvement of large areas of land into agricultural production as well as widespread usage of drainage reclamation in the 1970s - all caused prerequisites for additional impact on soil and accelerated the occurrence of degradation processes in the region, the endemic example of which may be the dust storm in the Volyn Highlands in 1969 [4]. After the former USSR drainage reclamation and development program in 1991 these areas are no longer appropriate for such operations because of their short-lived effect, lack of control and funding. Regulation of

water regime at very uneven distribution of moisture and the presence of close hydrological relationship between different combinations of soil from ground water level significantly complicates an optimal water regime in the territory, and the negative consequences from misbalanced drainage reclamation predictably emerged in organic and mineral soils, including areas at a considerable distance (3-12 km) outside of reclamation facilities [9]. The solutions to the proliferation of soils dusting in the long term perspective are the following: practices to restore drainage systems; bilateral water regime of soil instead of gravity-flowing; changes in the nature of soil organic origin with simultaneous fertility increase; restoration of vegetation and leveling blow plots by erosion-protective techniques [7].

**The purpose of this work** is to assess efficiency of locally implemented erosion preventive measures in combination with other methods of operational management, on example of Kopayivska soil drainage system lands in Shatsky district, Polissya region to protect these lands from the spread of deflationary processes in future.

## MATERIALS AND METHODS

The study of erosion control measures with aim to suspend local deflationary processes occurrences was carried out during 2009-2015 years within Kopayivska drainage network near the village Pishcha, Shatsky region (until 2005 – a former part of Lyubomlsky region), Polissya, Ukraine (Fig. 1).

This area with extraordinarily mosaic and multivariate mineral compositions of soils having varying degrees of podzolization, gleyfication and with presence of overdried organic soil types is not resistant to wind. The main soil types with local deflation processes are soddy gley podzolized and soddy carbonate soils on a territory with GIS-coordinates between 51, 60147 and 51, 60274 of N-north latitude, and between 23,82486 and 23,82733 of E-east longitude in Western part of Polissya Region. During research on soddy gley and soddy carbonate soils the potentially possible annual soil loss was

calculated on a base of measured in-site pins data on an area of 5 ha for a period of 5 years.



Fig. 1. Location of experiment area near the village Pishcha (Shatsky region, Polissya, Ukraine).

Source: Own materials of soil erosion control lab., NSC-ISSAR

Following data with direct observation of the removed soil material carried out from 2009 to 2015 pointed on a 1.5 cm layer of soil carried beyond the land area of 5,030 hectares. According to installed pins of 10 cm height above the soil surface for a period of 5 years investigation, equivalent to the entire area - 750 m<sup>3</sup>. After taking into account the average value of soil density for soddy gley and soddy carbonate soils within 1.5 g/cm<sup>3</sup> we calculated the total loss from research area amounted to 45 tons of soil from 1 hectare per year. Taking into account a fact about limiting level of losses to these soils is 10 times smaller [2], we intend to conduct research that relates to the regulatory enabling erosional processes in such agriculture landscape. In order to restore the adjustments in the composition of soil nutrients and to suspend local deflationary processes the studies were planned to compare efficiency of different scenarios of erosion preventive activities at that site and select the most appropriate one [1].

Among the appropriate scenarios for action were the following:

(i) organic fertilizer input in the form of litter manure with such nutrient content characteristics: Soil Organic Matter (SOM) – 20%, Nitrogen – 0.5%, Phosphorus – 0.2%, Potassium – 0.6%;

(ii) mineral fertilizers input in the form of: (i) Ammophos® (NH<sub>4</sub>H<sub>2</sub>PO<sub>4</sub> + (NH<sub>4</sub>)<sub>2</sub>HPO<sub>4</sub>)

including: 10-12% of Nitrogen and 52% Phosphorus,

(ii) Kalimag-30® (K<sub>2</sub>SO<sub>4</sub>•MgSO<sub>4</sub>), include: K<sub>2</sub>O — 24-26%; MgO — 11-18% of Potassium;

(iii) shift the direction of intensive land usage expressed by extensive-grazing termination of the established grasslands by perennial grasses (in the form of red clover «*Trifolium Pratense* » *lat.*)(Fig. 2).



Fig. 2. General view of red clover “*Trifolium pratense*” Lat.

Source: Illustration from Thome, O. V., 1905 [12].

To determine the cost-effectiveness of erosion preventive activities for each scenario it was planned to employ the set of indicators that would fully reflect the feasibility of activities application. These equations 1-3 included: avoided soil losses, productivity of the different entities, costs of materials and financial means per 1 ha of crops, the cost of 1 kg of product profitability and income [5].

Calculation for avoided soil losses was determined by the formula:

$$\Delta L = L_1 - L_2 \quad (1)$$

where  $L_1$  - loss of soil on eroded lands in the actual structure of sown areas, t / ha;  $L_2$  - loss of soil on eroded lands after the implementation of protective measures, t / ha. The content of organic matter and nutrients in the soil were set by agrochemical survey results and included in research data.

For determining the profit from the introduction of erosion preventive measures ( $P_c$ ) the following formula was used:

$$P_c = (C_1 + C_2) - C_p \quad (2)$$

where  $P_c$  - conditional profit, UAH;  $C_1$  - cost of seeds, UAH;  $C_2$  - cost of hay, UAH;  $C_p$  - production costs, UAH.

The level of profitability was assessed by comparing the conditional profits with production costs as follows:

$$P = \frac{P_c}{C_p} 100 \quad (3)$$

where  $P$  - profitability of farming practices, %;

$P_c$  - conditional profit, UAH;  $C_p$  - production costs, UAH.

## RESULTS AND DISCUSSIONS

This section presents the evolution of variation coefficients calculated on the basis of the methodology presented above. Price variation is very important in the production decision as well as in the calculation of vegetable farmers' incomes. Table 1 presents the values of variation coefficients of the monthly procurement prices by development regions and by types of vegetables. During efficiency evaluation of soil measures the comparison of three different scenarios (mineral fertilizers use (input), organic fertilizers use (input) and growing of perennial grasses in traditional technologies of farming) was performed.

The economic effect was determined by conventional profit from 1 hectare of implementing farming practices and environmental effect – as a result of obtained measures to reduce losses of soil and by a reduction of soil degradation degree, expressed in the prevented quantity of removed soil material. In determining the value of humus and nutrients losses, averted from the implemented deflation preventive measures, the appropriate recalculation of manure and fertilizers were made using their acquisition price or average implementation fertilizer prices considering cost of their introduction into the soil.

After taking into account a nutrition content of removed soil surface layer for soddy gley soil, the quantity were on a level: P (Phosphorus) – 117.0 mg/kg per hectare (or 26.3 kg/ha), K (Potassium) – 78.0 mg/kg per hectare (or 17.55 kg/ha); for soddy carbonate soil: P – 27.5 mg/kg per hectare (or 6.19 kg/ha), K –

44.0 mg/kg per hectare (or 9.9 kg/ha). After multiplying these values by 0.3 (constant factor to convert kg/ha) we converted them in mg/100 g of soil. The amounts of phosphorus and potassium for soddy gley and for soddy carbonate soils were on a level: 35.1 and 8.25 kg/ha for phosphorus; 23.4 kg/ha and 13.2 kg/ha for potassium.

Total amount of removed soil from investigation area as it presented above reached 45 tonnes of soil. The percentage of soil organic matter (SOM) in removed soddy gley soil – 5.22%, that converted in losses of 235 kg of SOM per hectare, and for soddy carbonate soil – 1.67%, that converted in losses of 75 kg of SOM per hectare.

Three scenarios to compensate soil losses from eroded research area presented below:

**Organic fertilizers.** To compensate the losses of organic matter on the investigation area is urgent to make organic fertilizer input in amount of 66 t/ha in the form of litter manure during five years, the same quantity of 50 t/ha on soddy gley soils and 16 t/ha on soddy carbonate. Given that with input of 50 t/ha manure for the entire period a soddy gley soils get on a 250 kg of Nitrogen, 125 kg/ga of Phosphorus, 300 kg of Potassium in form of active substance; so as soddy carbonate - 80 kg of Nitrogen, 40 kg and 96 kg of Phosphorus and Potassium resp. Furthermore, fertilizers input will fully compensate the loss of elements provoked by wind erosion. The market price of manure adopted in our calculations as 80 UAH per ton, and the cost for fertilizer application were on a level as 10% of the fertilizer cost. Under such conditions the cost of restoring the SOM content to a previous level were for soddy gley soil – 4,400.00 UAH/ha and for soddy-carbonate – 1,408.00 UAH/ha in period of 5 years. The cost of fertilizer application as well were on a level of 10% of the fertilizer cost, which was a 495.81 UAH/ha on soddy gley soils, and 167.46 UAH/ha on soddy carbonate. Before the input of organic manure to compensate the removed content of SOM due to the rapid change in the price of fuel and oil lubricants, the costs for purchasing, transportation, storage and application of soil

organic and mineral fertilizers were taken into account as a 15% of additional costs.

**Mineral fertilizers.** Such measures to improve soil fertility of deflated soils and protect soil from deflation in future are presented by implication and increasing of soil nutrients content till the recommended level by means of mineral fertilizers Ammophos® and Kalimag-30® [8]. To restore a losses of elements the quantity of needed mineral fertilizers input included Ammophos® [Ca (H<sub>2</sub>PO<sub>4</sub>) · 2H<sub>2</sub>O + 2CaSO<sub>4</sub>] (19% of Phosphorus in active substance) to restore the contents of Phosphorus and Kalimag-30® granulated bulk (K<sub>2</sub>SO<sub>4</sub> · MgSO<sub>4</sub> · 6H<sub>2</sub>O (with 26% of Potassium in active substance) - to restore the losses of Potassium. The costs of fertilizers input were on a level of 10% of the fertilizer costs and for soddy gley soils they were 45.07 UAH/ha, so as for soddy carbonate – 15.22 UAH/ha.

Considering that Ammophos® contains a 10% of Nitrogen in active substance, we assume that soddy gley soil received additionally 5.26 kg/ha of this element so as soddy carbonate received additionally 1.24 kg/ha but losses of SOM in this way were not compensated at all. Total costs of mineral fertilizers usage to restore a level of fertility were 495.81 UAH/ha and 167.46 UAH/ha for different types of soils as reflected in Table 1.

Table 1. Calculation of costs to compensate nutrient losses with mineral fertilizers input, Pishcha Shatsky district, Volyn region, 2013-2018

Type of mineral fertilizer	Prices for 1 ton of fertilizer, UAH	Content of nutrients, %	Needed portion and cost of fertilizers for a period of five years			
			For soddy gley soil		For soddy carbonate soil	
			Kg	UAH per ha	Kg	UAH per ha
Ammophos	5,900	50	52.6	310.34	12.38	73.04
Kalimag-30	2,400	30	58.5	140.40	33.00	79.20
Costs for input of mineral fertilizers	-	-	-	45.07	-	15.22
Total	-	-	-	495.81	-	167.46

Source: Own calculation on the basis of prices data for experiment beginning in 2013, NAAS

**Perennial grasses.** The shift of the intensive land use direction expressed by extensive-grazing termination of the established grasslands by perennial grasses in the form of

red clover proved to be a non-profit scenario even with seeds sales in a first year.

To make it profitable from second year of growing we arranged a realization of seeds and hay according to their actual market prices and received conditional profit – 607.1 UAH/ha for system with mineral fertilizer input and 425.0 UAH/ha without fertilizer input. In any of these cases the level of profitability is definitely high with numbers from 48% to 57.5%, comparing with a production costs from 2,125.65 UAH/ha to 2,649.6 UAH/ha after 5 years of grasses seeding application.

The cost of the eroded soil restoration is shown as a result of expected wind erosion losses in terms of the quantity and prices of organic and mineral fertilizers required to compensate the loss of deflation after taking into account the costs of purchasing, transporting, storing and application.

The evaluation of soil deflation preventive measures proved a faster efficiency of the mineral fertilizer input version than involving only perennial grass growing. In this case the extra economic effect (from the sale of seeds and hay grasses) and direct environmental effect in the form of prevented soil losses were obtained from second year of implementation as reflected in Table 2.

Type of deflation preventive variations presented with: 1. The use of organic fertilizers; 2. The use of mineral fertilizers; 3. The growing of perennial grasses.

On an area of 5 ha the seed cost 2.51 UAH/kg resulted in the amount spent of 200.8 UAH in actual prices [11]. The full economic effect on the cultivation of perennial grasses option was 1524 UAH/ha per 2016 year. Furthermore, it should be noted that if in calculation this year were used market prices of 2017-2018 for the seeds of clover at least, the potential economic impact of this measure would have been much higher. After the calculations of specified environmental and economic performance, we have adjusted the increase in deflationary stability of soils after changing the direction of the economic use of land by the termination of grazing plot, creating meadows of perennial grasses like clover with the prospect of

obtaining seed in the early years (the recommended frequency - every five years).

After implication of these farming activities on the deflated areas of the local drainage network as a result – some of parameters returned to a level before erosion processes appeared (among such parameters are: soil stability and connectivity of soil particles).

Table 2. Comparison of ecological and economic efficiency of seeding grasses in the conditions of mineral fertilizers and absence of fertilizer

Number and type of deflation preventive variations	Costs for remediation for 5 years, Hr, UAH per ha	Conditional profit (loss) for the 5 years, hr per ha		
		Economic, hr per ha	Ecological, (Prevented soil losses)	
			Soddy gley soils	Soddy carbonate soils
1. Organic fertilizers	5,808.0	-	SOM – 11.5 t/ha; N – 250 kg/ha; P – 125 kg/ha; K – 300 kg/ha	SOM – 3.76 t/ha; N – 80 kg/ha; P – 40 kg/ha; K – 96 kg/ha
2. Mineral fertilizers	663.3	-	N – 5.26 kg/ha; P – 26.3 kg/ha; K – 17.55 kg/ha	N – 1.24 kg/ha; P – 6.19 kg/ha; K – 9.9 kg/ha
3. Perennial grasses	2,649.6	1523.9 UAH per ha from products realization on market	Reduce of deflation processes (225 t/ha of soil); additional creation of 15.9 cwt/ ha of biological nitrogen annually.	
			SOM – 11.5 t/ha; P – 26.3 kg/ha; K – 17.55 kg/ha	SOM – 3.76 t/ha; P – 6.19 kg/ha; K – 9.9 kg/ha

Source: Own calculation on the basis of prices data for experiment beginning in 2013, NAAS

It was found that the potential soil loss gradually reduced to 70-75% in the first year and reached 50-55% in the 5th year as a result of some farming practices and changing the purpose of land usage, reduction and regulation of grazing. Implementation of soil-based agriculture as part of deflation preventive activities on these lands enabled to avert the loss of humus from 0.025 to 0.5 t/ha, which indicates their significant environmental effects. The comparison of characteristics efficiency of preventive deflation measures as use of organic fertilizers, use of mineral fertilizers and growing of perennial grasses presented in Table 3.

In the short term it is advisable to assess the actual extent of deflationary processes in order

to determine their causes, furtherly intensify and hold a series of urgent preventive actions in the form of compensation nutrients and annual surveillance of eroded areas.

Table 3. Comparison of characteristics efficiency of preventive deflation measures for soils, Pishcha Shatsky district, Polissya region, 2013-2018.

Parameters	Growing "Red clover" as perennial grasses («Trifolium Pratense» Lat.)	
	with mineral fertilizer input	without mineral fertilizer input
<u>1 year of implementation</u>		
Production costs, UAH per ha	1,656.0	1,430.0
Yield of clover seeds, 100 kg per ha	1.5	
Constant price in 2010, UAH/kg for seeds for hay	500.99 17.11	
The cost of seeds, UAH per ha	751.5	
Conditional income (loss) from sale of seeds, UAH/ha	-904.5	-678.5
<u>2-5 years of implementation</u>		
Production costs for the year, UAH/ha	248.4	173.9
Yields of clover for hay, t/ha	5.0	3.5
The cost of hay, UAH per ha	855.5	598.9
Conditional profit for the year, UAH per ha	607.1	425.0
<u>5 and more years of implementation</u>		
Production costs, UAH per ha	2,649.6	2,125.6
Production value, UAH per ha	4,173.1	3,146.9
Conditional income, UAH per ha	1,523.9	1,021.3
Level of profitability, %	57.5	48.0

Source: Own calculation on the basis of prices data for experiment beginning in 2013, NAAS

## CONCLUSIONS

Creation of protective cover using perennial grasses with incorporation of a certain amount of organic or mineral fertilizers is one of optimal ways to restore eroded lands with further selling products in the form of seeds and hay. The implementation of such activities can profit on the 5th year. Such farming practices as changing the direction of land usage from tillage to creating meadows by growing perennial grasses, showed their efficiency due to the relatively small value - 2,650 UAH/ha for the entire period of obtaining conditional income - 1,524 UAH/ha in five years implementation – obtaining clover seeds in the first year and hay for the next four years.

Perennial grasses due to a strong root system are binding the soil particles and reduce the soil remove by wind speed in the surface layer.

More optimal in this case is not to cultivate them in the field rotation but in soil protective or fodder crop rotations. By developing a strong root system the soil is well sealed, combined with the Nitrogen fixing bacteria features contributing additional nitrogen annually and clover yield – all of this is enough to stop and prevent deflation processes. The best solution to the issue of deflation, preventive deterioration on agricultural lands and local dusting due to light soil particle size distribution is minimal tilling along with fertilizers application in combination with perennial grasses sowing every 5th year.

## REFERENCES

- [1]Balyuk, S. A., Kucher, A. V., 2015, Rational use of soil resources and soil fertility restoration: organizational and economic, ecological, normative and legal aspects. Kharkiv, Smuhasta Typographiya. (ukr.)
- [2]Bulygin, S., 2005, Formation of environmentally sustainable agriculture landscapes. Kyiv, Vintage. (ukr.)
- [3]Bulygin, S., Kotova, M., 1997, Soil erosion in Ukraine, quantitative estimation and perspectives of soil erosion reduction. Collection of papers by Ukrainian members of ESSC, 3: 12-22.
- [4]Burakov, V. I., Timchenko, D. O., 1979, Do pitannya pro otsinku deflyatsiyanoi nebezpechnosti terytorii URSR [The assessment of deflation hazard of USSR]. Agrochemistry and soil science, 38: 86-91.(Ukr.)
- [5]Dmytrenko, V. L., 1992, Economica protiverozionnyh meropriyaty [Economy of erosion priventive activities]. Donetsk. Region. (Rus.)
- [6]Dolgilevich, M. J., 1997, Extent and severity of wind erosion in Ukraine. Proceedings of International Symposium Commemorating the 50<sup>th</sup> Anniversary of USDA-ARS Wind Erosion Research, Manhattan, USA.
- [7]Fryrear, D. W., Skidmore, E. L., 1985, Methods for controlling wind erosion. Chapter 24, Soil erosion and Crop Productivity. ASA-CSSA-SSSA, Madison, USA
- [8]Izvekov, A. S., Rybalkin, P. N., 1975, Vetrovaya eroziya pochv [Wind soil erosion]. Moscow, Kolos. (rus.)
- [9]Shumann, M., Joosten, H., 2008, Global Peatland Restoration. Greifswald. Institute of Botany and Landscape Ecology.
- [10]Skoropanov, S. G., 1963, Aktivno ispolzovat osushaemye zemli [Active use of dried lands]. Hydrotechniks and land reclamation, 6: 3-9 (Rus.)
- [11]Syabluk, P. T., Melnik, Y. F., Zubets, M. V., Mesel-Veselyaka, V. Y., 2008, Tsinoutvorennya ta normatyvni vytraty v silskomu hospodarstvi. Teoriya, metodologiya, praktyka [Pricing and regulatory costs in agriculture. Theory, methodology, practice]. Part II. Kyiv, NSC "IAE". (ukr.)
- [12]Thome, O. V., 1905, Flora von Deutschland, Österreich und der Schweiz. Gera, Zezschwitz Leibnitz.

## DEVELOPMENT OF AGRICULTURAL PRODUCTION COOPERATION IN RUSSIA: ISSUES AND PROSPECTS

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### Abstract

*Achieving a successful resolution to a nation's food problem is largely dependent on the development of cooperation. As an organizational-legal form of business in the agro-industrial complex, cooperation is represented by agricultural production cooperatives. Most of the world is currently dominated by consumer cooperatives, while Russia – by production ones. Over the last ten years, the number of production cooperatives in Russia has declined. The primary reason behind this is their low investment attractiveness. The paper examines the role of cooperation in driving sustainable development in rural areas, makes a case for the efficiency of production cooperatives as opposed to other forms of business, and reiterates the need for further development of cooperation in the country. A cooperative is not just a for-profit organization but a socio-labor form of business as well. The current level of profitability of agricultural production in cooperatives does not allow them to implement reproduction on an enlarged scale at this time. The authors explore a set of primary areas for the development of agricultural production cooperation in the country and examine a set of key measures of government support for it.*

**Key words:** agricultural cooperation, production and consumer cooperatives, economic efficiency, intensification, government support, Russia

### INTRODUCTION

A crucial area for driving growth in the agricultural sector and resolving the social problem in rural areas is the development of cooperation. It not only helps improve the competitiveness of agricultural producers but facilitates boosts in the income and well-being of participants in cooperation and helps drive sustainable development in rural areas. In addition, it plays an important role in preserving the rural population and preventing the desolation of particular regions. Domestic and foreign best practices attest to cooperation being one of the more efficient mechanisms for adapting agriculture to the new economic conditions associated with Russia's entry into the WTO and the imposition of international sanctions on it.

As an organizational-legal form of business, cooperation is represented by a system of various cooperatives and unions thereof. In rural areas, there operate agricultural cooperatives, the activity of which is

regulated by the federal law 'On Agricultural Cooperation'.

An agricultural cooperative is one of the existing organizational-legal forms of business. It is an organization that is set up by agricultural producers and citizens with a private subsidiary plot on a voluntary membership basis with a view to engaging in joint production (or some other type of) business activity, with a focus on pooling pecuniary equity contributions with each other for the purpose of meeting the material and other needs of members of a cooperative [2].

Agricultural cooperatives are divided into production and consumer ones. The key differences between the two are the following: (a) a production cooperative is a for-profit organization, while a consumer cooperative is a not-for-profit one;

(b) a production cooperative can be set up by natural persons – legal persons may only be associate members in it. By contrast, both natural and legal persons may be members in a consumer cooperative;

(c) in a production cooperative, the members personally do the work, while there is no such requirement in a consumer cooperative – the work is done by wage workers, i.e. a line has been drawn between membership and labor activity in a consumer cooperative.

## MATERIALS AND METHODS

The statistical-economic method makes it possible to comprehensively characterize the phenomenon under study by way of mass digital data, so the authors employed it to analyze the current condition and trends in the development of the agricultural production cooperatives sector and assess the efficiency of its operation. The monographic method helps gain insight into particular units within the general aggregate which are typical enough to characterize the phenomenon under study. This method was employed to explore the activity of agricultural organizations that are distinguished by high business results. The economic-mathematical method makes it possible to solve multifactor economic problems using computers. To address issues of optimizing production in agricultural artels, economic-mathematical modeling was employed. The computational-constructive method helps determine a set of ways to resolve the issue in the long run. It was used to lay the foundation for the development of agricultural cooperation in the long run with a view to resolving the issue of achieving sustainable development in rural areas.

## RESULTS AND DISCUSSIONS

Most of the world is currently dominated by consumer cooperatives, i.e. agricultural cooperatives that seek to fulfill the needs and aspirations of their members. By contrast, Russia is dominated by agricultural production cooperatives. Many researchers view production cooperatives as the more acceptable form of business in rural areas. The following factors speak in favor of agricultural production cooperatives:

(i) members of a cooperative must personally work in it, with making a mandatory equity contribution guaranteeing them a job in the

cooperative. In making the decision about the choice of organizational-legal form as a production cooperative, the team simultaneously takes on the obligation to provide employment to all of its members. This, in a sense, helps stabilize the social situation in rural areas, especially in the nation's rural hinterland;

(ii) those in charge of a cooperative (its Board, Chairman, etc.) are elected quite democratically, and, if need be, they can be easily replaced; it is a lot harder to do this in business partnerships and societies;

(iii) in the event of exiting the cooperative, each member can get their equity contribution back;

(iv) revenue in a cooperative is mainly distributed based on work and only partially (under 30%) based on additional stakes in it;

(v) the number of members in a cooperative is unlimited.

Agricultural production cooperatives are a social and labor form of business aimed at meeting the needs of its members. This is where a significant portion of the rural population is employed. Cooperatives have relevant public amenities in place in the countryside and provide their members, who are running a private subsidiary plot, with fodder, transportation, fuel, and other resources [6, 7].

Russia's agro-industrial complex currently numbers 4,195 production cooperatives, which accounts for 21.1% of the total number of agricultural organizations of all organizational-legal forms in the country. Subsequent to the passage of the federal law 'On Agricultural Cooperation', the number of production cooperatives rose from 2.4 thousand in 1996 to 14.4 thousand in 2003 or increased 6 times. However, starting in 2004 their number has been declining sharply. This has affected the overall structure of the nation's existing organizational-legal forms of agricultural business. The relative share of production cooperatives in the total number of agricultural organizations has declined in virtually all federal districts, except North Caucasian Federal District. Over there, it has risen from 38.8% to 44.2%. The relative share of cooperatives has been dropping the fastest

in Volga Federal District and Central Federal District. In those regions, it has dropped by 39.6 and 32.8 percentage points, respectively. The structure of agricultural organizations is currently dominated by limited liability companies. These account for 57.5%, with their share growing from year to year. However, in certain regions cooperatives remain the main form of business. For instance, in the Republic of Dagestan, they account for 66.1%, in the Republic of North Ossetia–Alania – 64.1%, in Nenets Autonomous Okrug – 58.1%, in the Sakha (Yakutia) Republic – 57.0%, in Zabaykalsky Krai – 51.8%, in Vologda Oblast – 43.0%, in Smolensk Oblast – 41.7%, and in Kostroma Oblast – 40.8%.

One of the main causes behind the nation's sharp decline in the number of agricultural production cooperatives is their low investment attractiveness. Investors are not interested in investing in this form of business, while rural residents can hardly come up with sufficient funds on their own. The democratic principle of governance (each cooperative member entitled to one vote) does not let the investor determine the production, or any other, activity of the organization. Therefore, many cooperatives have changed their organizational-legal form of business from a limited liability company to a stock company. The social orientation of activity by agricultural cooperatives also does not let them attract investment. Most are operating on rented, not owned, land, which diminishes their investment attractiveness as well.

In Russia, the most popular types of cooperation today are crop cooperatives, as produce turned out by this sector (grain, sugar beet, sunflower seeds, etc.) is most profitable, and integrated ones, where the risk of losses from natural disasters and market fluctuations is much lower. In addition, multi-sector cooperatives make a more complete and even use of labor resources. Another type of cooperatives that is developing successfully at the moment is cooperatives with a closed production cycle, which are engaged in both the production and processing of output.

During the pre-reform period (prior to 1990), agriculture in Russia developed successfully

based on cooperation. By 1985, the nation's agriculture was dominated by production cooperatives in the form of kolkhozes and interfarm enterprises. These entities had in their use 53 million ha of agricultural land, or 44.3% of total land area, 24.2 million heads of beef cattle (40% of all cattle in the country), 14 million heads of pigs (35%), and 22.5 million heads of sheep and goats (35%). They produced 49% of all grain, 83% of all sugar beet, 71% of all sunflower seeds, 35% of all milk and wool, and 32% of all meat in the country. The shift to a market economy resulted in the dismantlement of most of the entrenched forms of cooperation in the nation [9].

Agricultural production cooperatives would normally be set up via the reorganization of agricultural organizations of various forms of business organized in the basis of former kolkhozes and sovkhoz (state-owned farms). Each enterprise participant would decide for themselves whether or not to join a cooperative and transfer the land and property share they were entitled to into the cooperative's mutual fund as an equity contribution. The reorganization of an enterprise would result in the formation of one or several cooperatives.

Among the nation's agricultural production cooperatives, the most popular form of agricultural business was agricultural artels (kolkhozes, i.e. collective farms). These accounted for 89.6% of all production cooperatives in the country. By contrast, cooperative farms (coopkhozes) were not very popular. The distinctive characteristics of a coopkhoz include the following: (1) the mutual fund does not incorporate land plots that remain in the ownership (owned or rented) of peasant (private) farms or private subsidiary plots, except for lands that are intended for common cooperative needs; (2) a coopkhoz's members include not just civilians (who are not entrepreneurs but are just running a private subsidiary plot) but individual entrepreneurs (farmers) as well [8]. Currently, production cooperatives are losing out in size of production and resource security to other organizational-legal forms of business in the country (Table 1). In 2017, the value of

gross agricultural output on average per 1 cooperative in Tambov Oblast was 63.4 million rubles, which was 4.4 times less than across agricultural organizations on the whole and 7.4 times less than in stock companies. The number of workers was less 1.6 times and 2.9 times, respectively. The smallest agricultural area was registered in cooperatives – 3,165 ha, and the largest – in limited liability companies – 6,036 ha. The number of workers per 100 ha of agricultural

land in cooperatives was 1.5 people, and in stock companies – 2.3 people. Cooperatives are in charge of 6.6% of total agricultural land and 8.0% of the total number of workers at agricultural organizations. This is testimony to that cooperatives are to a greater degree interested in providing rural residents with a job. A production cooperative is a social form of business that is aimed at meeting the needs of its members. This is where a significant portion of the rural population is employed.

Table 1. Size and Resource Security of Agricultural Organizations in Tambov Oblast, 2017

Indicators	Stock companies	Limited liability companies	Agricultural production cooperatives	State and municipal unitary enterprises	Total
Number of farms	33	196	35	3	267
On average per 1 farm:					
gross agricultural output, million rubles	468.1	285.7	63.4	152.3	277.6
agricultural area, ha	6,036	6,935	3,165	5,284	6,311
number of workers	139	73	48	117	79
fixed assets, million rubles	486.2	384.7	96.6	190.3	357.3
Capital-area ratio (value of fixed assets per 100 ha of agricultural land), thousand rubles	8,055	5,548	3,054	3,602	5,662
Capital-labor ratio (value of fixed assets per 1 worker), thousand rubles	3,503	5,259	2,011	1,631	4,554
Labor-area ratio (number of workers per 100 ha of agricultural land), people	2.3	1.1	1.5	2.2	1.2

Source: indicators are calculated on the basis of annual reports of agricultural organizations of the Tambov region provided by Tambovstat <http://tmb.gks.ru>

Cooperatives are endowed with the means of production worse than other organizational-legal forms of business. This is attested to by indicators such as the capital-area ratio and capital-labor ratio, which, respectively, are by 46.1% and 55.8% smaller than across agricultural organizations overall.

The purpose of activity by agricultural production cooperatives is to derive profits, as they are for-profit organizations.

Most cooperatives operate profitably, but the economic efficiency of their business activity is lower compared with that of other organizational-legal forms of business (Table 2).

In 2017, the return from land was by 54.4 %, the return from fixed assets was by 84.4 %, and labor productivity was by 62.0% lower in agricultural production cooperatives in

Tambov Oblast than across agricultural organizations overall.

Cooperatives posted the lowest level of profitability of agricultural production – 1.2%. The current level of profitability of agricultural production in cooperatives does not allow them to implement reproduction on an enlarged scale at this time.

In cooperatives, the economic efficiency of agricultural activity largely depends on the intensity of agricultural production. Under the current conditions, some of the key areas for the intensification of production include the use of intensive and resource-saving technology, adoption of scientifically substantiated crop rotation systems, enhancement of seed production and stock breeding in livestock farming, employment of high-yield and more efficient plant, livestock,

and poultry varieties that offer the greatest future promise, application of mineral and organic fertilizers in optimal quantities, utilization of effective biological and

chemical methods for the protection of agricultural crops, and reinforcement of the fodder base [12].

Table 2. Efficiency of Business Activity by Agricultural Organizations in Tambov Oblast, 2017

Indicators	Stock companies	Limited liability companies	Agricultural production cooperatives	State and municipal unitary enterprises	Total
Return from land (value of gross output per 100 ha of agricultural land), thousand rubles	7,756	4,120	2,004	2,883	4,399
Return from fixed assets (value of gross output per 100 rubles of fixed assets), rubles	96.3	74.3	65.6	80.0	77.7
Labor productivity (value of gross output per 1 worker), thousand rubles	3,373	3,906	1,320	1,306	3,538
Revenue per 1 farm, thousand rubles	18,781	43,461	699	2,666	34,163
Revenue per 1 ha of agricultural land, thousand rubles	3.1	6.3	0.2	0.5	5.4
Level of profitability, %	14.7	30.4	1.2	2.4	26.4

Source: indicators are calculated on the basis of annual reports of agricultural organizations of the Tambov region provided by Tambovstat <http://tmb.gks.ru>

Boosts in the efficiency of activity by cooperatives will be facilitated by the technical modernization of production and creation of a single production chain, which will incorporate the growing of produce and its processing, storage, grading, packaging, and sale.

The profitability of production largely depends on the successful sale of produce, i.e. on producers' marketing activity. Therefore, it may help to set up marketing units of their own in large cooperatives which turn out an extensive range of produce, as well as in farms that sell a major portion of their output to markets outside of their administrative district and oblast. Cooperatives with small volume of production may consider enlisting the services of specialized consulting firms. This may help provide executives and specialists at enterprises with information on product supply and demand and where and at what price it is advisable to sell their produce, and will help them make informed decisions when working out an optimal marketing strategy [8].

A necessary condition for the effective operation of production cooperatives is engaging them in agricultural consumer cooperation. The development of supply-sale, processing, servicing, and other consumer cooperatives will help resolve issues related to the provision of a cooperative's own members with the means and objects of production and services related to machinery and equipment maintenance and the processing and sale of output. Under the current conditions, it will be hard for a production cooperative to resolve these issues on its own.

The creation of consumer cooperatives will help foster effective interaction between producers and large retail chains, help producers expand their presence in the internal agri-food market, and help amplify their role in fulfilling government and municipal contracts. This will be facilitated by the creation of relevant logistics centers and wholesale-retail markets [5].

To some scholars, a promising form of cooperation in the area of production is interfarm cooperation, which incorporates

cooperation among agricultural organizations, cooperation between agricultural enterprises and private subsidiary plots, and cooperation among private farms. Given that different farms are at different stages of economic and technological development, joining their efforts together on a mutually beneficial basis in terms of agricultural production may help achieve substantial boosts in production efficiency based on more rational use of available resources and deeper intrasectoral specialization. These scholars believe that interfarm cooperation can develop in two major forms:

(a) based on long-term sustainable production-economic ties, involving entering into supply contracts, services contracts, etc.;

(b) as part of relevant organizational-production systems, with new legal persons created [3, 4].

Quite often, interfarm cooperation develops informally, without a legal person getting created. Surveys of farmers indicate that in 80% of cases cooperation takes place without legal formalization [1].

The Concept on the Development of Cooperation in Rural Areas for the Period through to 2020 sets out a set of key areas for the organization and development of cooperative units in rural areas, with a focus on boosting the efficiency of agro-industrial production and returns on agricultural labor and ensuring sustainable development in rural areas.

The document sets out the following objectives on the development of cooperation:

(i) creation of favorable statutory and socio-economic conditions for the development of rural cooperation at the federal, regional, and municipal levels;

(ii) enhancement of the existing mechanism of government support and development of new measures for fostering rural cooperation, including public-private partnerships;

(iii) facilitation of boosts in the number of rural cooperatives across a variety of areas of activity and pursuit of wider coverage of agricultural producers and rural residents with cooperation;

(iv) facilitation of major boosts in agricultural producers' profit margins by way of their active engagement in cooperative activity;

(v) more comprehensive and higher quality provision of various services to agricultural producers and rural residents;

(vi) creation and development of an independent cooperative system for the sale of agricultural output that will be capable of competing with large retail chains;

(vii) effective development of institutions of cooperation with a view to driving socio-economic development in rural areas and improving the quality of life of rural residents;

(viii) promotion of adherence to the principles of cooperation, legality, and the rule of law in the area of rural cooperation [10].

The development of rural cooperation must become one of the top-priority strategic areas for enhancing agricultural policy in the Russian Federation. Greater government support may need to be provided to agricultural production cooperatives as opposed to other producers, as the former are intended to resolve the social problems of the rural population as well. However, the Government Program for the Development of Agriculture and Regulation of Markets for Agricultural Produce, Raw Materials, and Food for the Period 2013–2020 does not provide for government support for the development of agricultural production cooperation. Government support for agriculture is not differentiated by organizational-legal form of business (Resolution of the Government of the Russian [11].

Government support should help create the conditions for the successful development of cooperation in rural areas. There is a need to make financial-credit resources more accessible, including for the development of the material-technical base for the storage, processing, transportation, and sale of agricultural output and food via concessional lending, reduce the tax load via the abolition of property tax, and reduce insurance payments into the state non-budgetary funds (the pension, social insurance, and compulsory medical insurance funds). The state is expected to provide assistance in

putting in place a property framework for agricultural production via the transfer into one's use, on concessionary terms, of state-owned property and land and reimbursing one for a portion of expenditure on production. This will facilitate the development of cooperation and boosts in economic activity among the rural population, in the employment rate, and in income.

## CONCLUSIONS

An agricultural production cooperative is not just a for-profit organization but also a social and labor form of business that is aimed at meeting the needs of its members. In the last few years, the number of cooperatives in Russia has declined sharply. One of the key reasons behind this is their low investment attractiveness. To successfully develop production cooperation, the nation needs to enhance its existing methods and tools for government support and ensure appropriate support in putting in place a sound material-technical base for cooperatives. A key way to achieve improvements in economic activity in the country is to intensify agriculture and direct it to a path of innovation-driven development.

## REFERENCES

- [1]Barbashin, E.A., Babkova, Iu. F., 2015, Kooperatsiya i agropromyshlennaya integratsiya kak osnovnye napravleniya povysheniya effektivnosti upravleniya izderzhkami proizvodstva v sel'skokhozyaistvennykh organizatsiyakh [Cooperation and agro-industrial integration as key areas for boosting the effectiveness of management of production costs in agricultural organizations], Vestnik Kurskoi Gosudarstvennoi Sel'skokhozyaistvennoi Akademii, 6: 5–7.
- [2]Federal'nyi zakon N 193-FZ "O sel'skokhozyaistvennoi kooperatsii", December 8, 1995 [Federal Law No. 193-FZ 'On Agricultural Cooperation' December 8, 1995]. [http://www.consultant.ru/document/cons\\_doc\\_LAW\\_8\\_572/](http://www.consultant.ru/document/cons_doc_LAW_8_572/)
- [3]Kriachkov, I.T., Mikhilev, A.V., Kriachkova, L.I., Pronskaia, O.N., 2013, O kooperatsii v proizvodstve, pererabotke i sbyte produktsii v agropromyshlennom proizvodstve [On cooperation in the production, processing, and sale of output in agricultural production], Vestnik Kurskoi Gosudarstvennoi Sel'skokhozyaistvennoi Akademii, 1: 5–7.
- [4]Krylov, V.S., Semkin, A.G., Baiunov, V.A., Mikheev, E. Iu, 2018, Sostavlyayushchie uspeshnogo razvitiya sel'skokhozyaistvennoi kooperatsii v raionakh Lipetskoi oblasti [Components of the successful development of agricultural cooperation in districts within Lipetsk Oblast], APK: Ekonomika, Upravlenie, 5: 11–21.
- [5]Kulikov, I.M., Minakov, I.A., 2018, A socio-economic study of the food sector: The supply side, European Research Studies Journal, 21(4): 175–184.
- [6]Minakov, I.A., 2008, Integratsiya kollektivnykh i lichnykh podsobnykh khozyaistv [Integration of collective and private subsidiary farms], Ekonomika Sel'skokhozyaistvennykh i Pererabatyvayushchikh Predpriyatii, 10: 60–62.
- [7]Minakov, I.A., 2016, Kooperatsiya i agropromyshlennaya integratsiya [Cooperation and agro-industrial integration], Saint Petersburg, Russia: Lan'.
- [8]Minakov, I.A., 2016, Razvitie integratsionnykh protsessov v agropromyshlennom komplekse: Monografiya [Development of integration processes within the agro-industrial complex: A monograph], Michurinsk, Russia: Izdatel'stvo Michurinskogo GAU.
- [9]Minakov, I.A., 2018, Uchenie A.V. Chayanova o kooperatsii i razvitie kooperativnoi sistemy v Rossii [A.V. Chayanov's cooperation teachings and the development of Russia's cooperative system], Vestnik Michurinskogo Gosudarstvennogo Agrarnogo Universiteta, 3: 145–151.
- [10]Petrikov, A.V., 2013, Materialy Pervogo Vserossiiskogo s'ezda sel'skikh kooperatorov (21-22 marta 2013 g., Sankt-Peterburg) [Proceedings of the First All-Russian Congress of Rural Cooperatives (March 21-22, 2003, Saint Petersburg)], Moscow, Russia: FGBNU Rosinformagrotekh.
- [11]Postanovlenie Pravitel'stva RF N 717, "O Gosudarstvennoi programme razvitiya sel'skogo khozyaistva i regulirovaniya rynkov sel'skokhozyaistvennoi produktsii, syr'ya i prodovol'stviya na 2013–2020 gody", July 14, 2012 [Resolution of the Government of the Russian Federation No. 717 'On the Government Program for the Development of Agriculture and Regulation of Markets for Agricultural Produce, Raw Materials, and Food for the Period 2013–2020', July 14, 2012]. [http://www.consultant.ru/document/cons\\_doc\\_LAW\\_1\\_33795/](http://www.consultant.ru/document/cons_doc_LAW_1_33795/), Accessed on Dec.10, 2018.
- [12]Tkach, A.V., Cherevko, A.V., 2017, Tendentsii i perspektivy razvitiya sel'skokhozyaistvennoi kooperatsii v Rossii [Trends in and prospects for the development of agricultural cooperation in Russia]. APK: Ekonomika, Upravlenie, 1: 42–49.



## FUNDING OPPORTUNITIES FOR FARMERS IN UKRAINE

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### **Abstract**

*The goal of the article is to analyze development of the state support for farming enterprises in Ukraine. Scientific solution of the set tasks required use of the following methods, particularly the method of comparative analysis was used to estimate expenditures of the state budget and programs of support for farming enterprises; abstract-logical method – to define the main problems of the state support for farmers in Ukraine; statistical-economic method – to evaluate current conditions and tendencies of development of the system of the state support for farmers. The work analyzes principal directions and problems of the state support for farming enterprises in Ukraine. It is confirmed that the State support for a farmer should be focused not only on support of the volume of production and producers' prices, but on implementation of innovative projects by farmers concerning sustainable land management.*

**Key words:** state support, farming enterprises, budget program

### **INTRODUCTION**

In Ukraine, efficiency of agricultural production of farming enterprises is at a lower level, comparing to the medium-size and large enterprises.

Nowadays, at most farming enterprises, yield capacity of the products of crop production is much lower than at medium-size and large enterprises. It is mainly forced by worse conditions of material and technical resources of the farming enterprises, complicated access to advanced technologies, insufficient use of crop protection agents, fertilizers, as well as high productive varieties of seeds that is first caused by a continuous lack of personal current assets and limited access to credit resources. Thus, the farming enterprises need considerable state support [5].

The conditions of farming enterprises are complicated by the fact that they cannot cancel earlier obtained credits of commercial banks. High loan interest rates and lack of property, which can be pledged, as well as unwillingness of commercial banks to credit agricultural producers are the reasons why farming enterprises cannot obtain new credits. Most of farming enterprises, which employ large area of land, need the state financial support.

### **MATERIALS AND METHODS**

The aim of the article is to analyze development of the state support for farming enterprises in Ukraine. Scientific solution of the set tasks required use of the following methods, particularly the method of comparative analysis was used to estimate expenditures of the state budget and programs of support for farming enterprises; abstract-logical method – to define the main problems of the state support for farmers in Ukraine; statistical-economic method – to evaluate current conditions and tendencies of development of the system of the state support for farmers. The work analyzes principal directions and problems of the state support for farming enterprises in Ukraine.

### **RESULTS AND DISCUSSIONS**

Economic changes in Ukraine of the recent years considerably influence the structure, character and tendencies of land use [7]. Among the total number of business subjects, farming enterprises constitute a principal organizational and legal form of economic activity in a village. Their activity is established on the work of the members of one family and is directly connected with the

land ownership right for and its use as the key assets for production and source of income. The number of acting farming enterprises constituted 34,137 units, that was almost 75% of the total number of economically active

agricultural enterprises. The largest number of the enterprises was in Zaporizhzhia, Kherson, Kirovohrad regions, and the least one – in Rivne, Ivano-Frankivsk, Chernivtsi and Volyn regions (Fig. 1).

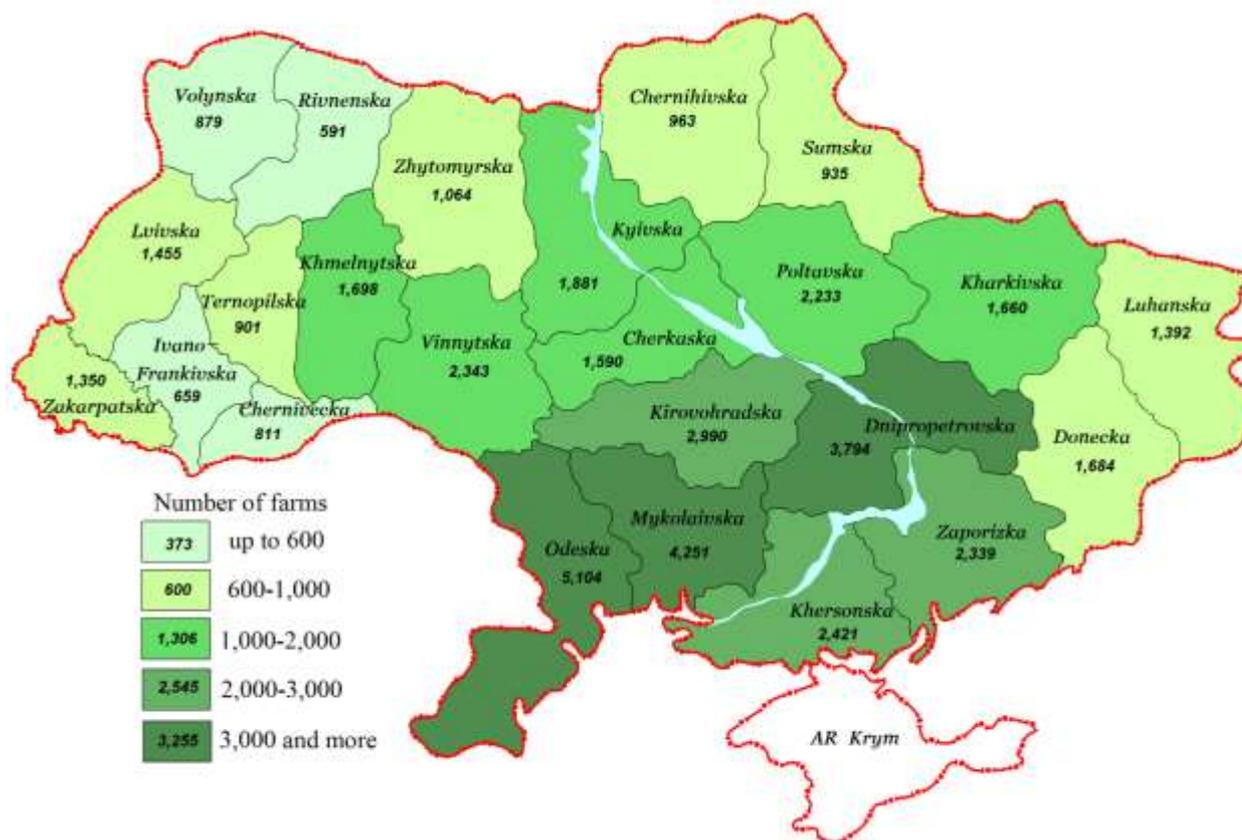


Fig. 1. Number of farming enterprises in Ukraine  
 Source: Completed by the authors according to the data [8], [12]

The farming enterprises employ 4.6 million ha or 22.9% of the total land use by agricultural enterprises, with the average area of 134.2 ha of lands per one enterprise. Among the total number of acting farming enterprises, 28,664 units employ land parcels with the area of up to 500 ha, that is almost 84 % of the total number of farming enterprises in Ukraine (Fig. 2). The average area of agricultural lands, which are employed by a farming enterprise, constitutes 78 ha [8]. The Principal Law, which defines legal, economic and social fundamentals of establishment and performance of farming enterprises as a progressive form of business activity in the field of agriculture of Ukraine, is the Law of Ukraine “About farming enterprises” of June 19, 2003 № 973 [1].

Articles 9 and 10 of the Law of Ukraine “About farming enterprises” determine assistance by means of the state and local budgets, including Ukrainian state fund of support for farming enterprises, which is a state budget institution and performs functions of implementation of the state policy concerning financial support of establishment and development of farming enterprises [1]. Ukrainian state fund of support for farming enterprises provides financial support for farming enterprises on an irretrievable base and on competition fundamentals of repayable base up to five years with pledged assets according to the Order of utilization of the funds, expected in the state budget and intended to support farming enterprises. It is approved by the Resolution of the Cabinet of Ministers of Ukraine of August 25, 2004 № 1102 (with amendments) [9].

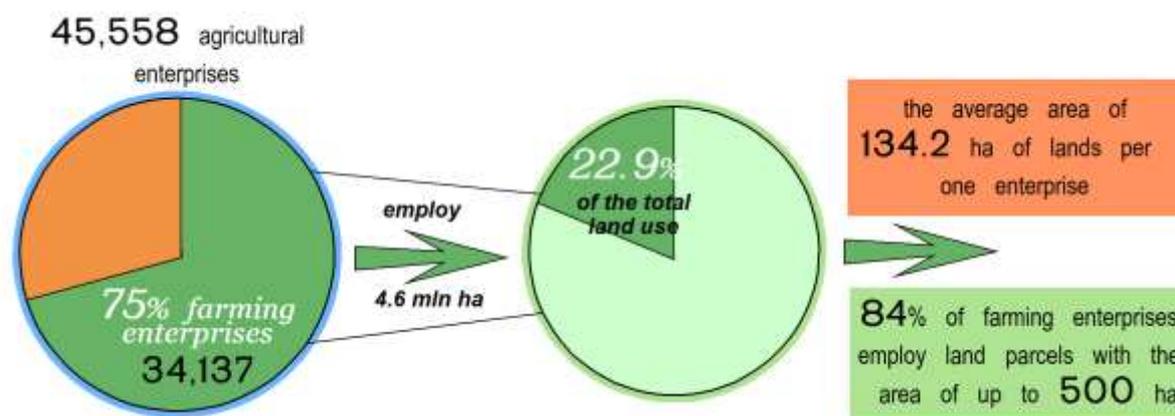


Fig. 2. Characteristics of farming enterprises of Ukraine.  
 Source: Completed by the authors according to the data [8].

In 2015-2017, budget support for development of farming enterprises was performed by the special program 2801460 “Supply of credits for farming enterprises”. According to the mentioned program, credit funds were supplied to the farmers mainly for such goals as purchase of equipment, machinery; refilling of current assets; production and processing of agricultural products; planting of perennials; credit and servicing cooperation development.

The Law of Ukraine “About the State budget of Ukraine for 2015” [2] expected costs in the amount of 25,600 thousand UAH. Actually, 158 farming enterprises obtained the support with the average amount of 162 thousand UAH per one farming enterprise.

The Law of Ukraine “About the State budget of Ukraine for 2016” [3] and the budget program 2801460 “Supply of credits for farming enterprises” expected budget appropriations only by means of costs of a special state fund in the amount of 15,819.2 thousand UAH, that was less than the claimed amount by 42,280.8 thousand UAH.

The Law of Ukraine “About the State budget of Ukraine for 2017” [4] expected costs in the amount of 65 million UAH, including 25 million UAH – from the general fund, 40 million UAH – from the special fund. In fact, 211 farming enterprises took the support with the average amount of 305 thousand UAH per one farming enterprise.

Along with the budget program 2801460 “Supply of credits for farming

enterprises”, farmers had the right to get support from the budget program 2801030 “Financial support for the measures in agro-industrial complex by easing of credits”.

In 2015, 177 farming enterprises got 27.9 million UAH. In 2015, the budget program 2801030 “Financial support for the measures in agro-industrial complex by easing of credits” expected 300 million UAH, which were used to reimburse the attracted credits of farming subjects, particularly 290.6 million UAH. Amount of the reimbursement to farming enterprises for the attracted privileged credits constituted 27.9 million UAH, or 9.6 % of the total amount of funds, focused on partial reimbursement of the interest rate of credits use. 177 borrowers got partial reimbursement of the credits interest rate. It constituted 28.1% of the total number of loan debtors, who took such support [6].

In 2016, 187 farming enterprises got 61.3 million UAH according to that budget program. It expected 285 million UAH, which were used for reimbursement of the attracted privileged credits for farming enterprises, i.e. 279.8 million UAH. Amount of the reimbursement, provided for farming enterprises for attracted privileged credits, constituted 59.1 million UAH or 21.1 % of the total amount of the costs, intended for partial reimbursement of the interest rate for credits use. 174 loan debtors or 26.2 % of the total number of borrowers, who used the support, got partial reimbursement for credits interest rates.

In 2017, the same budget program supplied 113.8 million UAH for 944 farming enterprises. Particularly, 300 million UAH were claimed to supply reimbursement for farming subjects for the attracted privileged credits, namely it constituted 297.8 million UAH. Amount of the reimbursement, supplied for farming enterprises for attracted privileged credits constituted 34.4 million UAH or 11.7 % of the total amount of the costs, focused on partial reimbursement of the interest rate for use of the credits. 178 loan debtors or 28.4 % of the total number of borrowers, who took such support, got partial reimbursement of credits interest rates.

Tendencies of the amounts of used state financial support for farming enterprises in the regions of Ukraine for 2015-2017 are presented in the table (Table 1).

The Table 1 demonstrates that for 2017, the largest amount of the used financial support, supplied to farming enterprises according to the national program 2801030 “Financial support for the measures in agro-industrial complex by easing of credits” is obtained by enterprises in Vinnytsia region (5877 thousand UAH or 8.9 %), and the least one – by the enterprises in Transcarpathian region (149 thousand UAH or 0.2 %). In contrast, the special budget program 2801460 “Supply of credits for farming enterprises” supplied support for the enterprises in Kirovohrad region (6,500 thousand UAH or 10 %) and Transcarpathian region (260 thousand UAH or 0.4 %) respectively.

Limited budget costs and impact of the economic crisis in 2017, caused 4.5 times reduction of the amount of the state support for farming enterprises according to the budget program 2801030, as compared to 2015.

To improve the situation concerning the state support for farming enterprises, in the second half of 2017, the Government approved the Concept of development of farming enterprises and agricultural cooperation for 2018-2020. The goal of the Concept is to create the necessary organizational, legal and financial preconditions for development of farming enterprises and agricultural cooperation, to improve their material and financial environment [11].

Table 1. The amount of state financial support for farming enterprises, thousand UAH

Budget Program	2801030 "Financial support for the measures in agro-industrial complex by easing of credits"			2801460 "Supply of credits for farming enterprises"		
	2015	2016	2017	2015	2016	2017
Region	2015	2016	2017	2015	2016	2017
AR Krym	..**	..**	..**	..**	..**	..**
Vinnytska	33,695	32,930	5,877	1,792	1,159	4,550
Volynska	16,763	8,064	1,166	394	265	1,040
Dnipropetrovska	11,199	11,187	4,232	2,261	1,301	5,850
Donecka	406	183	2,118	988	558	2,015
Zhytomyrska	5,514	6,607	1,871	407	261	975
Zakarpatska	993	46	149	120	74	260
Zaporizka	12,446	12,965	2,462	1,329	755	3,445
Ivano-Frankivska	5,088	4,623	890	225	149	585
Kyivska	18,974	30,079	4,837	1,132	721	2,730
Kirovohradska	9,717	10,428	3,369	2,532	1,568	6,500
Luhanska	1,396	3,361	1,297	1,288	744	2,665
Lvivska	15,339	8,471	1,518	909	539	1,950
Mykolaiivska	7,877	7,925	2,481	1,521	910	3,965
Odeska	8,383	10,983	2,940	1,838	1,240	5,395
Rivnenska	23,512	17,736	5,069	1,559	908	3,900
Poltavska	5,919	7,921	1,017	254	165	650
Sumska	9,110	6,449	3,206	704	478	2,080
Ternopil'ska	10,657	18,226	2,124	630	399	1,495
Kharkiv'ska	22,090	18,337	4,073	1,454	949	3,965
Kherson'ska	10,549	6,863	2,633	1,247	709	3,185
Khmelnitska	24,982	19,607	3,638	1,004	674	2,600
Cherkaska	27,295	19,068	5,308	1,160	717	2,860
Chernivecka	5,993	9,628	497	233	155	585
Chernihiv'ska	12,103	13,313	3,228	622	421	1,755
<b>Ukraine</b>	<b>300,000</b>	<b>285,000</b>	<b>66,000</b>	<b>25,600</b>	<b>15,819</b>	<b>65,000</b>

Source: Completed by the authors according to the data [13];

\*\* Statistical data are absent.

Implementation of the Concept was approved by the Order of utilization of the funds, expected in the State budget to finance the support for farming enterprises development [10]. According to the Order, the State support for development of farming enterprises was intended in 5 directions (Table 2). However, as one can see in the Table 2, such direction of the state support as reimbursement for the share of bought domestic machinery was financed with the excess of almost 9 million UAH.

Table 2. State support for farming enterprises by the directions of financing in 2018, thousand UAH\*

Directions of financing	Mechanism of implementation	Claimed financing, thousand UAH*	Actual financing, thousand UAH**
Partial reimbursement of the costs of purchased seed of agricultural crops, selected by the national subjects of seed study	Reimbursement of the costs is supplied for certified seed of agricultural crops of domestic selection in the amount of 80 % of the seed price without consideration of the amount of value added tax, but not more than 30 thousand UAH per one enterprise.	240,000.0	6,425.2
Partial reimbursement of the expenditures, connected with supplied agricultural advisory services.	Agricultural advisory services are reimbursed by partial expenditures, connected with supply of advisory services in the following directions: agronomy, veterinary, zooculture, accounting, marketing, juridical advices in the amount of 90 % of the costs, but not more than 10 thousand UAH.	5,000.0	203.5
Financial support for agricultural servicing cooperatives (ASC)	Financial support is supplied for dairy and fruit-berry directions to purchase equipment for storage and processing of agricultural products. Size of the financial support can take 70 % of the costs of bought equipment without consideration of VAT, but not more than 3 million UAH per one ASC.	155,000.0	8,575.5
Partial reimbursement of the costs of bought agricultural machinery and equipment of domestic production	Partial reimbursement is supplied for farming enterprises in the size of 40 % of the costs of bought machinery and equipment without consideration of VAT.	100,000.0	108,937.6
Easing of credits	Reimbursement is supplied for farming enterprises according to the charged and paid interests in the current year in the amount of 1,5 of a reference rate of the National Bank, but not more than the size, approved by the credit agreement, and reduced by 1 interest point.	500,000.0	8,457.1

\*According to budget program 2801230 "Financial support for farming enterprises development" for 2018

\*\*According to the data of the Ministry of Agrarian Policy and Food of Ukraine

Speaking about other points, particularly easing of credits and levels of financing, their level appeared to be very low. Such unsatisfactory implementation of the state program is explained by a low level of farmers' trust to any state initiative, as well as a slow tempo of decision-making by the banks concerning reimbursement of interest rates for farming enterprises.

The authors of the article consider that the procedure of obtaining of financial support on an irrevocable base is very complicated. To participate in competition for obtaining of financial support it is required from a farming enterprise to submit more than ten different documents and certificates to the competition board. Number of copies of the documents, confirming the right of property or use of a land parcel, can be calculated by dozens.

There are other drawbacks in the mechanism of the program implementation, in particular:

- the state support can be taken only once in a year. It does not concern the peculiarities of agricultural production, connected with performance of seeding twice a year (in spring and in autumn);
- after submitting of the required documents, agricultural producers are enlisted in the register of obtainers of partial reimbursement of the seed cost. However, the resolution does not consider sequence of payments according to the register, that can cause manual control for payment of grants and corruption;
- precise periods of the grants payment are not determined, but it is noted that payment of the reimbursement are made monthly.

## CONCLUSIONS

Thus, main problems of the state support for farming enterprises in Ukraine include a low level of farming enterprises' informing concerning opportunities to obtain the state support, as well as a complex procedure mechanism and obscure terms of the support obtaining, manual mechanism of the costs management, as well as insufficient amounts of financing from the state programs.

In the authors' opinion, efficiency of the state support for domestic farming enterprise can be secured not only by increase of the amount of budget financing, but also by organization of a clear procedure of the costs utilization. Attempts to improve financial discipline while utilizing budget costs, by means of a complicated procedure of financial support supply, cause a loss of farming enterprises' interest concerning obtaining of the support. The state support for farmers should be focused both on support of production output and producers' prices, as well as on support for implementation of innovative projects concerning sustainable land management by farmers.

## REFERENCES

- [1] About farming enterprises: Law of Ukraine, dated on June 19, 2003, №973-IV. Update date: July 10, 2018, <https://zakon.rada.gov.ua/laws/show/973-15>, Accessed on 24 January 2019.
- [2] About the State budget of Ukraine for 2015: Law of Ukraine, dated on December 28, 2014, №80-VIII. Update date: December 24, 2015. <https://zakon.rada.gov.ua/laws/show/80-19>, Accessed on 24 January 2019.
- [3] About the State budget of Ukraine for 2016: Law of Ukraine, dated on December 25, 2015, №928-VIII. Update date: December 22, 2016. <https://zakon.rada.gov.ua/laws/show/928-19>, Accessed on 24 January 2019.
- [4] About the State budget of Ukraine for 2017: Law of Ukraine, dated on December 21, 2016, №1801-VIII. Update date: November 09, 2017. <https://zakon.rada.gov.ua/laws/show/1801-19>, Accessed on 24 January 2019.
- [5] Berezovska, L., 2018, Analysis of the state support of farming houses in Ukraine. Scientific Journal of National University of Life and Environmental Sciences of Ukraine. Series: Economy, Agrarian Management, Business, Volume 284, 211-218.
- [6] Information concerning inspection of the expenditures in terms of financial support for the development of farms, 2018. <http://www.coop-union.org.ua/?p=8534>, Accessed on 20 January 2019.
- [7] Kyruultsiv, R., Kryshenyk, N., 2018, The influence of rural development programmes of agricultural and land use in Ukraine. Scientific Papers Series «Management, Economic Engineering in Agriculture and Rural Development», Vol. 18(1):211-218.
- [8] Ministry of Agrarian Policy and Food of Ukraine : official web-site, 2018. <http://www.minagro.gov.ua/node/25292>, Accessed on 24 January 2019.
- [9] On Approval of Procedure of Use of Funds Envisaged in the State Budget for financial support of farms development: Degree of the Cabinet of Ministers of Ukraine, dated on August 25, 2004. №1102. <https://zakon.rada.gov.ua/laws/show/1102-2004-%D0%BF>, Accessed on 21 January 2019.
- [10] On Approval of Procedure of Use of Funds Envisaged in the State Budget for financial support of farms development: Degree of the Cabinet of Ministers of Ukraine, dated on February 07, 2018 p. №106. <https://zakon.rada.gov.ua/laws/show/106-2018-%D0%BF>, Accessed on 20 January 2019.
- [11] On Approval of the Concept of Development of Farmers and Agricultural Cooperatives for 2018-2020: Degree of Cabinet of Ministers of Ukraine, dated on September 13, 2017 №646-p. <https://zakon.rada.gov.ua/laws/show/664-2017-%D1%80>, Accessed on 23 January 2019.
- [12] State Statistics Service: official web-site, 2018. [http://www.ukrstat.gov.ua/operativ/operativ2016/sg/ks\\_gp/ksgp\\_u/ksgp\\_11\\_2017u.htm](http://www.ukrstat.gov.ua/operativ/operativ2016/sg/ks_gp/ksgp_u/ksgp_11_2017u.htm), Accessed on 20 January 2019.
- [13] Ukrainian state fund of support for farming enterprises: official web-site, 2018. <https://udf.gov.ua>, Accessed on 23 January 2019.

## BROILER CARCASS PHYSICAL CHARACTERISTICS EVALUATION BASED ON BODY WEIGHT

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### Abstract

*This study which aimed to determine the physical characteristics of broiler carcasses based on body weight, was done at the Laboratory of Animal Product Processing Technology, Animal Husbandry, Universitas Padjadjaran, using 25 broilers strain Coobb with body weight between 1.3 - 1.7 kg. Analysis equipment used is analytical scales, thermometers and penetrometers to observe the carcass percentage, meat percentage, tenderness, water holding capacity, and cooking losses. This study used a Completely Randomized Design (CRD) with 5 treatments of T-1 (BW 1.3 kg), T-2 (BW 1.4 kg), T-3 (BW 1.5 kg), T-4 (BW 1.6 kg) and T-5 (BW 1.7 kg). Results indicated that the treatment had significant affected ( $P > 0.05$ ) the carcass percentage, meat percentage, tenderness, water holding capacity, and cooking losses.*

**Key words:** broiler carcass, carcass and meat percentage, tenderness, water holding capacity, cooking losses

### INTRODUCTION

The known origin of a product has proved to be one of the more important factors in product distinction and selection by consumers. The up and medium society today, has healthy lifestyle that demands the nutritionally food, for basic human growth and life. Broiler chicken is a food that has good nutrient content for human needs, are economics, good taste and aroma, soft texture and popular; make broiler chicken an alternative food for the society; has chemical composition of protein 18.6%, fat 15.1%, water 66.0% and ash 0.79% (Stadelman *et al.*, 1988) [11]. Intensive selection for growth in broilers is associated with increased metabolic requirements and feed consumption (de Jong and Guemene, 2011) [2], and finally has effect to body weight when the broiler was slaughter. Global poultry production and consumption have grown nearly 4% over the last decade (Jez, *et al.*, 2011) [4]. Poultry meat production effectiveness is influenced by many factors, such as live weight and carcass quality (Radu and Popescu-Miclosanu, 2012) [8].

As is known that the growth of broiler chickens is currently very fast. In the maintenance period of 30-35 days, body weight of 1.5 - 2.0 kg can be achieved per chicken and at this time many farmers started harvesting the chicken. However, the time of harvesters can be adjusted to the time of achievement of chicken body weight favoured by consumers. In certain regions consumers have the desire of broilers with small size (<1 kg per head), on the other hand there are consumers who like large broilers (> 2.0 kg per head). The differences in harvesting time and broiler chicken weight allow differences also in the carcass percentage and the quality of the physical properties of broiler chicken meat. Small broilers (1 -1.5 kg) are mostly in demand by household consumers, while large broilers (> 1.5 kg) are used for house hold processing, such as satay, fried, bake, and traditional dishes like *nasi goreng* (fried rice), *soto* (traditional Indonesian soup), satay, which began to be popularized by the Indonesian Ministry of Tourism; and for the chicken meat processing industry (nuggets, sausages, meat balls). Therefore, it is necessary to evaluate the characteristics of the

broilers physical properties, based on body weight so the consumers can get the necessary broiler carcasses as needed.

Body weights, taken up between four weeks to five weeks of age in broiler chicks, indicated better growth of male birds as compared to females (Sachdev, *et al.*, 2011) [9]. The dressed weight, carcass quality traits based on breast, drumstick, taken for birds at four to five weeks of age, were comparatively lower for females than the males, but in this research we didn't considerate of either sexes.

## MATERIALS AND METHODS

### Materials

25 broilers strain Coobb from Missouri Breeding Farm, Bandung, with body weight between 1.3 kg - 1.7 kg were used. Body weight 1.3 kg, usually reach at 4 weeks old; and the equipment were analytical scales, thermometers, and penetrometers.

### Methods

The research was carried out at Food Technology Laboratory, Animal Husbandry Universitas Padjadjaran using 25 broilers and analyzed using Completely Randomized Design with 5 treatments of differences in final body weight of broilers, T-1 (1.3 kg), T-2 (1.4 kg), T-3 (1.5 kg), T-4 (1.6 kg) and T-5 (1.7 kg). The broilers were using Kosher method slaughtering and the treatments were repeated 5 times. The observed variables included the percentage of carcass by comparing carcass weight with live weight, percentage of meat by comparing the meat gain with live weight, tenderness of meat using penetrometer, water holding capacity (WHC) measured using the Filter Pressing Method (Honikel and Hamm, 1994) [3], and cooking losses are measured by comparing the 30 minutes boiled meat at 80-82°C with 30 grams of raw meat.

### Statistical Analysis

The study was carried out experimentally, with Completely Randomized Design of unidirectional patterns, five treatments of body weight (1.3 kg, 1.4 kg, 1.5 kg, 1.6 kg and 1.7 kg), and repeated 5 times. To determine the effect of differences in body weight on broiler carcass physical

characteristics, the data were analyzed statistically according to the Completely Randomized Design unidirectional patterns five treatments of body weight (1.3 kg, 1.4 kg, 1.5 kg, 1.6 kg and 1.7 kg) with five replications for analysis of variance. If there are significant differences between treatments, Duncan's Multiple Range Test (SPSS-21 software package) is carried out.

## RESULTS AND DISCUSSIONS

The average carcass percentage, meat percentage, tenderness, water holding capacity (WHC) and cooking losses of broiler studied, were presented in Table 1 until Table 5.

### The broiler carcasses percentage

In Table 1 it can be seen the results for carcass percentage.

Table 1. The Averages data of Carcass Percentage

Observations	Body weight (Kg/bird)				
	1.3	1.4	1.5	1.6	1.7
1	67.6	70.1	70.8	71.2	70.2
2	69.2	70.6	70.0	71.5	72.3
3	70.0	72.4	72.1	72.0	72.9
4	67.2	69.9	70.0	70.0	70.6
5	70.0	70.0	71.1	70.0	71.5
Sum	344.0	353.0	354.0	355.5	357.5
Means	68.8 <sup>a</sup>	70.6 <sup>b</sup>	70.8 <sup>b</sup>	71.1 <sup>b</sup>	71.5 <sup>b</sup>

Source: Own results in the laboratory.

The highest average of carcass percentage was shown by 1.7 kg broiler chickens (71.5%), followed by 1.6 kg broilers (71.1%); 1.5 kg (70.8%); 1.4 kg (70.6%) and the lowest are 1.3 kg (68.8%). Even the increase of the body weight does not occur uniformly, but the averages percentage were increase as the body weight increase. According to Radu and Popescu-Miclosanu (2012) [8], the live weight of 50 days broiler, are between 2.554 – 3.047 kg; and the carcass weights are between 1.938 – 2.33 kg (the percentage around 75.88 – 76.46 %); and in this research the carcass percentage are between 68.8% to 71.5%. This result is consistent with the opinion of Bell and Weaver (2002) [1] which states that increasing weekly body weight does not occur uniformly. Every week, the growth of broiler

chickens increases until the maximum weight is obtained, and one that affects the percentage of carcass is live body weight. This result also shows that the percentage of broiler chickens carcasses in each treatment is in the range of 65-75% of live body weight when ready for slaughter (Murtidjo, 1987) [7]. From the results of analysis of variance, it is known that the differences in live body weight in the weight range 1.3 -1.7 kg have significant effect on the percentage of carcass produced.

*Meat Percentage*

In Table 2, one may see the results for meat percentage.

Table 2. The Averages data of Meat Percentage

Observation	Body weight (Kg/bird)				
	1.3	1.4	1.5	1.6	1.7
1	51.2	48.8	47.4	46.9	42.3
2	50.0	48.5	47.1	46.8	42.4
3	48.8	48.7	47.5	47.0	42.3
4	50.2	49.0	47.2	46.8	42.5
5	51.3	48.5	46.8	46.5	42.5
Sum	250.5	243.5	236.0	234.0	212.0
Means	50.1 <sup>a</sup>	48.7 <sup>b</sup>	47.2 <sup>c</sup>	46.8 <sup>c</sup>	42.4 <sup>d</sup>

Source: Own results in the laboratory.

Based on the results of analysis of variance, shows significant differences between treatments ( $P > 0.05$ ), the percentage of meat in the range of body weight 1.3-1.7 kg resulted the percentage of meat ranging from 42.4 - 50.1 % of life weight. This is due to the age of cutting which is some proportion between meat, bone, and fat and innards are much different.

*Meat Tenderness*

In Table 3, it can be seen the results for meat tenderness.

Meat tenderness was determined by the amount of pressure needed for each unit area ( $\text{kg} / \text{cm}^2$ ) of the product, which can be interpreted as the smaller tenderness obtained, the softer the meat. Meat tenderness is a function of production, value adding, and processing, especially for cooking method used when preparing the meat for consumption. Based on the results of analysis of variance, it did show significant differences

between treatments ( $P > 0.05$ ), this was due to the different age of slaughter in the broiler chickens. The amount and strength of collagen can increase with age, covalent crossing increases as long as the growth and development of livestock and collagen become stronger (Soeparno, 2005) [10]. The suitable cooking method, will reduce the cooking loss and increasing the Water Holding Capacity (Latif, 2010) [5].

Table 3. The Averages of Meat Tenderness

Observation	Body weight (Kg/bird)				
	1.3	1.4	1.5	1.6	1.7
1	106.6	104.4	99.7	102.7	93.1
2	105.9	104.7	99.1	102.7	92.9
3	106.7	103.9	99.9	97.2	93.0
4	106.4	104.7	100.1	97.0	94.0
5	106.4	105.3	100.0	96.9	93.5
Sum	532.0	523.0	499.0	484.5	466.5
Means	106.4 <sup>a</sup>	104.6 <sup>a</sup>	99.8 <sup>b</sup>	96.9 <sup>b</sup>	93.3 <sup>c</sup>

Source: Own results in the laboratory.

*Water Holding Capacity (WHC)*

In Table 4, one may see the results for water holding capacity.

Table 4. The data of Water Holding Capacity

Observation	Body weight (Kg/bird)				
	1.3	1.4	1.5	1.6	1.7
1	46.0	50.0	53.4	56.4	56.9
2	46.5	50.0	51.9	55.4	57.1
3	46.2	50.0	53.4	55.7	56.5
4	46.3	50.2	53.0	55.0	57.5
5	46.5	50.3	52.8	55.0	56.0
Sum	231.5	250.5	263.5	277.5	284.0
Means	46.3 <sup>a</sup>	50.1 <sup>b</sup>	52.7 <sup>c</sup>	55.5 <sup>d</sup>	56.8 <sup>e</sup>

Source: Own results in the laboratory.

Water holding capacity, measures the ability of meat to retain its liquid portion during storage, processing and cooking. The major methods used in this treatments is press and cooking methods.

The results of the variance analysis did show a significant difference ( $P > 0.05$ ) on the Water Holding Capacity (WHC) of each treatment which ranged from 46.3 - 56.8%. This result is slightly greater when compared to the research conducted by Muchbianto (2009) [6], that the range of the value of fresh broiler chicken water binding capacity is 25-38%. According to Soeparno (2005) [10], at the same age, gender has a small effect on

cooking shrinkage, but cutting weight affects cooking losses, especially if there are differences in fat deposits. This water binding capacity is also related to protein because free water molecules amount to about 10% bound between protein molecules will decrease if meat protein denatures. Fat levels are negatively related to protein levels. The higher the level of protein in broiler chicken the higher the binding capacity of water due to the ability of proteins to bind water chemically and increasingly according to fat content.

*Cooking losses*

In Table 5, one may see the results for cooking losses.

Table 5. The Averages data of Cooking Losses

Observation	Body weight (Kg/bird)				
	1.3	1.4	1.5	1.6	1.7
1	23.5	23.9	25.0	27.6	28.5
2	22.7	24.2	25.2	27.6	28.6
3	22.3	23.0	24.8	26.8	28.7
4	22.9	24.4	25.0	28.0	29.0
5	22.1	24.0	25.0	28.0	28.7
Sum	113.5	119.5	125.0	138.0	143.5
Means	22.7 <sup>a</sup>	23.9 <sup>b</sup>	25.0 <sup>c</sup>	27.6 <sup>d</sup>	28.7 <sup>e</sup>

Source: Own results in the laboratory.

The cooking losses, was used water-bath method, the meat samples are placed in thin-walled plastic bags, where the samples are immersed in continuously boiling water-bath for cooking, with the bag opening extending above the water surface.

The results of analysis of variance showed that the difference in body weight of broiler chicken pieces had significant effect ( $P > 0.05$ ) on cooking losses. Broiler growing, tend to be followed by increasing of body and abdominal fat. Abdominal fat accumulation in the carcass unfortunately is a problem during processing; because the carcass disposed abdominal fat as by products. The range of cooking losses in this study was 22.7 - 28.7%. Meat that has low cooking losses has good meat quality because of less nutritional. Meat with lower cooking losses has a relatively better quality than meat with a larger cooking losses, because losing nutrients during cooking will be less so that chicken meat with low cooking shrinkage will have better quality

compared to chicken with high cooking losses (Soeparno, 2005) [10].

In Table 6, there is the average of carcass percentage, meat percentage, meat tenderness, water holding capacity and cooking losses.

Table 6. The Averages of Carcass Percentage, Meat Percentage, Meat Tenderness, Water Holding Capacity and Cooking Losses

Variables	Body weight (Kg/bird)				
	1.3	1.4	1.5	1.6	1.7
Carcass percentage (%)	68.8	70.6	70.8	71.1	71.5
Meat percentage (%)	0.1	48.7	47.2	46.8	42.4
Meat tenderness (kg/cm <sup>2</sup> )	106.4	104.6	99.8	96.9	93.3
Water holding capacity (%)	46.3	50.1	52.7	55.5	56.8
Cooking losses (%)	22.7	23.9	25.0	27.6	28.7

Source: Own results in the laboratory.

**CONCLUSIONS**

Based on the research that has been done, it can be concluded that the difference in body weight in the range of 1.3-1.7 kg has significantly affected for ( $P > 0.05$ ) the percentage of carcass, percentage of meat, tenderness, water holding capacity, and cooking shrinkage.

**REFERENCES**

[1]Bell, D. D., Weaver, Jr., W. D., 2002, Commercial Chicken Meat and Egg Production. 5<sup>th</sup> ed. Kluwer Academic Publ.  
 [2]De Jong, I.C., Guemene, D., 2011, Major Welfare Issues in Broiler Breeders. World's Poultry Science Journal. Vol. 67 (1): 73 – 81.  
 [3]Honikel, K.O., Hamm, R., 1994, Measurement of Water Holding Capacity and Juiciness. In Quality Attributes and Their Measurement in Meat, Poultry and Fish Products. Adv. Meat Res. 9 : 139 - 140. Pearson, A.M. and T.R. Dutson (ed). Blackie Academic and Professional, Glasgow, UK.  
 [4]Jez, C., Beaumont, C., Magdelaine, P., 2011, Poultry Production in 2025 : Learning from Future Scenarios. World's Poultry Science Journal, Vol. 67 (1): 105 - 113.  
 [5]Latif, S. S., 2010, Effect of Marination on the Quality Characteristics and Microstructure of Chicken Breast Meat Cooked by Different method. Lucrari Stiintifice Seria Zootehnie, Vol. 54 (15): 314 – 325.

[6]Muchbianto, R., 2009, Pengaruh Penambahan Limbah Udang terfermentasi *Aspergillus niger* pada Pakan, terhadap Kualitas Fisik Daging Ayam Broiler (Effect of Addition of *Aspergillus niger* Fermented Shrimp Waste to Feed on Physical Quality of Broiler Chicken Meat). Skripsi. Animal Husbandry Technology Study Program. Faculty of Animal Husbandry. Brawijaya University. Malang. (in Indonesian).

[7]Murtidjo, 1987, Petunjuk Beternak Ayam Broiler (Broiler Chicken Farming Guidelines). Kanisius. Yogyakarta (in Indonesian).

[8]Radu, C.V., Popescu-Miclosanu, E., 2012, Comparative Study about Production and Slaughtering Performances in an Industrial Company with Ross308 Standard Chicken Hybrid. Scientific Papers Series D. Animal Science. Vol. LV:214 – 218.

[9]Sachdev, A. K., Marandi, S., Saxena, V.K., Tomar, S., Murugkar, H., Gopal, R., 2011, Effect of Brining on Egg Quality, Post Hatch Performances and Carcass Quality of Broiler Chicken. World's Poultry Science Journal. Vol. 67 (1): 95 – 104.

[10]Soeparno, 2005, Ilmu dan Teknologi Daging (Meat and Technology Science). Gadjah Mada University Press. Yogyakarta (in Indonesian).

[11]Stadelman, W.J., Olson, V.M., Samwell, G.A., Pasch, S., 1988, Egg and Poultry Meat Processing. Ellis Halwood Ltd.



## STUDY OF THE INFLUENCE OF THE FACTORS FOR THE DEVELOPMENT OF CULTURAL-HISTORICAL TOURISM IN BULGARIA

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### *Abstract*

*The article examines the conditions and factors of developing cultural tourism in Bulgaria. The author proves the point that the cultural tourism is not only different from the traditional tourist product, but is also specific, due to its role of formation of individual users. Based on a survey from among 115 real users of this type of tourism product, are defined the major factors of cultural tourism in Bulgaria. By using the scientifically based methodology, the factors are ranged. Three main factors are determined: cultural and historical sites, presentation of handicrafts and other local activities, presence of pristine nature. Indicated are the factors which discourage the potential users of cultural tourism. Based on the study and analysis, is concluded that Bulgaria has all the necessary conditions and prerequisites for developing cultural tourism. Formulated are specific conclusions and practical recommendations.*

*Key words:* cultural-historical tourism, factors, sustainable development

### INTRODUCTION

Culture, history and archaeology are fundamental elements upon planning and creating of a tourist product designed for both the domestic and the international market. They allow the relevant party that has genuine uniqueness and identity to be clearly identified by potential visitors and by operators in the tourist sector thus provoking tourist demand. Tourism is a priority branch of the Bulgarian economy, forming a significant part of the gross domestic product of the country. [4]

The cultural and historical heritage of a country plays a major role in promoting its reputation and in directing public's interest in recognizing, learning and obtaining fuller and lasting perception and understanding of its values.

If „Rural tourism generates additional income for rural families, creating jobs and reducing unemployment, reduced direct emigration from rural areas, contributes to the development of new activities and the diversification of the economy” [3], cultural and historical tourism not only differs in

content from the traditional tourist product but it is specific because of its role in the personal formation of its users. The use of a certain tourist product turns into a part of the process of formation and affirmation of the individual identity and personality. In this sense, cultural and historical tourism tends to become a positive necessity in the process of forming the individual. All this brings new meaning and new elements into the content of the tourist product.

From an economic point of view, cultural and historical tourism retains its ability to develop even in periods of stagnation of the economy, contributing to economic development, which makes it even more necessary. Therefore, tourism services in the rural areas are able to support local population and communities in developing economic diversity. [7]

Bulgaria is a country with great potential for development of tourism, based on the cultural and historical heritage. This heritage has a vivid identity due to the immediate interaction between cultural, historical, archaeological and natural resources. Connected in a single framework, these resources form a genuine uniqueness and specificity that makes them a factor in promoting tourist attraction and

hence factors for economic development. "... exploring the authentic and typical landscape of as well as the exploration of the regional cultural, natural, archaeological and historical capital" [5], is also an element of the content of rural tourism. The unification of Bulgaria's cultural, historical, archaeological and natural resources makes the country attractive and competitive tourist destination. Cultural tourism in Bulgaria has a great potential. It is a successor of Thracians, Romans, Slavs, Byzantines, Protobulgarians, Latins, Ottomans. Many ethnic groups found their second home here. [6]

Bulgaria has rich and various archaeological sites. Archaeological discoveries on the territory of the country show the existence of a cultural layout from prehistory to modern history. Conservation and valorisation of discovered areas and found objects are a strategically important prerequisite for the regional development of a tourist activity.

The main types of cultural and historical resources with a statute of cultural monuments are archaeological, architectural, religious and cult buildings and sites, ethnographic museums, historical sites and places, reserves and other cultural and historical values. They present an interest from a tourist point of view and they are the object or the purpose of a visit by tourists.

Archaeological monuments are objects, facilities or ancient funerals preserved on the ground, underground or under water. They show the economic, social and cultural development of the area or the region during the different historical eras and they are the only source of information about prehistoric societies and civilizations. Archaeological monuments from Antiquity, Thracian, Hellenic and Roman age are coins, ceramics, household items, helmets, knee-caps, etc.

A significant part of the traditional material culture is occupied by the architectural and construction heritage. It is a bearer of local, regional and national features and provokes undoubted interest to both foreign and Bulgarian tourists. The name "Revival house" is a term for the different types of dwellings built on the Bulgarian lands during the Renaissance (18th and 19th centuries). In the

different regions of the country due to a number of peculiarities - mountainous, semi-mountainous or plain terrain conditions, availability of different building material, habits and traditions of the population, different types of Renaissance houses were built. Churches and monasteries are the subject of tourist visits not only as cult buildings. Many of them attract tourists with their unique architecture, frescoes and carvings. Periodic and episodic events include congress events, exhibitions and fairs, shows and festivals, ethnographic celebrations and festivals.

All these cultural and historical monuments in Bulgaria generate profit for the tourist sector of the country. They contribute to the formation of tourist products which meet the more diversified and demanding needs of the visitors.

Almost the entire territory of Bulgaria with its millennial layering of cultural and historical sites creates opportunities for tourist adaptation. There are over 1,220 monuments of national importance in the country. Particularly of high value are the reserves - monuments of culture. They are distinguished by a significant number (49 in total), wide geographic scope and include: 22 architectural and historical monuments of culture; 23 historical and archaeological reserves, including the Thracian tomb, Sveshtari and the Madara Rider (under the auspices of UNESCO); 3 architectural-archaeological including the old part of the town of Nessebar (under the auspices of UNESCO) and a historical reserve (near the town of Svishtov). The cultural and historical heritage includes many architectural and ethnographic sites: two open ethnographic complexes ("Etar" and Zlatograd complex), whole villages formed as architectural reserves - Etar and Bozhentsi near the town of Gabrovo, the old part of the town of Nessebar, the old part of the city of Plovdiv with the ancient Roman theater, the old part of the town of Veliko Tarnovo, the village of Arbanassi near the town of Veliko Tarnovo, etc., a museum network of over 200 museums, including art galleries and a large number of Christian religious sites - churches and monasteries.

The largest territorial concentration (over 100) of monuments of national importance in 3 districts - Veliko Tarnovo, Plovdiv and Sofia represents 17.8% of the total number of monuments. [2] "The study of Northern Bulgaria identified 514 sites of cultural and historical value, important for the development of tourism". [1] A lot of sites are concentrated in the central and southern parts of Veliko Tarnovo region and in Gabrovo region. Another significant group of cultural and historical monuments is in Shumen region.

For tourism development the most valuable are the parts of the mountain Stara Planina, Shumensko, some territories in the Northwest region, because there is a unique combination and complementary anthropogenic and natural resources. However, the level of use of anthropogenic resources in these areas is lower than in the Black Sea and southern Bulgaria.

Historical and archaeological heritage, dating back thousands of years has destined Bulgaria for a well-deserved role in world history. Medieval and Roman traces still can be seen in the modern and cosmopolitan reality of the city of Sofia, in picturesque and dynamic cities like Plovdiv and Stara Zagora and many other Bulgarian cities. The total richness and uniqueness of Thracian towns in Perperikon, Kazanlak and others is inimitable; the Roman towns of Nicopolis ad Istrum, Nove and Ulpia Trayana; the medieval Bulgarian capitals Pliska and Preslav, the towns of the Ottoman rule Rousse, Shumen, Silistra and the city of Varna.

The legacy of the smaller centers, the atmosphere of the internal Bulgarian territories: from the Rhodopes mountain to Strandzha mountain and from the Rila-Pirin massif to the Black Sea represents a territorial dispersed collection. It shows the old constructive methods, national and regional traditions, folklore and crafts, culinary and antique wines and creates a unique and genuine atmosphere and experience.

Anthropogenic tourist resources have two essential functions – to attract tourists and to enrich the culture by giving emotional attitude during their stay in the certain destination.

They can be divided into the following categories: historical and archaeological monuments; cultural and ethnographic sites; religious sites and events; conference, sports and other events.

## MATERIALS AND METHODS

In 2017, a survey (*The survey covers the following sectors: 1) accommodation and meals; 2) historical and archaeological sites; 3) spa, spa and wellness centers; 4) environment; 5) sports; 6) cultural traditions and gastronomy*) was conducted to collect information on the opinion and attitude of leading experts from the tourism industry and from Bulgarian and foreign tourists towards the historical, architectural and archaeological sites visited in Bulgaria.

115 survey forms were completed and submitted correctly. The survey has the following main objectives: (1) Defining and ranking of the factors that attract Bulgarian and foreign tourists to the cultural, historical and archaeological sites as well as the image and attitude of the leading specialists from the tourist industry; (2) Identification of the factors that impede the process of development of cultural and historical tourism and their classification; (3) Identification of actions to be taken.

The following indicators are used: total assessment of the factors; importance of the individual factor in the overall result. Answers to the survey rank the individual factor in a specific place (1 to 8). The total number of replies is 8. The factor receiving eight points becomes the first one. The factor that received 7 points goes to second place, and so on. The calculated total result is divided by the number of respondents and an average score is obtained. It is divided by the sum of the scores of all the factors to calculate the importance with which the individual factor participates in the overall assessment. In Tables 1 and 2, the individual factors are ranked according to their importance.

Based on the survey are defined the factors that attract tourists. The following attracting factors were selected:

**1) Cultural and historical sites:** monasteries (Rila, Troyan, Bachkovo monasteries, etc.), churches, ethnographic complexes (Zlatograd, Etara), national museums, regional museums, sites of the cultural heritage of the Thracians like Mezek tomb, sites from the Roman epoch in the city of Plovdiv, the rock sanctuaries Tatul and Perperikon in the Eastern Rhodopes and others.

**2) Presentation of handicrafts and other local activities:** folklore events of national and local importance (village of Rozhen, village of Smilyan, the town of Koprivshtitsa, the town of Gabrovo, the town of Troyan, etc.). During the summer months, a number of festivals and other similar events take place in the seaside towns and cities, in the city of Burgas - international folklore festival, song competition "Bourgas and the Sea"; in the city of Varna - music festival "Varna Summer"; in the town of Kavarna - jazz festival; Varna International Film Festival "Love Is madness"; in the resort complex "Sunny Beach" international festival of popular song "The Golden Orpheus", in the town of Sozopol - art festival "Apolonia"; wine tasting, introducing traditional Bulgarian cuisine and many more.

**3) Pristine nature:** The parks: Strandzha, Bulgarka, Rodopi, Rila, Pirin, Ropotamo, other nature parks and reserves of great biodiversity - birds, wild animals (bears), plant species (orchids, etc.), natural landmarks and typical rural landscapes.

**4) New and well-organized facilities for various events** (congresses, conferences and exhibitions), well-developed infrastructure.

**5) Balneological centers with mineral water with different temperature and content of salts and minerals** - Hissariya, Velingrad, Devin, Sandanski, Kyustendil, Sapareva Banya, Mineralni Bani Haskovo, Mineralni Bani Stara Zagora, etc.

**6) Water parks, opportunities for practicing extreme sports such as rafting, climbing, etc., mountain hiking trails, orienteering, mountaineering, mountain biking, walking through nature parks and reserves, etc. sports activities.**

**7) Entertainment offered by discos, night bars, clubs, etc.**

**8) Possibility to hunt in hunting reserves (big and small wild game), fishing, collection of mushrooms, herbs, etc.**

## RESULTS AND DISCUSSIONS

Respondents of the survey rank the factors as follows: in the brackets are listed the next attraction factor and the relative share, the percentage of respondents who placed the factor in the relevant place in the overall order of importance. (Table 1) First, 25.80% (2nd place, 15.01%), the respondents (potential and actual consumers) place the "pristine nature" factor. 20.27% of the respondents (3rd place, 13.56%) place first "new and well-organized bases". 13.82% (4th place, 13.31%) place the factor "getting to know the traditional handicrafts, folklore, lifestyle; typical cuisine, learning recipes, making drinks, home-made products and quiet and relaxing atmosphere. 13.82% (7th place, 8.78%) place the factor "availability of spa centers with mineral water with different temperature and salt and minerals content". 6.91% of respondents (1st place, 21.39%) put the motif "opportunity to visit cultural, historical and architectural landmarks, religious monuments"; 6.45% of respondents (5th place, 12.20%) are attracted in the first place by "quest for pleasant experiences, entertainment offered by discos, night bars, etc.". 6.45% of respondents (6th place, 10.98%) rank first "Opportunities for practicing extreme sports, participating in hiking tours, orientation, mountaineering, mountain biking, riding, walking through nature parks and reserves, etc. 6.45% of the respondents (8th place, 4.86%) place first the opportunity for hunting, fishing, purchasing environmentally friendly products, fresh fruits, vegetables, animal products, etc., berries, mushrooms and herbs, etc." (Table 2) The development of cultural and historical tourism is to a small extent dependent on economic cycles such as stagnation, upsurge, crisis. According to the profile of an average typical tourist user who has an average-high income, the user generally does not reduce their demand for this type of tourist product even at a time of economic stagnation or crisis.

The interviewed people have identified the most attractive geographic regions in Bulgaria in terms of tourist development. The results of the conducted survey allow us to make the following analysis:

In order to promote the cultural and historical heritage as attracting factors for tourist demand, it is necessary in each individual territory for the local community to recognize and rediscover the values of the territory, to preserve the cultural and historical assets of the region. On this basis should be selected the main theme (mission) on which concepts for different tourist offers can be formulated.

The most attractive areas for cultural and historical tourism are divided into several directions and areas:

More than 45% of the respondents believe that the Bulgarian Black Sea coast is the richest tourist resource. It is the most valuable territory to be preserved and supported mostly by means of regulatory measures and strict control over the construction in order to avoid further deterioration of its condition. The greatest interest on the Bulgarian Black Sea coast is represented by the following cultural and historical sites: Pomorie monastery "St. Georgi"; Aladzha monastery; the old bishopry in Nessebar; the churches "St. Ivan the Baptist", "St. Stephan", "All-Being (Pantocrator)", "St. Ivan Neosvetni" and "St. Paraskeva" which are also located in Nessebar; the church "St. Virgin Mary" in Sozopol. According to respondents, the most visited cities are Veliko Tarnovo, Plovdiv, Sofia, Rousse, etc. and other places offering not only cultural and historical tourism but other types of tourism, too (such as spa/balneological products) - Hissariya, Velingrad, Sandanski, Kyustendil, Sapareva Banya and others.

Territorial locations of cultural and historical resources are mainly in larger cities and settlements - architectural monuments and well preserved Renaissance architecture in Sofia, Plovdiv, Koprivshtitsa, Veliko Tarnovo, Nessebar, etc., a large number of archaeological sites in Plovdiv, Veliki Preslav, Kardzhali, Nessebar, Kazanlak and others.

The development of cultural and historical tourism has real opportunities and prospects in the following areas: Bulgarian Black Sea Coast - the development of cultural tourism should be sought in complementing recreative offers and offers outside the summer season; Strandzha Mountain - ecological and cultural sectors thanks to natural, historical - cultural and landscape resources; Rhodope Mountains - diversification of winter offers and decrease of seasonality through integration of cultural, historical and ethnographic resources, Perperikon - a very attractive historical center (with a great contribution to the valorisation of the whole territory); the old capitals of Bulgaria - increasing the intangible content of the cultural supply - integrating the existing sites with expositions and exhibitions, products of other types of tourism, the valley of the Thracian kings - popularizing and valorising the significant historical resources of the Thracian civilization, preserved national traditions, events and services; the city of Plovdiv - cultural heritage directly related to the national identity of Bulgarians, increase of the intangible content of tourist supply; towns of Ruse and Pleven - potential for development of domestic and international tourism; the valorisation of the Danube River as a natural connecting axis throughout the territory; Stara Zagora and Sliven - a tourist destination mainly for Bulgarian tourists. Rhodopi, Rila and Pirin Mountains, the Central Stara Planina Mountains as well as the rivers Maritsa, Struma, Mesta, Danube, Arda, Ropotamo and other rivers have the greatest number of votes.

#### **Factors that impede the development of cultural and historical tourism in Bulgaria**

These factors are related to the insufficient development of transport infrastructure; lack of adequate leisure activities; low qualification of human resources employed in the tourist sector, poor quality of information tourist services (e.g. lack of a calendar to indicate events and happenings).

The main conclusions referring to the factors impeding the development of cultural and historical tourism in Bulgaria and for which priority actions need to be taken can be summarized as follows:

**1. Factors for which the public sector is responsible, especially transport infrastructure and public transport,** are critical for the development of cultural and historical tourism. Special attention should be paid to the infrastructure development.

The development of sustainable cultural and historical tourism as a tool for socio-economic growth is closely related to initiatives to improve accessibility, transport links and communications at national, regional and local level. Existing road, port and airport infrastructures are considered inappropriate for the logistics and transport needs of the country. The main objectives of the national policy for development and modernization of the road network of the country are the construction of highways along the main routes and those that are part of the European corridors. The rest of the national road network is in a mediocre state and there is a need to increase the security of the growing transport flow. Bulgaria has international airports in Sofia, Varna, Burgas, Ruse, Plovdiv and Gorna Oryahovitsa, which need modernization. Our most important seaports are Varna and Bourgas, and waterways - Vidin, Rousse and Lom, which should also be modernized. The rail sector also needs large investments, whether for infrastructure or for the landfills themselves. About 40% of the Bulgarian railway network is electrified and about 15% has a double track. There are serious problems with the sanitary and hygiene network in the sites, cities, town and villages; There is a low level of development of the environment for cultural and historical tourism - local and external;

**2. Factors related to tourism service are** not found to be critical. The quantity and quality of the accommodation base, the catering services and other recreational services are considered sufficient and of good quality. There is no real need to increase the capacity of the accommodation base: the reported significant problems are related to the low employment of the existing accommodation base. Only two are the regions with employment above the average for the country (30%) - the Bulgarian Black Sea and Strandzha Mountain. The problem is the low efficiency of the accommodation base

but not the supply shortage. A sustainable approach to the development of cultural and historical tourism can be achieved by investing in local attractions, improving the infrastructure and socialization of cultural and historical and natural sites as well as promoting local tourist product; The construction of new sites should be in areas where there are currently no accommodation facilities. The new sites should mainly include small hotels, family hotels and guest houses in the traditional for the region architectural style with an authentic atmosphere that are environmentally friendly;

3. Insufficiently developed element is **tourist information**: over 70% of respondents point out as a priority the need for a more active role of tourist information centers. A tourist who visits a country besides getting to use the main infrastructure (hotels, airports, etc.), also uses tourist information places. The contact points - infopoint, route signs, didactic signs - should be integrated in a homogeneous and connected project that will help guide the tourist but will also stimulate their attention and curiosity. It is possible to create informative routes and signage systems both dynamic and interactive through which the visitor can receive the latest information, book and even purchase tickets for other services and to be stimulated by offers and special promotions. Among the communication tools it is possible to create, for example, audio and video guides, creating attractive thematic brochures, television advertising (videos), effective participation in national and international exhibitions and markets.

4. The results of the study reveal a serious **human resource problem in tourist enterprises** related to qualifications, lack of managerial skills and entrepreneurial culture. Unsatisfactory level of tourist services in cultural and historical sites due to weak language skills, sales, interpersonal and other professional skills; due to the turnover of those employed in tourism. The activity of the public administration is also considered to be insufficient. Employment may be created in places of cultural and historical heritage, especially for young people who have graduated vocational secondary schools in tourism or the elderly population, for example retired teachers whose

professional qualification allows the provision of specialized services related to the

interpretation of the local lifestyle and culture, mountain leadership and more.

In a number of European countries, about 30% of cultural and historical tourism is directed around 30% of the tourist investments. At this stage, the development of cultural and historical tourism in Bulgaria should be connected to the effective absorption of funds from the European Structural Funds. Through implementation of regional projects, higher efficiency in the development of cultural and historical tourism can be achieved.

Table 1. Evaluation and weight of attraction factors

	Ball assessment	Detected ball assessment	Weight in the general
1	1834	8.4516	0.21360
2	1046	4.8202	0.12182
3	1288	5.9355	0.15001
4	1142	5.2627	0.13301
5	1163	5.3594	0.13545
6	943	4.3456	0.10983
7	417	1.9216	0.4856
8	753	3.4700	0.08770

Source: Own calculation.

Table 2. Ranking the attractors factors

No	Attracting factors	Weight in the general assessment
1	<b>Factor 1:</b> cultural, historical, religious sites;	0.2136
2	<b>Factor 3:</b> virgin nature;	0.15001
3	Factor 4: new well-organized accommodation facilities, events, exhibitions, etc .;	0.13545
4	<b>Factor 2:</b> presentation of crafts and local activities, acquaintance with life, culture, folklore;	0.13301
5	<b>Factor 7:</b> entertainment venues from discos, night bars and more.	0.12182
6	<b>Factor 6:</b> opportunities for extreme sports, mountain climbing, riding, orientation, trekking, etc .;	0.10983
7	<b>Factor 5:</b> balneological centers with mineral water;	0.08770
8	<b>Factor 8:</b> opportunities for hunting, fishing, gathering of herbs, mushrooms, etc .;	0.04856

Source: Own calculation.

The priority actions to be taken, according to the opinion of the tourists who took part in the

survey and have already visited different cultural and historical sites in Bulgaria are:

- Renovation, restoration and conservation of archaeological sites; restoration of old buildings and territorial structures; preservation of values with an emphasis on the relationship between historical heritage, local traditions and modern interventions;
- Implementation of the European standards in improving the infrastructure used to go to cultural and historical sites, such as road network and public transport;
- Improvement of tourist supply by strengthening the network of information tourist offices, access to tourist information, creation of new tourist routes, training of qualified personnel;
- Development of tourist advertising; maximum visibility and recognition of the tourist offer;

## CONCLUSIONS

Bulgaria has rich and various cultural and historical tourist potential which is still not enough utilized and implemented for the development of cultural and historical tourism. This development should urgently address a number of important issues - especially in areas such as: tourist valorisation of cultural and historical resources; development and enrichment of the proposed tourist product by incorporating elements of cultural and historical character; promoting advertisement of Bulgaria as a destination for cultural and historical tourism; training and permanent qualification of the personnel in the sector; development and modernization of the general technical and specialized tourist infrastructure; taking action at national, regional and local level in these key problematic areas.

Solving of these issues requires conceptual solutions and broad co-ordination between public and private sector and local government.

The prospects for the development of cultural and historical tourism are related to the achievement of basic strategic objectives in the following directions:

-Development of a strategy for the development of cultural and historical tourism in the country, defining the main long-term goals and priorities for the public sector, the local self-government authorities and the tourism sector; uniting the efforts for development of cultural and historical tourism at the three spatial levels - national, regional and local as well as between the authorities and the tourist sector;

-Developing sustainable and competitive tourist products (thematic products and routes) in the field of cultural and historical tourism through applying innovative approaches in cooperation with cultural institutions, academic institutions, tourism businesses and local authorities;

-Creating and imposing a recognizable image of Bulgaria as a destination for cultural and historical tourism; developing and imposing a national tourist brand of Bulgaria for this purpose;

-Creating a register of cultural monuments of tourist importance which are public state property;

-Introduction of modern forms of sales and distribution - creation of on-line ticket centers, electronic tickets, combined tickets for different sites, etc.;

-Infrastructure development, improvement of accessibility, transport links and communications at national, regional and local level; improving transport information;

-Reducing the seasonality of the national tourist product by increasing the possibilities for its year-round practice; increasing the average annual occupancy of the accommodation base;

-Development of methodology and implementation of a system for tourist monitoring of cultural and historical sites at municipal level;

-Organization of advertising campaigns for the promotion of cultural and historical tourism; production of souvenirs, thematically related to the cultural and historical sites;

-Advertising design of tickets for museums and other cultural and historical sites to play the role of souvenirs (according to the example of cultural cities in Europe and the world);

-Improving the collection of incomes from entry fees and tickets for cultural and historical sites by introducing new charging technologies (for example, electronic chip tickets).

-Creating a permanent partnership between higher education institutions and vocational schools in tourism - on the one hand, and on the other - tourist business, local authorities and non-governmental organizations in the field of cultural and historical tourism to conduct marketing surveys and analyzes; to organize student internships in the field of tour guiding, animation and information services for tourists in order to attract young work force in the sector; training and permanent qualification of the personnel in the sector;

-Encouraging the membership of municipalities with cultural and historical sites in international, national and regional tourist organizations.

## REFERENCES

- [1]Bachvarov, M., Tonchev, C., Mileva, S., Nikolova, I., Osnovi na tourisma (Fundamentals in tourism), pub. "Tilia", Sofia, 1996, p.34.
- [2]Dulevski, L., 2011, State and prospects of cultural and historical tourism in Bulgaria, , ИСС, Sofia, 2011 г., p.3-9.
- [3]Lulcheva, I., 2017, Diagnosis of state of rural tourism in Borino municipality. Trakia Journal of Sciences, Vol. 15, Suppl. 1, pp 36 – 41.
- [4]Lulcheva, I., 2018, Opportunities for the development of rural tourism in small settlements, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development Vol. 18, Issue 2, 2018, p. 283-287.
- [5]Lulcheva, I., Arseniou, S., 2018, Synergy – Rural tourism and sustainable development of rural areas in Bulgaria, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol. 18, Issue 3, 2018.
- [6]Obreshkov, I., 2015, Correlation Analyses on Ethnographic Complexes In Bulgaria. Физическая культура и спорт – основа здоровья нации, Иркутск, том I, pp. 340-343, УДК 796.5. ISBN 978-5-8038-1010-0
- [7]Popescu Agatha, 2016, The position of tourist and agritourist guesthouses in Romania's accommodation structures, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol. 16, Issue 1, 417-424.

## DISTRIBUTION OF THE RETAIL PRICES OF DAIRY PRODUCTS AMONG SUPPLY CHAIN PARTICIPANTS IN LITHUANIA

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### Abstract

*This study aims at evaluating the developments in the distribution of the retail prices of dairy products among supply chain participants in Lithuania over the period of 2008 to 2017 and at revealing the main factors that determine this distribution. In order to achieve this aim, the structure of the Lithuanian dairy supply chain has been examined and the shares of milk producers, dairy processors, retailers and state (VAT) in the retail prices of dairy products (drinking milk and Tilsit cheese) have been calculated. The structure of the Lithuanian dairy supply chain indicates that milk producers, a large majority of which are small-scale dairy farmers, are fragmented and less organized, while the dairy processing industry and retail trade can be considered as heavily concentrated. Over the past ten years, the shares of retailers in the retail prices of dairy products have shown an increase, while the shares of milk producers in these prices have decreased. Horizontal concentration and vertical integration are the main instruments that could help to increase the market power of milk producers. Furthermore, milk producers should be opened to entering direct sales marketing, or short food supply chains.*

**Key words:** dairy products, milk producers, dairy processors, retailers, share of the retail price, Lithuania

### INTRODUCTION

Over the years, global and domestic dairy prices have become quite volatile. Dairy price volatility has raised serious concerns about the functioning of global and domestic dairy supply chains and the distribution of value added between milk producers, dairy processors and retailers. At European Union level, it has been recognized that it is important to ensure effectiveness and efficiency of the food supply chain providing consumers with lower prices and supply chain participants with a sustainable distribution of value added [6].

A number of studies were carried out in different countries in order to evaluate the distribution of the retail prices of dairy products among supply chain participants and to identify key factors that determined this distribution over time [e.g. 1; 3; 5; 10; 13; 15; 17; 18]. Studies covering longer periods confirmed that the shares of the retail price received by retailers and dairy processors increased and the share of the retail price received by milk producers decreased [1; 3; 15; 17].

A similar study was carried out in Lithuania in 2009 [11]. This study aimed at evaluating how income from sales of dairy products was distributed between milk producers, processors, retailers and state. Five most popular dairy products were chosen for the analysis (drinking milk (2.5% milk fat), sour cream, butter, *Tilsit* cheese and cottage cheese). The results of the study showed that in 2008, the shares of milk producers in the retail prices of dairy products ranged from 23% to 50%. Processors received 15–36% of the retail prices of dairy products, while retailers received 20–27%. The shares of milk producers in the retail prices of sour cream, butter and *Tilsit* cheese were higher than in the retail prices of drinking milk and cottage cheese. Since this study was carried out almost ten years ago and covered only one year (2008), therefore it would be of particular interest to evaluate the changes that occurred over time.

### MATERIALS AND METHODS

This study aims at evaluating the developments in the distribution of the retail

prices of dairy products among supply chain participants in Lithuania and at revealing the main factors that determine this distribution. In order to achieve this aim, two tasks have been set:

-to examine the structure of the Lithuanian dairy supply chain;

-to calculate the shares of milk producers, dairy processors, retailers and state (VAT) in the retail prices of dairy products.

The study covers the period 2008–2017 (the last ten years).

In order to examine the structure of the Lithuanian dairy supply chain, data from the statistical office of the European Union EUROSTAT [8], European Commission [7], Lithuanian Department of Statistics (Statistics Lithuania) [20], Farm Accountancy Data Network (FADN) [9], State Enterprise Agricultural Information and Rural Business Centre [2], State Food and Veterinary Service of the Republic of Lithuania [19], Competition Council of the Republic of Lithuania [4] and Nasdaq Baltic Stock Market have been used [16].

In order to calculate the shares of milk producers, processors, retailers and state (VAT) in the retail prices of dairy products, two specific products with different added value have been chosen: drinking milk (2.5% milk fat) (low added value) and *Tilsit* (semi-hard) cheese (high added value). These products belong to the two groups of dairy products which together account for almost half of the Lithuanian dairy processing industry sales on the domestic market (in 2017, 48%). All data needed for the calculation (purchase prices for raw milk, sales prices of the Lithuanian dairy processing industry and retail prices in the Lithuanian supermarkets) have been taken from the State Enterprise Agricultural Information and Rural Business Centre [2]. In this study, the shares of milk producers, processors, retailers and state (VAT) in the retail prices of dairy products are expressed in relative terms.

The study has been performed employing the methods of mathematical-statistical analysis and systematic, comparative and logical analysis.

## RESULTS AND DISCUSSIONS

### *Milk production*

Milk production in Lithuania occupies an important place in the agriculture of the country, but its significance is declining: in 2008, the proportion of milk yield in the total agricultural production made up 23.0%, while in 2016, it made up 17.2%. In 2017, compared to 2008, milk production decreased from 1883.8 to 1617.0 thousand tonnes, or by 14.2%, while milk purchase for processing increased from 1375.6 to 1401.5 thousand tonnes, or by 1.9%.

In Lithuania, small-scale dairy farming is dominant. The average dairy farm in the country is among the smallest in the EU. In 2008, the number of cows per dairy farm was 3.5 and in 2016, it was 6.6. Smaller average dairy farms were found only in Romania: in 2016, the average dairy farm in Romania had 2.4 cows and the average dairy farm in Lithuania had 6.1 cows [12].

In Lithuania, agricultural companies kept the largest herds of dairy cows. According to FADN data, the number of cows per agricultural company of field crops–grazing livestock increased from 337.8 in 2008 to 454.7 in 2016. The average size of family farm generating the largest incomes from milk production was much smaller and it decreased from 13.3 dairy cows in 2008 to 9.8 dairy cows in 2016.

In 2017, 64% of all Lithuanian dairy farms had 1–2 cows and only 1.8% had 50 and more cows. The dairy farms with 50 and more cows kept 40% of all cows in the country. Between 2008 and 2017, the number of dairy farms dropped by 62% and the number of cows fell by 28%. During that period, the number of all dairy farms with less than 50 cows was declining and only the number of dairy farms with 50 and more cows was growing. In 2017, as compared to 2008, the number of cows on dairy farms with 50 and more cows rose by 21%. The decrease in the number of dairy farms with less than 50 cows was the result not only of the deterioration of the very smallest subsistence and semi-subsistence farms with 1–2 cows due to advanced age of

owners of these farms but also of low raw milk prices paid to small milk producers.

The average purchase price for raw milk in Lithuania is among the lowest in the EU. According to Eurostat and European Commission data, as regards the period 2008–2017, in 5 out of 10 years, the average purchase price for raw milk in Lithuania was the lowest in the EU, in 4 out of 10 years, it was 4–12% higher than in Romania, and in the remaining year, it was 3.5% higher than in Latvia and 16.5% higher than in Romania. During that period, the average purchase price for raw milk converted to 3.7% of fat in Lithuania was the lowest in the EU.

The tradition to impose low purchase prices for raw milk on milk producers is rather old and dates back to 1990 when Lithuania restored its independence. In Soviet times, between 1986 and 1990, on average 3,145 thousand tonnes of raw milk was produced every year. According to mandatory planned order, around 40% of the total raw milk was used for processing of dairy products which were dispatched to the Soviet Union. Since 1991, the Lithuanian dairy products were no longer placed in the Soviet Union. At that time state dairy processing enterprises had no experience in exporting of dairy products, in addition, there was no legal basis for exports. During the first years after Lithuania restored its independence, there were large quantities of raw milk on the domestic market while demand for dairy products was limited. In 1993, the average purchase price for raw milk in Lithuania was 6.02 EUR/100 kg. This price was the lowest among present EU Member States and stood at 23% of the average. Although raw milk prices paid to milk producers later increased, the tradition to maintain low purchase prices for raw milk continued.

Small dairy farmers receive considerably lower prices for raw milk than the largest ones. In 2017, the smallest dairy farmers and dairy farmers keeping about 50 cows received about 40% and 20% lower prices for raw milk of basic indicators (in Lithuania, 3.4 of fat and 3.0 of protein), respectively, than the largest ones. The economic viability of dairy farms with less than 50 cows is not ensured and the

development of these farms becomes problematic. It is particularly difficult for these farms to stay in business when purchase prices for raw milk drops and the fluctuations of these prices related to trends in global dairy prices are frequent and deep.

In order to receive higher purchase prices for raw milk, dairy farmers join cooperatives (processors pay more for larger quantities of raw milk). In 2017, there were 29 cooperatives in Lithuania that purchased raw milk. Other corporate forms also purchased and resold raw milk to processors. In 2017, 18% of the total raw milk was purchased by cooperatives. The horizontal cooperation was dominant in milk production: large quantities of raw milk purchased by cooperatives were resold to processors. Only 3 cooperatives processed small quantities of raw milk and sold dairy products on the domestic market. In 2008, the project of vertical integration was launched, when a total of 150 milk producers established the agricultural cooperative Pienas LT, the aim of which was to build a dairy processing enterprise and to supply all milk produced on their farms to that enterprise. This project was supported by the Lithuanian Government and co-financed by the EU funds. In 2016, this enterprise officially started its activity, began to produce and sell dairy products both on the domestic and foreign markets. In 2016, the sales volume of Pienas LT represented 4.4% of the total sales volume of the Lithuanian dairy processing industry, while in 2017, it represented about 6% (according to provisional data).

#### *Manufacturing of dairy products*

The dairy processing industry is the leading component of the Lithuanian food processing industry. Measured by production value, it accounts for almost one third of the total output of the Lithuanian food, beverages and tobacco processing industry (28% in 2008, 29% in 2017). In 2017, as compared to 2008, the sales volume of the Lithuanian dairy processing industry increased by 36%, to EUR 964.7 million. The dairy processing industry is export-oriented. In 2008, the volume of exports represented 51% of the total sales volume of the Lithuanian dairy processing industry, while in 2017, it

represented 55%. Dairy processing enterprises are lacking in raw milk, therefore additionally rely on import from neighbouring countries (Latvia and Estonia). In 2008, a total of 194 thousand tonnes of raw milk was imported representing 14% of the total raw milk purchased in that year in Lithuania, and in 2017, a total of 407 thousand tonnes of raw milk was imported representing 29% of the total raw milk purchased in that year in Lithuania. The surplus of raw milk in neighbouring countries and the possibility to import large quantities of this milk allow dairy processing enterprises to impose low purchase prices for raw milk on milk producers.

According to the State Food and Veterinary Service, in 2008, there were 33 dairy processing enterprises, and their branches, and ice-cream companies. This number increased to 36 in 2017. About half of all dairy processing enterprises and their branches belong to five major groups. In 2008, the sales volume of the largest group represented 28% of the total sales volume of the Lithuanian dairy processing industry, while in 2017, it represented 25%. In 2008, the concentration index of five major groups of dairy processing enterprises was 0.92, while in 2017, it declined to 0.82 due to the entry of "Pienas LT" into the market. Although the market concentration declined over the past decade, it still remained very high. Between 2008 and 2017, the raw milk purchase market was dominated by several purchasers, therefore this market was oligopsonic.

#### *Retail trade*

The Lithuanian food retail market is characterised by high concentration. Until 2016, there were four major retail chains (Maxima, Iki, Norfa and Rimi) operating in the food retail sector. For a long time, the market share of these retailers in the retail food market had been gradually increasing while the market share of the independent retailers or those incorporated into smaller chains or other combinations had been gradually decreasing. According to the Competition Council of the Republic of Lithuania, the market share of Maxima, Iki, Norfa and Rimi in the retail food market rose

from 62% in 2004 to 73% in 2010. Between 2010 and 2013, these retailers controlled about 75% of food sales. The number of major retail chains remained unchanged until the year 2016, when a new participant entered the Lithuanian food retail market. In that year Lidl, a German-based global discount retail chain, opened its first stores in Lithuania. Over the last year, this retail chain rapidly expanded and became one of five major retail chains, along with Maxima, Iki, Norfa and Rimi.

Retailers have contracts with all large dairy processing enterprises. Due to the significant market power of retailers, selling dairy products on the domestic market leads to a lower profit for dairy processors than export sales. Small dairy processing enterprises are not in a position to cooperate with the largest retailers since their production volumes are not enough to ensure the availability of dairy products in all retail shops [14].

#### *Distribution of the retail prices of dairy products among supply chain participants*

In 2008, milk purchasers and processors received the highest share of the retail price of drinking milk (40.1%), and milk producers received the second highest share (28.2%) (Table 1). The shares of milk producers and processors in the retail price of *Tilsit* cheese were almost equal (more than 36% each) (Table 2). Retailers, compared to milk producers and processors, received significantly lower shares of the retail prices of drinking milk and *Tilsit* cheese (16.4% and 11.8%, respectively). In 2009, the situation changed. In that year, as compared to 2008, the shares of retailers in the retail prices of drinking milk and *Tilsit* cheese increased by 9.0 and 10.3 percentage points, respectively. As a result of the economic crisis, the retail prices of drinking milk and *Tilsit* cheese declined by 12.5% and 6.5%, respectively. Milk producers and processors received lower income from sales of drinking milk (by 28.5% and 23.0%, respectively) and from sales of *Tilsit* cheese (by 30.8% and 11.0%, respectively). Retailers, unlike milk producers and processors, received higher income from sales of both drinking milk (by 34.9%) and *Tilsit* cheese (by 74.3%).

Between 2009 and 2017, the shares of retailers in the retail prices of drinking milk and *Tilsit* cheese showed an overall increasing tendency. In 2017, retailers received 32.1% of the retail price of drinking milk and this share was the largest among supply chain participants and by 15.7 percentage points higher than in 2008. The share of retailers in the retail price of *Tilsit* cheese rose from 11.8% in 2008 to 26.4% in 2017, or by 14.6 percentage points and it was the second largest among supply chain participants.

Table 1. Shares of milk producers, milk purchasers and processors, retailers and state (VAT) in the retail price of drinking milk (2.5% milk fat, 1 l plastic bag) sold in the Lithuanian supermarkets in 2008–2017, %

	Milk producers	Milk purchasers and processors	Retailers	State (VAT)
2008	28.2	40.1	16.4	15.3
2009	23.3	34.9	25.4	16.4
2010	29.2	24.0	29.5	17.4
2011	28.8	25.8	28.0	17.4
2012	27.6	29.5	25.6	17.4
2013	32.5	27.1	23.1	17.4
2014	28.8	32.2	21.7	17.4
2015	24.0	35.3	23.3	17.4
2016	23.4	33.6	25.7	17.4
2017	26.5	24.0	32.1	17.4
<b>Change 2017 compared to 2008, percentage points</b>	<b>-1.7</b>	<b>-16.1</b>	<b>15.7</b>	<b>2.1</b>

Source: Own Calculations.

Table 2. Shares of milk producers, milk purchasers and processors, retailers and state (VAT) in the retail price of *Tilsit* cheese (1 kg) sold in the Lithuanian supermarkets in 2008–2017, %

	Milk producers	Milk purchasers and processors	Retailers	State (VAT)
2008	36.7	36.2	11.8	15.3
2009	27.2	34.3	22.1	16.4
2010	33.4	28.9	20.3	17.4
2011	29.6	33.4	19.6	17.4
2012	27.1	32.9	22.6	17.4
2013	33.1	28.0	21.6	17.4
2014	29.9	27.1	25.6	17.4
2015	24.0	31.8	26.9	17.4
2016	24.9	27.8	29.9	17.4
2017	32.0	24.2	26.4	17.4
<b>Change 2017 compared to 2008, percentage points</b>	<b>-4.7</b>	<b>-12.0</b>	<b>14.6</b>	<b>2.1</b>

Source: Own Calculations.

During that period, the share of state (Value added Tax) in the retail prices of drinking milk and *Tilsit* cheese also increased since the standard tariff of VAT was set at the level of 19% on January 1, 2009, and on the level of 21% on September 1, 2009. In 2017, as compared to 2008, milk producers and processors received lower shares of the retail prices of drinking milk and *Tilsit* cheese. During that period, the shares of milk producers in the retail prices of drinking milk and *Tilsit* cheese decreased by 1.7 and 4.7 percentage points, respectively, and the shares of processors in the retail prices of drinking milk and *Tilsit* cheese decreased by 16.1 and 12.0 percentage points, respectively.

As regards the developments in the distribution of the retail prices of dairy products among supply chain participants, these should be viewed in the context of the fact that the Lithuanian dairy processors sell dairy products produced from local milk not only on the domestic market but also almost half of them export. Prices of dairy products on the foreign markets fluctuate much more than on the domestic market (Figure 1).

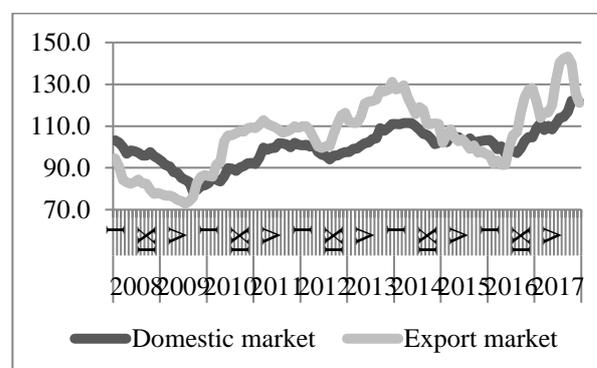


Fig. 1. Price indices of dairy products sold by the Lithuanian dairy processing enterprises on the domestic and export markets in 2008–2017, % (2007–12=100%)  
Source: Statistics Lithuania.

The Lithuanian dairy processors set prices for raw milk, taking account of the global demand for dairy products. If the global demand for dairy products is dropping, in order to avoid losses, processors are pushing down prices for raw milk. During that period, retail prices of dairy products sold on the domestic market in comparison with prices of exported dairy products are more stable and

the share of processors in the retail prices of dairy products increases significantly. If the global demand for dairy products is growing, in order to make a gain, processors are pushing up prices for raw milk. During that period, retail prices of dairy products sold on the domestic markets do not rise so rapidly as prices of exported dairy products and the share of processors in the retail prices of dairy products decreases. A significant increase in the shares of processors in the retail prices of drinking milk and *Tilsit* cheese was observed between 2008 and 2009 when the world was facing the economic crisis and between the second half of 2014 and the first half of 2016 when the global demand for dairy products fell (partly due to a trade embargo imposed by Russia) and prices of dairy products declined as the result. The Lithuanian dairy processors were particularly hard hit by the embargo since the exports of dairy products to Russia represented about one third of the total exports of dairy products (Figures 2 and 3).

According to the reports of the largest Lithuanian dairy processing enterprises listed on the Nasdaq Baltic stock market, between 2008 and 2017, these enterprises incurred losses only in 2008. In each subsequent year, their financial performance was positive with two exceptions when two dairy processing enterprises incurred losses in some individual years. As regards family farms generating the largest incomes from milk production, their financial performance was deteriorating. According to FADN data, in 2008, on family dairy farms, the net profitability with subsidies amounted to 51% and the net profitability without subsidies amounted to 21%. Since 2009, on these farms, the net profitability without subsidies was negative, and since 2014, the net profitability with subsidies was also negative. In 2016, on family dairy farms, the net profitability with subsidies amounted to -4% and the net profitability without subsidies amounted to -66%. Milk production in agricultural companies was profitable over the period considered with the exception of 2009 in which the losses were incurred. In 2008, on agricultural companies, the net profitability

without subsidies amounted to 19%, while in 2016, it amounted to 4%.

Dairy sectors in some EU Member States face the similar situation. According to IFCN data, in 2017, in the EU, milk producers received on average 45.3% of the retail price of drinking milk, while in Lithuania, they received only 27.6%. In seven countries (namely, in Luxembourg, Romania, Finland, Bulgaria, Italy, Latvia and Sweden), the share of milk producers in the retail price of drinking milk was smaller than in Lithuania (Table 3).

Table 3. Certain indicators of the EU Member States' dairy sectors

EU Member State	Share of milk producers in the retail price of drinking milk in 2017, %	Average number of dairy cows (heads) per farm in 2016	Share of raw milk purchased for processing by the largest dairy processor or share of production of the largest dairy processor in 2016 or 2017, %	Average purchase price for raw milk in 2017, EUR/100 kg
Luxembourg	23.8	73.0	41	35.42
Romania	24.3	2.4	17	29.19
Finland	24.8	37.3	80	37.72
Bulgaria	26.6	8.8	n/a	30.52
Italy	26.6	52.0	4	37.02
Latvia	26.9	8.9	41	30.61
Sweden	27.2	83.0	66	37.94
<b>Lithuania</b>	<b>27.6</b>	<b>6.1</b>	<b>25</b>	<b>29.76</b>
Czech Republic	29.5	218.0	13	31.59
Netherlands	29.5	97.0	75	37.96
Austria	31.1	17.0	40	37.34
Slovenia	31.6	11.5	3	30.32
Ireland	31.8	84.0	n/a	36.42
Slovakia	32.2	36.0	n/a	30.99
France	33.5	57.6	19	34.40
Greece	34.8	47.6	n/a	38.79
Portugal	35.9	49.2	32	29.68
Croatia	36.2	16.3	37	31.38
Belgium	37.1	43.2	34	35.05
Hungary	38.5	25.1	n/a	30.48
Spain	40.6	54.0	n/a	30.96
Denmark	42.6	185.0	97	36.90
Cyprus	43.7	133.6	n/a	55.88
Germany	45.3	61.0	26	36.41
Poland	45.9	9.1	n/a	32.37
Estonia	52.5	49.5	n/a	32.68
United Kingdom	52.7	143.0	22	31.82
Malta	61.9	57.0	n/a	48.09
<b>EU-28 (weighted average)</b>	<b>45.3</b>	<b>18.4</b>	<b>12.7</b>	<b>32.10</b>

Source: IFCN Dairy Report, European Commission.

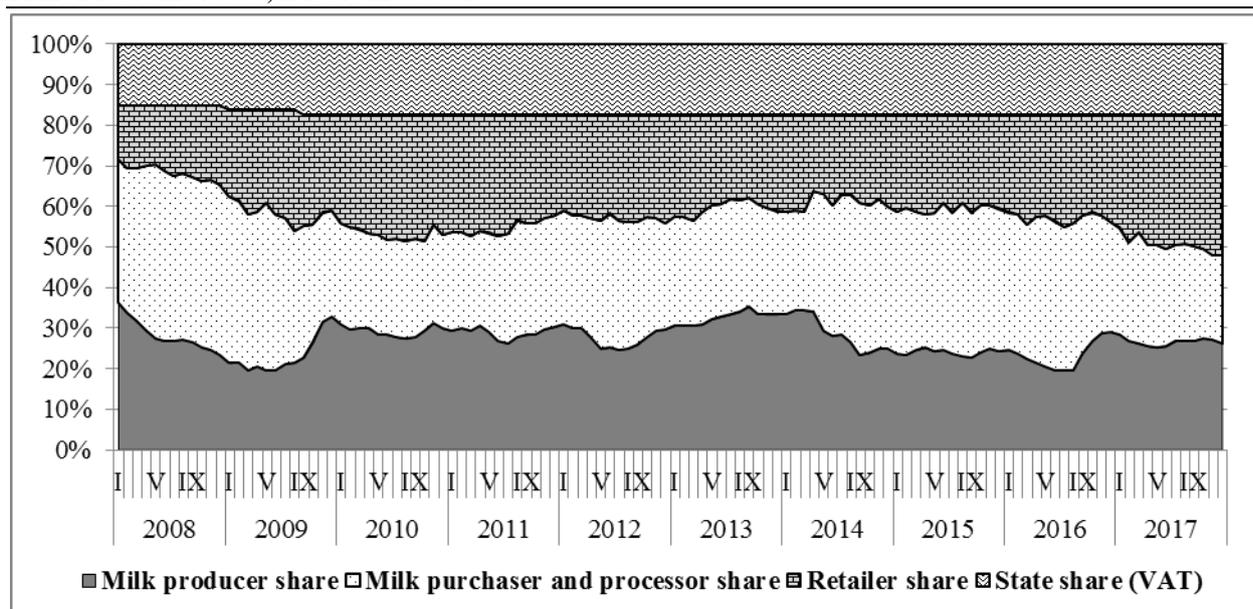


Fig. 2. Structure of the retail price of drinking milk (2.5% milk fat, 1 l plastic bag) sold in the Lithuanian supermarkets in 2008–2017, %  
 Source: Own Calculations.

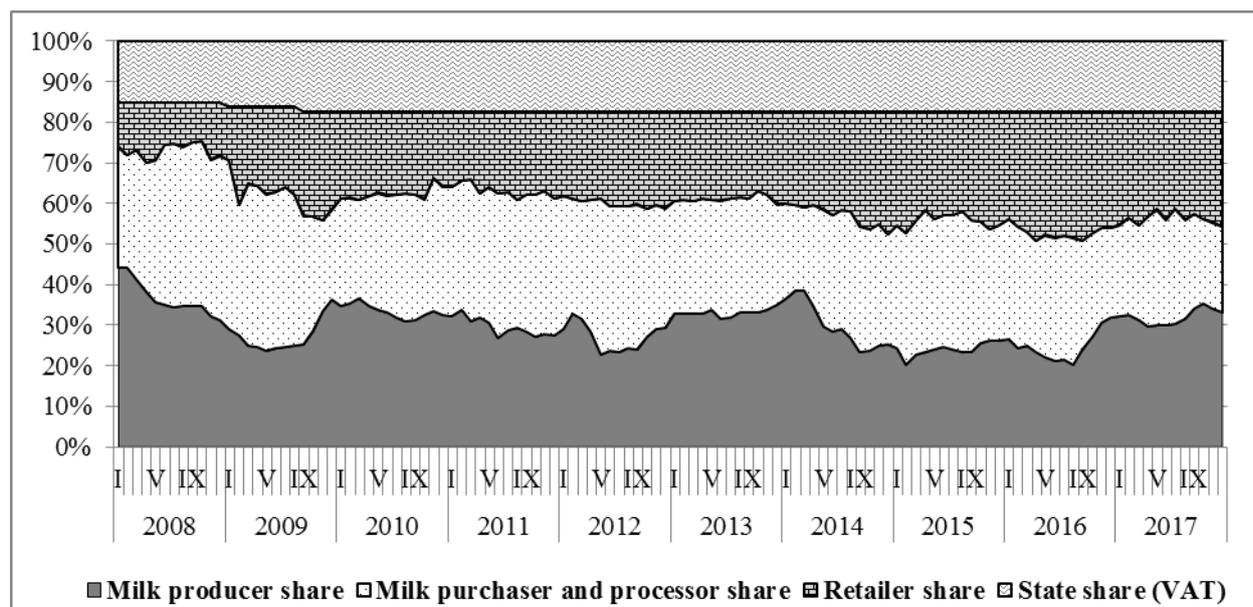


Fig. 3. Structure of the retail price of *Tilsit* cheese (1 kg) sold in the Lithuanian supermarkets in 2008–2017, %  
 Source: Own Calculations.

In all these countries, either small-scale dairy farming is dominant (Romania, Bulgaria and Latvia) or dairy processing industry is highly concentrated (Finland, Sweden and Luxembourg). In Italy, dairy farms are not small (the average size of dairy farm is 52 cows) and the level of the concentration in the dairy industry is not high (the largest dairy processing enterprise processes about 4% of the total raw milk) but milk producers receive only 26.6% of the retail price of drinking

milk. This can primarily be explained by the fact that cooperatives purchase 60% of the total raw milk. Since the vertical integration is dominant in these cooperatives, there is no difference which supply chain participants (milk producers or processors) receive higher shares of the retail prices of dairy products.

## CONCLUSIONS

In order to evaluate the developments in the

distribution of the retail prices of dairy products among supply chain participants in Lithuania over the period of 2008 to 2017 and to reveal the main factors that determine this distribution, the structure of the Lithuanian dairy supply chain has been examined and the shares of milk producers, processors, retailers and state (VAT) in the retail prices of dairy products (drinking milk and *Tilsit* cheese) have been calculated.

The structure of the Lithuanian dairy supply chain indicates that milk producers, a large majority of which are small-scale dairy farmers, are fragmented and less organized, while the dairy processing industry and retail trade can be considered as heavily concentrated. The bargaining power of retailers and dairy processors is seen as high, while the bargaining power of milk producers is relatively low. Milk producers are usually the weakest link in the negotiations and therefore, low purchase prices for raw milk are imposed on them, especially at the time when the global demand for dairy products is dropping.

Over the past ten years, the shares of retailers in the retail prices of dairy products have shown an increase, while the shares of milk producers in these prices have decreased. The main factors that determine the distribution of the retail prices of dairy products between milk producers, dairy processors and retailers in Lithuania are as follows:

- different levels of concentration in the milk production, manufacturing of dairy products and retail trade (market dominated by a large number of small-scale dairy farms, several large dairy processing enterprises (several raw milk purchasers) and few big retailers);
- low levels of vertical integration;
- tradition to impose low purchase prices for raw milk on milk producers ever since Lithuania restored its independence in 1990;
- fluctuations in global demand for dairy products;
- possibility to import large quantities of raw milk from neighbouring countries in which there is a surplus of raw milk.

Horizontal concentration and vertical integration are the main instruments that could help to increase the market power of milk producers. Furthermore, milk producers

should be opened to entering direct sales marketing, or short food supply chains.

## REFERENCES

- [1]Agra, C. E. A. S., 2007, The Gap between Producer Prices and the Price paid by the Consumer, European Parliament, Brussels.
- [2]Agricultural Information and Rural Business Centre, 2018, <https://www.vic.lt>, Accessed on December 10, 2018.
- [3]Collins, A. *et al*, 2006, Food Prices in Ireland – Report for the Consumer Liaison Panel, Dublin, Department of Agriculture and Food.
- [4]Competition Council of the Republic of Lithuania, 2018, Annual Reports, <http://kt.gov.lt/en/administrative-information/annual-reports-1>, Accessed on December 8, 2018.
- [5]DairyCo, 2012, Dairy Supply Chain Margins 2011/2012, <https://dairy.ahdb.org.uk/resources-library/market-information/dairy-supply-chain-reports/dairy-supply-chain-margins-2012/#.XE3gIWmxUdU>, Accessed on December 13, 2018.
- [6]EC-European Commission, 2009, Analysis of price transmission along the food supply chain in the EU, Commission Staff Working Document SEC/2009/1450 FIN, European Commission.
- [7]European Commission, 2018, Agriculture and rural development, EU Market Observatories, EU Milk Market Observatory, [https://ec.europa.eu/agriculture/market-observatory/milk/latest-statistics/prices-margins\\_en](https://ec.europa.eu/agriculture/market-observatory/milk/latest-statistics/prices-margins_en), Accessed on December 2, 2018.
- [8]Eurostat, European Statistics, 2018, <http://ec.europa.eu/eurostat>, Accessed on December 18, 2018.
- [9]FADN survey results 2008–2017, Vilnius, Lietuvos agrarinės ekonomikos institutas, 2009–2018.
- [10]Figiel, S., Hamulczuk, M., 2010, Development and Application of Advanced Analytical Methods for Ex-Ante and Ex-Post Evaluation of the Effects of Changes in the Common Agricultural Policy and in Macroeconomic Determinants (Synthesis).
- [11]Gapšys, A., Mikelionytė, D., Eičaitė, O., 2009, Pieno produktų vertės pasiskirstymas tarp pieno gamintojų, perdirbėjų ir prekybininkų // Žemės ūkio mokslai, ( Distribution of the value of dairy products among milk producers, processors and traders, Agricultural Sciences), T. 16, Nr. 1–2, p. 87–95.
- [12]Hemme, T. (ed), 2018, IFCN Dairy Report 2018, IFCN, Kiel, Germany.
- [13]Hemme, T., Wesseling, K., 2006, Analysis of the Dairy Chain in Six Countries, Pp. 160-161 in IFCN Dairy Report 2006, edited by T. Hemme, Kiel, International Farm Comparison Network (IFCN) Dairy Research Center.
- [14]Jansik, C., Irz, X., Kuosmanen N., 2014, Competitiveness of Northern Europe dairy chains, Helsinki, MTT publications N° 116: 160p.

[15]Krieviņa, A., 2010, Milk Price Distribution and Factors in Value Adding Chain, Economic Science for Rural Development, 21, 116-122.

[16]Nasdaq Baltic stock market, 2018, Reports of the largest Lithuanian dairy processing enterprises, <https://www.nasdaqbaltic.com/market/?pg=reports&list%5B%5D=BAMT&list%5B%5D=BAIT>, Accessed on December 8, 2018.

[17]Niemi, J., Jansik, C., Huan-Niemi, E., 2011, June, Price formation and margin behaviour in the Finnish food markets, In 21st Annual IFAMA World Symposium in Frankfurt on June, pp. 20-21.

[18]Popovic, R., Radovanov, B., 2010, Price transmission in Serbian dairy chain, Economics of agriculture, 57(4).

[19]State Food and Veterinary Service of the Republic of Lithuania, 2018, Register of food business operators dealing with food of animal origin, <http://vetlt1.vet.lt/vepras/>, Accessed on December 4, 2018.

[20]Statistics Lithuania, <https://www.stat.gov.lt/#>, Accessed on December 12, 2018.



## RESOURCE USE EFFICIENCY OF POULTRY LAYERS PRODUCTION IN ROGO LOCAL GOVERNMENT AREA KANO STATE, NIGERIA

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### **Abstract**

*The study was carried out to determine the resource use efficiency of poultry-layers production in Rogo Local Government Area of Kano State. A sample of 150 farmers was selected by simple random sampling technique. The data was analyzed using descriptive statistics, frequency, percentage, multiple regression and marginal analysis. The result reveals that, the cost incurred on purchasing chicks has significant at 1%; medication has significant at 5% and labour at 5%. The positive nature of the relationship of the chicks, medication and labour means increase at one unit of chick; medication and labour would cause the quantity of output to increase by certain percentage. The negative relationship of electricity to the returns implies that decrease in one unit cost of the input will cause the return to decrease by certain percentage. The result indicates that all the variables inputs in the production were inefficiently utilized because none of the ratio equals to one. The farmers under-utilized the chicks, electricity and medication. The labour ratio is less than one showing that the farmers over-utilized labour. The result indicates the need for making input affordable and accessible to farmers so as to improve efficiency. It also implies that the farmers might be earning higher returns if more of the various resources were efficiently utilized. It was also recommended that poultry layers farmers should implement better management practices to minimize the incident of their resource used inefficiently to improve the profitability and resource use efficiency of poultry production.*

**Key words:** *poultry layers production, resource use efficiency, marginal analysis, Rogo L.G.A., Kano State*

### **INTRODUCTION**

Poultry production in Nigeria is an important industry as evidenced by the fact that Nigeria leads all other African countries in poultry production [3]. Poultry production is one of the fastest and most economical routes to achieve the much desired objectives of increased animal protein intake, as well as diversification of several agricultural rural economies [9] Poultry provides an acceptable form of protein to most people throughout the world. Poultry enterprises have rapid production cycle interval and high rate of productivity. Certain breeds of birds can produce eggs within sixteen weeks of age like Rhodes Island, New Hampshire, and Leghorn [11]. Poultry product is used in the manufacture of many industrial goods and is also suitable for genetic nutritional and physiological studies [11]. According to [14], poultry production is one of the profitable agricultural enterprises and it is this accruing return from the enterprises that can be used to

improve the life of rural dwellers. [1] Reported that, the level of consumption of meat and other animal protein in Nigeria is estimated at about 8 grams per caput per day, which is about 27 grams less than the minimum requirements recommended by National Research Council of United States of America. The recommended protein intake in Nigeria is 35/grams/caput/day [3] the task of closing this animal protein gap or deficiency, taking into consideration may largely depends on increased poultry production at least in the short run. The poultry products which are sold contribute about 15% to the annual financial income of the household [8]. [2] Reported that the commercialization of poultry-keeping is a recent development in the humid tropical country like Nigeria. In Nigeria as contrasted with the temperate countries the industry is less capitalized, consisting of smaller units who depends more on manual labour. The birds usually perform at a lower level, and partly on this account, the cost of poultry production is higher. [10],

in Nigeria, despite the growth in the egg production industry since 2000 local demand and has not been matched supply with reported egg imports of 730 million eggs imported in 1999 [13].

Efficiency and productivity, although referring to distinct concept derived from production function are interrelated and are common performers measure by which agricultural units are evaluated. The everyday meaning of the term 'efficiency' refers to a situation where resource is used to their capacity so that no resource is wasted. [6], it is a measure of efficiency accounting for a single output and multiple outputs. The efficiency of an economic unit is a holistic measure used and all inputs produced in determining 'how well' or 'how effectively' the decision making unit combines input to produce output.

#### **Research question**

It is against this background that the current study to answer the following research questions:

- (i)What is the socio-economical characteristic of the layers producers in Rogo?
- (ii)Are the resources efficiently utilized?
- (iii)What are the relationship between the value of output and the value of input used in the production?

#### **The objectives of the study:**

The broad objective of the research is to determine the resource use efficiency of poultry layers production in Rogo Local Government.

#### **The specific objectives of the study are:**

- (i)Identify the socio-economic characteristics of layers producers in the study area.
- (ii)Determine the relationship between the value of output and the value of input used in the production.
- (iii)Determine the resource use efficiency in the study area.

## **MATERIALS AND METHODS**

### **The study Area**

The study was carried out in Rogo Local Government Area of Kano state Nigeria. It was created out of Karaye Local Government in 1996 with it headquarters at Rogo town and

it is located at the western part of the state. The Local Government has twenty-two districts. The area lies between Sudan vegetation zones with annual rainfall of 870.20 mm – 1,100mm [5]. It has the minimum and maximum temperature 35°C to 40° C respectively. The location of the area is at latitude 10° 33<sup>1</sup> N and longitude 7° 34<sup>1</sup> E.

### **Sampling technique and sampling size**

A purposive sampling technique was used in selecting the districts, villages and the respondents. The selection of the village was based on the large volume of poultry (layer) production in the area. Ten district were selected out of the twenty-two district and they are; Zarewa, Rogo, Beli, Ruwan Bago, Kadana, Bari, Falgore, Yanoko and Barbaji. In each village, fifteen farmers were selected. A total of 150 respondents were selected in the areas. The list of the poultry farmers were obtained from Kano state Agricultural and Rural Development Authority (KNARDA), from the random selection was accomplished. The method employed for the random selection in each district was that the numbers of the layer farmers was written on a paper. The papers were shuffle and boys were asked to pick continuously until the desired sample size was obtained in each of the selected districts.

### **Method of data collection**

The data for this study was collected through the use of structured questionnaire. The questionnaire were designed to provide relevant information on the socio-economic characteristics of the layers farmers, the relationship between the value of output and the value of input used in the production and the resource use efficiency in the study area.

### **Data analysis**

The analytical techniques used for the data analysis includes descriptive statistics, frequency and percentage to determine the socio-economical characteristics of the poultry layers farmer. The production function analysis was used to determine the relationship between the output value and input value in production. The marginal analysis was used to find the efficiency in the resources used in the production.

### **Specification of the regression model**

The multiple regression models were used to analyze the relationship between the dependent variables (Yi) and the independent variable (Xi). The independent variable examined were the cost of chicks (X1), cost of transportation (X2), cost of electricity (X3), cost of housing (X4), cost of feed (X5), cost of medication (X6), cost of labour (X7) and cost of feeders and drinkers (X8). In this study, the linear and semi-log functions of the multiple regression models were employed and express in (1) and (2) respectively.

Linear functional form is:

$$Y = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + b_8x_8 + u \dots\dots\dots (1)$$

The functional form of semi-log was transformed into logarithmic equation form to linearize and simplify the function.

The logarithmic transformation of the model is:

$$\log Y = \log a + b_1 \log x_1 + b_2 \log x_2 + b_3 \log x_3 + b_4 \log x_4 + b_5 \log x_5 + b_6 \log x_6 + b_7 \log x_7 + b_8 \log x_8 + u \dots\dots\dots (2)$$

The functional form of the model used in the analysis include linear and Cobb Douglas functional forms. The model with the best fit (e.g. linear) was selected on the basis of R<sup>2</sup> value, F-ratio value and number of significant coefficients.

**Measurement of resource use efficiency**

In order to determine the resource use efficiency of poultry layers farmers, the study adopt the method used by [7] where the marginal value product (MVP), the additional income received from using an additional units of financial input for each resource was computed and compared with the respective acquisition cost (MFC).

$$r = \text{marginal value product/marginal factor cost} = \text{MVP} / \text{MFC} \dots\dots\dots (3)$$

r = efficiency ratio.

MVP = value of one unit of the product.

MFC = cost of one unit of a particular resource.

The MVP was calculated as follows:

$$\text{MVP} = \text{MPPX}_1 \times P_y$$

$$\text{MPPX}_1 = dy / dx_1 = b_1x/y$$

Note: Y and X are the arithmetic mean values of the yield (Y) and input (X) respectively, b<sub>i</sub> is as defined earlier and by P<sub>y</sub> is the price of unit output.

Decision rules:

If r = 1 it implies that resource is efficiently utilized.

r > 1 it implies that resource is underutilized.

r < 1 it implies that resource is over utilized.

**RESULTS AND DISCUSSIONS**

**Socio-economic characteristics of the respondents**

Table 1 set out the socio-economic parameters of the respondent, while Table 2 shows the multiple regression analysis to express the relationship between the value of output and the value of input used in the production. Table 3 shows the marginal analysis to determine whether the resource was efficiently utilized.

Table 1. Distribution of the respondents by socio-economic characteristics

Demographic factors	Frequency	Percentage
<b>Gender</b>		
Male	120	80
Female	30	20
<b>Marital status</b>		
Married	115	77
Single	35	23
<b>Household size</b>		
1 – 4	25	16.7
6 – 10	110	73.3
11 – 20	15	10
<b>Educational level</b>		
Qur’anic	25	16.7
Primary	1	0.6
Secondary	15	10
Tertiary	109	72.6
<b>Years of Experience</b>		
1 – 5	20	13.33
6 – 10	120	80
11 – 20	10	6.6

Source: Field survey, 2018.

The results in Table1 show that most of the respondents were male (80%) and married (77%). The dominance of males in the poultry

business may be connected with the huge sums of money needed to start the business which is often difficult for women to raise in the part of the world. The household size of the respondents was 6 – 10. According to [12], the large family labour especially when labour - intensive techniques are required. All the respondents are educated with a majority (72.6%); having University education that shows the higher the level of education aid the adaptation of new innovations and perceptions was attributed to the level of education that leads in increasing the productivity [7s]. The result shows that (80%), of the respondents 6 – 10 years of experience in poultry layers production. It indicates that the farmers in the study area had more experience up to (80%) which indicates that, the years of experience had direct relationship with age of the producers. The older the farmer in the business the more the experienced he is in layers production and so the more output realizes and higher net farm income [5].

The results in Table 2 indicates that semi – log and linear production functions analysis shows the cost incurred on purchasing chicks (x1) had significant at 1%, medication (x6) had significant at 5% and labour had significant at 5%.

This positive nature of the relationship of the chicks, medication and labour means increase in one unit of chicks, medication and labour would cause the quantity of output produced to increases by certain percentage of 0.996%, 0.2224% and 0.228% respectively.

The quantity of electricity (x3), had a negative significant at 1%. The negative relationship of supply of electricity to the output produced implies that decrease in one unit cost of (x3) would cause the production of output to decrease by 0.2%. The transportation (x2), housing (x4), feeds (x5), drinkers and feeders

were not statically significant at any of the conventional level to affect the output of layers producers.

The non significant of these inputs, may be attributed to the fact that the farmer did not used these inputs at the right time.

Table 2. Production function estimates for poultry layers enterprise

Variables	Coefficients	STD Error	T – value
Constant	-0.002	0.823	-0.003
Chicks (x1)	0.996	0.120	8.333*
Transportation (x2)	0.085	0.103	0.824
Electricity (x3)	-0.214	0.071	-3.021*
Housing (x4)	-0.152	0.129	-1.175
Feeds (x5)	0.007	0.075	0.096
Medication (x6)	0.224	0.094	2.389**
Labour (x7)	0.228	0.945	2.412**
Drinkers and Feeders (x8)	0.082	0.055	1.26

$R^2 = 0.66$ ,  $F = 34.72^{**}$  and  $^{**}$  significant at 1% and 5 level of profitability respectively.

$R^2 = \text{adjusted} = 0.64$

Source: Field survey, 2018.

The result further revealed that about 64% Of the variation in output value was accounted for the inputs included in the analysis. It is therefore follows that other factors not in the analysis accounted for the remaining 36% of variations in output value.

#### Resource use efficiency

Marginal analysis was used to determine economic efficiency of resources used. Evaluation of the resources used enable a firm to know their operation status in order to know their operation status in order to adjust the production prizes to achieve economic rationality.

The results indicates that all the variables inputs in the production were in efficiently utilized because none of the ratios equal to one as indicated in table 3.

Table 3. Estimation of Resources use efficiency of significant variables

Variables	APP	MPP	MVP	MFC	R = MVP/MFC
Chicks	5.49	5.471	656.52	120	5.47
Electricity	33.19	7.103	355.15	5000	7.1
Medication	54.209	12.1438	1760.70	14500	12.14
Labour	180.86	41.185	1075.0	1500	0.71

Source: Field survey, 2018

The ratios indicated that sampled farmers under-utilized the chicks, electricity and medication. The reasons could be due to high price of chicks, electricity and medication. The under-utilization of chicks was due to high cost of purchasing the day old chicks and started pullet, while, the electricity was due to lack of constant supply light for brooding while, the medication could be due to high cost of the input and farmers do not apply drugs and medication except when there is any sign of sickness. The efficiency ratio for the labour was less than one showing that the sampled farmers over utilized labour on the farms. This could be due to low wage rate for labour and availability of family labour which was usually not valued.

The results was collaborated with [4], that reported farmers were inefficient in all of the resources in his analysis, that indicates the need for making inputs affordable and accessible to the farmers so as to improve efficiency. It also implies that the farmers might have been earning higher returns if more of the various resources were efficiently utilized. The relationship between the value of output and the value input used in the production indicates that the total average cost of the production was ₦89062, 473, while the total average net farm income was found to be ₦152651.01 higher than the total cost of production. Thus, from the analysis it can be seen that layers production is profitable. This relationship of output value and the value of input was explained by the semi-log function that estimates the physical input-output relationship.

## CONCLUSIONS

Evidently, the study established that poultry layers production was in lucrative business in Rogo Local Government area. However, farmers were far from being efficient in their use of productive resources. The study revealed that some of the inputs (chicks, medication and electricity) were underutilized. While labour was over-utilized. The study led to the following recommendations:

(i) Therefore, there was a need on extension activities of the Agricultural Development project to focus attention on ways farmers could be trained in inputs utilization.

(ii) A deliberate policy on labor management practices should also be encouraged so that farmers can utilize labour efficiently.

(iii) To improve the profitability and resource use efficiency of poultry production farmers should implement better management practices to minimize the incidence of disease outbreaks, thereby reducing the cost of production.

## REFERENCES

- [1] Agromisa, 2006, Agrodok small – scale chicken production. Co – published by CTA, Wageningen, the Netherlands p.91.
- [2] Evbuomwan, G.O., 2006, Empirical Analysis of Cost and returns to Commercial table egg Production in Lagos State. Economic and financial Review. Central Bank of Nigeria. 44(2):39 – 59.
- [3] F.A.O., 2003, Egg marketing. A guide for the production and sale eggs, FAO. Agricultural services bulletin 150 Rome, Italy. p.10.
- [4] Gegu, J.O., Adeyinka, I.A., Sekoni, A.A. (eds), 2005, Poultry Production in Nigeria. A Training Manual on National Training Workshop on poultry production in Nigeria held 1 – 6 September, 2005, Shika, Zaria, Nigeria. Published by the National Animal Production Research Institute, Ahmadu Bello University, Shika, and Zaria, Nigeria.
- [5] M.S.N.S., 2009, The Meteorological Stations in Nigeria states. The comparisons of 2008/2009 Mean Monthly Maximum Temperature and Rainfall in Nigeria. pp. 1- 4.
- [6] Ogundari, K., 2009, A Meta-analysis of Technical Efficiency in Nigeria Agriculture. Contributed paper prepared for presentation at International Association of Agricultural Economist Conference, Beijing, China, in August 16 – 22, 2009.
- [7] Oladeebo, J.O., Ambe-Lamido, A.I., 2007, Profitability, Input Elasticities and Economic Efficiency of Poultry Production. International Journal of Poultry Science. 6 (12): 994 – 998.
- [8] Olukosi, J.O., Abraham, O.O., 2008, Introduction to Agricultural Production Economics Principles and Application. Abuja, Nigeria. G.U. publications, 3<sup>rd</sup> edition, p. 112.
- [9] Olukosi, J.O., Isitor, S.U., 2005, Introduction to Agricultural Marketing and Prices. Principles and Application. Abuja, Nigeria. G.U. publications, 2<sup>nd</sup> edition, pp. 89 – 91.
- [10] Oluyemi, J.A., Robert, F.A., 2002, Indices of performance of layers poultry production warm wet climate 1<sup>st</sup> edition, Ibadan University Printing Press. p.380.
- [11] Smith, A.J., 2001, Poultry: The Tropical Agriculturists. (ed), (rev. 2001), Macmillan London Oxford; Co-published with CTA, Wageningen, the Netherlands. 242 pp.

[12]Sonaiya, E.B., 2001, Small Poultry holdings, the family and community development-ethnology, ethics and self interest. Livestock community and environment. Proceedings of the 10<sup>th</sup> Conference of the Association of Institutions for Tropical Veterinary Medicine. Copenhagen, Denmark.

[13]United States Department of Agriculture, ( 2001), International egg and poultry review. USDA. August 7, 48 (32) 1 – 4.

[14]Wethli, E., Jensen, H.A., 2005, Chickens for profit. Starting small scale poultry business. ITDG publishing UK. 100 pp.

## PROFITABILITY ANALYSIS OF POULTRY LAYERS PRODUCTION IN THREE SELECTED LOCAL GOVERNMENT AREAS OF KANO STATE - NIGERIA

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### Abstract

*The study analyzed the profitability of layer poultry production in three local Government Areas (Rogo) Kumbotso and (Gezawa) of Kano State Nigeria. Random sampling techniques were used to select 150 layer poultry farmers. Data collection was by administration of questionnaires. Data collected were analyzed using descriptive statistics and Net farm income model to achieve the objectives of the study. The results from the costs and returns analysis shows the poultry layer production in the study area was profitable. The average returns per Naira invested the farmer will realize 0.58. Thus, the net farm income obtained is higher than the total costs incurred by the layer poultry farmer in the study area. Income can still be improved upon with appropriate pricing, adoption of proper management practices and accessing low cost inputs through bulk purchasing by farmers' cooperatives. The constraint faced by the layer farmers are limited access to credit, high cost of feed, frequent outbreak of diseases and high cost of vaccine and medication. It is recommended that appropriate input pricing, formation of society with the aim of purchasing feed mixing equipment which will help to reduce the cost of feed and adoption of proper management practices will improve income.*

**Key words:** profitability, layer poultry, production, spent layers, Kano state

### INTRODUCTION

The term poultry refers to all domestic birds kept for egg or meat production [5]. These include chicken, turkey, duck, geese, swan, ostriches and guinea fowl [9].

Profitability in layer production enterprise has encouraged more investment in the sector [1]. Poultry is one of the most profitable agricultural ventures and certainly the most profitable livestock enterprise. According to [10] supplementing protein in the diet of pullet chicks is a necessary step in promoting the growth rate and facilitating higher returns profitability in layers production.

Poultry products have social and important spiritual benefits and play an important role in economy in which it contribute about 10% of Agricultural GDP [2]. In many customs poultry is used for ceremonies sacrifice, gift and savings [8]. [4] Stated that poultry

products which are sold contribute about 15% to the annual financial income of the house hold. Poultry provide meat, egg, feathers, manure, fertilizer, mayonnaise and dehydrated acid and play an important role in rural economy. In fact, poultry production is unique in that it offers the highest turnover rate and the quickest returns to investment outlay in the poultry enterprise production. Poultry layers production is important element in diversifying Agricultural production and increasing household food security. [3], stated that the role of poultry production in the economic development included the provision of adequate products of various industries such as pharmaceutical industries which supply the drugs and vaccines as poultry inputs, it increases the income of participating poultry entrepreneurs farmers, thereby improving their standard of living as it provide the research question.

### The research questions

Despite the importance of poultry layers production in increasing the annual financial income of the household, a short fall in egg production in Nigeria has been as a result of grossly high demand for poultry egg and dwindling supply of the product [6]. This forms like focus of this study, using three selected Local Government Areas of Kano State as a case study. To this end an up to date knowledge of profitability in the industry will go a long way in bridging some of the knowledge gap and help in formulating policies aimed at ensure increased and more profitable poultry production in the country. In line with this, it is therefore important to undertake a study of this nature to provide the answers to the following research question.

- (i) What are the socio-economic characteristics of the poultry layers producers?
- (ii) What is the average flock size?
- (iii) What is the average crates of eggs produced per production cycle?
- (iv) How profitable is the poultry layers enterprises?

### Objective of the study

The broad objective of this study was to analyze profitability of egg production in three selected Local Government Areas (LGAs), of Kano State.

The specific objectives are to:

- (i) Identify the socio – economic characteristics of layers production in the study area.
- (ii) Find out the average flock size per house hold
- (iii) To determine the average crates produced per production cycle.
- (iv) Determine the profitability of layers production enterprise.

## MATERIALS AND METHODS

### Population and Scope

The research was targeted and carried out in three selected Local Government Areas, namely Kumbotso, Gezawa and Rogo Local Governments Areas in Kano State, Nigeria. A total number of 150 people were selected from the Local Government. Questionnaire Survey was adopted in

collection of data so as to ascertain some of the claims.

### Data collection

The data for this study were collected through the use of structured questionnaire. The questionnaires were designed to provide relevant information. The Local Government Areas are selected based on intensity of poultry layers producing villages from each selected (LGAs) were purposively selected based on their intensity in production. A total of one hundred and fifty (150) layers farmers were randomly selected in six selected villages. In each village 25 farmers were selected given total of 150 respondents. The list of the poultry farmers were obtained from Kano State Agricultural and Rural Development Authority (KNARDA) from the random selection was accomplished.

### Data analysis

Data collected were analyzed by descriptive statistics such as range, frequency distribution, and percentages to achieve the first and second objectives. The third 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 [7]. The farm budget model was used to compute the costs and returns in layers production in the study area.

This is:

$$NFI = GI - TC \text{ - - - - - (1)}$$

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 layers birds at the end of the production.

TC = total cost. This represents all the enterprises incurred in a production by the farmers. This include chicks (x1), transportation (x2), light (x3), housing (x4), feed (x5), medication (x6), labour (x7), drinkers and feeders (x8).

Total Revenue: This represents the total out multiply by the price. The components of the revenue include Eggs, spent layer and litter.

## RESULTS AND DISCUSSIONS

### Socio-economic characteristics of the respondent

The socio-economic characteristics of the respondents consider in this study include gender, marital status, household size, educational level, years of farming experience and source of capital.

Table 1. Distribution of respondents according to socio-economic characteristics

Variables	Frequency	Percentage
<b>Gender</b>		
Male	115	77
Female	35	23
<b>Marital status</b>		
Married	95	64
Single	55	36
<b>Holding size</b>		
1 – 5	15	36
6 – 10	35	10
<b>Education level</b>		
Qur’anic	25	16.7
Adult	12	8.0
Primary	32	21.3
Secondary	53	35.33
Tertiary	28	18.66
<b>Experience (years)</b>		
1 – 5	20	13.33
6 – 10	30	20.0
11 – 15	60	40
16 and above	40	26.7
<b>Source of fund</b>		
Commercial banks	38	25.3
Personal savings	112	74.7

Source: field survey, 2018.

As indicated in table 1, the results of the study revealed that, the majority of the poultry layers farmers were males at the proportion of (77%). This confirmed the popular belief about the study area that farming was the major occupation which male folks dominate. Majority of the respondents (95%) are married. This shows that the society places high premium on marriage 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 house hold 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 that family. The larger the family size the greater the labour on the farm and thus greater output for the farmers. The level of education of the respondents is moderately educated that would enable them to grasp new innovation and the perception and also help them in decision making as regards to their production, which may lead to boosting to poultry layers production. The result shows 89.99% of the respondents have between 6 – 20 years experience in poultry egg enterprise that indicates that the higher the years of experience of the farmers the more output realized and higher net farm income. It is expected that the years of experience in poultry layers production usually determines the effectiveness of farmers’ decision with respect to inputs combinations or resource allocation. Table 1 reveals that 74.7% of the respondents source their funds for initial investment from personal saving; they don’t have access to credit. This situation could be explained by small nature of their farm holdings and absence of collateral security that may be needed by the financial institutions before granting loans to prospective farmers. Also commercial banking demands much collateral and high interest rate from farmer which made it difficult for the farmers to obtained loans from banks.

### The Flock size per household

Table 2 showed the distribution of respondents according to the size of flock.

Table 2. Flock size per house hold

Flock size	Frequency	Percentage
≤ 99	18	12
100 – 199	72	48
200 – 299	26	17.33
300 – 399	22	14.66
400 – 499	12	8
Average = 156.96		

Source: Field survey, 2018.

The results indicates 12% had  $\leq 99$  birds, 48% had 100 – 199 birds, 17.33% had 200 – 299 birds, 14.66% 300 – 399 birds and 8% had 400 – 500 birds. The 110 – 1,999 birds that had 48% was due to ease management and more economical to handle. The flock size of any large enterprise depends greatly on the resources base of the farmer and purpose for which the birds are kept.

**Creates of eggs produced per production cycle**

Table 3 indicates that the number of creates produced per production cycle. The quantity of eggs produced depends on the number of birds kept, the proper management and

healthy breed. The result showed 16% had 448 creates of eggs per ( $\leq 99$  birds), 23.33% had 476 creates of eggs with (100 – 199 birds), 20% had 560 creates of eggs with (200 – 299 birds), 23.33% had 697 creates of eggs with (300 – 399 birds), and 17.33% had 728 creates of eggs produced by the farmer was according to the recommended level, since it is within the range of 42 – 50 weeks and 51 – 52 weeks, hence it is an indication that, there is a healthy breed of birds and proper management practices. While the below production as a result of unhealthy breed and poor management practices. That creates has total number of 30 eggs.

Table 3. Distribution of respondents according to quantity of creates produced per production cycle

Flock (size)	No. of creates produced per production cycle	Period (weeks)	Frequency	Percentage
$\leq 99$	448	30 – 32	24	16
100 – 199	476	33 – 34	35	23.33
200 – 299	560	35 – 40	30	20
300 – 399	697	41 – 50	35	23.33
400 – 500	728	51 – 52	26	17.33
			150	100

Source: Field survey, 2018

Average = 252.25

**Net farm incomes analysis of layer poultry production**

The cost and returns analysis was employed to determine the profitability of this production the returns to be compared with the total costs; if the total return is greater than the total cost, the enterprise is said to have made profit. Thus, the profitability or net return of an enterprise is taken as total revenue less total of production, these consist of costs incurred on inputs such as feed, chicks, transportation, electricity (brooding), medication, labour and other items like housing, feeders and drinkers.

From table 4; it could be seen that average Net farm income obtained from all the respondent is ₦152,651.01. This finding is consistent on the profitability of layer poultry production. The size and the positive value of the net farm income shows that the respondents were able to cover their total expenses with level of net farm income obtained and had a sizeable proportion as a return to management. This shows poultry

layers production is profitable in the study area. The average returns per naira invested the farmer will realize ₦0.58.

Table 4. Average costs and Returns of layers poultry per 150 layers in the study area

Cost items (₦)	Amount (₦)	Percentage
Variables		
Chicks	28,793.33	33.6
Feeds	45,871.53	53.6
Transportation	19,07.86	2.2
Electricity	47,65.66	5.5
Medication	2918.0	3.4
Labour (family and hired)	874.60	1.0
Total variables costs	85,131.02	99.3
Fixed costs:		
Depreciation on housing	2,468.0	0.02
Feeders and drinkers	1,463.45	0.16
Total fixed costs	3,931.45	0.044
Total costs	89,062.473	
Total Revenue	2,152.34	
Net farm income per production cycle	152,651.01	
Return to Naira invested	0.58	

Source: Field Survey, 2018.

The implication of this is that farmers raising layer poultry birds will survive both in the

short and in the long run because the resources engaged in its production were efficiently utilized.

## CONCLUSIONS

From findings of this study, it is concluded that poultry layer production in the area of the study is profitable with a return of ₦0.58 per every Naira invested.

The study leads to the following recommendations:

(i) Farmers should form cooperatives groups and seek governments assistance towards improving their business through access to credit facilities and a positive policy definition that would enhance the enterprises

(ii) Farmers should make sure that, day old chick they buy are of healthy breed and high quality .

(iii) Farmers should form cooperative society in order to be train in how to adjust their inputs accordingly to ensure efficient resource utilization.s

(iv) Extension agents in the State should be properly trained and provided with all necessary technological packages required to teach and guide farmers on improved poultry production.

## REFERENCES

- [1] Alders, R., 2004, Poultry for Profit and Pleasure. Diversification booklet 3. FAO Rome Vol. 9, (82):9 – 40.
- [2] Central Bank of Nigeria, 2008, National Economic and Medium Scale Commercial Poultry Farming.
- [3] Food and Agricultural Organization, 2012, Agribusiness Handbook: Poultry Meat and Eggs. Investment Center Division. FAO. Rome, Italy.
- [4] Monsi, A., 2005, Poultry Production in Nigeria: A Paper presented at the Annual Science Workshop. In the new Millennium: Challenges and Options Held at the Micheal Okpara University of Agriculture, Umudike, Nigeria 6<sup>th</sup> November, 2005. 16 p.
- [5] Ogunlade, I., Adebayo, S.A., 2007, Socio-Economic Status of Women in Rural Poultry Production in Selected Areas of Kwara State, Nigeria. International Journal of Poultry Science, 8 (1): 55 – 59.
- [6] Ojo, M.A., Ojo, A.O., Jirgi, A.J., Ajayi, O.J., 2012, Non-Parametric analysis of production efficiency of poultry egg farmers in Delta State, Nigeria. British Journal of Poultry Science, 1 (2); 18 – 24.

[7] Olukosi, J.O., Abraham, O.O., 2008, Introduction to Agricultural Production Economics, Principles and Applications Abuja, Nigeria. G.U. Publications 3<sup>rd</sup> edition. p.112.

[8] Olukosi, J.O., Isitor, S.U., 2005, Introduction to Agricultural Marketing and Prices: Principles and Applications. Abuja, Nigeria. G.U. Publications 2<sup>nd</sup> edition. pp. 89 – 91.

[9] Oluyemi, J.A., Roberts, F.A., 2002, Indices of performance of layers poultry production warm wet climate 1<sup>st</sup> edition Ibadan university printing press. p380.

[10] Sonaiya, E.B., Swan, S.E.J., 2004, Manual Technical Guide on small scale poultry production. FAO. Animal production and Health No. 1. Rome, Italy.



## REGIONAL ASSESSMENT OF STABILITY OF THE IRRIGATED AGRICULTURE

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### Abstract

*The article examines the influence and interrelation of factors of production - capital and labor on the economic sustainability of facilities operating in the system of irrigated agriculture. The studies were conducted on the basis of statistical data of agricultural producers who use irrigation technology. The article examines a significant differentiation of the basic parameters of agricultural production (security of labor, land, material and technical resources), significantly affecting the conditions and performance of the studied farms. The relationship of production factors and the increase in the value of gross output is considered taking into account the basic performance parameters. The article uses the most universal and acceptable Cobb-Douglas production function for the agricultural production industry, which represents the interrelation of production factors - in our case for a quantitative assessment of the interrelation of fixed assets, labor resources and their impact on the sustainability of production. The results show a relative change in the volume of production, expressed as a percentage, with a relative increase in the corresponding factor of production by 1%.*

**Key words:** agriculture, agricultural economy, irrigated agriculture, sustainable functioning, potential

### INTRODUCTION

The ameliorative complex is a complex system, which is aimed at eliminating adverse climatic conditions that adversely affect the sustainability of agricultural production. The uneven income of agricultural products produced, not only by year but also by season, associated with the specific conditions of agricultural production, allows modern scientists to consider such negative and positive fluctuations from the position of creating opportunities to combat adverse conditions. This is, first of all, ensuring the sustainable functioning of agricultural production in a stable development of production with minimal dependence on the prevailing weather conditions [8, 9]. Thus, it is possible to assert that sustainability determines the stable development of production, including in irrigated agriculture. The stagnation of actually watered areas, deterioration of the quality of the reclamation fund, reduced operational readiness of irrigation systems, downsizing of agricultural

producers and the violation of the technological integrity of irrigation systems leads to a decrease in the productivity of irrigated land [7, 10]. The need to address the pressing problems of ensuring the country's food security, achieving stability, increasing the volume and efficiency of agricultural production, reducing its negative environmental impacts has recently attracted the attention of many government bodies [13]. Assessment of the steady state and development prospects of irrigation land reclamation in Russia is relevant. The parameters of the structural units (objects) in irrigated agriculture should ensure that each economic entity sustainability and long-term normal and economically efficient farming.

### MATERIALS AND METHODS

The article assesses the financial sustainability of enterprises using a system of relative indicators (financial ratios), using the method of comparisons to establish compliance of their values with regulatory restrictions. The

integral indices [2, 4] of the commercial potential ( $I_{cp}$ ) and production potential ( $I_{pp}$ ) are calculated:

$$I_{cp} = \sqrt[3]{i_A + i_B + i_C} \quad (1)$$

where:  $i_A$  – index of land potential;

$i_B$  – index of labor potential;

$i_C$  – index of the fixed and current assets;

When calculating indices of land and labor potentials, fixed and current assets for  $I_{cp}$ , we used the profit indicator ( $P$ ), and for  $I_{pp}$  – the indicator of the value of gross output.

For the construction of the production function for 30 farms with irrigated lands, the data of statistical reports on average for the past three years were used. In our case, the Cobb-Douglas production function has an appearance:

$$Y(K, L) = A \times K^\alpha \times L^\beta \quad (2)$$

where:  $Y$  – agricultural output (gross output), thousand rubles;

$A$  – constant which is responsible for scale number (coefficient of neutral technical progress);

$K$  – cost of fixed capital, thousand rubles;

$L$  – farm labour (the average annual number of the workers occupied in agricultural production), the people;

$\alpha$  – coefficient of elasticity on the capital;

$\beta$  – coefficient of elasticity on labour.

## RESULTS AND DISCUSSIONS

This section presents the calculated integral indices of the commercial potential ( $I_{cp}$ ) and production potential ( $I_{pp}$ ) based on the methodology presented above. The cost of gross output and fixed assets are given at comparable prices with the help of deflator indices. Schematically presented factors (Fig.1) that determine the sustainability of irrigated agriculture, allow us to conclude that stably stable production within reasonable indicators provides basic resource factors in both simple and expanded reproduction.

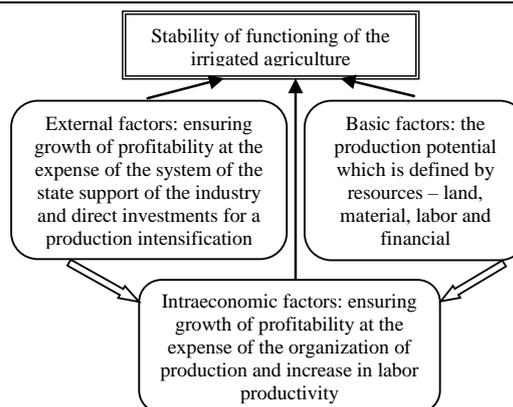


Fig.1. Factors affecting stability of the irrigated agriculture

Source: Own determination.

A group of 30 enterprises with different areas of irrigated land, typical of existing microzones of irrigated agriculture in the forest-steppe, steppe and semi-desert zones of the region, was chosen as the objects of economic research. The degree of sustainability of their functioning was assessed by means of the production potential of irrigated agriculture on the basis of indicators: the returns of the factors of production used, the structure of resources and the established cost of commercial products. Table 1 shows the grouped data of the integral evaluation of the management of the existing potential of the objects studied: the integral indices of commercial ( $I_{cp}$ ) and production potentials ( $I_{pp}$ ) [12]. Depending on the autonomy ratio (in our case, sustainability) and the area of irrigated land, 9 groups are allocated.

### Influence of resource providing on firmness of irrigated agriculture

Successful choice of production structure, sales success lead to an increase in gross product and an increase in  $I_{pp}$ . Businesses that did not achieve positive returns had a negative  $I_{cp}$ . Practice has shown that preference is given to the most commercially attractive, i.e. most profitable crops. This situation is due to changes in production orientation in farms, as well as product prices. The correlation of the magnitude of the potential with the end results of operation provides a comprehensive picture of the degree of utilization of productive resources to achieve economic sustainability.

Table 1. Integrated assessment of economic stability depending on the area of the irrigated lands and autonomy coefficient

Variables (Years)		Equity Ratio								
		0.14-0.28	0.42-0.56	0.7-0.84		0.84-0.98				
		The area of the irrigated lands, ha								
		601-1,000	>1,700	1,001-1,700	>1,700	51-100	251-600	601-1,000	1,001-1,700	>1,700
		1	2	3	4	5	6	7	8	9
Index of labor potential (i <sub>b</sub> )	2015	1.55(6.45)	0.58(11.29)	0.42(11.27)	11.62(26.61)	0.26(4.44)	-0.55(3.09)	2.01(1.28)	1.77(9.04)	1.15(6.50)
	2016	1.91(10.33)	0.87(12.40)	0.89(10.05)	13.7(34.48)	0.03(4.53)	1.99(14.73)	0.86(6.87)	1.81(13.19)	2.74(16.84)
	2017	0.84(7.80)	1.26(13.70)	0.66(10.54)	4.64(18.73)	-0.52(3.88)	0.19(17.05)	2.16(7.74)	0.81(10.26)	2.72(10.06)
Index of the fixed and revolving funds (i <sub>c</sub> )	2015	0.13(0.54)	0.02(0.43)	0.01(0.28)	0.43(0.99)	0.03(0.51)	-0.02(0.14)	0.15(0.09)	0.09(0.43)	0.07(0.41)
	2016	0.12(0.62)	0.03(0.42)	0.02(0.25)	0.36(0.89)	0.003(0.49)	0.08(0.61)	0.06(0.51)	0.08(0.58)	0.15(0.93)
	2017	0.05(0.49)	0.05(0.49)	0.02(0.31)	0.15(0.62)	-0.06(0.42)	0.007(0.61)	0.21(0.75)	0.03(0.43)	0.19(0.74)
Index of land potential (i <sub>a</sub> )	2015	0.13(0.54)	0.28(5.32)	0.06(1.63)	0.59(1.37)	0.07(1.10)	-0.07(0.42)	0.40(0.26)	0.09(0.45)	0.05(0.29)
	2016	0.14(0.77)	0.38(5.38)	0.13(1.45)	0.69(1.75)	0.008(1.13)	0.27(1.99)	0.17(1.37)	0.09(0.65)	0.13(0.77)
	2017	0.07(0.64)	0.62(6.79)	0.13(2.03)	0.34(1.39)	-0.13(0.99)	0.03(2.57)	0.67(2.39)	0.04(0.54)	0.19(0.71)
Integral index of the commercial potential (I <sub>cp</sub> ) in the current prices	2015	0.29	0.15	0.06	1.45	0.08	-0.09	0.49	0.24	0.16
	2016	0.32	0.21	0.14	1.50	0.009	0.35	0.21	0.23	0.37
	2017	0.14	0.33	0.12	0.63	-0.16	0.03	0.67	0.10	0.47
Integral index of the production potential (I <sub>pp</sub> ) in the current prices	2015	1.24	2.96	1.73	3.31	1.36	0.57	0.32	1.20	0.92
	2016	1.70	3.04	1.54	3.78	1.36	2.62	1.69	1.71	2.29
	2017	1.35	3.58	1.88	2.53	1.17	2.98	2.41	1.34	1.74

Source: (1) Own calculation, 2015-2017; (2) in brackets – assessment is determined by the cost of a gross product in the current prices.

If there are enough resources, their inefficient use leads to a decrease in the production potential and at the same time to an over-expenditure of all factors of production [6]. The conducted studies allow us to further formalize the task of developing methods for the sustainable functioning of irrigated agriculture in the region, given that the industry is a dynamic multi-criteria system with a sectoral structure and many management parameters.

#### Assessment of the influence of production factors on the economic sustainability of irrigated agriculture

The objects functioning in the branch of irrigated agriculture in the region include the territories of irrigated lands - more than 257 thousand hectares (3.0% of the total agricultural land in the region). The share of the value of the main ameliorative funds is 35.5% of the fixed production assets of the agro-industrial complex of the region, which indicates a high capital intensity of production using irrigation technologies. The cycle of capital turnover in the industry is much longer than in industry, and especially in trade [5]. The most significant problem is the provision

of continuous expanded reproduction of the main production and non-production assets in the industry. In accordance with the fundamentals of the microeconomic theory of production [3], the stability of the functioning of irrigated agriculture in the economic interpretation is assessed as such use of production resources, which has a direct impact on the final results of production, which does not lead to their reduction. At the same time, the interrelation of factors of production and the increase in the value of gross output must be considered taking into account the basic performance parameters. To determine and assess the factors influencing economic sustainability for the agricultural industry, we use the Cobb – Douglas production function (2) [11, 14], in our case:

$$Y(K, L) = 46,17 \times K^{0,49} \times L^{0,5} \quad (3)$$

An inspection of the equation on adequacy (significance) and check on adequacy of regression coefficients was respectively carried out:  $A=46.14$ ,  $\alpha=0.49$ ,  $\beta=0.5>0$ ;  $\alpha+\beta \approx 1(0.49+0.5=0.99)$  – the condition is satisfied.

The results of the study allow us to draw the following conclusions. With an increase in the fixed capital by 1%, the gross output increases by 0.49%, and with an increase in the number of employees by 1%, the gross output increases by 0.5%. Since  $\alpha < \beta$ , it can be concluded that in the studied period there is a saving effect, i.e. labor resources were used more intensively than fixed assets. The

increase in gross production is characterized by elasticity coefficients with production factors showing a relative change in the volume of production, expressed as a percentage, with a relative increase in the corresponding factor of production by 1%. The received results are presented on graphics (Fig. 2).

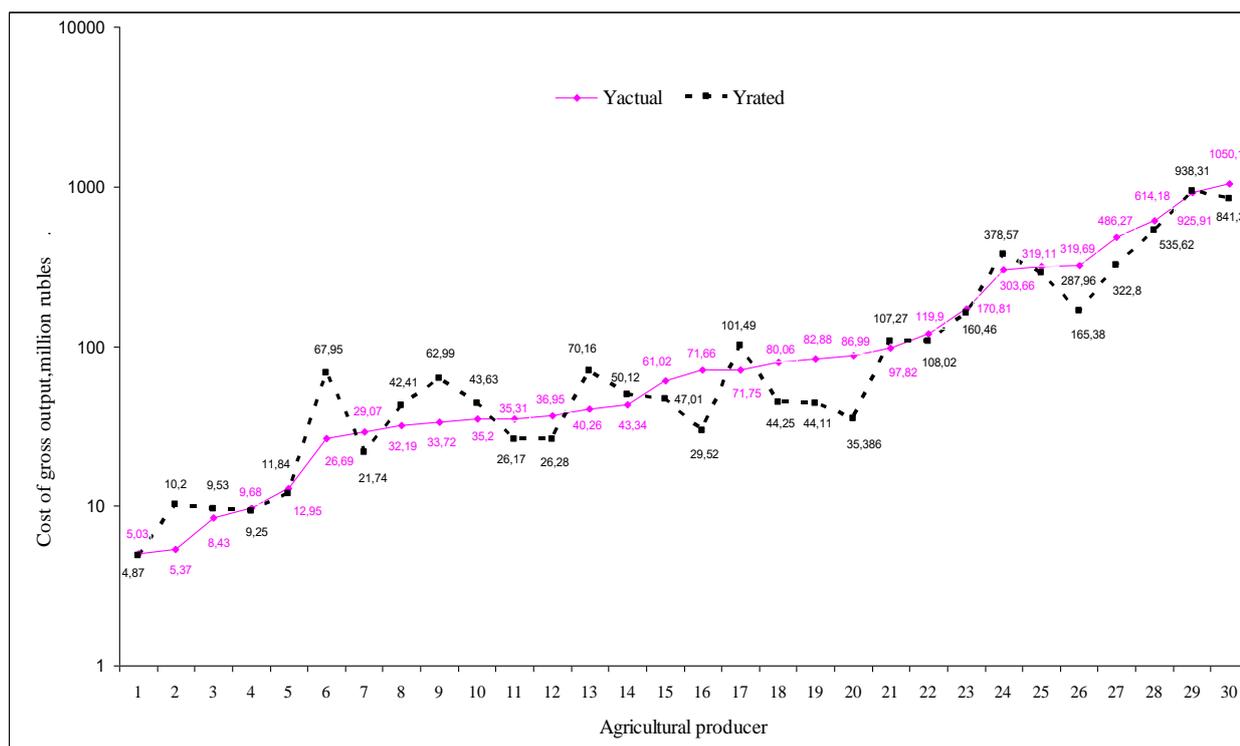


Fig.2. Dependence of sustainable functioning of agricultural producers on the volume of gross output  
 Source: Own calculation.

In 18 agricultural producers out of 30 studied, the actual gross output ( $Y_{actual}$ ) is higher than the calculated gross output ( $Y_{rated}$ ), which indicates a fairly stable functioning of these agricultural enterprises. In 12 farms, the estimated value of gross output exceeds the actual level, which indicates unused stocks of production factors (capital and labor). Thus, the calculated data allow us to predict options for the development of enterprises, to choose the most optimal size, to determine the required amount of fixed capital.

Sustainable development in relation to the agricultural sector is specified in the materials of the FAO session in Rome in 1996 [1], which is justified as increasing food production in a sustainable way and ensuring

food security. N.K. Vasilyeva [15] argues that the sustainability of agricultural production requires understanding the ability of the system, under any conditions of the internal and external environment, to carry out progressively expanded reproduction to meet the vital needs of present and future generations while preserving and increasing the natural potential. F.A. Ward [16] proved that each component of sustainability has a quantitative expression in the relevant group of economic indicators. Therefore, the category of sustainability of the functioning of irrigated agriculture should be viewed as a constant process of interaction and interaction of its structural elements, in the context of the development of agricultural reproduction in

general. Accordingly, the achievement adopted at the enterprise profitability of production and preservation of the number of working personnel. This research position is confirmed by the theory of J. Hicks - E. Lindahl [5] maximum flow of total income, in terms of the economic approach, which proves that the necessary conditions for achieving optimal economic growth rates are not only efficient use, but also the preservation of productive resources, through which a social product was produced, i.e. this flow can only be produced if the total capital is preserved, with which this income is obtained.

## CONCLUSIONS

The stability of the functioning of irrigated lands, as an integral part of the agricultural sector, is characterized by the preservation of agricultural land areas, without assuming a decrease in their fertility, while simultaneously obtaining the maximum economic income per unit area. The objectives of the operation are achieved by developing the industry through renewal and adaptation to a changing external environment.

In modern conditions, the main criteria for the sustainability of structural units (objects) in irrigated agriculture are the economic parameters that allow to compare the costs and profits from the sale of products, to ensure that each economic entity has a long duration of economically efficient management.

Building a production function using the Cobb-Douglas production function confirms the conclusions about the significant influence of internal factors that increase profitability at the expense of cost savings at the production and sales stages, and significantly affects the economic sustainability of irrigated agriculture. Using this production function, you can practically determine by how many percent the production will change, labor productivity, capital productivity will change when the values of resource provision are changed.

The sustainable functioning of irrigated agriculture, within the established economic indicators, is determined by the basic factors of economic sustainability, affecting the internal possibilities for the effective use of the resources available, and external conditions - market conditions of consumers and suppliers, pricing, monetary and fiscal policies of the state. Economic sustainability is determined through an assessment of its main elements, as well as factors affecting the sustainable development of the industry.

## REFERENCES

- [1]Agenda 21, Promoting Sustainable Agriculture And Rural Development, Chapter 14, 1996, Rome: FAO, <http://www.un-documents.net/a21-14.htm>, Accessed on September 24, 2018.
- [2]Bondina, N., Bondin, I., 2013, Major factors affecting effectiveness of use of production potential, *International agricultural magazine*, 1: 24-27.
- [3]Economic theory under Lobacheva E.N. edition, 2012, M.: 516
- [4]Frolov, A., 2015, Analysis of effectiveness of functioning of agricultural producers of Stavropol Krai, *Rural economics of Russia*, 4: 71-78.
- [5]Hicks, Dzh. R., 2006, Capital and body height, Milestones of an economic thought. *International economy*, Vol. 6: 488-503.
- [6]Nesmyslenov, A.P., Novikova, S.M., 2018, Potential of irrigated agriculture is the basis of sustainable functioning of the sector, *Agrarian scientific magazine*, 7: 88-91.
- [7]Nesmyslenov, A.P., Pototskaya, L.N., Shelenok, A.V., *et al*, 2017, Increase in effectiveness of agricultural land use in irrigated agriculture, in the monograph Zavorotin E.F. and others: Organizational and economic mechanism of sustainable development of agro-industrial complex and rural territories in the Volga region, *VRIOAIC*, pp. 55-82.
- [8]Noses, V.V., 2005, Concept and content of stability of agricultural production, *Scientific notes of the Russian state social university*, Vol. 1: 105-113.
- [9]Official site of the Food and Agriculture Organization of the United Nations (FAO), Strategic work of FAO on increase in stability of production of food and farming, 2017, FAO: 28, <http://uni-sz.bg/truni11/wp-content/uploads/biblioteka/file/TUNI10015719.pdf>, Accessed on July 5, 2018.
- [10]Portal of Department of melioration of the Ministry of Agriculture of the Russian Federation, 2018, <http://mcx-dm.ru>, Accessed on March 23, 2018
- [11]Revazov, B.V., 2007, Application of Cobb-Douglas production function as element of effective management of sustainable development of the enterprise, *Economic bulletin of the Rostov state university*, 4 (Vol. 5, P. 3): 310-315

[12]Silayeva, L., Kharitonova, T., Alekseeva, S., 2017, Technique of assessment of resource potential in the agricultural organizations, Rural economics of Russia, 6: 72-77.

[13]The decree of the President of the Russian Federation No. 440, 01.04.1996, About the Concept of transition of the Russian Federation to sustainable development, the current version, <http://kremlin.ru/acts/bank/9120>, Accessed on October 23, 2018.

[14]Tolmachev, M.N., 2011, Problems of creation of production functions in the Russian agriculture, <http://cyberleninka.ru/article/n/problemy-postroeniya-proizvodstvennyh-funktsiy-v-rossiyskom-selskom-hozyaystve>, Accessed on October 23, 2018.

[15]Vasilyeva, N.K., 2005, Methods of assessment of stability of production in the agrarian sector, Economic bulletin of the Rostov state university, Vol. 3 (4): 93-97.

[16]Ward, F.A., 2012, Financial mechanisms in irrigated agriculture, Financing of water resources management and infrastructure in agriculture of the countries of the OECD, [http://www.cawater-info.net/library/rus/carewib/financial\\_mechanisms\\_1.pdf](http://www.cawater-info.net/library/rus/carewib/financial_mechanisms_1.pdf), Accessed on September 20, 2018.

## QUALITY EVALUATION OF ORGANIC DAIRY PRODUCTS IN RELATION TO THE CONVENTIONAL

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### **Abstract**

*In this paper proposes assessment of the quality of milk products from two perspectives, conventional and organic products. In the first part of the paper, by studying literature, will bring attention to their views about the relationship between prejudice and conventional and organic products in terms of quality and price. The main research methods used throughout the paper method will be: SAIN-LIM, with which it will be able to appreciate the level of quality of such products and the method of comparative analysis of the results obtained after calculating the two indicators. In the second part will choose a product ecological and conventional for several categories of dairy products to determine the value of the indicators described above. Thus, with the help of these results can appreciate differences in terms of the quality of certain conventional and ecological products and their impact on population health.*

**Key words:** quality, dairy products, conventional, organic

### **INTRODUCTION**

The concept of quality is a term that is used in all fields with different meanings, corresponding to each of them; the meanings of this concept are philosophical in nature, economic, technical, social, and last but not least the nature of logic [9]. So we can say that between the quality and the consumer are relationships of interdependence which is why the quality of a product is determined by the characteristics that it possesses [4].

Consumer demands determines the evolution of quality and for this reason these demands must be fulfilled in order to permanently achieve products offering the final consumer satisfaction and generate profit in time [7].

The food industry must maintain high-quality standards and to ensure the safety of agri-food products to meet consumer needs, regarding purchase decisions and to identify their preferences for food high quality and affordable price [1].

Organic agriculture is based on a principle well founded in that health is placed above all the health of soil, plant, animal, and the inhabitants of the planet, and its conventional

farming relies on a major objective, which is to maximize productivity and hence profitability [10]. Increasing agricultural productivity to feed the growing population without soil deterioration, water quality and the environment is a critical necessity that people face on a daily basis [6].

Organic foods are products of animal or plant origin, which have been produced without the use of chemicals such as pesticides or herbicides, without synthetic additives substances from their processing, non-genetically modified and which have not been exposed radiation, and their benefits are equal for the health of the consumer, but also for the environment, which does not suffer as a result of technological processes [2].

One of the differences between organic and conventional food may be how they are grown, produced and processed, and with regard to specific rules regarding what is considered environmentally friendly product or conventional may vary depending on the region [8].

The dairy industry has two main production areas: the first production area is the primary production of dairy farms, the keeping of

cows, goats for the production of milk for human consumption, and the second area of production is the processing of milk, ranging from processing to sellable life [5].

The food supply chain quality issue has received considerable attention in recent years in the dairy industry, quality and safety problems occur more frequently in the upstream supply chain, such as milk sources. The quality of dairy products directly affects the health and safety of consumers, the image of the branded product, but also the competitive advantage and sustainable development of the dairy supply chain [3].

## MATERIALS AND METHODS

For assessing the quality of organic products and conventional labels have been studied to 12 products. Use of SAIN-LIM can achieve nutritional profile, such as evaluation and quality of organic products and sanogenetic conventional.

According to [11], the calculation of the method SAIN-LIM is:

$$SAIN = \frac{\sum_{i=1}^n ratio_i}{n} * 100$$

$$ratio_i = \left[ \frac{nutrient_i}{RV_i} \right] * \frac{100}{E}$$

Acceptability threshold established for the SAIN indicator is over 5 units. The nutrient i is composed of all positive nutrients, RVi represents recommended requirements, n is the number of positive nutrients, and E is the energy value of the product.

$$LIM = \frac{\sum_{j=1}^3 ratio_j}{3}$$

$$ratio_j = \left[ \frac{nutrient_j}{MRV_j} \right] * 100$$

The threshold of acceptability for this indicator, LIM, is over 7.5 units. The nutrient j is composed of a negative impact all nutrients, and MRVj represents the maximum volume recommended for that nutrient.

By analysing possible situations in which you can wrap foods, depending on the method SAIN-LIM, 4 main categories:

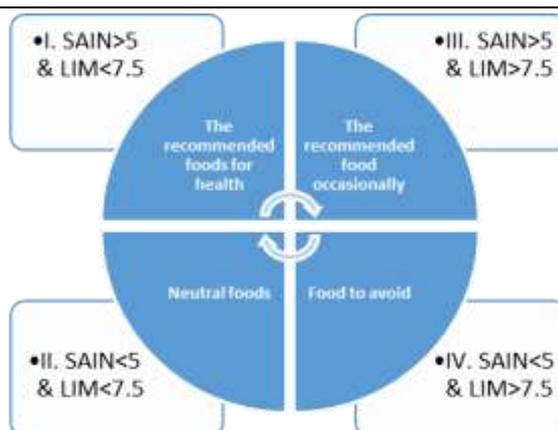


Fig. 1. Classification of products in four categories SAIN-LIM

Source: own processing based on Voinea *et al* (2015).

## RESULTS AND DISCUSSIONS

As was noted previously, have been assessed twelve products in the dairy category, divided into conventional products and organic products, 6 for each of the categories, which are: milk, yogurt, kefir, butter, feta cheese, and cow's milk cheese. These products have been chosen because it was easier to find the equivalent of these organic products category. Centralization of data taken from the label the nutritional content, energy value, but also other aspects is contained in table 1.

Table 1. Distribution of respondents by age depending on gender

Existing information on labels	Energy value (kcal)	Protein (g)	Carbohydrates (g)	Fat (g) / saturated	Fiber (g)	Salt(g)	Vitamins/ Minerals
<b>Conventional Products</b>							
Milk	45	3.3	4.5	1.5/0.9	0	0.06	125mg Ca
Yogurt (3.5%)	59	3.2	3.7	3.5/2.1	0	0.06	125mg Ca
Butter	744	0.6	1	82/56.6	0	0.03	
Kefir	57	3.2	3.6	3.3/2	0	0.1	
Feta Cheese	283	16	0.2	24.3/15.5	0	3	
Cow's cheese	261	15	0.7	22/15.4	0	2.2	
<b>Organic Products</b>							
Milk (1.5%)	44	3.2	4.5	1.5/0.9	0	0.06	125mg Ca
Yogurt (3.5%)	61.5	3.3	4.2	3.5/3	0	0.13	125mg Ca
Butter	743	0.7	0.6	82/53.9	0	0.03	
Kefir	57	3.4	4.1	3/2.5	0	0.1	
Feta Cheese	288	17	0.03	24.4/17.7	0	2.8	
Cow's cheese	277	17	0.15	23/15.2	0.8	4	

Source: Own calculation.

For both conventional milk and conventional yogurt and for milk and yoghurt ecological environmentally friendly have been taken into account and the content of vitamins and minerals.

For the determination of indicators of SAIN and LIM were calculated average values of nutrients with positive and negative impact of recommended daily.

As a result of the calculations of the two indicators, for conventional dairy products were obtained the following results shown in Figure 2.

Thus, the SAIN indicator is 15.52% for milk, 11.84% for yogurt, 7.02% for kefir and the LIM indicator is 4.61% for milk, 5.90% for yogurt, 5.85% for kefir, these are recommended for conventional health products, because they both indicators correspond to allowable values.

Because the SAIN indicator is 0.10% and the LIM indicator is 86.55%, butter is a conventional product avoided.

Because the SAIN indicator is 7.07% for feta cheese and 7.18% for cow's milk cheese, and the LIM indicator is 36.12% for feta and 32.97% for cow's cheese, these conventional dairy products are recommended.

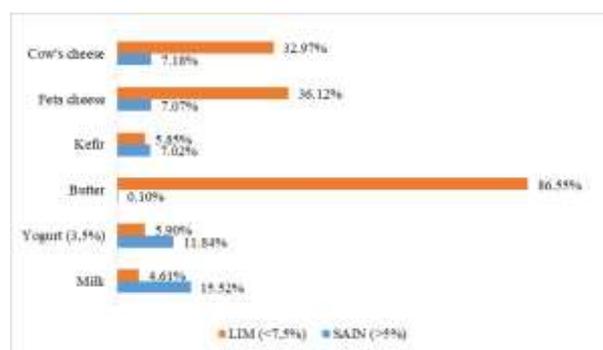


Fig. 2. Conventional dairy products

Source: own processing after calculating indicators SAIN-LIM

As regards the results of the method SAIN-LIM, for organic dairy products were obtained the following results shown in Figure 3.

The SAIN indicator is 15.87% for milk and 7.46% for kefir, and the LIM indicator is 4.61% for milk and 6.94% for kefir, these organic products are recommended for our health, since both indicators have acceptable values.

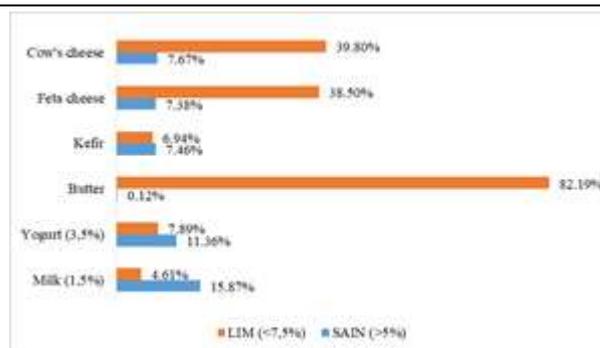


Fig. 3. Organic dairy products

Source: own processing after calculating indicators SAIN-LIM

Because the SAIN indicator, the butter has the value of 0.12% and for LIM indicator, the value is 82.19%, butter is a product of avoided.

Because the SAIN indicator is 11.36% for yogurt, is 7.38% for feta cheese and 7.67 % for cow's cheese and the LIM indicator is 7.89% for yogurt, is 38.50% for feta cheese and 39.80% for cow's cheese, these organic dairy products are featured occasionally.

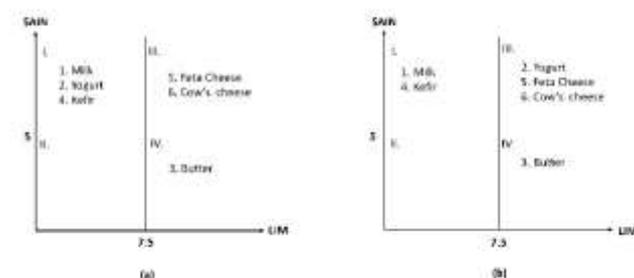


Fig. 4. Classification of dairy products in four categories SAIN-LIM

(a)-Conventional dairy products; (b)-Organic dairy products

Source: own processing after calculating indicators SAIN-LIM

Differences between conventional dairy products and organic dairy products, as regards indicators of SAIN-LIM, are quite different depending on the product. The organic milk has made a favorable difference compared to the conventional, having an increase of 0.35 percentage points for the SAIN indicator and the LIM indicator remained at the same value. The conventional yogurt has seen a difference favourable compared with organic yoghurt, with higher value of the SAIN indicator of 0.48 percentage points, while the LIM indicator is

below the recommended limited in relation to the yogurt. The organic butter recorded a favourable difference of 0.2 percentage points for SAIN indicator and the LIM indicator was reduced by 4.36 percentage points. The other three products, the kefir, the feta cheese and cow's cheese have recorded similar differences between conventional and organic products, for the SAIN indicator these differences are favourable (increase) and for the LIM indicator are unfavourable differences (increase).

## CONCLUSIONS

The study wanted to examine differences in nutritional point of view, for two sets of dairy products, one conventional and one ecological. Thus centralizing data on tags nutritional products concerned and analysing them through method SAIN-LIM were recorded relative nutritional differences.

Ranking the products analysed in the four possible categories, you can observe the differences between the two systems, from the very beginning. For conventional products: in the first category (healthy) were ranked the milk, yogurt and kefir; in the third class (featured products occasionally) were registered feta cheese and cow's cheese; butter being the only food "to be avoided". For organic products, the situation is about the same, just that yogurt has gone from "healthy products" to the class "featured products" on an occasional basis.

Contrary to expectations, not all organic products have registered positive values of the two indicators in relation to conventional products, namely, only milk and butter have registered favourable values compared to conventional ones. The organic yogurt has recorded a negative difference in comparison with conventional; and other products, the kefir, the feta cheese and the cow's cheese recorded the favourable differences only for SAIN indicator, not for the LIM indicator.

## REFERENCES

[1]Biano, A., 2017, Applications of hyperspectral imaging for quality assessment of liquid based and

semi-liquid food products: A review, *Journal of Food Engineering*, Vol. 210:10.

[2]Cireș, V., 2009, Alimentele ecologice nu vor lipsi de pe masa moldovenilor (Organic food will not be absent from the table of Moldovans), *Information and Analytical Bulletin - Agency for Innovation and Technology Transfer of the Academy of Sciences of Moldova*, pp.10.

[3]Ding, H., Fu, Y., Zheng L., Yan Z., 2018, Determinants of the competitive advantage of dairy supply chains: Evidence from the Chinese dairy industry, *International Journal of Production Economics*, <https://doi.org/10.1016/j.ijpe.2018.02.013>, <https://www.sciencedirect.com/science/article/pii/S0925527318301026>, Accessed on Jan.5, 2019.

[4]Grigoraș, M., 2017, Nutritional imbalance –behavior tendency of the young generation of consumers *Journal „Economica”*, no.2 (100), pp.24-35, [http://www.ase.md/files/publicatii/economica/2017/ec\\_2017\\_2.pdf](http://www.ase.md/files/publicatii/economica/2017/ec_2017_2.pdf), Accessed on Jan.5, 2019.

[5]Mahath, C.S., Mophin Kani, K., Dubey, B., 2019, Gate-to-gate environmental impacts of dairy processing products in Thiruvananthapuram, India, *Resources, Conservation & Recycling*, Vol.141:40-53.

[6]Mostofa Amin, M.G., Karsten, D. H., Veith, L. T., Beegle, B. D., Kleinman, J. P., 2018, Conservation dairy farming impact on water quality in a karst watershed in North Eastern US, *Agricultural Systems*, Vol.165, 187-196.

[7]Pascu, E., 2014, Noțiuni privind calitatea produselor și serviciilor (Notions regarding the quality of products and services), 2nd Edition, Universitara Publishing House, Bucharest, Romania, pp.13

[8]Popa, M. E., Mitelut, A. C., Popa, E. E., Stan, A., Popa, V. I., 2018, Organic foods contribution to nutritional quality and value, *Trends in Food Science & Technology*, <https://doi.org/10.1016/j.tifs.2018.01.003>.

[9]Ștețca, G., Mocuța, N., Pop, A., 2012, Strategii de management privind calitatea alimentelor (Management strategies regarding food quality), Risoprint Publishing House, Cluj-Napoca, Romania, pp.6

[10]Ursu, A., Șurcă, E., Petre I., 2017, Indicatorii ai eficienței economice pentru agricultura convențională și ecologică (The indicators of economic efficiency for conventional and organic agriculture), ASE Publishing House, Bucharest, pp.10

[11]Voinea, L., Popescu, D.V., Negrea, M.T., 2015, Good practices in educating and informing the new generation of consumers on organic foodstuffs, *Amfiteatru Economic*, Vol.17(38):357-375.

## CHEMICAL AND MICROBIOLOGICAL STUDY FOR THE WATERS OF LAKE BRĂTENI

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### Abstract

*The present paper is a study of the water quality sampled from Brăteni Lake and the streams near the lake. The analysis targets the microbiology via DNA extraction, PCR and sequencing of DNA fragments and the chemistry through nitrate and ammonium determination. For the quantification of bacteria present in water samples, 3 culture media were used: R2A for oligotrophic microorganisms, Standard I as a complete medium and Burks for nitrogen fixing bacteria enrichment. The identified bacteria included, Pedobacter, Streptomyces, Bacillus, Flavobacterium and Sphingobacterium. Nitrate and ammonium had higher concentrations in one of the streams near the lake. The results highlighted a close link between land use and lake water quality, agricultural activity having a strong influence on water quality.*

**Key words:** Brăteni Lake, water quality, microbiology, DNA extraction, nitrate

### INTRODUCTION

The available freshwater resources of the planet are starting to become scarce. The European Union makes considerable efforts in protecting them [11], e.g. with the Water Framework Directive that is an important document in this direction [3]. Water is one of the most important and protected resources in the EU and worldwide, inducing studies on physiochemical water quality [9], [1]. The environmental system can be defined and understood by knowing the microorganisms present in the study area [4]. Some more chemically distinct media (alkaline, acidic) have a specific diversity of microorganisms that can create an endemic system [14]. Other studies placed a rather large emphasis on the microbiological composition, the bacteria being an important consumer of organic matter and implicitly a regulating factor of water quality [6]. The microbiological water quality can influence the fauna in the studied water body [5]. An important influence on

water quality is the human activities around the water body [8]. In particular, the land use is an important factor for the chemical and microbiological components controlling the surrounding water quality [16]. A preliminary study conducted during November 2015 and April 2016 pointed to intermediate nitrate pollution in the studied water body [10].

### MATERIALS AND METHODS

#### Study area

The studied lake is in the northern central part of Romania. It is located in the Transylvanian Depression and covers approximately 25 ha. The studied area is under a moderate continental climate. The rainfall regime varies between 600 - 650 mm/year and the average annual temperature is just above 8°C [2]. The land surrounding the lake is used for agriculture with some of the streams that supply water to the lake (Fig.1) receiving inflow from agricultural fields. The fauna and flora of the lake is rich and representative for

the studied area. The riparian vegetation surrounding the lake provides excellent shelter for the lake fauna consisting of many fish and amphibian species. The most common fish species found in this lake are: *Carassius gibelio*, *Abramis brama*, *Cyprinus carpio*, *Aristichtys nobilis*, *Silurus glanis*, *Perca fluviatilis*, *Lepomis gibbosus*, *Hypophthalmichthys molitrix* and *Scardinius erythrophthalmus*.

### Methodology

Water samples were collected from Brăteni Lake and the streams near the lake (Fig.1). Points P1, P2 and P3 were sampled from the lake surface and points P4 - P7 were located in the creeks near the lake, while point P8 was downstream from the lake. The water samples were collected in February 2017 in sterile

polyethylene containers of 500 mL. For all water samples, nitrate and ammonium concentrations were measured (Sera Kit, Hamburg, Germany; readout with Genesys Spectrophotometer Thermo Fisher, Waltham, USA). To perform microbiological analyses, three media including Standard I (Roth, Karlsruhe, Germany), R2A [12] and Burks [13] for plating dilutions of up to  $10^{-3}$  in triplicates. Pure cultures were obtained after taking the number of colonies per mL. After DNA extraction with Chelex [7], PCR (primers 27f:5'AGAGTTTGATCCTGGCTCAG3' and 1492r:5'ACGGCTACCTTGTTACACTT-3') was performed [15]. Sequencing (GATC, Cologne, Germany) yielded phylogenetic determination performed by comparison to known sequences (NCBI Genbank, USA).

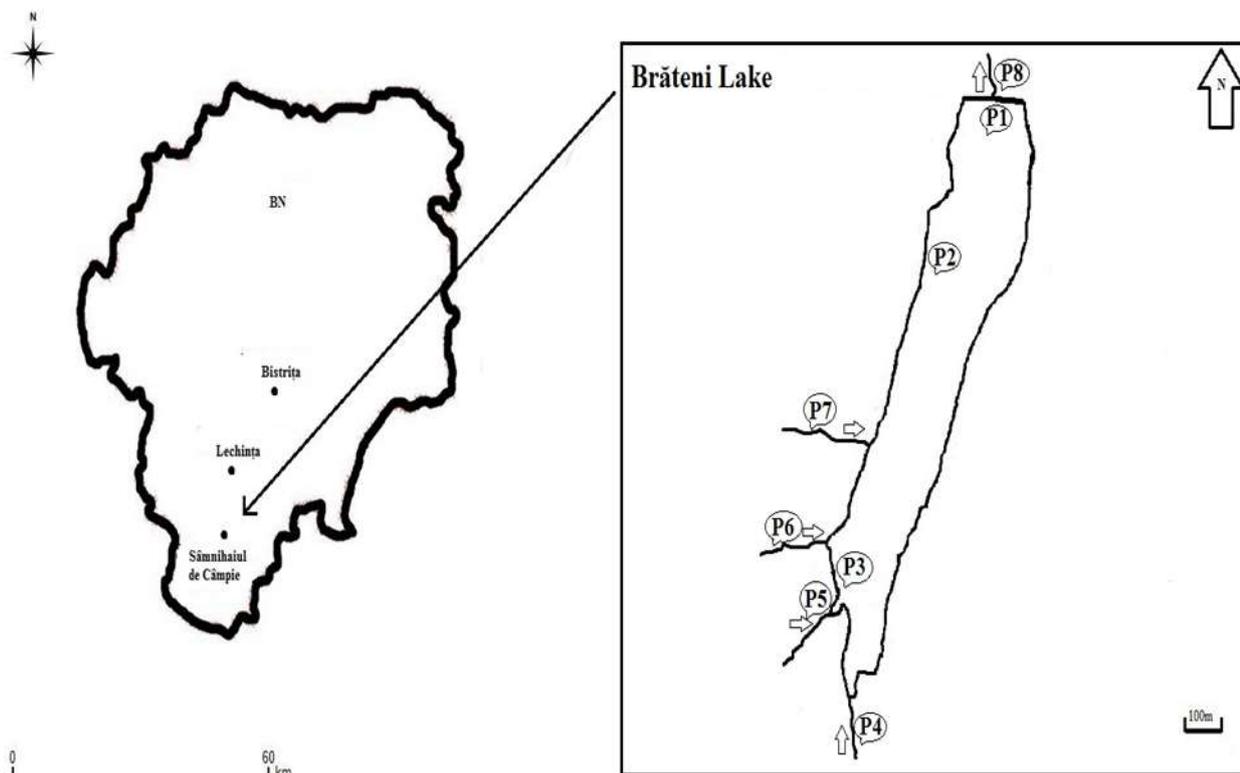


Fig. 1. The study area with sampling points (P1 – P8).  
Source: Own determination

## RESULTS AND DISCUSSIONS

The colonies obtained from non-selective Std I media (Fig.2) showed that the points inside the lake (P1,P2,P3) had lower colony forming

units compared to the external sampling points, which at P5 exceeded 3,000 colonies/ml.

R2A medium is more selective and facilitates the emergence of bacteria from an aquatic

environment, which was visible in higher concentrations of colonies at the sampling site P2 in the lake, with up to 8,000 colonies/ml. Measuring point P5 yielded increased bacterial loads for the stream environment.

Burks medium allows enrichment of soil bacteria, especially including nitrogen fixing species, which was seen with higher yields for the external sampling points of the lake.

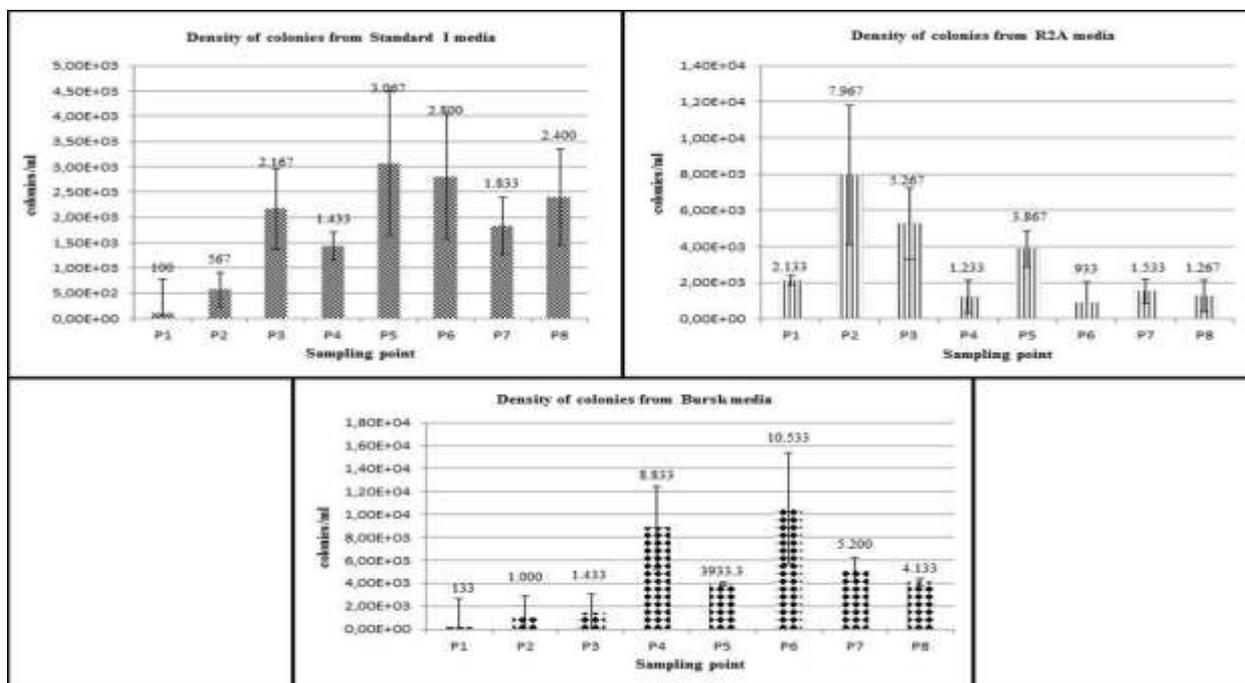


Fig. 2. Colony forming units at 8 sampling points using three different media (n=3).  
 Source: Own determination

Point P6 exceeded the concentration of 10,000 colonies/mL, followed by point P4 with a concentration of approximately 9,000 colonies/ml. The points inside the lake (P1, P2, P3) did not have values above 1,500 colonies/ml. At the points outside the lake there is a much larger bacterial presence (especially in the Standard I and Burks medium). The nitrogen fixation correlated weakly with

nitrate concentration (Fig.3) with a maximum at point P4, over 3 mg/L, exceeding Romanian legislation (Order 161/2006), which is ranked in the 3rd quality class. A low ammonium concentration in lake water was observed with a peak at point P6, above 1.4 mg/L (Fig.4). If we relate to the waters outside the lake (points P4 – P8), they fall into the 3<sup>rd</sup> and 4<sup>th</sup> quality class.

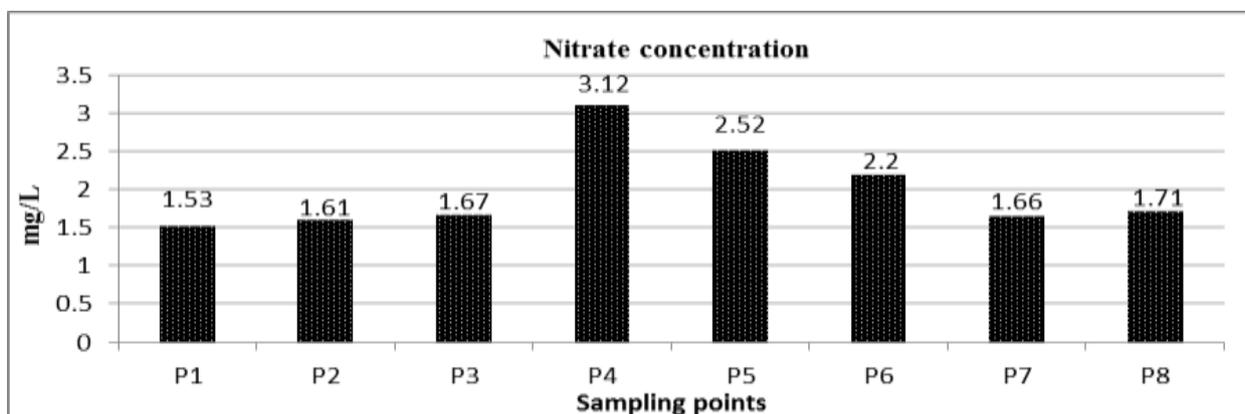


Fig. 3. Nitrate concentration (mg/L) from water samples (P1 – P8).  
 Source: Own determination

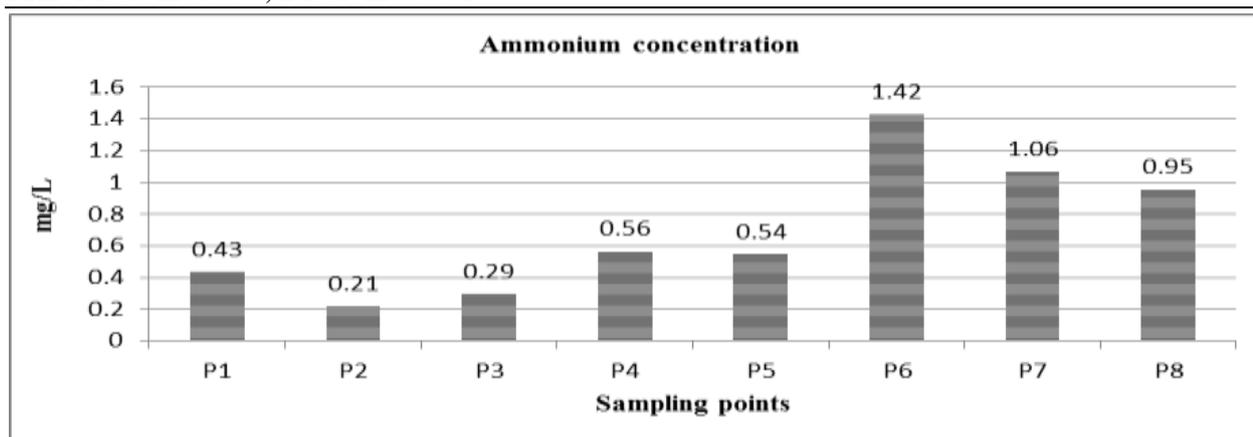


Fig. 4. Ammonium concentration (mg/L) from water samples.  
 Source: Own determination

The comparison with the Romanian legislation (Order 161/ 2006) confirms that the lake tributaries have a pronounced pollution, but the lake water still has acceptable quality for the type of use.

The isolates were phylogenetically analyzed and their next neighbors show very different habitats, none of them associated with eutrophic lakes (Table 1).

Table 1. Bacterial isolates from the different sampling points

Name of isolate	Accession number for 16S rDNA sequence of nearest neighbor	Place of discovery	Sampling point
<i>Duganella zoogloeooides</i> strain NBRC 102465	NR_114106.1		P1
Uncultured bacterium clone ncd2091d04c1	JF169117.1	Leather	P3
<i>Pseudarthrobacter</i> sp. strain MB10	KY445627.1	Soil	P3
<i>Pseudomonas</i> sp. FBF96 partial	HG805767.1		P4
<i>Pseudomonas fluorescens</i>	AB680976.1		P4
<i>Mycobacterium</i> sp. Ellin113	AF408955.1		P4
<i>Bacillus</i> sp. strain yangyueK2	KU977127.1	Soil (China)	P4
<i>Bacillus</i> sp. strain 70015	MF045082.1	Ocean sediment in Bohai Bay (China)	P4
<i>Plantibacter</i> sp. strain BAV2857	KY074037.1	Rain in Montgomery (USA: Blacksburg, VA)	P4
<i>Flavobacterium</i> sp. WB2.1-19	AM934633.1	Harsh water brook (Germany: Westenhoefer Bach)	P4
<i>Variovorax</i> sp. HP3O1	KM187456.1	Amphibian <i>Pseudacris crucifer</i>	P5
<i>Pseudomonas</i> sp. 41110	KC834307.1	Rhizosphere	P5
<i>Streptomyces</i> sp. WP-XU-1-2	KC555534.1		P5
<i>Pseudomonas lini</i> strain 48C10	KT695832.1	Soil (Wisconsin)	P5
<i>Rahnella aquatilis</i> strain CZ-BHG006	KT765843.1	Fecal (China: Qinghai Lake)	P5
<i>Sphingobacterium</i> sp. THG-CR32	KF999712.1	Artichoke tea (South Korea)	P6
<i>Pedobacter agri</i> strain YF28-3(1)	KT369848.1	Mount Qilian (China)	P6
<i>Paenibacillus polymyxa</i> strain ATCC	CP011420.1	Soil (Belgium)	P6
<i>Variovorax</i> sp. SAP777.1	JX067694.1	Floral nectar	P7
<i>Pseudomonas</i> sp. DRE-2009-B3	FM956661.1	Phenol (United Kingdom: West Midlands)	P7
<i>Flavobacterium</i> sp. I	KF555636.1	Soil	P7
<i>Pedobacter terrae</i> strain QT16	GU385862.1	Soil (China: Qinghai-Tibet)	P7

Source: Own determination.

In this points is an important variety of bacteria, but most of these bacteria are normal occurrence in the soil. A few examples from our research are: *Pseudomonas* sp., *Pedobacter terrae*, *Pseudomonas lini*., *Bacillus* sp., *Paenibacillus polymyxa*., *Pseudarthrobacter*

sp., *Flavobacterium* sp.

## CONCLUSIONS

The lake receives water with higher concentrations of nitrate and ammonium.

These potentially harmful substances are diluted in the lake water. At the same time, the tributaries also carried higher bacterial loads, many of which are related to soil-specific clades. Their presence in the water bodies thus might indicate agricultural input into the eutrophic lake. The highest number of isolates on R2A medium from points within the lake (P1, P2, P3), show that dilution of nitrate coincides with lower abundance of bacteria.

The creeks have a semi-permanent character and at least part of the year they do not represent a habitat for typical water body associated bacteria.

The presence of many soil bacteria as seen from isolation with Burks medium revealed that specifically sampling point P6 shows large influence of soil, possibly by erosion processes during winter. According to the results presented here, an adverse effect of the agricultural activity around the lake on water quality could be seen combining chemical and microbiological analyses. Specifically, the nitrate and ammonium concentrations necessitate further monitoring, especially for the creeks.

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## REFERENCES

- [1]Awang H., Daud Z., Hatta M., 2015, Hydrology Properties and Water Quality Assessment of the Sembrong Dam, Johor, Malaysia, *Procedia - Social and Behavioral Sciences*, Vol. 195: 2868 – 2873.
- [2]Bâca I., Onofreiu A., 2016, County Bistrita-Nasaud: historical and geographical coordinates, Book in Romanian, 15 p., Cluj-Napoca.
- [3]ECC (European Community Commission), 2000 Commission Directive 2000/60/EC of the European Parliament and the Council establishing the framework for community action in the field of water policy. Off. J. Eur. Union, OJL 327.
- [4]Giampaoli, S., Alessandrini, F., Frajese, G.V., Guglielmi, G., Tagliabracci, A., Berti, A., 2018, Environmental microbiology: Perspectives for legal and occupational medicine, *Legal Medicine*, Vol. 35: 34-43.
- [5]Klapper, R., Meyer, C., Kuhn, T., Karl, H., 2017, Food safety aspects of fresh Nile perch (*Lates niloticus*) fillets from Lake Victoria imported to the European market: Helminth parasites and microbiological status, *Food Control*, Vol. 78: 311-316.
- [6]Lew, S., Glinska-Lewczuk, K., Burandt, P., Obolewski, K., Gozdziejewska, A., Lew, M., Dunalska, J., 2016, Impact of environmental factors on bacterial communities in floodplain lakes differed by hydrological connectivity, *Limnologia*, Vol. 58: 20-29.
- [7]Lu, S., Goering, M., Gard, S., Xiong, B., McNairn, A.J., Jaspersen, S.L., Gerton, J.L., 2010, Eco1 is important for DNA damage repair in *S. cerevisiae*, *Cell Cycle*, Vol. 9(16): 3335-3347.
- [8]Mendoza, R., Silva, R., Jiménez, A., Rodríguez, K., Sol, A., 2015, Lake Zirahuen, Michoacan, Mexico: An approach to sustainable water resource management based on the chemical and bacterial assessment of its water body, *Sustainable Chemistry and Pharmacy*, Vol. 2: 1-11.
- [9]Nazeer, S., Hashmi, M.Z., Malik, R.N., 2014, Heavy metals distribution, risk assessment and water quality characterization by water quality index of the River Soan, Pakistan, *Ecological Indicators*, Vol. 43: 262-270.
- [10]Nicula, A.M., Roba, C., Pistea, I., Rosu, C., 2017, Assessment of water quality from Brăteni Lake, Bistrița-Năsăud County, *Carpathian Journal of Earth and Environmental Sciences*, Vol. 12(2): 365 – 370.
- [11]Palma, P., Fialho, S., Alvarenga, P., Santos, C., Brás, T., Palma, G., Cavaco, C., Gomes, R., Neves, L.A., 2016, Membranes technology used in water treatment: Chemical, microbiological and ecotoxicological analysis, *Science of the Total Environment*, Vol. 568: 998-1009.
- [12]Reasoner, D.J., Geldreich, E.E., 1985, A new medium for the enumeration and subculture of bacteria from potable water, *Applied and Environmental Microbiology*, Vol. 49(1): 1-7.
- [13]Subba Rao, N.S., 1977, Soil microorganisms and plant growth, Oxford and IBH, New Delhi, 1-19.
- [15]White, T., Bruns, T., Lee, S., Taylor, J., 1990, Amplification and direct sequencing of fungal ribosomal RNA Genes for phylogenetics, Academic Press, pp.315-322.
- [14]Tiago, I., Veríssimo, A., 2013, Microbial and functional diversity of a subterrestrial high pH groundwater associated to serpentinization, *Environmental Microbiology*, Vol. 15(6): 1687-706.
- [15]White, T., Bruns, T., Lee, S., Taylor, J., 1990, Amplification and direct sequencing of fungal ribosomal RNA Genes for phylogenetics, Academic Press, pp.315-322.
- [16]Zablotowicz, R.M., Zimba, P.V., Locke, M.A., Knight, S.S., Lizotte, Jr. R.E., Gordon, R.E., 2010, Effects of land management practices on water quality in Mississippi Delta oxbow lakes: Biochemical and

microbiological aspects, Agriculture, Ecosystems and Environment, Vol. 139(1-2): 214–223.

## TECHNICAL EFFICIENCY OF SMALLHOLDER POULTRY FARMERS IN AKURE SOUTH LOCAL GOVERNMENT AREA, ONDO STATE, NIGERIA

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### Abstract

*The study examined the technical efficiency of smallholder poultry farmers in Akure South Local Government Area, Ondo State, Nigeria. The study used a multi-stage sampling procedure to select eighty respondents with the aid of structured questionnaire. The primary data collected were analysed using descriptive statistics, budgeting analysis and the stochastic frontier production function model. Findings revealed that majority (65%) of the respondents were male. The mean age of the respondents was 40 years. About 66.3% of the respondents were married and majority (85.0%) of the respondents were literate with at least primary school education. The mean of farming experience was 7 years, indicating that most of the farmers were new entrants into the poultry business. The findings indicated that poultry production by smallholder farmers was a profitable enterprise in the study area. The results of the stochastic frontier analysis revealed that farming experience, access to credit facilities, membership of cooperative association and extension contact influenced the technical efficiency of smallholder poultry farmers in the study area. It was therefore, recommended that government should work on providing credit access to farmers while also stimulating agricultural extension programs through educational and research institutions. Also, farmers should come together often so that they can pool resources together and easily get the government's attention.*

**Key words:** efficiency, farmers, Ondo State, poultry, smallholder

### INTRODUCTION

Agriculture remains an important economic sector in many developing countries. It is a source of growth and a potential source of investment opportunities for the growing industries. However, the primary place agriculture occupies in Nigerian economy in providing food and fibre for the populace, has made it the most important sector influencing the livelihood of over 70% of Nigerians and a larger employer of labour in Nigeria (Aina and Omonona, 2012) [3]. However, the Nigerian poultry industry in particular has been rapidly expanding in recent years and is therefore one of the most commercialized subsectors of Nigerian Agriculture (USDA, 2013; Adene and Oguntade 2006) [1, 12]. The popularity of poultry production can be explained by the fact that poultry has many advantages over other livestock. Poultry birds are good converters of feed into useable protein in meat and eggs. The production costs per unit remain relatively low, and the

return on investment is high (Heinke *et al.*; 2015) [7]. Poultry refers to all birds of economic value to man. They are domesticated birds kept for eggs, meat, feathers and sometimes manure. These include: domestic fowl, turkey, pigeon, duck, geese, quail, guinea fowl, peacock and recently ostrich. They all belong to the zoological class Aves (Atteh, 2015) [5]. Smallholder poultry constitutes the most important sector, which accounts for the major poultry products supply in the developing world (Jato *et al.*, 2012) [8]. However, an attempt to utilize the full potentials of this sector has frequently failed due to the technical inefficiency which has consistently put the poultry farmers on the verge of economic redundancy and incapacitation. In the past 10 years, poultry products consumption in developing countries has increased by 5.8 percent per year, faster than the growth in population which also gave rise to increase in demand. For the supply to meet or exceed the demand for poultry

products, there should be a significant improvement in the efficiency so as to maximize the use of existing input.

## MATERIALS AND METHODS

### Study Area

The study was conducted in Akure South Local Government Area, Ondo State, Nigeria. It is located in the Southern part of Ondo State sharing boundaries with Akure North and Ifedore Local Government Areas in the North, Idanre Local Government in the South and Ondo East and Ile Oluji Local Government Areas in the West. Most of the land available to communities in the local government area is arable which is why they practise farming as the major occupation for family consumption and to meet commercial needs. The area consists largely of Yoruba-speaking people. The local government occupies a geographical area of 1,591 square kilometers with population of about 420,594 inhabitants (NPC, 2006) [9]. Its climatic condition also favours the rearing of poultry birds which are basically everywhere in the state. Research reports have however shown that poultry is more of major economic activities for people living in the rural communities that are abundant in the Akure South Local Government area of Ondo State.

### Data Source and Sampling Technique

Primary data were used for this study. The data were collected from the respondents with the aid of a structured questionnaire. Multi-stage Sampling Procedure was used for selecting the respondents used in this study. The first stage involved purposive selection of Akure South Local Government Area because of its high population. The second stage involved random selection of four (4) villages from the Local Government Area. In the final stage, 20 respondents from each village were selected to make a total of 80 respondents used for the study.

### Analytical Technique and Model Specification

Data collected were analysed with the use of descriptive statistics, budgeting analysis and econometric analysis involving the use of stochastic frontier production function model.

Descriptive statistics was used to present the socio-economic characteristics of the respondents. Budgeting analysis was used for the estimation of profitability of poultry production in the study area while the stochastic frontier production function model was used to estimate poultry farmer's technical efficiency.

### Budgeting Analysis

The Gross Margin (GM) of an enterprise is the difference between the Total Value of Production (Total Revenue) and the Total Variable Cost (TVC) of production that is (eqn. 1):

$$GM = TR - TVC$$

$$= \sum P_i Q_i - \sum C_j X_j \quad (1)$$

where:

subscripts I refers to the i-th respondents while j represents observation of the j-th variable costs

GM = Gross margin

TR = Total revenue of different poultry products in naira for i-th poultry farmers

TVC = Total variable costs involved in rearing the different poultry birds in naira for i-th poultry farmers

$P_i$  = Price per kg of each poultry bird

$Q_i$  = Quantity of the different poultry birds reared by the i-th poultry farmers

$C_j$  = Unit cost of j-th input used by the i-th poultry farmers

$X_j$  = Quantity of j-th variable input used by the i-th poultry farmers.

If  $GM > 0$ , then the farm enterprise is profitable

If  $GM < 0$ , then the farm enterprise is not profitable

The variables cost items are cost of wages paid to crew members, expenses on fuel (petrol), kerosene, oil, feed, water and maintenance/services.

The Net Revenue (NR) represents the difference between total revenue and total cost. The Net Revenue is given by (eqn. 2):

$$NR = TR - (TVC + TFC) \quad (2)$$

where:

TFC = Total Fixed Cost

TVC = Total Variable Cost

### The Stochastic Frontier Production Function Analysis (SFPFA)

The SFPF inefficiency studies were employed in this study. In the SFPF, the error term is assumed to have two components parts,  $V_i$  and  $U_i$ . The  $V_i$  covers the random effects (random errors) on the production and they are outside the control of the decision unit while the  $U_i$  measures the technical inefficiency effects, which are behavioural factors that come under the control of the decision unit.

They are controllable errors if efficient management is used. The stochastic frontier approach is generally preferred for research because of the inherent variability of entrepreneurial productions due to interplay of raw materials, sophisticated equipment and environmental failures of many firms who are small enterprises, where keeping of accurate records is not always a priority; hence, available data on production are subject to measurement errors (Ojo and Ajibefun, 2002) [10]. Also, the specification of the stochastic frontier production model is stated thus:

$$Y_i = f(X_i; \beta) \exp (V_i - U_i), i = 1, 2, \dots, n,$$

where:

$Y$  is output in a specified unit,

$X$  denotes the actual input vector,

$\beta$  is the vector of production function parameters and

$\varepsilon_i$  is the error term that is decomposed into two identically distributed with mean zero and constant variance ( $\sigma^2$ ).

$V_i$  captures the white noise in the production, which are due to factors that are not within the influence of the producers. It is independent of  $U_i$ . The  $U_i$  is a non-negative one-sided, truncation at zero with the normal distribution (Battese and Coelli, 1996) [6]. It measures the technical inefficiency relative to the frontier production function, which is attributed to controllable factors (technical inefficiency), it is half normal, identically and independently distributed with zero mean and constant variance.

The variances of the random errors ( $\sigma^2_v$ ) and that of the technical inefficiency effects ( $\sigma^2_u$ ) and overall model variance ( $\sigma^2$ ) is related thus:

$$\sigma^2 = \sigma_u^2 + \sigma_v^2 \text{ and} \\ \text{the ratio, } \gamma = \sigma_u^2 / \sigma^2 \text{ is called gamma.}$$

It measures the total variation of output from the frontier, which can be attributed to technical inefficiency (Aigner, Lovell, & Schmidt, 1992) [2].

The TE of an individual firm is defined in terms of the observed output ( $Y_i$ ) to the corresponding frontier output ( $Y_i^*$ ). The  $Y^*$  is maximum output achievable given the existing technology and assuming 100 per cent efficiency.

It is denoted as:

$$Y_i^* = f(X_{ib}) + V_i$$

$$TE = Y_i / Y_i^*$$

Also, TE can be estimated by using the expectation of  $U_i$  conditioned on the random variable ( $V-U$ ) as shown by Battese and Coelli (1996), that is:

$$TE = \frac{f(X_{ib}) + V_i - U_i}{f(X_{ib}) + V_i}, \text{ and that } 0 \leq TE \leq 1$$

The production technology of those in poultry production was developed through Cobb–Douglas frontier production function and which was further adopted and specified by Tadesse and Krishnamurthy (1997) [11] as follows:

$$\ln Y_i = \ln \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + V_i + U_i$$

$Y$  = Output (value of eggs, spent layers, market weight broilers and cockerels sold in naira)

$X_1$  = Farm size (number of birds)

$X_2$  = Cost of veterinary services (₦)

$X_3$  = Quantity of feed (kg)

$X_4$  = Labour input (man days)

$X_5$  = Capital input (₦)

$X_6$  = Cost of utilities and other expenses (₦)

$\beta_0$  = Constant terms

ln = Natural logarithm;

$V_i$  = Random error assumed to be independent of  $U_i$ . Identical and normally distributed with zero mean and constant variable  $N(0, \sigma_v^2)$ .  $U_i$  = Technical inefficiency effect which is assumed to be independent of  $V_i$ , they are non-negative truncation at zero or half normal distribution with  $N(0, \sigma_u^2)$ .  $\beta_j = \sigma^2_v, \sigma^2_u, \sigma^2$  are unknown scalar parameters to be estimated.

The inefficiency model ( $U_i$ ) is defined by:

$$U_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + \delta_6 Z_6 + \delta_7 Z_7 + \delta_8 Z_8 + \delta_9 Z_9$$

where:  $U_i, Z_1, Z_2, Z_3, Z_4, Z_5, Z_6, Z_7, Z_8, Z_9$  represent: technical inefficiency effects, marital status, gender, family size, level of education, years of experience, extension contact, credits, membership of cooperative association and distance of farm to major road.

## RESULTS AND DISCUSSIONS

### Socio-Economic Characteristics of Respondents

The results of the summary of socio-economic characteristics showed that the average age of respondents in the study area was 40 years. This implies that respondents were still within the active age which is required for farming activities. Most (65.0%) of the respondents were male while 35% of the respondents were female. This was expected given the drudgery nature, physical and energy demand as well as capital intensive nature of investment required to establish smallholder poultry farm enterprise. Most (66.3%) of the respondents were married.

Table 1 further shows that about 28.8% had secondary school education; about 15.0% had no formal education while 7.5% and 48.8% had primary education and tertiary education respectively. A huge proportion (85.0%) of the respondents had one form of western education or the other. Educational level of farms owners is very important in the management of poultry and it is known to affect their farming activities. The high

literacy level of the respondents would afford them the opportunity to understand and adopt modern farm practices thereby enhancing productivity and profitability.

Furthermore, Table 1 shows that only 5% of the respondents had between 11-20 years of farming experience in smallholder poultry enterprise and a total of 78.2% had between 6-10 years. The mean years of farming experience was found to be 7 years. This suggests that majority of the smallholder poultry farms owners in the area were fairly new entrants into the business. It is generally expected that productivity increases with years of farming experience. Experienced smallholder poultry farms owners are likely to make better decisions to enhance productivity and income.

Table 1. Socio-Economic Characteristics of the Respondents

Variable	Frequency	Percentage
<b>Sex</b>		
Male	52	65.0
Female	28	35.0
Total	80	100.0
<b>Marital status</b>		
Single	23	28.8
Married	53	66.3
Widowed	4	5.0
Total	80	100.0
<b>Age</b>		
20-29 years	10	12.5
30-39 years	23	28.8
40-49 years	36	45.0
50-59 years	9	11.3
60 and above	2	2.5
Total	80	100.0
<b>Level of Education</b>		
No formal education	12	15.0
Primary School education	6	7.5
Secondary school education	23	28.8
Tertiary education	39	48.8
Total	80	100.0
<b>Farming Experience</b>		
1-5 years	13	16.3
6-10 years	63	78.2
11 and above	4	5.0
Total	80	100.0

Source: Computed from field Survey, 2018.

### Costs and Returns of Smallholder Poultry Farmers

The Table shows the costs incurred and the profit realized by the smallholder poultry farmers in the study area. The mean of the total revenue, total variable cost and gross margin obtained in the study area were ₦5,250.85, ₦3,802.15 and ₦1,448.70 respectively. The findings indicated that poultry production by smallholder farmers was a profitable enterprise in the study area.

Table 2. Cost and Returns of Smallholder Poultry Farmers

Cost Item	Mean	Percentage
<b>Variable Cost</b>		
Stocking	222.19	5.71
Feeding	3,082.27	79.21
Labour	205.07	5.26
Vet. Service	192.23	4.94
Utility and other costs	100.39	2.58
Total Variable Cost	3,802.15	97.71
Total Fixed Cost	89.11	2.29
Total Cost	3,891.26	100
<b>Revenue</b>		
Eggs	4,528.89	86.25
Spent layer	593.06	11.2
Manure	110.35	2.10
Empty bags	18.55	0.36
Total Revenue	5,250.85	100
Net Farm Income	1,359.59	
Gross Margin = TR – TVC	1,448.70	

Source: Computed from field Survey, 2018.

### Estimates of the Stochastic Production Function

The estimates of the Cobb-Douglass stochastic production function are as presented in Table 3. The value of gamma ( $\gamma$ ) = 0.99 is statistically significant at the 5% level, which implies that 99% of the residual variation egg output was due to the inefficiency effect. Thus, the Cobb-Douglas functional form is an adequate representation of the data. Table revealed that the mean technical efficiency of 56.0% was recorded in the study area. This suggests that an average of about 56% of potential maximum output is gained due to production efficiency while the short fall (discrepancy between observed

output and the frontier output) can be attributed to inefficiencies.

The major factors affecting the output of poultry eggs were in flock size, veterinary services, feed intake and labour. The coefficient of in flock size had a positive and significant relationship with output at 1% level. This implies that poultry egg production increased with increase in number of birds kept. Similarly, the coefficient of veterinary services was positive and significant at 1% level which implies that proper management involving the provision of adequate, qualitative and timely veterinary services to the birds will improve the technical efficiency of the farmers. The coefficient of feed cost was also positive and significant at 5% level. This indicates that the higher the feed intake by the birds, the greater the technical efficiency of the farmers. Furthermore, coefficient of labour variable was positive and significant at 1% level. On the other hand, the results of the inefficiency model showed that the coefficients of years of experience, extension contact, credits and membership of cooperative association were negative and statistically significant indicating that these factors led to increase in technical efficiency of poultry farmers in the study area.

The year of experience is negatively significant at 1% level of probability which implies that farmers with more years of experience tend to be more technically efficient in poultry egg production. Continuous practice of an occupation for a long period presumably makes a person more experienced and more productive in practice. The estimated coefficient of access to credit is significant at 1% level. This suggests that smallholder poultry producers who have greater access to credit tend to be more efficient in poultry egg production. Also, the availability of credit helps to finance the purchase of feed and some expensive fixed inputs which have a positive effect on smallholder poultry production.

Furthermore, the coefficient of membership of cooperative association is negative and statistically significant at 1% level. According to Amos (2013) [4], membership of association is of immense benefits to

members, it gives opportunity for bulk purchase of inputs at discounted rates and helps members secure credit facilities as at when due. Poultry farmers that belong to one or more cooperative societies tend to be more technically efficient in their production. This is because membership of organization affords the operators the opportunity of sharing information on modern poultry egg production practices by interacting with other farmers.

Table 3. Estimates of the stochastic production function and inefficiency parameters of smallholder poultry farms

Variables	Coefficients	Std error	t-ratios
<b>General model</b>			
Constant	1.513*	0.522	2.900
In flock size	0.195*	0.077	2.536
In veterinary services	0.240*	0.069	3.499
In feed intake	0.107**	0.054	1.997
In labour	0.288*	0.035	8.197
In capital inputs	0.039	0.058	0.666
In utilities & other expenses	0.023	0.042	0.562
<b>Inefficiency model</b>			
Constant	0.623	0.823	0.769
Marital status	2.583	3.096	0.834
Gender	0.146	0.505	0.288
Family size	-0.005	0.003	-1.484
Educational level	-0.001	0.008	-0.075
Years of experience	-0.018*	0.006	-2.985
Extension contact	-0.011**	0.005	-2.240
Credits	-0.363*	0.103	-3.536
Membership of cooperative	-0.341*	0.119	-2.871
Distance of farm to major road	-0.023	0.042	-0.562
<b>Variance parameters</b>			
Sigma	0.213*	0.004	6.043
Gamma	0.999**	0.466	2.145
Log likelihood	15.731		
Mean Technical Efficiency	0.56		
Number of Observations (N)	80		

Note: \* = significant at 1%, \*\* = significant at 5%, ln= natural logarithm

Source: Computed from field Survey, 2018.

The coefficient associated with extension contact in the inefficiency function was

negative and statistically significant at 5% level, implying that the variable reduced farm's technical inefficiency. Poultry farmers who had been regularly trained and visited by extension agent, and participated in some demonstration trials tend to be more technically efficient.

### Constraints to Smallholder Poultry Production

The results of the analysis presented in Table 4 revealed the constraints to smallholder poultry production in declining order of importance in terms of severity of the challenges.

Respondents rated limited finance as the most important problem. This could be the reason why farmers could not acquire the necessary inputs especially fixed inputs for large scale production which attracts higher profit and efficiency. This is because in addition to the quantity of inputs used, the timing of input usage also affects farm output. High cost of inputs was the next most important constraints identified by the respondents. High cost of inputs makes it very difficult for existing firms to expand their scale of operation making a large number of them to stagnate in the small scale class, while new ones are reluctant to go into the business.

Stocking of poor breeds of poultry is tantamount to waste of effort because such breeds are positioned to get infected with diseases than good breeds. Poor quality day old chicks make the farms' investment less profitable if not a complete loss. Scarcity of raw materials for plants, fixtures, buildings and equipment coupled with their high cost were identified by the respondents as the 4<sup>th</sup> most pressing constraint. It can be inferred that many small-scale poultry farms probably have been compelled to close down and those still managing to survive are producing at very high cost and contending with serious inputs limitations.

The respondents in the study area pointed inadequate storage facilities as 5<sup>th</sup> most important problem to their business. The decision makers found it very difficult to purchase enough inputs especially feed which at harvest periods usually considerably cheap and available. The eggs can only be stored for

few days in which case must be disposed even when the price is not favourable in order to avoid complete loss. Marketing of products and inadequate extension services were of minor problems to the poultry industry in the study area.

Table 4. Ranking of Constraints to Smallholder Poultry Production

Constraints	Frequency	Percentage	Rank
Limited finance	72	19.3	1 <sup>st</sup>
High cost of inputs	66	17.7	2 <sup>nd</sup>
Disease outbreak	60	16.1	3 <sup>rd</sup>
Scarcity of raw materials	54	14.5	4 <sup>th</sup>
Lack of storage facilities	43	11.5	5 <sup>th</sup>
Marketing of products	39	10.4	6 <sup>th</sup>
Inadequate extension services	39	10.4	6 <sup>th</sup>

\*Multiple responses allowed

Source: Computed from field Survey, 2018

## CONCLUSIONS

The conclusion drawn from the study area shows that most of the smallholder poultry farmers were males and their age was within the economically active age which favoured the adoption of poultry farming. Most of the smallholder poultry farmers were married and highly experienced in farming because of families' inheritance. Majority engaged in poultry farming because it was a family business and to augment income from other sources. Limited finance, high costs of poultry farming inputs, disease outbreak, scarcity of raw materials, lack of storage facilities, marketing of products and inadequate extension services were the hindrances in the poultry business. Also, factors like years of farming experience, access to credit facilities, membership of cooperative associations and extension contact were seen to be very important to the technical efficiency of smallholder poultry farmers in the study area.

## REFERENCES

- [1]Adene, D.F., Oguntade, A.E., 2006, The Structure and Importance of the Commercial and Village-Based Poultry Systems in Nigeria. Food and Agriculture Organization Bulletin.
- [2]Aigner, D.J., Lovell, C.A.K., Schmidt, P., 1992, Formulation and Estimation of Stochastic Frontier Production Function Model. Journal of Econometrics. 6(2):21–37.
- [3]Aina, S.O., Omonona, B.T., 2012, Nigerian Agricultural Insurance Scheme prospect, Achievement and Problem. Global Advance Research Journal of Agricultural Science, Vol. 1(5):090 - 095.
- [4]Amos, A. P., 2013, Allocative Efficiency of Resource-Use by Cassava Farmers in Wamba Local Government Area, Nasarawa State, Nigeria; International Journal of Economic Development Research and Investment. 4(3):12.
- [5]Atteh, J.O., 2015, Theory and Practice of Poultry Production. Graphcom Publishers. Pp. 1-12.
- [6]Battese, G., Coelli, J.J., 1996, Identification of Factors which Influence the Technical Inefficiency of Indian Farmers. Australian Journal of Agricultural Economics. 6(1):48–55.
- [7]Heinke, H., Alexandra, C., Ludwig, T., 2015, The Poultry Market in Nigeria: Market Structures and Potential for Investment in the Market. International Food and Agribusiness Management Association (IFAMA). Pp 197 International Food and Agribusiness Management Review Volume 18 Special Issue A., www.ifama.org, Accessed on 7<sup>th</sup> December 2018.
- [8]Jato, N.A, Maikasuwa, M.A., Jabo, M.S., Gunu, U.I., 2012, Assessing the Technical Efficiency Level of Poultry Egg Producers in Ilorin, Kwara State: A Data Envelopment Analysis Approach. European Scientific Journal 8(27): 111.
- [9]National Population Commission, 2006, Estimated population figures. National Population commission of Nigeria, Abuja.
- [10]Ojo, S.O., Ajibefun, I.A., 2002, Effect of Training on Labor Productivity in Ondo State, Nigeria. Journal of Sustainable Agriculture and the Environment. 2(2):275–279.
- [11]Tadesse, B., Krishnamurthy, S., 1977, Technical Efficiency in Paddy Farms of Tamil Nadu. An Analysis Based on Farm Size and Ecology Zone. Agricultural Economics. 16:185–192.
- [12]USDA, 2013, Agricultural Marketing Service: Livestock, Poultry and Grain Market News. International Egg and Poultry Review, Vol.16, No.08.



## EFFECTIVENESS OF COMMUNICATION METHODS OF COMMUNITY - BASED NATURAL RESOURCES MANAGEMENT PROGRAMME IN ONDO STATE, NIGERIA

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### Abstract

*Community-Based Natural Resources Management Programme (CBNRMP) is a development effort that uses different adaptable communication methods to empowering the local people in deriving their livelihood from natural resources in a sustainable way. How effective these communication methods remain unanswered? This study examined the effectiveness of communication methods used by Community - Based Natural Resources Management Programme (CBNRMP) in Ondo State, Nigeria. A total of 216 respondents were selected for the study using multistage sampling technique. Data were analysed with frequency count, percentages, mean, and standard deviation while inferences were made with correlation analysis. The results showed that 88.4 percent of the respondents were married with the mean age of  $32.52 \pm 12.93$  years and mean household size was  $7.44 \pm 2.05$  persons. Friends and neighbour (mean = 3.59), contact farmers (mean = 3.42) and Group meetings (mean = 3.07) were the most available communication methods to the respondents while Group meetings (mean = 3.63) and friends and neighbour (mean = 3.46) were the most accessible communication methods to the respondents. Group meetings scored highest (3.50) in facilitating feedback and were found to be the most effective methods used in the programme in disseminating agricultural information. Correlation analysis shows that at  $p \leq 0.01$ , there were significant relationship between effectiveness of communication methods and availability ( $r = 0.337$ ) and accessibility ( $r = 0.196$ ). The study concluded that the most effective communication method was group meeting. It is therefore recommended that relevant stakeholders who desire to convey a development service delivery in rural areas should ensure use of group meetings based on its characteristics of availability, accessibility and feedback mechanism.*

**Key words:** Community-Based Natural Resource Management Programme, effectiveness, communication methods, socio-economic characteristics

### INTRODUCTION

In order to improve the quality of life of the rural dweller and help the community to conserve as well as enjoy the resources, the World Bank promoted a new initiative known as International Fund for Agricultural Development (IFAD)-Niger Delta Development Commission (NDDC) also referred to as the Community-Based Natural Resource Management Programme (CBNRMP) in conjunction with the Federal Republic of Nigeria. The programme is a response to a request by the Federal Government for assistance to alleviate rural poverty in the Niger Delta Region (Abia, Akwa Ibom, Bayelsa, Cross Rivers, Edo, Delta, Imo, Ondo and Rivers States) [8].

According to [18], CBNRMP is an approach under which communities become responsible for managing natural resources (forests, land, water, biodiversity) within a designated area. Community-based natural resources management programme was launched and took off in Nigeria on 6<sup>th</sup> July 2005 and scheduled for completion on 30<sup>th</sup> September, 2013 but it was extended till September, 2015 in response to the request of the Federal Government of Nigeria (FGN).

Ondo State CBNRMP was established in July, 2006 and implemented using Community Driven Development Approach whereby the participating Local Government Councils (LGCs) and the benefiting Communities with technical support from the FGN/NDDC, the State, NGOs and CBOs supported initiatives

identified and developed by the rural community, with active participation of women, youth and other vulnerable groups. According to [9], the programme encourages the rural poor to participate in development activities and the objective of the programme was to reduce tensions and conflict by improving employment opportunities for young people and channelling their energies into the development of sustainable livelihoods and natural resource management activities. However, a lot of development programmes have been organised in order to improve the quality of life and standard of living of rural dwellers by successive governments in Nigeria using rural development approach. Among such programmes are the Agricultural Development Programme (ADP) 1974, Operation Feed the Nation (OFN) 1976, Green Revolution (GR) 1979, Directorate of Food, Roads and Rural Infrastructure (DFRI) 1986, FADAMA I, 1993, National Economic Empowerment for Development Strategy (NEEDS) 2004, among others. But, the findings of [3] revealed that some rural communities still appear to be underdeveloped despite the development efforts made by successive government with their collaboration with international donor agencies to ensure development of rural areas. According to [12], information is regarded as one of the most valuable resource in agriculture and rural development programmes. However, Nigerian farmers have not felt the impact of agricultural innovations because they do not have access to required information that could boost their productivity [7]. Therefore, the information aspects and communication method used by any development programme is germane to its success, and for the beneficiaries to understand what the programme is set to do and for them to see it as their own, there must be effective communication between the implementers and beneficiaries of the programme. In the submission of [16], the effectiveness of communication methods is measured by their ability to change a static situation into a dynamic one. [5] reported that interpersonal contact methods (e.g. farm

visits, method and result demonstrations, group meetings) were mostly employed and found more effective than the mass media methods (e.g. radio, television, village instructional board) in disseminating improved agricultural technologies to farmers in Lagos State, Nigeria. The Community-Based Natural Resources Management Programme (CBNRMP) is a development effort that used different communication methods to empower the local people in Ondo State in deriving their livelihood from natural resources in a sustainable way. How effective these communication methods were remain unanswered, hence this study.

It specifically described the personal and socio-economic characteristics of respondents; identified the communication methods used in CBNRMP in the study area; determined the characteristics of the communication method used, examined the effectiveness of communication methods used by the programme and determined the relationship that exist between socio-economic characteristics of the beneficiaries and effectiveness of communication methods.

## MATERIALS AND METHODS

The study was conducted between May and December 2017 in Ondo State, Nigeria. The State lies between latitudes 6°00' and 8°45' North and longitudes 5°30' and 6° East in Southwest Nigeria [11].

Ondo State occupies a landmass of about 15,000 Square kilometres with a population 4,011,407 people [14]. Multistage sampling procedure was used to select respondents for the study. The programme covered nine Local Government Areas (LGAs) within the two agricultural zones such as (Ilaje, Ese-Odo, Irele, Okitipupa, Odigbo, Ile-Oluji, Ondo East, Ifedore and Idanre). Proportionate sampling procedure was used to select 70 percent of the total number of LGAs that participated in CBNRMP to give six LGAs in all. Then all the three communities which participated in the programme in each selected LGAs were chosen to give a total of 18 communities. At the final stage, 12 respondents were selected from each selected

communities through snow- ball sampling technique, giving a sample size of 216 respondents. Three indicators were used to measure the characteristics of the communication methods as used by [4]. They were: availability, accessibility and mode of feedback of the communication methods.

The mean score and the standard deviation was used to group the effectiveness of the communication methods used by the respondents into three categorised as highly effectiveness, moderate effectiveness and low effectiveness. Effectiveness score of between mean score plus one standard deviation and above were ranked high, those with score between mean score minus one standard deviation and below were ranked low and those scores between highly effective and low levels were ranked moderate. Pre-tested and validated interview schedule was used to elicit relevant quantitative data on socio economic characteristics of the respondents, communication methods, characteristics and effectiveness of the communication methods from the respondents. Data were analysed using frequency counts, percentages, mean and standard deviation to summarised the data while Product Pearson moment correlation were used to draw inference on the hypothesis.

## RESULTS AND DISCUSSIONS

### Personal and socio-economic Characteristics of Respondents

Results in Table 1 show that 52.8 percent of the respondents were between the ages of 35 – 49 years and 25.5 per cent were between 50 – 64 years. Mean age of respondents was  $32.52 \pm 12.93$  years. These results indicate that larger proportions of the respondents were in their active age of productivity. The implication is that the respondents would actively participate in the development programme that is aimed at improving their standard of living. Most (88.4%) of the respondents were married, 5.6 per cent were single, while very view (3.7% and 2.3%) were divorced and widowed respectively.

Table 1. Distribution of respondents by personal and socio-economic characteristics

Variable s	Frequenc y (f)	Percentag e (%)	n=216
<b>Age (years)</b>			
20 – 34	31	14.4	Mean = 32.52 SD = 12.93
35 – 49	114	52.8	
50 – 64	55	25.5	
65 and above	16	7.3	
<b>Marital status</b>			
Married	191	88.4	
Single	12	5.6	
Divorced	8	3.7	
Widowed	5	2.3	
<b>Household size</b>			
below 6	113	52.3	Mean = 7.44 SD = 2.05
6 – 12	81	37.3	
Above 12	22	10.2	
<b>Major occupation</b>			
Farming	170	78.7	
Trading	21	9.7	
Artisan	10	4.6	
Civil service	15	7	
<b>Annual income</b>			
200,000 and below	48	22.2	Mean = 726,698.81 SD = 194354.67
200,001-400,000	38	17.6	
400,001-600,000	23	10.6	
above 600,000	66	30.6	
undisclosed	41	19	

Source: Field survey, 2017

The mean household size was  $7.44 \pm 2.05$  which shows they had moderate household size which could give them more time to participate fully in community development programme activities. Larger proportion (78.7%) of the respondents were farmers, 9.7 percent were traders, 4.6 percent were artisans and 7 percent were civil servants. This finding agrees with the submission of [1] that 83.3 per cent of CBNRMP participant in Ondo State were farmers by occupation. The implication is that rural dwellers are multi -tasked individuals and likely to be very busy and time conscious. In order to gain their attention and commitment to development activities or introduce innovation to them, good communication methods that will enhance

quick understanding should be employed. Mean annual income earned by the respondents was ₦726,698.81 ± 194,354.67. This value represented the annual income of the respondents on their farm activities altogether and translated to ₦60,558.23 monthly. This finding is contrary to the report of [15] which established that the mean annual income of farmers that participated in the same programme (CBNRMP) in Abia and Cross River States were ₦201, 441.00 and ₦198, 650.00 respectively. This implies that the participant of CBNRMP in Ondo State earned more income that encourages farming activities in the study areas.

**Identification of communication methods**

Results in Table 2 reveal that friends and neighbours (75.9%) and contact farmers (66.7%) were the most prominent individual methods of communication used by the programme in the study area. The result agrees with the assertion of [6] that majority of the farmer that participated in CBNRMP in Ondo State heard about the programme through friends and neighbours. This might be as a result of the settlement pattern of the people that is nucleated in nature or the lack of extension services to the people in the study area which predisposes them to scavenge for agricultural information from every available means.

Furthermore, results in Table 2 show that group meetings (73.1%) and workshop (53.6%) were the most prominent group methods of communication utilized as information source about the programme. The result indicated that many of the respondents identified more than one group methods of communication as sources of information about the programme. It can be inferred that the programme made use of different group methods of communication to disseminate agricultural information based on the goal of the programme for better understanding by the participants.

Moreover, result in Table 2 show that a little above average (56.5%) of the respondents identified bulletin as part of the mass media communication method used in the course of the programme. This is a deviation from the finding of [10] who submitted that few (5%)

of the respondents in his study area indicates print media as method of communication and majority (87%) indicate radio as method of communication. The occurrence of bulletin as the most identify mass media used in the study area might be as a result of literate level of the respondents.

Table 2. Percentage distribution of the identified communication methods used

Identified communication methods	Freq	%
<b>*Individual Methods</b>		
Friend and Neighbour	164	75.9
Contact farmer	144	66.7
Farm visit	74	34.3
Mobile phone	58	26.9
Home visit	40	18.5
<b>*Group Methods</b>		
Group meeting	158	73.1
Workshop	118	53.6
Seminar	114	52.8
Conference	50	23.1
<b>Mass media</b>		
Bulletin	122	56.5
Slide	68	31.5
Not applicable	26	12

\*Multiple responses

Source: Computed from field survey, 2017

**Characteristic of the communication methods**

Characteristics of the communication methods that were investigated in this study were availability, accessibility and the mode of feedback of the communication methods. Results in Table 3 reveal that friend and neighbour were the most available communication methods to the respondents with a score 3.59. This was followed by contact farmers ( $\bar{x} = 3.42$ ) and group meetings ( $\bar{x} = 3.07$ ). This finding agreed with that of [17] who asserted that friends and neighbours constituted the most available individual method of communication. This might due to the pattern of their settle which is nucleated in nature and can predispose the farmers to a face to face interaction among themselves. Also, the results in Table 4 show that the most accessible communication methods to the

respondents were group meetings ( $\bar{x} = 3.63$ ) and friends and neighbours ( $\bar{x} = 3.46$ ). Each scored above 3.50 out of the maximum scores of four. This implies these communication methods were always readily available at the disposal of the respondents. Furthermore, results in Table 5 reveal that the respondents indicated ‘open expression of acceptance’ as feedback to the message received through

Workshop ( $\bar{x} = 3.10$ ), Farm visit ( $\bar{x} = 2.99$ ) and group meeting ( $\bar{x} = 2.81$ ). Each of these scored above the grand mean of 2.45. The findings indicate that workshop, farm visit and group meeting as methods of communication scored highest in facilitating feedback and this help to determine the attention, comprehension and acceptance of the sender’s message by the receiver.

Table 3. Distribution of the availability of communication methods to the Respondents (n =216)

Communication Methods	NA Freq (%)	RA Freq (%)	OA Freq (%)	AA Freq (%)	Mean Score	Rank
<b>Individual method</b>						
Friend/Neighbour	—	10(4.6)	69(31.9)	137(63.4)	3.59	1
Contact farmers	—	23(10.6)	72(33.3)	119(55.1)	3.42	2
Farm visit	14(6.5)	48(22.2)	14.6(67)	8(3.7)	2.69	7
Mobile phone	47(22)	61(28)	61(28)	47(22)	2.50	8
Home visit	61(28)	110(51)	44(20.4)	1(0.5)	1.93	11
<b>Group methods</b>						
Group meeting	8(3.7)	7(3.2)	162(75)	39(18.1)	3.07	3
Workshop	23(10.6)	15(6.9)	125(58)	53(24.5)	2.96	4
Seminar	24(11)	32(14.8)	151(70)	9(4.2)	2.71	6
Conference	28(13)	10(5.0)	178(82)	0(0)	2.25	10
<b>Mass media methods</b>						
Bulletin	23(10.6)	61(28.2)	64(29.6)	68(31.5)	2.82	5
Slide	65(30)	33(15.3)	118(55)	0(0)	2.29	9

NA = Not available, RA = rarely available, OA = occasionally available, AA = Always available

Source: Field survey, 2017

Table 4. Distribution of the accessibility of communication methods to the respondents (n= 216)

Communication methods	NA Freq(%)	LA Freq(%)	MA Freq(%)	HA Freq(%)	Mean score	Rank
<b>*Individual methods</b>						
Friend and Neighbour	1(0.5)	20(9.3)	68(31.4)	127(58.9)	3.46	2
Contact farmers	1(0.5)	44(20.3)	81(37.5)	90(41.7)	3.20	4
Farm visit	23(10.6)	53(24.5)	68(31.5)	72(33.3)	2.88	6
Mobile phone	64(29.6)	83(38.4)	49(22.7)	20(9.3)	2.12	9
Home visit	99(45.8)	65(30.2)	48(22.2)	4(1.9)	1.44	10
<b>*Group methods</b>						
Group meeting	—	4(1.8)	71(32.9)	141(65.3)	3.63	1
Workshop	12(5.6)	12(5.6)	131(60.6)	61(28.2)	3.12	5
Seminar	11(5.1)	65(30.1)	103(47.7)	37(17.1)	2.77	7
Conference	119(55.1)	40(18.5)	28(13.0)	29(13.4)	1.42	10
<b>Mass media methods</b>						
Bulletin	4(1.9)	28(13.0)	89(41.2)	95(44.0)	3.27	3
Slide	16(7.4)	78(36.1)	104(48.2)	18(8.3)	2.57	8

NA = Not accessible, LA = Less accessible, MA = moderately accessible, HA = highly accessible.

Source: Field survey, 2017.

Field observation from the study shows that majority of the communication methods used by CBNRMP aid feedback and this might

contribute to their effectiveness as communication methods.

Table 5. Distribution of the respondents according to the mode of feedback of the communication methods

Communication methods	Sym. Freq(%)	CUM Freq(%)	OER Freq(%)	OEA Freq(%)	Mean	Rank
<b>Individual methods</b>						
Farm visit	18(8.0)	82(38.0)	—	116(54)	2.99	2
Contact farmer	59(27.3)	78(36.1)	4(1.9)	75(34.7)	2.44	4
Home visit	48(22.2)	111(51)	10(4.6)	47(21.8)	2.26	6
Mobile Phone	80(37.0)	74(34.3)	14(6.5)	48(22.2)	2.14	8
Friend and neighbour	85(39.4)	90(41.7)	21(9.7)	20(9.3)	1.89	9
<b>Group method</b>						
Workshop	10(4.6)	82(38.0)	—	124(57.4)	3.10	1
Group meeting	31(14.4)	73(33.8)	18(8.3)	94(43.5)	2.81	3
Conference	63(29.2)	82(38.0)	15(6.9)	56(25.9)	2.30	5
Seminar	83(38.4)	73(33.8)	—	60(27.8)	2.17	7

Grand mean = 2.45, Sym = Symbolic, OER = open expression of rejection, CUM = clear understand the message, OEA = Open expression of acceptance.

Source: Survey from field 2017.

### Effectiveness of communication methods

Results in Table 6 show the mean score of the frequency of use of each communication methods by the respondents, the number of messages received and the number of messages that had feedback through each communication source. Group meetings ( $\bar{x} = 3.50$ ) as method of communication was frequently used by the respondents to communicate on the agricultural benefit of the programme. Friend and neighbour ( $\bar{x} = 3.22$ ), workshop ( $\bar{x} = 2.88$ ), seminar ( $\bar{x} = 2.81$ ) among others were occasionally used by the respondents. Others include bulletin ( $\bar{x} = 1.81$ ), slide ( $\bar{x} = 1.77$ ), and mobile phone ( $\bar{x} = 1.68$ ) were rarely used by the respondents. Each of these methods scores below 2.50 out of the maximum score of four. Overall results indicate that group meetings as methods of communication were mostly used by the respondents to receive agricultural information and this might facilitate its effectiveness. The inference is that farmers prefer communication methods which facilitated face to face interaction between themselves and the message source to other methods that do not allow for free interpersonal discussion. Furthermore, results in Table 5 reveal that majority (87% and 70%) of the respondents received 23 and 22 messages through friends and neighbours and contact farmers respectively, many (67% and 59.7%) of the respondents received 25 and 22

messages through group meetings and workshop respectively. About 48 percent of the respondents received 12 messages through bulletin, 46.3 percent received 20 messages through seminars, and 23.1 percent received 8 messages through mobile phones while 26.8 percent of the respondents received 16 messages through conferences as methods of communication. The overall results indicated that the largest numbers of the messages received by the respondents were through group methods of communication. This implies that group methods of communication were effective in the course of the programme. This is line with the submission of [13], that group methods of communication were found to be the most effective methods in disseminating agro-forestry technologies in Uganda. Moreover, results in Table 5 reveal that many (56% and 49%) of the respondents sent 20 and 21 messages as feedback to the source through group meetings and workshop respectively; 43.9 percent and 42.5 percent of the respondents sent 18 and 15 messages as feedback to the source through contact farmers and seminars. Many (40.2%) of the respondents sent 13 messages as messages to the source through farm visit while 21.2 percent and 13.8 percent of the respondents sent 8 and 14 messages as feedbacks to the source through mobile phones and conferences respectively. The overall results indicate that group methods were more

effective because they were mostly utilize by the respondents to communicate information back to the programme officers. The findings contradicted that of [2] that mass media was effective in dissemination of agricultural technologies among farmers in Kaduna North Local Government Area, Nigeria.

Table 6. Distribution of respondents according to most frequently used communication methods

Communication method	Mean Freq of use	No of messages received	No of message with feedback
<b>Individual methods</b>			
Friend & Neighbour	3.22	23 (92)	-
Contact farmer	2.51	22 (88)	18 (72)
Farm visit	2.48	13 (52)	13 (52)
Mobile phone	1.68	8 (32)	8 (32)
Home visit	1.66	-	-
<b>Group methods</b>			
Group meeting	3.50	25 (100)	20 (80)
Workshop	2.88	22 (88)	21 (84)
Seminar	2.81	20 (80)	15 (60)
Conference	1.50	16 (64)	14 (56)
<b>Mass media</b>			
Bulletin	1.80	12 (48)	-
Slide	1.77	-	-

Source: Field survey, 2017

Further analysis in Figure 1 reveal the level of effectiveness of the communication methods used in disseminating agricultural messages to the farmers in study area. The total mean score and standard deviation obtained from the entire variable treated under objective three were subjected to further analysis which groups the effectiveness of the communication method in to three levels of highly effective, moderately effective and lowly effective. About 17 per cent of the respondents indicated a high level of effectiveness, two - third (66.7%) of the respondents indicated moderate level of effectiveness and 16.7 per cent of the respondents indicated high level of effectiveness of the communication methods used in the programme.

The overall results indicated that communication methods used by CBNRMP were on the moderate level of effectiveness.

This might be as a result of some problem encountered in the utilization of the communication methods such as long distance to place of meeting, poor mobile network and wide communication gap between group members and the leaders.

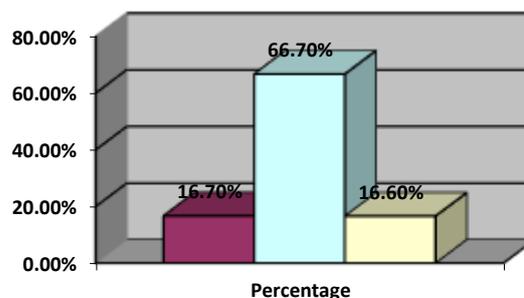


Fig. 1. Distribution of the respondents by level of effectiveness of the communication method.

Source: Field Survey, 2017.

### Correlation analysis between effectiveness of communication methods and the Characteristics of the communication methods

The results in Table 7 reveal that at 99 per cent confidence level, availability ( $r = 0.337$ ), accessibility ( $r = 0.196$ ) of the communication methods had positive and significant relationship with the effectiveness of the communication methods. Results further show that at 99 per cent at confidence level, there was negative and significant relationship between aiding feedback of the communication methods ( $r = -0.432$ ) and the effectiveness of the communication methods. This implies that the higher the availability and accessibility of the communication methods, the higher their effectiveness. With respect to aiding of feedback of the communication methods, the more the communication methods allow for feedback, the lesser their effectiveness. The contribution of availability of communication methods, accessibility of communication methods and aiding of feedback of the methods were 11.4 percent ( $r^2 = 0.1135$ ), 3.84 percent ( $r^2 = 0.0384$ ) and 18.7 percent ( $r^2 = 0.1877$ ) to the effectiveness of communication methods.

Table 7. Correlation analysis between effectiveness of communication methods and the characteristics of the communication methods

Characteristics of communication methods	r	r <sup>2</sup>	p-value
Availability of the communication methods	0.337**	0.1136	0.000
Accessibility of the communication methods	0.196**	0.0384	0.004
Aiding of feedback of the methods	0.432**	0.1866	0.000

\*\*Significant at  $p \leq 0.01$ ; \*Significant at  $p \leq 0.05$

Source: Computed from field survey 2017

## CONCLUSIONS

Majority of the respondents were married and had farming as their major occupation. Group meeting and friend and neighbour were the most available and accessible communication methods to the respondents. Workshop, farm visit and group meeting as methods of communication were major means of facilitating feedback. Group methods of communication were found to be the most effective methods used in the programme in disseminating agricultural information and the communication methods were on moderate level of effectiveness. Policy makers, donor agencies, government and non-government organizations who desire to convey a development service delivery in rural areas should ensure the selection of appropriate communication methods such as group meetings among others to reach rural dweller for better participation in development programme.

## REFERENCES

[1]Adisa, B. O., 2013, Assessing the Contribution of Community-based Natural Resource Management Programme to Environmental Sustainability in Ondo State, Nigeria. *African Journal of Environmental Science and Technology* 7(10), pp. 932-937.

[2]Ariyo, O. C., Ariyo, M. O., Okelola, O. E., Aasa, O. S., Awotide, O. G., Aaron, A. J., Oni, O. B., 2013, Assessment of the Role of Mass Media in the Dissemination of Agricultural Technologies among Farmers in Kaduna North Local Government Area of Kaduna State, Nigeria. *Journal of Biology, Agriculture and Healthcare*. 3. 19-28.

[3]Dauda, R. O. S., 2002, Rural Poverty in Nigeria. Characteristics, Dimensions and Trend: *Nigerian Journal of Rural Sociology* 4 (1): 17 – 20.

[4]Farinde, A. J. 1991, "Effectiveness of the Extension Teaching Methods Used in Disseminating Improved Agricultural Technologies in Lagos State". Unpublished M. Phil. Thesis, Obafemi Awolowo University, Ile-Ife, pp232

[5]Farinde, A. J., Jibowo, A. A., 1994, Effectiveness of extension teaching methods for disseminating improved agricultural technologies in Lagos State, Nigeria. *Journal of Agriculture, Science and Technology* 4(1): 1-9.

[6]Fayeun, T. M., 2013, Impact of Community-Based Natural Resources Management Programme on the socio economic development of Ondo State, Nigeria. Unpublished B. Agric. project. Department of Agricultural Extension and Rural Sociology. Obafemi Awolowo University, Ile – Ife.

[7]Ibrahim, A. A., Mustapha, S. B., Mamza, B. T., 2014, Assessment of Lake Chad Research Institute "Adopted Schools" for Dissemination of Improved Agricultural Technologies in Borno State and Department of Agricultural Extension Services, University of Maiduguri, Nigeria, *International Journal of Research in Agriculture and Food Sciences* 2, (5). <http://www.ijsk.org/ijrafs.html>, Accessed on 6th May, 2016.

[8]International Fund for Agricultural Development (IFAD), 2001, *The Challenge of Ending Rural Poverty*. Oxford: Rural Poverty Report. Oxford University Press.

[9]International Fund for Agricultural Development (IFAD), 2011, *Rural Poverty in Nigeria*. <http://www.ruralpovertyportal.org>, Accessed on 10<sup>th</sup> August, 2016.

[10]Miriam, M., Omoregie, I., Uzendu P. O., 2013, Contributions of Mass Media to the Development of Agricultural Extension in Ika North East L.G.A of Delta State. Department of Agricultural Economics and Extension, Enugu State University of Science and Technology (ESUT) Enugu, Nigeria. *Academic Journal of Plant Sciences* 6 (3): 127-133.

[11]Mogaji, K. A., Aboyeji, O. S., Omosuyi, G. O., 2011, Mapping of lineaments for groundwater targeting in the basement complex region of Ondo State, Nigeria, using remote sensing and geographic information system (GIS) techniques. *International Journal of Water Resources and Environmental Engineering* 3(7), pp. 150-160.

[12]Morrow, K., Nielsen, F., Wettasinha, C., 2002, Changing Information flows. *LEISA* 18(2) 4 - 5.

[13]Mukadasi, B., Mohamed, B., Willey, B., Peter, N., 2009, Individual and Group Extension Methods: Perspectives from Vi-Agroforestry Project in Masaka district, central Uganda. Faculty of Forestry and Nature Conservation, Makerere University Box 7062 Kampala, Uganda.

[14]National Population Commission (NPC) 2006, National Population and Housing Census. N.P.C Abuja.

[15]Nwaobiala, C. U., Ogbonna, M. O., Egbutah, E. U., 2014, Assessing Levels of Participation among Farmers in IFAD/FGN/NDDC/Community-Based Natural Resource Management Programme in Abia and Cross River States, Nigeria. Discourse Journal of Agriculture and Food Sciences 2(5): 136-141, [www.resjournals.org/JAFS](http://www.resjournals.org/JAFS), Accessed on 2<sup>nd</sup> July, 2017.

[16]Okunade, E. O., 2007, Effectiveness of Extension Teaching Methods in Acquiring Knowledge, Skill and Attitude by Women Farmers in Osun State. European Journal of Social Sciences 4(2): 22-30.

[17]Oto, J. O., Shimayohol, D., 2011, Extension communication channels' usage and preference by farmers in Benue State, Nigeria. Journal of Agricultural Extension and Rural Development Vol. 3(5):88-94.

[18]World Bank, 2012, Evaluation of Community Based Projects in Sub Saharan Africa. The World Bank Observer, Washington D. C. USA.



## AGROCHEMICAL BASED INFORMATION USAGE AMONG FARMERS: A PATHWAY TO SUSTAINABLE COCOA PRODUCTION IN OSUN STATE, NIGERIA

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### Abstract

*The study accessed agrochemical based information usage among cocoa farmers in Nigeria with a view to determine the sustainability of information sources for an increased cocoa production in the study area. Simple random sampling was used to select 120 cocoa farmers using structured interview schedule. Results showed that farmers were in their 50s with about 12 years of formal education. Radio (mean = 2.56) ranked highest among the sources of information while about 60 percent of the respondents indicated a very high level of usage of agrochemical information in cocoa production. Results of Pearson Product Moment Correlation showed a significant relationship between farmers' perception ( $r = 0.365$ ;  $p \leq 0.01$ ) and usage of agrochemical based information. The findings conclude that the use of mass media as the most frequently used among farmers for agrochemicals in cocoa production may be sustainable. It is therefore recommended that the use of mass media for agrochemicals usage in cocoa production should be reinforced in passing other information to cocoa farmers.*

**Key words:** agrochemicals, information, sustainability, pathway

### INTRODUCTION

Cocoa scientifically called *Theobroma cacao* is an important cash crop in Nigeria that contributed as high as 15 percent to the total Nigerian export in the 1970s [10]. Historically, cocoa was introduced to Nigeria in 1887 [4] and “in the 1960s, Nigeria became the first producer in Africa and the second largest producer in the world” [1]. This therefore made cocoa to be the most important agricultural export crop in the 1960s/70s, as it contributed significantly to the foreign exchange earnings of the country. In the early 70s, the production increased to about 308,000 metric tons and this put Nigeria as the largest producer in West Africa [8]. However, the production suffered a declined trend after 1971 farming season. Specifically, export declined to 216,000 and 150,000 metric tons in 1976 and 1986 respectively. This decline in production reduced the country's market share to about 6 percent, thereby making Nigeria the fourth largest

producer in the world after Indonesia, Ivory-Coast and Ghana and third largest exporter in West Africa after Ivory Coast and Ghana [6]. According to [6] the International Cocoa Organisation reported that the current cocoa production status stood as 248,000 Metric tons in 2013/2014 cropping season, while 195,000 Metric tons was estimated to be the total production in 2014/2015 cropping season and projected that the country would experience a slight increase of 5,000 Metric tons in 2015/2016 in addition to the 2015/2016 production. Thus, 200,000 Metric tons was forecasted to be produced in 2016/2017. At a time, cocoa bean produced in Nigeria became unacceptable due the type and nature of agrochemicals used [7]. Agrochemical is a generic term for the various chemical products used in agriculture. In most cases, agro-chemical refers to the broad range of pesticides which includes insecticides, herbicides, fungicides and nematicides, rodenticides, molluscides, avicides, repellents and attractants used in agriculture, public

health, horticulture, food storage or a chemical substance used for a similar purpose (National Agency for Food and Drug Administration Control [11]. It may also include synthetic fertilizers, hormones and other chemical growth agents, concentrated stores of raw animal manure. Agrochemical usage in Nigeria has been on the increase ever since its introduction in early 1950s for cocoa production..It is worthy of note that appropriate use of agrochemicals can boost the production of cocoa, poor agrochemical coverage resulting from the use of inefficient application equipment, wrong timing, irregularity and wrong technique of spraying are capable of accelerating the rate at which insects and pests develops resistance to agrochemicals. Along with the screening of new agro-chemicals such as insecticides, fungicides and herbicides, new spraying pumps are usually evaluated by the Cocoa Research Institute of Nigeria (CRIN), for their efficiency before they are recommended for use in the application of cocoa agrochemicals. CRIN has the mandate to screen and recommend potential cocoa agrochemical and spraying equipment in Nigeria. However, with the new European Union (EU) Legislation on Maximum Residue Levels (MRLs) allowed on cocoa beans and products, some of the agrochemical especially pesticides are still undergoing screening and the previously recommended pesticides were banned [5]. Similarly, inappropriate use of chemicals on cocoa farms exposes farmers to some risks due to the hazardous effects of these chemicals. The residual effect of the chemicals on cocoa also constitutes concern if the chemicals are not properly handled [8]. Generally, pesticides are toxic and can have serious health hazards to human beings. Lack of quality and timely information about the agro-chemical, farmer's inability to comply with some of these precautionary measures and inappropriate handling of agrochemical due to carefree attitude may influence the agrochemical usage [3]. Therefore, cocoa farmers in Nigeria may be limited in knowledge of the above mentioned conditions that may increase cocoa production and if not properly managed may pose a serious health

hazard. However, access to certified information sources may be of great help. Nevertheless, information as to the usage among farmers remains largely undocumented in literature, especially in Osun State where production has been on the increase over the years due to its proximity to Ondo State which is the largest producer of cocoa in Nigeria, hence the need for this study.

### **Objectives of the study**

The specific objectives of the study were to:

- describe the socio-economic characteristics of cocoa farmers in Osun State;
- identify sources of agro-chemical based information among cocoa farmers;
- determine the cocoa farmers perception of agro-chemical based information; and
- examine usage of agro-chemical based information among cocoa farmers in the study area

### **MATERIALS AND METHODS**

The study was conducted between February and June 2017 in Osun State of Nigeria. The State is situated in the southwestern part of Nigeria. Osun State lies within latitude 7° and 8° 02' N and longitude 4° and 5° 04' E. Osun State has an area of approximately 14, 875 square kilometres and a population of 3,423,535 by the 2006 National Population Census figure . Agro-ecologically, Osun State is divided into three agricultural zones by the Osun State Agricultural Development Programme (OSSADEP). These zones are Osogbo zone with 13 Local Government Areas (LGAs), Ife/Ijesa zone with 10 Local Government Areas (LGAs), and Iwo zone with 7 Local Government Areas (LGAs). A multistage sampling procedure was adopted to select the sample for this study. In the first stage, purposive sampling technique was used to select Osun State for the study because it is the third largest cocoa producing State in Nigeria. At the second stage, purposively sampling procedure was used to select six (6) cocoa producing LGAs across the three (3) agricultural zones of the State. The six (6) LGAs were Ede South from Osogbo zone, Ife-South, Ife-North, Atakunmosa West,

Atakunmosa East, from Ife/Ijesha zone while Irewole was selected from Iwo zone. Two (2) farming communities were then purposively chosen based on the predominance cocoa plantation from each of the six (6) LGA to give a total of twelve (12) communities selected for the study. Simple random was used to select twenty (20) respondents from register of cocoa farmers in each community to give a total of 120 respondents for the study. Data generated were analysed using descriptive like frequency, percentages, mean and appropriate charts while Pearson's Product Moment Correlation was used to make inferences from the data. The usage of agro-chemical based information was measured by listing and scoring the content of information against four-point rating scale of Very often (3), Often (2), Rarely (1), Never (0).

## RESULTS AND DISCUSSIONS

Result in Table 1 show the mean age of the respondents was  $49.75 \pm 16.19$  years. The findings show that the population of cocoa farmers in the study area were in their middle age. The inference is that older people were involved in the cultivation of cocoa in the study area more than young ones. This may not be unconnected to the fact that cocoa production kept decreasing since crude oil was discovered and exploration started in the 70s. This has taken away government attention from agriculture as government is no longer investing much in agriculture through the payment of subsidy and the provision of facilities thus leading to massive exit of youth from cocoa production. This agrees with the findings of [13] that the mean age of the cocoa farmers in Ogun and Ondo States was 52.8 years. The implications of these is that the preponderance of older folks in cocoa production will affect the extent of usage of agro-chemical information usage as compared to youths who are more prone to innovation usage and has the ability to take risk. Similarly, results showed that majority (90.8%) of the respondents were male. This result indicated that there were more male cocoa farmers than female cocoa farmers in

Osun State, Nigeria. A probable reason for this could be that cocoa production requires more physical strength and labour that may not be at the advantage of women as men have been reported to engage in more muscular activities in farming than women [9].

In addition, majority (79.2%) of the respondents were married. This result indicated that cocoa production attract more married people. The reason for this may not be farfetched as older farmers were initially indicated to be engaged in the production of cocoa. This may be as an advantage as more family labour may be available for use as spouse and children may be of great assistance to their parents in the cultivation of cocoa. Furthermore, the results show that the mean household size was on the average of 8 persons per household. The implication of this finding is that more family labour for cocoa production would be readily available since relatively large household size is an obvious advantage in terms farm labour supply. This agrees with the submission of [13] that the higher the household size of the farmers, the higher the supply of family labour to cocoa production activities in Ogun and Ondo States.

The mean year of education of cocoa farmers in the study area was  $12.5 \pm 3.8$  years. This implies that the cocoa farmers were literate which allows them to have the capacity to effectively read, write, communicate verbally and understand things more thereby giving them more access to derive information from available sources, especially on agrochemical usage in the cultivation of cocoa with a view to increasing productivity. This finding is in agreement with that of [2] which reported that increase in education of farmers positively influence adoption of improved practices. Also, the mean annual income of the respondents in cocoa production was ₦525,504  $\pm$  467325.6. The high standard deviation implies that there was a wide gap between farmers' income in cocoa production in the study area. This result contradicts that of [12] that found the mean income of cocoa farmers in Osun and Edo States at ₦51,000. The high income of cocoa farmers may be as a result of

high price of cocoa beans in the last few years at the international market. High income of cocoa farmers should afford them the opportunity of using the recommended agrochemicals and protective wears.

Table 1. Distribution of respondents by their socio-economic characteristics

Variables	Freq	Percentage	Mean ± SD
<b>Sex</b>			
Male	109	90.8	
Female	11	9.2	
<b>Marital Status</b>			
Single	14	11.7	
Married	95	79.2	
Separated	1	0.8	
Widowed	10	8.3	
<b>Age (Years)</b>			
25-34	23	19.2	49.75 ± 16.19
35-44	26	21.7	
45-54	28	23.3	
55-64	14	11.7	
65+	29	24.2	
<b>Income (₦)</b>			
35,000-100,000	11	9.2	
120,000-185,000	18	15	
200,000-350,000	24	20	525,504 ± 467,326
400,000-850,000	48	40	
1,000,000-3,000,000	19	15.8	
<b>Household size</b>			
2-7	56	46.7	
8-13	56	46.7	7.63 ± 3.72
≥14	8	6.7	
<b>Years of Formal Education</b>			
0-6	15	12.5	
7-12	58	48.3	12.54 ± 3.84
≥13	47	39.2	

Source: Field survey, 2017.

### Sources of agro-chemical based information in cocoa production

Results in Table 2 showed that with respect to sources of information by respondents on cocoa agro-chemicals, radio ranked highest with mean of 2.56. This was followed by agro-chemicals retailers ( $\bar{x} = 2.38$ ), newspaper and magazine ( $\bar{x} = 2.30$ ), farmer's cooperative ( $\bar{x} = 2.27$ ), fellow farmers and friends ( $\bar{x} = 2.25$ ). However, extension workers ( $\bar{x} = 1.55$ )

and Agricultural show/workshop ( $\bar{x} = 1.54$ ) ranked least source of information on cocoa agro-chemicals by the respondents. These results indicate that information sources most accessible to cocoa farmers were the radio, agro-chemical retailers, newspaper and magazine, farmer's cooperatives, fellow farmers and friends. The implication of this is that governmental/non-governmental organizations could use these avenue or media to provide relevant cocoa agro-chemical based information to the cocoa farmers in the study area. The findings therefore contrast the submission of [12] that interpersonal sources of information like fellow farmers, extension agents, sales agents and cocoa merchant were major source of information on cocoa agro-chemicals.

Table 2. Sources of information to agrochemicals usage among farmers

Sources of Agro-chemical information	Mean	SD
Radio	2.56	0.61
Agro-chemical retailers	2.38	0.60
Newspapers and magazine	2.30	0.72
Farmer's cooperative	2.27	0.71
Fellow farmers and friends	2.25	0.83
Television	2.22	0.80
Cocoa Association Nigeria	2.21	0.78
NGOs in agriculture	2.12	0.79
Cell phone	2.02	0.70
Internet	1.88	0.87
Community leaders	1.75	0.73
Village head	1.74	0.54
Live drama	1.66	0.78
OSSADEP extension worker	1.55	0.62
Agricultural show/Workshop	1.54	0.59
Video production	1.50	0.65

Source: Field survey, 2017.

### Perception of respondents on agro-chemical information usage

Result in Table 3 revealed that the grand mean was 3.05 with standard deviation of 0.34. The perceptual statements with mean greater than 3.39 ( $3.05+0.34$ ) were the statements such as there should be regular awareness

creation on radio and/or television on the usage of recently prescribed cocoa agro-chemical, trained in the use of agro-chemical, regular training on banned agro-chemical should organised, government should provide subsidies on approved cocoa pesticides and making them available. The perceptual statements with mean less than 2.71 (3.05-

0.34) were the statement such as mixing of two or more agrochemical to control cocoa diseases is an ideal practice, I am not aware of any international /national prohibition of pesticides, I do experience some discomfort during/after use of agro-chemical while those mean between 2.71 and 3.39 were moderately perceived.

Table 3. Rank-order of respondents' weighted mean score on the perception of cocoa farmers towards agro-chemical information usage

Perception	Mean	SD	Rank
There should be awareness creation on radio and/or television on the usage of recently prescribed cocoa agro-chemical	3.90	0.44	1 <sup>st</sup>
Trained in the use of agro-chemicals	3.73	0.62	2 <sup>nd</sup>
Regular training on banned cocoa pesticides should be organised	3.65	0.90	3 <sup>rd</sup>
Government should provide subsidies on approved cocoa pesticides and make them available	3.54	1.05	4 <sup>th</sup>
Use of banned agro-chemical is more profitable to me than prescribed agro-chemical	3.27	1.19	5 <sup>th</sup>
The containers of agro-chemical are properly disposed after use	3.23	0.84	6 <sup>th</sup>
I have never been admitted at hospital due to poisoning due to agro-chemicals	3.22	1.29	7 <sup>th</sup>
I do not read the labels of agro-chemicals	3.04	1.02	8 <sup>th</sup>
Agro-chemicals have hazardous effect on human health	3.00	1.28	9 <sup>th</sup>
I am not too concerned about expiry date of agro-chemicals	2.99	1.00	10 <sup>th</sup>
Wearing of protective clothes before use of agro-chemicals is a common practice with me	2.98	1.12	11 <sup>th</sup>
Some of the banned pesticides are cheaper therefore government should lift ban on them	2.95	1.39	12 <sup>th</sup>
Agro-chemicals do not have any effect on the environment	2.79	1.28	13 <sup>th</sup>
Mixing of two or more agro-chemicals to control cocoa diseases is an ideal practice	2.54	1.38	14 <sup>th</sup>
I am not aware of any national /international prohibition of pesticides	2.41	1.34	15 <sup>th</sup>
I do experience some discomfort during/after use of agro-chemicals	1.53	1.09	16 <sup>th</sup>

Grand mean =3.05±0.34

Source: Field survey 2017.

### Usage of Information on Agro-chemical

The result in the Table 4 below show the usage of information on agro-chemical by cocoa farmers. The information on proper storage of agro-chemicals ranked highest with the mean score (2.66), followed by do not drink anything during spraying with mean score (2.57), do not eat anything during spraying with mean score (2.53), use of recommendation dosage with mean score (2.52) were used at a very high level. Information on seeking prompt medical attention due to poisoning from agro-chemical usage (2.46), observance of expiry date of

agro-chemical (2.38), avoidance of use of banned agrochemical (2.23), reading labels of agro-chemical before use (2.20), proper disposal of containers (2.15) were used at high level while information on posting of treated field with mean score (0.52) are used at low level. The grand mean was 2.06 with standard deviation 0.39. The information with mean greater than 2.45 (2.06+0.39) were the respondents' proper storage of agro-chemical, do not eat anything during spraying of agro-chemical, do not eat anything during the spraying of agro-chemical, use of recommendation dosage and seeking of

prompt medical attention due to poisoning from agro-chemical usage. Further analysis to determine the level of agrochemical usage revealed that about 60 percent of the respondents recorded high usage in agrochemical usage. The ranking implies that there should be more information on cocoa

agro-chemical based information on “do not spray agro-chemical against the direction of the wind”, “wash your body and cloth after spraying of agro-chemical”, “posting treated field” through various channel or media of passing information as shown in Table 4 and Figure 1.

Table 4. Usage of Information on Agro-chemical

Content of information	Mean	S.D
Proper storage of agro-chemicals	2.66	0.54
Do not drink anything during spraying of agro-chemical	2.57	1.02
Do not eat anything during spraying of agro-chemical	2.53	1.06
Use of recommendation dosage	2.52	0.57
Seeking prompt medical attention due to poisoning from agro-chemical usage	2.46	1.02
Observance of expiry date of agro-chemical	2.38	0.83
Avoidance of use of banned agro-chemical	2.23	1.00
Reading labels of agro- chemical before use	2.2	1.03
Proper disposal of containers	2.15	0.86
Avoidance of mixing two or more agro-chemicals for diseases and pest control	1.71	1.16
Putting on protective wears when using agro-chemicals	1.68	1.09
Do not spray agro-chemicals against the direction of the wind	1.59	0.95
Wash your body and cloth after spraying of agro-chemical	1.58	1.12
Posting treated field	0.52	1.09

Grand Mean = 2.06±0.36

Source: Field Survey, 2017

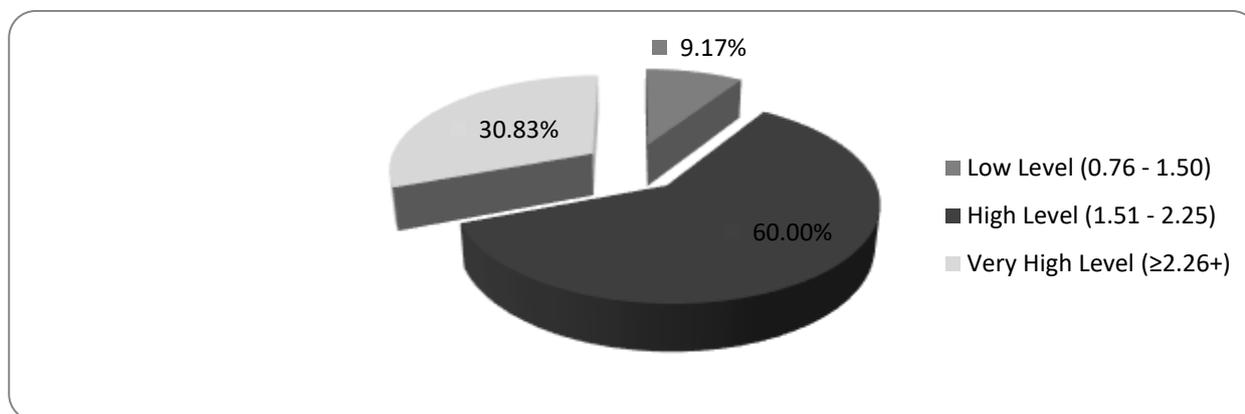


Figure 1. Level of Usage of Information on Agro-chemicals

Source: Field Survey, 2017.

### Relationship between farmers' perception and usage of agrochemical information

The results in the Table 5 show the results of correlation analysis of perception of farmers towards agro-chemical based information and agro-chemical based information usage. The result showed that at 0.01 level of significance, positive significant relationship existed between famers' perception towards agro-chemical based information and agro-chemical based information usage. This

implies that perception of the farmers toward agro-chemical is of high relevance towards agro-chemical based information usage. This is evidence that demonstrates that farmers had favorable perception towards the use of agrochemical based information that will have positive effect on productivity. The study conforms to the findings of [14] that established that favourable disposition towards information sources will be an added advantage in decision making in agricultural enterprises.

Table 5. Results of correlation between perception of farmers and agrochemical usage

Variable	R	r <sup>2</sup>	P-Value
Perception of agrochemical information	0.365**	0.113	0.01

\*\*Correlation is significant at the 0.01 level (2 tailed)

Source: Field survey, 2017

## CONCLUSIONS

Based on the major findings, it was concluded that the main sources of agro-chemical information among the respondents were through mass media such as radio, and interpersonal sources like agro-chemical retailers, fellow farmers and friends; the respondents had favourable disposition to the information usage on agrochemicals and usage of information on agro-chemicals was high. It recommended that main sources of agro-chemical information should be reinforced in passing other information to the cocoa farmers.

## REFERENCES

[1]Adegbola, M. O. K., Abe, J. O., 1983, Cocoa Development Programme, Nigeria. Research Bulletin No 9.Cocoa Research Institute of Nigeria Printing Unit. 9: 3-5.

[2]Agwu, E.A., Anyanwu, A.C., 1996, Socio-cultural and Environmental Constraints in Implementing the NALDA Programme in South eastern Nigeria. A case study of Abia and Enugu State. J. Agric. Educ, 2: 68-72.

[3]Asogwa, E. U., Dongo. L. N., 2009, Problems associated with pesticides usage and application in Nigeria cocoa production: A review. African journal of agricultural research 4 (8): 675-683.

[4]Ayorinde, J. A., 1966, Historical Notes on the Introduction and Development of Cocoa Industry in Nigeria. Nigerian Agricultural Journal. 3(1): 21-30.

[5]Cocoa Research Institute of Nigeria (CRIN), 2006, Information Booklets of Cocoa Research institute of Nigeria. Ibadan: CRIN Press: 5-10.

[6]Folayan, J. A., Daramola, G. A., Oguntade, A. E., 2006, Structure and performance evaluation of cocoa marketing institutions in Southwestern Nigeria: analysis. Journal of Food, Agriculture and Environment. 4 (2): 123-128.

[7]Govinda, B., 2014, An overview of agro-chemicals and their effects on environment in Nepal. Applied ecology and environmental sciences. Volume 2(2):66-73.

[8]Nmadu, J. N., Halima, S., Omojeso, B. V., 2015, Socio-economic factors affecting adoption of

innovations by Cocoa farmers in ondo state, Nigeria. European Journal of Business, Economics and Accountancy.3(2): 58-66.

[9]Makina, S., 2014, Female Labour Participation in Agriculture: A Case of Andhra Pradesh, Sai-Sudhir P. G. College, ECIL, Hyderabad.

[10]Oluyole, K. A., Yusuf, S. A., Alao, T. K., 2013, Application of Game Theory to Cocoa Production Management Systems in Ondo State, Nigeria. Global Journal of Science Frontier Research Agriculture and Veterinary, 13(12): 10-15.

[11]National Agency for food and Drug Administration and control (NAFDAC) 1996, Pesticide Registration Regulations. BV303 – B307.

[12]Ogunjimi, S. I., Farinde, A. J., 2012, Farmer’s knowledge level of precautionary measures in agro chemical usage on cocoa production in Osun state and Edo state, Nigeria. International Journal of agriculture and forestry, 2(4): 186-194.

[13]Omoare, A. M., Oyediran, W. O., Fakoya, E. O., 2016, Comparative assessment of cocoa farmers’ knowledge and attitude to training on good cultural management practices in ogun and ondo states, Nigeria. internal journal of agricultural extension and rural development studies, 3 (3):35-51.

[14]Oriakhi, H., Okoedo-Okojie, D. U., 2013, Arable crop farmers preference for agricultural information sources and adoption of technology in Edo State, Nigeria. Journal of Agriculture and Veterinary Science, 3(1): 31-35.



## AN INVESTIGATION INTO RUSSIA'S CURRENT LEVEL OF SELF-SUFFICIENCY IN GRAIN

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### *Abstract*

*The market for grain is vital to the achievement of a nation's food security, promoting development in adjacent sectors of its economy, and driving its economic development in general. This paper attempts to determine the degree to which reductions in grain production in 2018 may affect Russia's self-sufficiency in grain and grain prices. To this end, the authors analyzed the formation and use of grain resources in the Russian Federation, assessed Russia's self-sufficiency in grain, and assessed the correlation between grain production and grain prices in the Russian Federation. The findings indicate that Russia's grain production is currently characterized by positive trends, with boosts posted in grain production, reserves, and exports. With Russia's increasing self-sufficiency in grain, its robust grain production levels are making it possible to fully provide for the nation's internal need for grain, as well as produce enough grain to export. In the authors' view, reductions in grain production in 2018 should not jeopardize Russia's self-sufficiency in grain or cause its shortages. Reduced grain production should not result in a rise in prices for grain and related food products (bread, macaroni, flour, etc.), as Russia's domestic market for grain has no reverse correlation between production and prices. Despite the positive trends, Russia's grain production sector has been faced with a number of issues, like low economic efficiency levels, low productivity levels, and poor grain quality. These issues could be resolved through modernizing the nation's grain production sector, with a focus on directing the Russian economy to an innovation-focused path of development.*

**Key words:** grain, grain production, food sovereignty, self-sufficiency, price, exports, imports, consumption

### INTRODUCTION

Grain is a strategically important product that is crucial to the steady operation of a nation's market for food and ensuring its food security, which, in turn, is an element of its national security [19]. Grain is needed to produce many other food products, like flour, breads, pastry, macaroni, starch, and food concentrates. Products made from grain have high nutritional value and contain a number of important nutrients that people need: carbohydrates, proteins, fats, phosphorus, potassium, magnesium, calcium, as well as B, PP, and E vitamins [8]. Since it contains many nutrients and possesses high energy value, grain is a crucial item of food for livestock and poultry, as it facilitates high weight gains, high milk yield, and high egg production [5]. In addition, some scholars have noted the social significance of the market for grain,

associated with the fact that there is a high share of rural residents among the population and there are significant labor resources engaged in the reproduction process [1].

In the summer of 2018, the Ministry of Agriculture of the Russian Federation [11] made projections that in 2018 the nation would harvest 100 million tons of grain, i.e. 35.5% less than in 2017. Despite the fact that by November 19, 2018 the nation's grain harvest had reached 115.6 million tons, it was, nevertheless, smaller than in 2017 by 15.6%. This decline in crops has triggered a concern about the nation's ability to meet the need of the state and regions for grain, as well as possible spikes in prices for grain and related food products (above all, bread). These warnings have been voiced by many of Russia's famous media outlets (e.g., Rossiyskaya Gazeta, Nezavisimaya Gazeta, Gazeta.ru, IF Regnum, AEI Prime, etc.) and

have had a wide appeal among the general public. Russia's self-sufficiency in grain has taken on special significance under conditions of the imposition of economic sanctions and in a climate of the pursuit of a policy of import substitution, one of the key objectives in which is the achievement of food sovereignty.

In this regard, the authors undertook to investigate how drops in Russia's grain production in 2018 may affect its grain self-sufficiency and grain prices. To this end, they analyzed the formation and use of grain resources in the Russian Federation, assessed the nation's self-sufficiency in grain, and assessed the correlation between grain production and grain prices in Russia.

The current level of development of Russia's agricultural sector as a whole is insufficient to ensure its food security, which is due to the lack of a single mechanism for the development of the nation's agro-industrial complex, the use of outmoded production technology, a poorly developed infrastructure, the underestimation of the role of farmers in the development of the nation's agri-business sector, and the lack of support on the part of the state while lending levels are quite high [7]. Enterprises within the actual grain sector are constantly faced with nonpayment, great risks in running the business, a lack of qualified personnel, increased plant and equipment wear and tear, and insufficiently effective mechanisms of government support and regulation [9]. Scholars A.N. Osipov, D.Iu. Fediushin, and A.N. Davletshin [12] have noted that among the many issues facing Russia's grain sector today the most significant one is the poor technical capacity of its production base. In addition, O.A. Eremchenko [3] is pointing to a worsening in the quality of Russia's grain output.

Note, however, that in the period 2012–2016 the Russian Federation enjoyed steady boosts in grain production [5]. According to M.L. Vartanova and E.V. Drobot [17], Russia's current level of grain production has matched the Soviet level – following a major slump during the 1990s and the early 2000s. In 2016, the nation's gross grain harvest totaled 120.7 million tons, which matches the 1970s level.

At present, Russia's total grain planting area is greater than half of its total area under crops, with grain accounting for over a third of the nation's gross crop farming output [8]. In the structure of the nation's land under grain production, the share of food crops accounts for nearly two-thirds of all plantings [16]. Grain production is concentrated mainly in agricultural enterprises, while the share of farming enterprises in the overall structure of production is around 1% [8]. With that said, Russia's self-sufficiency in grain is greater than in any other type of agricultural produce (e.g., milk, meat, vegetables, etc.), the indicator of self-sufficiency being 100% [7].

For the Russian Federation, grain is a strategic export product, with a quarter of all Russian grain exported [8]. In 2014, after the West imposed economic sanctions on Russia and Russia introduced a food ban against it in return, Russia's grain exports rose by 46.7% in value terms [14]. Having said that, certain scholars view the present-day state of Russia's grain sector as ambiguous, as boosts in grain exports are accompanied by low levels of economic efficiency of grain production [5]. Scholars G.I. Andriushchenko and A.N. Davletshin [1], who have analyzed a set of indicators of the economic efficiency of Russia's grain production, are noting an increase in grain production costs based on increased expenditure on the cultivation of grain crops, and are pointing to the volatility of production despite the nation's planted acreage staying the same, which is associated with unstable crops due to high dependence on natural-climatic conditions. M.L. Vartanova and E.V. Drobot [18], likewise, view the situation as ambiguous, as increases in grain exports may lead to grain shortages and price hikes in the domestic market.

Thus, the findings from a set of earlier studies characterize Russia's grain production quite equivocally. On the one hand, the nation's boosts in grain production and exports and its high level of self-sufficiency in grain (as opposed to other agricultural products) are viewed as a success. But, on the other hand, Russia's grain sector is faced with a set of major issues, including poor technical capacity and low economic efficiency.

Conclusions drawn from an overview of the literature may provide a proper insight into the current condition of Russia's grain sector, as well as some of the possible implications of reductions in grain production in Russia in 2018.

## MATERIALS AND METHODS

The study consisted of three stages.

The first stage involved analyzing a set of general trends for change in indicators characterizing grain resources and the use of grain in the Russian Federation. In particular, the authors examined the nation's grain production, grain imports and exports, production-based and personal grain consumption, volumes of processed grain, and grain losses.

In the second stage, the authors analyzed Russia's self-sufficiency in grain based on the following coefficient:

$$K = \frac{P}{PC + C + CC + L}$$

where:

K was the coefficient of grain self-sufficiency;

P was the grain production, million tons;

PC was the amount of grain used for production-based consumption, million tons;

C was the processed grain, million tons;

CC was the amount of grain used for personal consumption, million tons;

L was the amount of grain that was lost, million tons.

In the third stage, the authors assessed the relationship between grain production and grain prices through the example of wheat, barley, corn, and buckwheat. In 2017, the first three of the grain crops, combined, accounted for 88.4% of Russia's entire grain harvest (wheat – 63.4%, barley – 15.2%, and corn – 9.8%) [13]. The choice of buckwheat was associated with its high price. In 2016, Russia's average price for a ton of buckwheat was 2.9 times higher than the price of wheat, while in 2017 this figure was 2.1 times higher [13]. To assess the strength of the relationship between production and prices across particular grain crops, the authors constructed relevant scatter plots, examined various types

of relationships (linear, exponential, logarithmic, and second-degree polynomial), and computed the coefficient of determination ( $r^2$ ) and the linear pair correlation coefficient ( $r$ ):

$$r = \frac{\sum(PR - \overline{PR}) * (P - \overline{P})}{\sqrt{\sum(PR - \overline{PR})^2 * \sum(P - \overline{P})^2}}$$

where:

$r$  was the coefficient of correlation;

PR was the grain crop production for the year, thousand tons;

$\overline{PR}$  was the average grain crop production, thousand tons;

P was the average annual grain crop price, rubles per ton;

$\overline{P}$  was the average average-annual grain crop price, rubles per ton.

To interpret the results and measure the strength of the relationship, the authors employed the Chaddock scale. In performing their calculations, the authors drew upon official data from Rosstat [13] (more specifically, data provided in the 'Balances of Food Resources. Grain Resources and the Use of Grain' section) and from the Ministry of Agriculture of the Russian Federation [11].

## RESULTS AND DISCUSSIONS

Despite Russia's 2018 grain harvest being 19.8 million tons (14.6%) smaller than the figure from the previous year, it, nevertheless, may be regarded as good. The nation's grain harvest achieved in the period 2016–2017 is its record-high harvest in the last 18 years (Figure 1). 115.6 million tons of grain, harvested as of November 19, 2018, cannot beat the harvest achieved in the period 2016–2017, but the figure is beating the annual figures for 1991–2015. The current, 2018, harvest is also greater than the average annual grain harvest achieved in the last 10 years, which is 99 million tons. The share of grain produced in Russia in the nation's total volume of grain resources (exclusive of carry-over stocks) has exceeded 95% since 2001 and 99% since 2014. In 2017, the share of grain produced in Russia was 99.5% of the nation's grain production and imports combined.

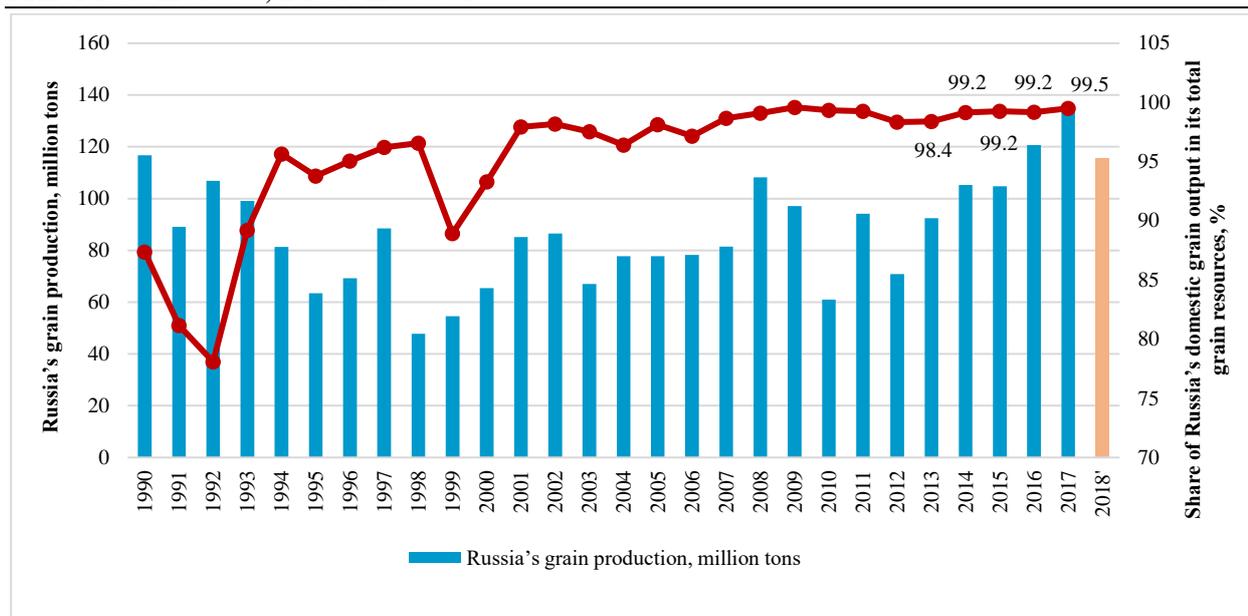


Fig. 1. Grain production in the Russian Federation. Data from Rosstat [13] and Ministry of Agriculture of the Russian Federation [11]. Calculations by the authors.

In the period 1990–1993, Russia’s foreign grain trade turnover was based mainly on imports. Later on, it declined, and in the period 1994–2001 it totaled less than 8 million tons per year. However, starting in 2002 the nation has witnessed a trend of increases in its foreign trade turnover as a

result of boosts in exports (Figure 2). In 2017, Russia exported 43.3 million tons of grain, which was 13.1 times more than in 2001 and 3.1 times more than in 2010. With that said, in 2017 the share of imports in the nation’s foreign grain trade turnover was just 1.6%.

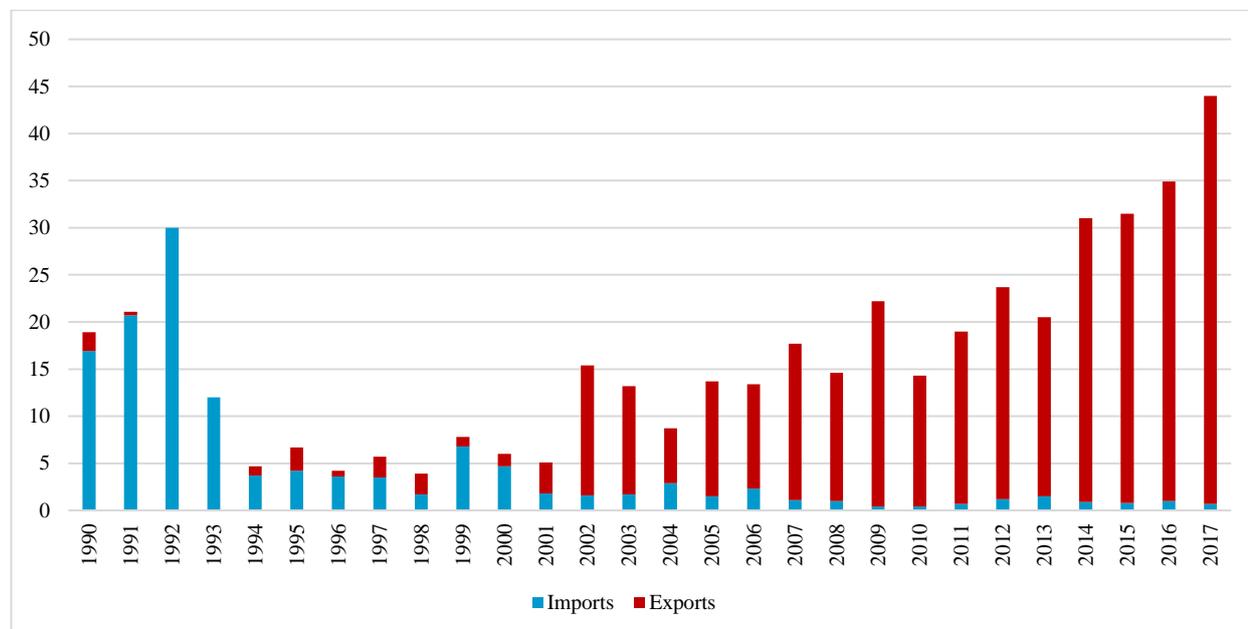


Fig. 2. Russia’s grain imports and exports, million tons. Source: Data were taken from Rosstat [13]. Calculations were made by the authors.

A major portion of Russia’s internal need for grain deals with its being processed into flour, groats, animal feed, etc. Starting in 2013, the

nation’s grain processing volumes have gradually increased. In 2017, the figure reached 53.3 million tons, which, however,

was about 1.4 times less than in 1992. The average volume of production-based grain consumption (the use of grain for the seeds and livestock and poultry feed) between 2010 and 2015 was around 20 million tons. In 2016, the figure rose to 22.4 million tons, and in 2017 it reached 24.3 million tons. The production-based consumption levels registered in 2017 were the highest in the period 1999–2017. Prior to 2018, the nation’s grain losses almost always were less than 1% of its total volume of grain resources (exclusive of 1990). Personal consumption was a steady 0.1 million tons per year (Table 1).

In measuring a nation’s food security, the most significant indicator is the coefficient of security, i.e. the ratio between production and domestic consumption (inclusive of losses). In the period 1990–1996, as well as in the period 1998–1999, in 2003, and in 2010 the coefficient of grain security in the Russian Federation was less than 1. All other years, including in the period 2011–2017 the coefficient of self-sufficiency was greater than 1, which was testimony to the nation’s grain production prevailing over its domestic grain consumption.

Table 1. Grain Production and Consumption in the Russian Federation (million tons)

Year	Production	Production-related consumption	Processed into flour, groats, animal feed, etc.	Losses	Personal consumption	Grain self-sufficiency coefficient
1990	116.7	30.5	94.7	2.3	0.0	0.92
1991	89.1	32.2	89.7	1.7	0.1	0.72
1992	106.9	31.7	76.7	1.8	0.1	0.97
1993	99.1	32.3	71.1	1.6	0.1	0.94
1994	81.3	31.2	63.1	1.5	0.1	0.85
1995	63.4	30.1	56.4	1.5	0.1	0.72
1996	69.2	27.6	44.7	1.0	0.1	0.94
1997	88.5	27.7	46.9	1.0	0.1	1.17
1998	47.8	26.5	44.7	1.0	0.1	0.66
1999	54.6	22.9	40.8	0.8	0.1	0.85
2000	65.4	22.3	40.6	0.8	0.1	1.03
2001	85.1	23.8	45.7	0.9	0.1	1.21
2002	86.5	24.0	49.3	0.8	0.1	1.17
2003	67.0	22.4	46.3	0.9	0.1	0.96
2004	77.8	22.9	44.7	0.9	0.1	1.13
2005	77.8	22.0	44.0	0.9	0.1	1.16
2006	78.2	21.8	46.2	0.9	0.1	1.13
2007	81.5	20.8	45.1	1.0	0.1	1.22
2008	108.2	22.6	49.4	0.9	0.1	1.48
2009	97.1	22.1	48.8	1.0	0.1	1.35
2010	61.0	20.4	43.9	0.9	0.1	0.93
2011	94.2	20.9	47.4	0.9	0.1	1.36
2012	70.9	20.5	43.8	1.1	0.1	1.08
2013	92.4	20.0	44.5	1.2	0.1	1.40
2014	105.3	21.0	46.4	1.0	0.1	1.54
2015	104.8	20.9	48.2	1.1	0.1	1.49
2016	120.7	22.4	51.7	1.2	0.1	1.60
2017	135.4	24.3	53.3	1.6	0.1	1.71

Source: Data were taken from Rosstat [13]. Calculations were made by the authors.

On top of that, starting in 2013 Russia's grain production has been 1.4 times more than its grain consumption. In the period 2014–2017, the coefficient of grain self-sufficiency in Russia had the greatest value in the entire period under review, coming in at 1.71 in 2017 (Table 1).

To analyze the correlation between grain production and prices, the authors examined the situation with wheat, barley, and corn, which, combined, accounted for 88.4% of the nation's total grain production, as well as Russia's most expensive grain crop – buckwheat. The approximation (determination) validity coefficients, computed in Excel for various types of relationships (linear, exponential, logarithmic,

and second-degree polynomial), had the greatest values for all the grain crops in the event of a linear trend.

Figure 3 evidences that there is no reverse dependence of prices on production for any of the grain crops. Just on the contrary, corn prices exhibit quite a high direct dependence on production (coefficient of correlation equals to 0.92), wheat prices – high direct dependence on production (coefficient of correlation equals to 0.75), and buckwheat prices – tangible direct dependence on production (coefficient of correlation equals to 0.6). The correlation between barley production and prices is a direct moderate one.

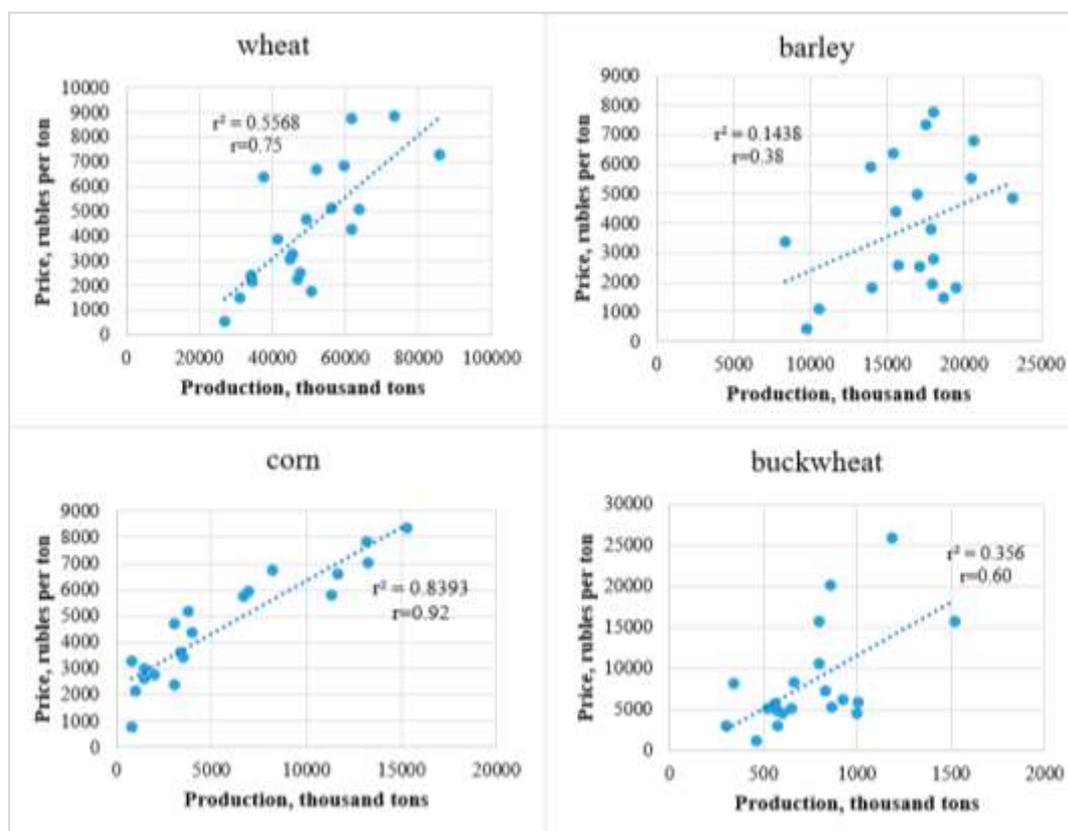


Fig. 3. Correlation between production and the average prices for particular grain crops in the Russian Federation in the period 1990–2017.

Source: Data were taken from Rosstat [13].

Thus, Russia's domestic need for grain has been fully met via domestic production, which is sufficient to be able to export grain as well. Reductions in grain production in 2018 have been preceded for five years by trends of increases in grain production, grain exports,

the share of domestic grain output in the nation's total grain resources, and the share of grain exports in its foreign grain trade turnover.

There is no reverse correlation between grain production and prices. On the whole, the

development of the Russian market for grain has been characterized by positive trends in the context of the nation's grain self-sufficiency levels.

The nation enjoyed continued boosts in grain production in the period 2013–2017, achieving between 2016 and 2017 record-high volumes in the last 18 years. Reductions in production in 2018 vis-à-vis the previous year should not be a concern. Firstly, in 2017 the nation's grain harvest was record-high, while in 2018 it was greater than the nation's average. Secondly, by the late 2017 Russia accumulated record-high reserves of grain – 90.7 million tons [13]. Given the nation's harvests of the last few years, the Russian Federation can be officially considered self-sufficient in grain, in terms of both food and feed consumption, with the nation currently consuming 72–75 million tons of grain per year [8].

In addition, the findings from the research reported in this paper indicate that there is no reverse correlation between grain production and grain prices. Just on the contrary, certain grain crops are characterized by varying-level direct linear correlations. Thus, reductions in production should not cause a sharp rise in grain prices and, consequently, in prices for related food products (e.g., bread, macaroni, flour, etc.). In addition, in 2017 the average grain prices from producers were lower than in the period 2015–2016, while there was an increase in grain reserves [13]. The authors are of the view that grain prices in the Russian market for grain depend more not on production but on world prices. In particular, the current increase in grain prices in the world market is associated with poor harvests in Europe, caused by natural-climatic phenomena.

The findings from a research study by Deppermann et al. [2] attest that the Russian Federation (along with Ukraine) has the potential to increase the nation's grain production levels further. However, it will be possible to achieve substantial boosts in grain production and grain harvesting efficiency only through modernizing the sector technologically [3]. There are a number of studies [1, 12] that have pointed out the grain

sector's relatively poor technical and technological condition as a key issue that needs to be addressed in the near term. Scholar N.Iu. Shovunova [16] notes that in the above indicator Russia is currently lagging behind not only economically developed nations but the world economy as a whole. M.L. Vartanova and E.V. Drobot [18] view the digitalization of grain production as a solution to issues of low productivity and high production costs. However, the scholars warn that new technology, which can help boost production efficiency, can only be afforded by large and medium-sized businesses, not farmers.

Despite Russia's shift to a path of innovation-focused development, to which the nation has committed formally, the issue of creating and implementing new technology remains a concern with many of the sectors within the Russian economy. The Russian Federation is significantly lagging behind world leaders in the number of patents issued and in effect [10], with the national economy currently characterized by institutional gaps and an imbalance between the government, science, and the business community [4, 15]. Thus, the need for technical modernization of the grain sector is part of a broader issue related to innovation-driven economic development in Russia. Work on resolving the issue must be systematic; it must be carried out by reference to the degree to which companies are actually prepared for change and to possible effects of modernization [6, 20]. The authors are of the view that modernization must be a key area for the development of Russia's grain sector, which should help resolve issues of low economic efficiency and productivity, high production costs, poor quality, as well as help fulfill the nation's grain potential to the fullest.

## CONCLUSIONS

The research reported in this paper study has produced the following findings and conclusions.

-In recent years (starting in 2013), Russia's grain production has been characterized by positive trends, with boosts posted in

production, reserves, and exports. The share of the nation's domestic grain output in its total grain resources is over 99%, with grain exports accounting for over 98% in the nation's foreign grain trade turnover. In 2017, the figures were the highest in the last 18 years.

-The Russian Federation is highly self-sufficient in grain. Starting in 2013, the coefficient of Russia's self-sufficiency in grain has increased. In 2017, it was 1.71. In other words, grain production in the Russian Federation is 1.71 times higher than its levels of production-related and personal consumption, processing, and loss. Thus, Russia's current levels of grain production are making it possible to fully provide for the nation's internal need for grain, as well as produce enough grain to export.

-Reductions in grain production in 2018 should not jeopardize Russia's self-sufficiency in grain or cause its shortages. This is substantiated by the nation's positive trends indicative of boosts in its grain production, reserves, and exports, the absolute prevalence of domestic grain output in its total grain resources and of grain exports in its foreign grain trade turnover, its high grain self-sufficiency levels, as well as the fact that its 2018 grain harvest is greater than its average grain harvest achieved in the last 10 years, with its grain reserves being record-high at the moment.

-Reductions in Russia's grain production in 2018 should not result in a rise in prices for grain and related food products (bread, macaroni, flour, etc.), as the domestic market for grain has no reverse correlation between production and prices. Just on the contrary, certain grain crops (e.g., wheat, barley, corn, and buckwheat) are characterized by varying-level direct linear correlations. Grain prices in the Russian market are more dependent on prices in the world market than on domestic production.

-Despite the positive trends, Russia's grain production sector has been faced with a number of issues, like low economic efficiency levels, low productivity levels, and poor grain quality. These issues could be resolved through modernizing the nation's

grain production sector, with a focus on directing the Russian economy to an innovation-focused path of development.

## REFERENCES

- [1]Andriushchenko, G. I., Davletshin, A. N., 2014, Tekushchee sostoyanie i potentsial razvitiya rossiiskogo rynka zerna [The current condition of and potential for the development of the Russian market for grain], Upravlenie Ekonomicheskimi Sistemami: Elektronnyi Nauchnyi Zhurnal, 12: 19.
- [2]Deppermann, A., Balkovič, J., Bundle, S.-C., Di Fulvio, F., Havlík, P., Leclère, D., Schepaschenko, D., 2018, Increasing crop production in Russia and Ukraine – Regional and global impacts from intensification and recultivation, Environmental Research Letters, 13(2).
- [3]Eremchenko, O. A., 2017, Tekhnologicheskie bar'ery razvitiya zernovoi otrasli Rossii [Technological barriers to the development of Russia's grain sector], Ekonomika Nauki, 3(2): 89–104.
- [4]Galimulina, F. F., Shinkevich, A. I., Komissarova, I. P., Mayorova, A. N., Astafyeva, I. A., Klimova, N. V., Zhukovskaya, I. V., 2016, Technology platforms as an efficient tool to modernize Russia's economy, International Journal of Economics and Financial Issues, 6(1): 163–168.
- [5]Generalov, I. G., Polianskii, M. V., Suslov, S. A., 2018, Ukreplenie prodovol'stvennoi bezopasnosti v RF i na otdel'nykh ee territoriyakh [Bolstering food security in the Russian Federation and particular regions within it], Karelian Scientific Journal, 7(2): 60–62.
- [6]Guseva, O. Iu., 2013, Kontseptual'ni zasadi i prikladni aspekti kompleksnogo otsinyuvannya gotovnosti pidpriemstv do zmin [Conceptual foundations and applied aspects of integrated assessment of the degree to which companies are prepared for change], Aktual'ni Problemi Ekonomiki, 7: 72–80.
- [7]Klimova, N. V., 2016, Obespechenie prodovol'stvennoi bezopasnosti Rossii kak strategicheskaya zadacha gosudarstva [Ensuring Russia's food security as a strategic objective for the government to tackle], Ekonomika: Vchera, Segodnya, Zavtra, 2: 74–89.
- [8]Kostrova, Iu. B., Shibarshina, O. Iu., 2018, Analiz i perspektivy razvitiya zernovogo rynka v RF [An analysis of and the prospects for the development of Russia's market for grain], Azimut Nauchnykh Issledovaniy: Ekonomika i Upravlenie, 7(2): 177–180.
- [9]Mansurov, R. E., 2015, Sovremennoe sostoyanie razvitiya zernoproduktovogo podkompleksa Respubliki Buryatiya [The current state of the development of the grain sub-complex in the Republic of Buryatia], Azimut Nauchnykh Issledovaniy: Ekonomika i Upravlenie, 4: 48–51.
- [10]Mayorova, E. A., Shinkareva, O. V., Nikishin, A. F., Uryaseva, T. I., Malinin, S. A., 2018, Developing innovations in retail trade in Russia, Espacios, 39(19).

[11] Minselkhoz, 2018, The Ministry of Agriculture of Russia. <http://mcx.ru/>, Accessed on Dec.10, 2018.

[12] Osipov, A. N., Fediushin, D. Iu., Davletshin, A. N., 2015, Sovremennye tendentsii razvitiya rossiiskogo rynka zerna [Present-day trends in the development of the Russian market for grain], *Ekonomika Sel'skogo Khozyaistva Rossii*, 3: 5–22.

[13] Rosstat, 2018, Rossiya v tsifrakh 2018: Kratkii statisticheskii sbornik [Russia in figures 2018: A brief statistics digest]. [www.gks.ru/free\\_doc/doc\\_2018/rusfig/rus18.pdf](http://www.gks.ru/free_doc/doc_2018/rusfig/rus18.pdf), Accessed on Dec.10, 2018.

[14] Seifullaeva, M. I., Panasenko, S. V., Shirochenskaya, I. P., Tsvetkova, A. B., Yevseyeva, J., 2018, Main tendencies and problems of agricultural export and import in Russia under economic sanctions, *Espacios*, 39(9).

[15] Shinkevich, A. I., Kudryavtseva, S. S., Ivanov, G. G., Korotun, O. N., Ishmuradova, I. I., Galimulina, R. R., Ostanina, S. Sh., 2017, Research and technological capacity of Russia as an indicator of knowledge economy growth, *International Journal of Advanced Biotechnology and Research*, 8(4): 1381–1388.

[16] Shovunova, N. Iu., 2016, Tendentsii v proizvodstve i realizatsii zerna v Rossiiskoi Federatsii [Trends in the production and sale of grain in the Russian Federation], *Niva Povolzh'ya*, 1: 128–136.

[17] Vartanova, M. L., Drobot, E. V., 2018, Vliyanie neprostrykh protivorechivyykh protsessov na rost otechestvennogo sel'skogo khozyaistva Impact of difficult contradictory processes on the growth of domestic agriculture [The impact of certain tough, contradictory processes on growth in domestic agriculture], *Rossiiskoe Predprinimatel'stvo*, 19(1): 13–36.

[18] Vartanova, M. L., Drobot, E. V., 2018, Perspektivy tsifrovizatsii sel'skogo khozyaistva kak prioritetnogo napravleniya importozameshcheniya [The prospects for the digitalization of agriculture as a priority area for import substitution], *Ekonomicheskie Otnosheniya*, 8(1): 1–18.

[19] Vinogradova, M. V., Kulyamina, O. S., Koroleva, V. A., Larionova, A. A., 2015, The impact of migration processes on the national security system of Russia, *Mediterranean Journal of Social Sciences*, 6(3): 161–168.

[20] Vinogradova, M. V., Babakaev, S. V., Larionova, A. A., Laiko, M. Yu., Kobyak, M. V., 2016, Modernization of management: Social and socio-cultural aspects, *International Journal of Environmental and Science Education*, 11(15): 7847–7856.



## ASPECTS OF THE HYDROLOGICAL BALANCE OF THE RAZIM SINOE COMPLEX

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### Abstract

*This paper follows the description of the physico-geographic natural setting from the Razim-Sinoe lagoon complex area and the detailed presentation of its characteristics. The tasks of the study are determined by the achievement of goals by conducting a series of data and information analyzes, consulting a number of specialized sources in the field of geography. The statistical data and graphs present in the paper were processed after the Meteorological Center Dobrogea Litoral and the Dobrogea Seaside Basin Administration. Materials and studies were also carried out by Geoecomar, but also by the Danube Delta Biosphere Administration, given the complexity of the complex. The interpretation of the obtained information and data is presented by the analysis method, being represented by interpretations, maps, graphs, tables, statistical data representing the product of the research, indicating the role of the elements in the structure of the whole work. Given the large expanse and geographical position of the lagoon complex, the hydric and physico-chemical regimes have certain peculiarities. Due to its peculiarities, the very diverse fauna and flora present in the Razim-Sinoe complex, it can be said that it is one of the main tourist attractions in the area.*

**Key words:** hydrological balance, water, food, tourism

### INTRODUCTION

The formation of the Razim-Sinoe lagoon complex, for more than 1,000 years, has contributed both the gradual eastward movement of the shoreline along Delta and the Danube with alluvial deposits. [2]

The two trials took off the shore of Halmyris' old golf course under the direct intervention of the sea and created favorable conditions for the formation of new shores that isolated the complex.



Fig. 1. The golf phase of the Razim-Sinoe complex  
Source: Tulcea Danube Delta Museum.

The Razim-Sinoe lagoon complex is a part of the former marine bay that stretched between Midia's head in the south and the Danube peninsula in the north and which in ancient Greek-Roman communication still spread with the Black Sea. The justification for the inclusion of this lagoon complex in the Danube Delta consists in the formation of perisipes (narrow strips of seabed land formed by the accumulation of alluviums that close a liman or a lagoon).



Fig. 2. The lagoon phase of the Razim-Sinoe complex  
Source: Tulcea Danube Delta Museum.

At a certain point, by advancing the mouths of the Danube (St. George's arm) to the east

and by clogging the arms of Dunavăț and Cerneț, the Razim complex was about to lose touch with the Danube. [1]

## MATERIALS AND METHODS

In order to accomplish this work a number of bibliographic sources, from various specialized books, to websites using methods of research, analysis and synthesis of information were used and consulted. The statistical data and graphs present in the paper were processed after the Meteorological Center Dobrogea Litoral and the Dobrogea Seaside Basin Administration. Theoretical information from the books of Ovidius University Library and the Ioan N. Roman County Library was also accessed. Materials and studies were also carried out by Geocomar, but also by the Danube Delta Biosphere Administration, given the complexity of the complex.

The interpretation of the obtained information and data is presented by the analysis method, being represented by interpretations, maps, graphs, tables, statistical data representing the product of the research, indicating the role of the elements in the structure of the whole work.

Synthesis is another method used in the realization of the work, and can not exist in the absence of detailed analysis, representing the part of a scientific work presented as a short presentation on the structure of the work and as an explanation on the subject under consideration.

In relation to analogue data processing, the digital one has a much wider scope for analyzing, storing, shaping and representing some natural images and processes. For this purpose, different statistical data, maps, tables were used to better visualize the content of the paper.

## RESULTS AND DISCUSSIONS

### Hydrological regime and hydrological balance

Given the large expanse and geographic location of the Razim-Sinoe lagoon complex,

the water and physico-chemical regimes have certain peculiarities. [3]

Relative to the surface of the 867 km<sup>2</sup> complex, the 2,462 km<sup>2</sup> receiving basin is quite small given the climatic conditions it finds (precipitation of about 400 mm/year and water evaporation of about 850 mm/year). Among the most important rivers we mention Telița and Taița, which come in the Babadag lake and therefore in Razim, Slava and Beidaud, in Ceamurlia Lake and further in Golovita, Salines in Sinoe, Weddings and Săcele in Nuntași-Tuzla Lake. Although all the mentioned rivers have permanent character, the volume of water they bring into the complex is quite insignificant in the weight ratio of water (400 l / s, Telița 80 l / s multi-year average). [4]

If this complex had no connection with the Black Sea through which the sea waters penetrate into the lakes when the level falls or would not have received natural freshwater channels from the Sfântu Gheorghe arm, emery lake plain.

Because of its connection with the Black Sea, the Razim-Sinoe lagoon complex had salty waters with tendency to concentrate and salinize in the more isolated southern compartments (Sinoe, Istria, Weddings-Tuzla), close to seawater. Towards the end of the last century the Dunavăț and Cerneț channels were dredged and a submersible submersible threshold was built at Gura Portiței to limit the penetration of salty waters from the sea and the leakage of the sweet ones into the lagoon complex.

The Razim-Sinoe complex is the second largest morpho-hydrographic unit, after the actual delta, which is part of the Danube Delta Biosphere Reserve. [6]

Under natural, unplanned conditions, where rainfalls at the lakes cover only 8.8% at intakes and 19% loss at loss, the persistence of the lakes was made possible by the Danube contribution, namely the Sfântu Gheorghe branch with 40% and the mutual network with The Black Sea through the most important links (Gura Portiței and Periboina).

Prior to the first interventions of man in the modification of the water relations with the surrounding area, the water balance with its

consequences was determined by the low intake of fresh water from the Danube and the marine ones. The waters of the complex were wild in the northern compartment (the lakes Razim, Golovița and Zmeica) and salted in the southern part (Sinoe, Istria, Nuntași-Tuzla).

To exploit the fishing potential of this complex, especially of the northern compartment, which was subject to deficient state in terms of freshwater intake, at the beginning of the twentieth century, on the proposal of Gr. Anttipa, in 1905, the Charles Canal (the current Dunavăț), in 1913 the channel Elisabeta (between the lakes Babadag and Razim - now called the Enisala canal) and in 1914, the Ferdinand canal (the current Dranov). [8].

By the construction of the fishing facilities in the Dranov unit and northern Razim Lake, after 1950, several canals were dug, but the main role in the fresh water supply remained also through the channels of Dunavăț, Dranov and Lipoveni. [10]

Another stage in human intervention in the Razim-Sinoie Complex is in the 1970s of the twentieth century, when the northern compartment was transformed by appropriate works into a freshwater basin which, besides the fishery function, and water supply of irrigation systems in the adjacent area of about 120,000 ha. [5]

For this purpose Gura Portiței was closed, on the Grindul Lupilor (Channels II and V), which connect with the southern compartment, the tunnels of the Dunavăț and Dranov channels were built at a capacity of 100 m<sup>3</sup>/s at average flows. Through these hydrotechnical works, the normal retention level in the northern compartment is +0.50 m (compared to the Black Sea level at Sulina), and in the southern compartment (Sinoe), +0.30 m. Communication with the Black Sea in present is done by the Periboina fishing fence and the Edighiol hammer, on the Chituc grinder. [9]

The volume of fresh water (0.3-0.5 g / l fixed residue) in the northern compartment is 500 mil.m<sup>3</sup>. This volume of water has been used in irrigation systems during the period of operation to almost normal capacity by 1989

through six pumping stations, which have produced and produce many problems at the moment with juvenile fish juveniles.

The hydrological balance of the Razim-Sinoe lagoon complex was calculated for two periods according to the equations:

$$X + YB + YD - Z - YM = \pm \Delta V \text{ for the period } 1956-1970;$$

$$X + YB + YD - Z - YM - Ir = \pm \Delta V \text{ for the period } 1984-1987.$$

Table 1. The hydrological balance of the Razim-Sinoe Complex in the periods (1958-1970) and (1984-1987)

Period		1958-1970	1984-1987
X	Mil. m <sup>3</sup>	334.5	286.1
	%	8.8	6.9
YB	Mil. m <sup>3</sup>	45.6	44.2
	%	1.2	1.1
YD	Mil. m <sup>3</sup>	1,542.7	1,755
	%	40	42.1
Z	Mil. m <sup>3</sup>	724.1	646.4
	%	19	15.5
YM	Mil. m <sup>3</sup>	1,170.4	663.0
	%	30.7	15.9
Ir	Mil. m <sup>3</sup>	-	530
	%	-	12.7
ΔV	Mil. m <sup>3</sup>	10.3	242
	%	0.3	5.8

Source: Romania's Georgraphy (Geografia României) Vol. 5, 2005.

In Table 1, the terms have the following specification:

X- lakes surface precipitation;

YB - liquid effluent from the associated river basin;

YD - liquid flow from the Danube through channels;

X - evaporation from lakes;

YM - shallow leakage in the Black Sea through the breaks of coastal seams (called ditches or periboines);

Ir = volume of water used for irrigation;

ΔV = the difference in volume of water accumulated (+) or lost (-) in the analyzed period compared to the previous one.

In the first period (1956-1970) there is a large proportion of YD and YM components in relation to others, rainfall and leakage in the native hydrographic basin. Evaporation played an important role in the hydrological balance.

In the second period (1984-1987), when the balance sheet was conducted for strictly economic purposes (irrigation), by increasing the water intake in the Sfântu Gheorghe arm and limiting the leakage in the Black Sea, there is a change in the weight of the components, YD, halving YM and obviously participating in the irrigation component (Ir). These changes in the balance have led to major transformations in the Razim and Golovița lakes and, to a certain extent, to the southern ones (Sinoie, Histria, Nuntași). [7]

## CONCLUSIONS

The Razim-Sinoe complex is a part of the Danube Delta Biosphere Reserve, located in the south of the Danube Delta, formed mainly of lakes, seashores and several higher relief formations.

The Razim-Sinoe complex is the only coastal lake in Romania, which is connected to both the Danube and the Danube. After some hydro-technical works in 1970 Razim-Sinoie lagoon complex was transformed into two units: the Razim unit and the Sinoe unit.

During the formation of the complex, over 1,000 years, both the presence of the Danube with alluvial deposits and the gradual eastward movement of the coastal currents contributed as Delta advanced.

Given the large expanse and geographical position of the lagoon complex, the hydric and physico-chemical regimes have certain peculiarities.

The fisheries in the north (Agighiol-Sarinasuf), the western part (Babadag with Tăuc and Topraichioi, Sălcioara) and the southwest (Jurilovca-Ceamurlia), related to the change of the basic use (fishing) (Razim) in agro-fishery use has led to important changes in the hydrological functionality and appearance of the water balance of the Razim-Sinoie Lake Complex.

Due to its peculiarities, the very diverse fauna and flora present in the Razim-Sinoe complex, it can be said that it is one of the main tourist attractions in the area.

## REFERENCES

- [1]Damian, N., 2013, Mediul geografic și factorii de risc social din Delta Dunării, Editura Universitară, (The geographic environment and the factors of social risk in the Danube Delta, Universitara Publishing House), București, pp.32-33.
- [2]Driga, B.V., 2004, Delta Dunării- Sistemul Circulației Apei, Ed. Casa Cărții De Știință, (The Danube Delta- The system of water circulation, teh House of Science Book Publishing), Cluj-Napoca, pp.45-47.
- [3]Gâștescu, P.,1969, Lacurile din Romania, Editura Academiei Republicii Socialiste Romania, (The lakes of Romania, The Publishing House of the Academy of the Socialist Republic of Romania), Bucuresti, pp.29.
- [4]Grigore, P., Bogdan, O., Zăvoianu,I., 2005, Geografia României, Vol. V, Editura Academiei Române (Geography of Romania, Vol. V. The publishing House of the Romanian Academy), București, pp.88-99.
- [5]Master Planul Rezervației Biosferei Delta Dunării (The Master Plan of the Danube Delta Biosphere Reservation), 2005, Institutul Național de Cercetare și Dezvoltare Delta Dunării ( the Danube Delta National Research and Development Institute), [http://www.ddbra.ro/media/master%20plan%20RBDD\(2\).pdf](http://www.ddbra.ro/media/master%20plan%20RBDD(2).pdf), Accessed on Jan.5, 2019.
- [6]Mutihac,V., Ionesi, I.,1974, Geologia României, Editura Tehnologică (Geology of Romania, Tehcnological Publishing House), București, pp.45.
- [7]Năstase, A., 2009, Cercetări asupra diversității ihtiofaunei din Delta Dunării pentru exploatarea durabilă a resurselor piscicole (Teză de Doctorat), (Researches on the ihtio-fauna diversity in the Danube Delta for the sustainble use of the fish resources (Ph.D.thesis), Galați.
- [8]Neacșa, O., Popovici, C.,Popa, G.,Buzea, N.,1969, Resursele climato-terapeutice ale litoralului românesc, Editura Academiei Române ( The climate-therapeutical resources of the Romanian Seashore, The Publishing House of the Romanian Academy), București, pp.36.
- [9]Planul de Amenajare a Teritoriului Zonal „Delta Dunării” (The plan of territorial management "The Danube Delta"), 2008, Institutul Național de Cercetare și Dezvoltare Delta Dunării ( the Danube Delta National Research and Development Institute), [http://www.mie.ro/\\_documente/dezvoltare\\_teritoriala/a\\_menajarea\\_teritoriului/patz\\_delta\\_dunarii/CD\\_Predare2\\_1/Strategie\\_at\\_2\\_final.pdf](http://www.mie.ro/_documente/dezvoltare_teritoriala/a_menajarea_teritoriului/patz_delta_dunarii/CD_Predare2_1/Strategie_at_2_final.pdf), Accessed on Jan.5, 2019.
- [10]Văidianu, N., 2013, Rezervatia Biosferei Delta Dunării, Editura Ars Docendi The Danube Delta Biosphere Reservation, Ars Docendi Publishing House), Bucuresti, pp.27-28.

## CHARACTERISTIC ASPECTS OF THE DANUBE DELTA LAKES

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### **Abstract**

*The study area is a unique zone called the Danube Delta. The name "delta" derives from the Greek "delta" because of its equilateral triangle shape. Inside this triangle there is a positive relief represented by beams and islands, as well as a negative relief such as canals, marshes, ponds, lakes or Danube arms. The research methods used the statistical data provided by the competent bodies, which were processed and analyzed. It used the computerized processing that generated tables and graphs. The delta hydrography is represented by the Danube's arms, lakes, ponds, marshes, lakes, ponds, canals and sahale. The lakes are distributed throughout the delta, and, as mentioned by P. Gâtestescu in 1969, are concentrated in several lacustral complexes: Sireasa, Storm, Pardina, Matița-Merhei, Dranov, Gorgova-Isac and Roșu-Puiu and Zătoanele. The 2005-2010 interval captures the lakes in the Danube Delta in a predominantly good ecological state for almost all chemical compounds, from oxygen, to copper, zinc, iron, nickel.*

**Key words:** delta, lake, vegetation, ecology, environment

### **INTRODUCTION**

The total Delta area is 4,152 km<sup>2</sup>, of which 3,318 km<sup>2</sup> representing 82% of the delta surface are found in the territory of our country. However, this area of 3,218 km<sup>2</sup> is the actual delta surface (2,491 km<sup>2</sup>) and the area of Lagunar Razim-Sinoe (827 km<sup>2</sup>). [2]

The Danube Delta is an alluvial plain, which is in a continuous process of formation, dominated by marshy areas. It has the shape of an equilateral triangle, where 20.5% of the delta territory is under 0 meters, and 79.5% above this level.

Most of the areas have altitudes between 0 and 1 m. The highest "altitudes" are located on the marine beams (Letea grunt 12.4 m and Caraorman grunt 7 m), and the highest depths are found on the Danube arms (-39 m on the Chilia branch, -34 m on the Tulcea arm, -26 m on the Sf. Gheorghe arm, -18 m on the St. George's arm). The average altitude of the Danube Delta is 0.52 m, and the relief is composed of a variety of positive and negative microforms at whose formation the Danube, the Black Sea contributed, and last but not least, the aeolian processes, the vegetation, the eustathic and epigenetic movements and especially the anthropic

factor. These forms of relief are divided into two types of relief: major and medium and minor.

### **MATERIALS AND METHODS**

In order to write the paper I have consulted several specialized bibliographic sources and used data from research institutions such as Constanta Meteorological Station or Tulcea Environmental Protection Agency.

The statistical data provided on the characteristic aspects of the lakes, data that were processed, analyzed and interpreted graphically were used.

### **RESULTS AND DISCUSSIONS**

The major relief includes three subtypes: the fluvial delta, the maritime delta and the submerged delta (belonging to the continental platform).

The medium and minor relief includes beams, fluvial arms, secondary deltas, marshy fields, beaches, dunes, etc (Figure 1).

“The Danube Delta falls within the temperate climate zone and the coastal climate, and is subjected to three external influences, such as: continental, pontic influences and those of the advective air that pervade to the west or east, depending on the direction of travel air masses; as a result of the delta position of the

delta between the continental drylands surrounding it, which surrounds it in the north, west and south, and the Black Sea to the east”. [2]

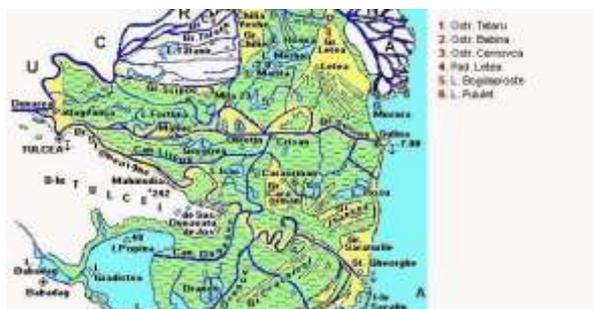


Fig.1 The Danube Delta

Source: <http://www.info-delta.ro/delta-dunarii-17/>

### Hydrography

“The hydrographic network within the Danube Delta is very complex and has one of the most important roles in the delta, having both an economic role, attracting tourists in these areas, and its navigable potential, a landscaping landscape, and that of feeding the lakes with water”. [1]

“Also, hydrographic network is one of the determining factors in the emergence, and then in ensuring the evolution and functioning of the Danube Delta.

The hydrography of the delta is represented primarily by the Danube's arms, ponds, marshes, lakes, ponds, canals and sahal”. [3]

The arms of the Danube are the most important hydrographic element in the Danube Delta, namely Chilia, Sulina and Sfântu Gheorghe that flow directly into the Black Sea.

The Chilia arm transports 60% of the water and alluviums, the Sulina arm transports 18% And St. George's arm carries 22% of the volume of water.

Lakes are one of the most important morphohydrographic elements in the Delta, which occupies an area of about 25,666 hectares today.

Over time, there has been a dramatic decrease in the number of lakes in the delta, due to the numerous landscaping works that have been considered as desulphurization, the most important being the Sireasa and Pardina, in which 40 and 120 lakes were drained respectively; or the restriction of the

hydrographic arteries, which ensured the connection with the Danube arms. In this respect, it is noticed that, from 661 lakes (only lakes with an area of more than 1 hectare were considered), which occupied 31,493 ha (9.49% of the Danube Delta area), - registered in 1964, following inventory by the State Water Committee, the number of lakes has now been reduced to 479, which occupies an area of 25,794 ha, only 8.06% of the total deltaic space. [8]

Table 1. Number, surface and volume of lakes in the Danube Delta

Unity	Number	Surface		Volume	
		m <sup>2</sup>	%	m <sup>3</sup>	%
Letea	214	9,463.50	36.69	128,593,375	39.41
Caraorman	175	12,802.50	49.63	159,124,000	49.12
Dranov	90	3,528.50	13.68	31,640,250	11.47
Total Delta	479	25,794.25	100	319,357,625	100.0

Source: Driga ( 2004) [2].

The deltaic lakes are outlined by vegetation such as reed and poplar, as well as several emitting or submerged beams. These lakes keep permanently, or only temporarily, with the Danube's arms, through the intersection of the canal network and the lakes, or even underground, beneath the plaque, thus making a continuous exchange of waters; making it difficult to accurately assess the water balance of a single lacquer. [6]

Under these conditions, the water balance of the whole depression lake complex is usually determined and calculated. [8]

Lakes are distributed throughout the delta, but there is a clear difference in the number and size of the lakes between the western and eastern parts. This differentiation resulted from much more intense alluvial processes in the western part, but also from the higher degree of antropic intervention compared to the eastern part. Thus, the western part is characterized by a larger number of lakes, but with smaller areas, while the eastern part of the delta is characterized by a smaller number of lakes, but with larger surfaces. [9]

Another significant difference between the two extremes lies in the depth of the lakes, reduced in the west, below 1 m, unlike the eastern one, where the average depth is 1-3 m, or even much larger if we take into account and the category of meander lakes, which

have depths of over 7 m. The aspect of the shore is another differentiating element, well defined and outlined by the fluvial banks in the west, compared to those in the eastern delta, where we meet rather a pseudo-shore, the shore line being contoured by reed and plum. [9]

Varnishes with areas of less than 0.5 km<sup>2</sup> are treated differently due to their specific character and are located mainly in the delta area between the main Danubian arms. These lakes also have the name "ghioluri" and have a depth of -0.5 m, which makes it impossible to wipe them even with the smallest waters.

### Specific issues

Lacustrian complexes are complex depression areas, made up of lakes, bounded by high tides, bushes and plains, and which are interconnected by a network of hedges and canals, which also ensures their water connection with the Danube arms. Thus, the entire area can be considered a unitary lake system, often outlined by vegetation and rarely by girders. [5]

The Danube Delta, as mentioned by P. Gătestescu in 1969, is composed of several lacustral complexes such as Sireasa, Sturuna, Pardina, Matița-Merhei, Dranov, Gorgova-Isac (corresponding to the fluvial delta), and Rosu-Puiu and Zătoanele included in the maritime delta).[7]

We will then look at some detailed aspects of the water balance of the Matița-Merhei Complex.

Given that the Danube level variation regime directly determines that of the Matița-Merhei complex, the maximum quantities of water stored in this complex are produced between April and June, while the minimum values are recorded in the season autumn, and even winter.

Based on the morphohydrographic map of the Danube Delta, with a scale of 1:50,000, conducted by the Institute of Geography in 1963, it follows that the level observations at the center of the Matita-Merhei complex highlight two thresholds at 105 and 200 cm, which determines: the volumes, levels, water-covered areas and the changes recorded in the

process of water exchanges between the lake area and the Danube arms.[4]

Thus, raising the water level, even by 1 cm at the threshold of up to 105 cm, increases the volume of water throughout the depression area and lake. [10]

Given the variation of the level of the Danube River, which inevitably determines the variation of the level within the Matița-Merhei complex; the largest quantities of water stored in the latter occur in the period April to July, with maxims in May and June, while the minimum values occur in the autumn and winter seasons.

For a more explicit analysis, an interval of 22 years (1964-1985), which was the highest level, was considered. Under these conditions it is noted:

- the interval from May 27 to May 31, 1970, when there were high levels at Matiacherhana, namely 244 cm, which means that the daily volume of cantonated water was about 803 million m<sup>3</sup>;

- April 7-9, 1981, the largest volume of water cantonated daily from the analyzed period (1964-1985), ie 834.8 million m<sup>3</sup>, which led to the reaching of a level of 252 cm in the Matița-cherhana

- February 9-12, 1964, when the lowest daily water volume, namely 139.8 million m<sup>3</sup>, was registered.

In order to determine the water balance for the Matița-Merhei complex, the years were selected:1964 (the year with the lowest levels),1970 (the year with the highest levels), 1975 and 1980, these being the years with the most accessible data.[2]

For these years the quantities of atmospheric precipitation were recorded and analyzed at the meteorological stations in Gorgova, Chilia Veche and Vâlcov (belonging to Ukraine), the largest quantities being received at Gorgova (325.2 mm in 1970 and 546.1 mm in year 1980). (Driga, 2004) [2].

Table 2. Volume of water stored in Matița-Merhei lake depression in 1964 (million m<sup>3</sup>)

YEAR	1964											
Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Mediate	178	180	234	312	382	360	288	240	188	208	310	362
Maximum	208	201	251	366	385	385	315	276	211	266	334	379
Date	1-2	29	31	31	11-16	1	1	1-2	3-4	30-31	22-26	24-27
Minimum	155	140	201	256	366	321	276	206	170	185	271	334
Date	23-29	9-12	1	1	1-2	29-30	31	29-31	24-26	15-21	1	1

Source: Driga (2004) [2].

Table 3. Water volume stored in Matița-Merhei lake depression in 1970 (million m<sup>3</sup>)

YEAR	1970											
Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Mediate	346	460	682	762	796	766	666	498	422	298	244	282
Maximum	430	515	778	799	803	803	729	60	455	350	266	289
Date	30-31	28	31	30	27-31	1	1	1	1	1	28-30	18-22
Minimum	302	430	522	749	790	712	614	430	366	256	233	266
Date	7-10	1	1	8-13	7-9	30	31	23-25	30	31	9-13	1

Source: Driga (2004) [2].

Table 4. Water volumes stored in the Matița-Merhei Lagoon Depression in 1975 (million m<sup>3</sup>)

YEAR	1975											
Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Mediate	502	351	262	344	466	554	636	519	348	256	256	244
Maxi Mum	525	433	297	414	496	601	696	679	363	299	287	287
Date	4-6	1	31	30	31	19-21	16-21	1	1	1	4-6	8-9
Mini Mum	436	292	241	302	420	477	566	363	304	226	226	208
Date	31	28	13-15	1	1	6	1	31	30	22-23	20-21	31

Source: Driga (2004) [2].

Table 5. Water volumes stored in Matița-Merhei lake depression in 1980 (million m<sup>3</sup>)

YEAR	1980											
Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Mediate	370	444	446	459	548	570	524	446	344	308	430	470
Maxi Mum	404	518	525	499	720	720	554	550	410	385	455	525
Date	1	25-27	1	23-25	30-31	1	10	1	1	31	17-18	31
Minimum	344	337	391	407	464	487	487	401	271	236	401	410
Date	31	1	27-29	1	4	29-30	4-5	27-31	30	5	3	1

Source: Driga (2004) [2].

Based on the direct observations made on the cork on Lake Gorgova, which only functioned until 1975, it was possible to estimate the evaporation of the water, which was correlated with the evaporation from the surface of the soil, as well as with the moisture deficit, from the same station, for the years 1975, 1980 and 1982. [2]

Water evaporation ranged from 1,126.2 mm in 1975 to only 947.6 mm in 1980, meaning that if we report the precipitation evaporation, it would result in an aridity index of 0.36 in 1964; 0.34 in 1970; 0.40 in 1975 and the maximum of 0.58 in 1980. [2]

Under these circumstances, the Matița-Merhei complex receives an average of 80.9 million m<sup>3</sup> of rainfall and releases 301.9 million m<sup>3</sup> of evapotranspiration, resulting in an average annual deficit of 221 million m<sup>3</sup>, a deficit which normally, without the water supply by the Danube, would make it impossible for this complex, and hence the entire deltaic territory. The 2005-2010 interval captures the lakes in the Danube Delta in a predominantly good ecological state for almost all chemical compounds, from oxygen, to copper, zinc, iron, nickel, and so on. [2]

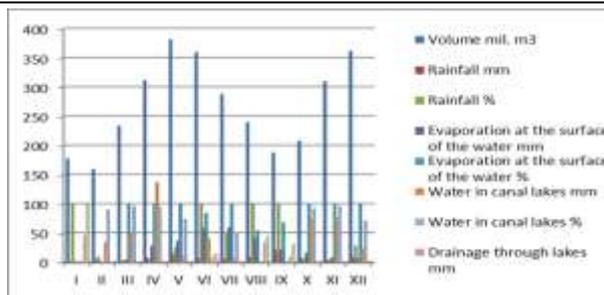


Fig.2. The water balance of the Lake Matita-Merhei Lake Complex in the years 1964, 1970, 1975 and 1980  
Source: Own determination.

The best concentrations, which have provided a very good environmental status, are pH, oxygen, phosphorus, sulfate, chromium, calcium and zinc, which suggests a very low acidity and an optimal level for fish multiplication and development, and of the lacustrine vegetation, while at the opposite end, with very harmful concentrations for the deltaic lakes, there were nickel, iron and copper, chemical compounds resulting from the processes of dyke development, river transport, and spills and not only by the local population and / or industrial plants in the Delta area, which are very dangerous to the life of the fish, leading to the reduction or even disappearance of one or more species of fish and / or plant species.

## CONCLUSIONS

The Danube Delta is the second largest wetland in Europe but also the lowest and the newest plains region, located on the territory of two countries: Romania and Ukraine.

The total delta area is 4 152 km<sup>2</sup>, of which 3 318 km<sup>2</sup>, are located on the territory of our country.

The Danube Delta is an alluvial plain, in a continuous process of formation, dominated by marshy areas, with the shape of an equilateral triangle, in which a relief consisting of a variety of positive and negative microforms is carried out, showing a medium altitude of 0.52 m.

The delta hydrography is represented by the Danube's arms, lakes, ponds, marshes, lakes, yaks, canals and sahals. Of all these hydrographic elements, an important place is occupied by the lakes, which have drastically

reduced their number from 661 lakes in 1964 to just 479 lakes today.

The lakes are distributed throughout the delta, and as P. Gâștescu mentioned in 1969, they are concentrated in several lacustral complexes such as: Sireasa, Fortuna, Pardina, Matia-Merhei, Dranov, Gorgova-Isac, Rosu-Puiu and Zătoanele.

Delta Lakes take up the need for precipitation water as well as channels, channels that act as water regulators, helping either to feed the lakes with water or to drain water from the lakes to the arms. Another particularly important process in the water circulation process in the Danube Delta is evaporation, a process that causes the loss of a large quantity of water.

The 2005-2010 interval captures the lakes in the Danube Delta in a predominantly good ecological state for almost all chemical compounds, from oxygen, to copper, zinc, iron, nickel, and so on. The best concentrations, which have provided a very good environmental status, are pH, oxygen, phosphorus, sulfate, chromium, calcium and zinc, which suggests a very low acidity and an optimal level for fish multiplication and development, and of lacustrine vegetation, while at the opposite pole, with very harmful concentrations for the animals the deltaic lakes were nickel, iron and copper, chemical compounds resulting from the process of dyke, river transport and wastewater discharges, and not only by the local population and / or industrial plants the area of the Delta, and which are very dangerous for the life of the fish, leading to the diminution or even disappearance of one or more species of fish and / or plant species.

## REFERENCES

[1]Damian, N., 2013, Mediul geografic și factorii de risc social din Delta Dunării, Editura Universitară, (The geographic environment and the factors of social risk in the Danube Delta, Universitara Publishing House), București, pp.32-33.  
[2]Driga, B.V., 2004, Delta Dunării- Sistemul Circulației Apei, Ed. Casa Cărții De Știință, (The Danube Delta- The system of water circulation, teh House of Science Book Publishing), Cluj-Napoca, pp.45-47.

[3]Gâștescu, P.,1969, Lacurile din Romania, Editura Academiei Republicii Socialiste Romania, (The lakes of Romania, The Publishing House of the Academy of the Socialist Republic of Romania), Bucuresti, pp.29.  
[4]Grigore, P., Bogdan, O., Zăvoianu,I., 2005, Geografia Romaniei, Vol. V, Editura Academiei Române (Geography of Romania, Vol. V. The publishing House of the Romanian Academy), București, pp.88-99.  
[5]Master Planul Rezervației Biosferei Delta Dunării (The Master Plan of the Danube Delta Biosphere Reservation), 2005, Institutul Național de Cercetare și Dezvoltare Delta Dunării ( the Danube Delta National Research and Development Institute), [http://www.ddbra.ro/media/master%20plan%20RBDD\(2\).pdf](http://www.ddbra.ro/media/master%20plan%20RBDD(2).pdf), Accessed on Jan.5, 2019.  
[6]Mutihac,V., Ionesi, I.,1974, Geologia României, Editura Tehnologică (Geology of Romania, Tehnological Publishing House), București, pp.45.  
[7]Năstase, A., 2009, Cercetări asupra diversității ihtiofaunei din Delta Dunării pentru exploatarea durabilă a resurselor piscicole (Teză de Doctorat), (Researches on the ihtio-fauna diversity in the Danube Delta for the sustainble use of the fish resources (Ph.D.thesis), Galați.  
[8]Neacșa, O., Popovici, C.,Popa, G.,Buzea, N.,1969, Resursele climato-terapeutice ale litoralului românesc, Editura Academiei Române ( The climate-therapeutical resources of the Romanian Seashore, The Publishing House of the Romanian Academy), București, pp.36.  
[9]Planul de Amenajare a Teritoriului Zonal „Delta Dunării” (The plan of territorial management 'The Danube Delta'), 2008, Institutul Național de Cercetare și Dezvoltare Delta Dunării ( the Danube Delta National Research and Development Institute), [http://www.mie.ro/\\_documente/dezvoltare\\_teritoriala/a\\_menajarea\\_teritoriului/patz\\_delta\\_dunarii/CD\\_Predare2\\_1/Strategie\\_at\\_2\\_final.pdf](http://www.mie.ro/_documente/dezvoltare_teritoriala/a_menajarea_teritoriului/patz_delta_dunarii/CD_Predare2_1/Strategie_at_2_final.pdf), Accessed on Jan.5, 2019.  
[10]Văidianu, N., 2013, Rezervatia Biosferei Delta Dunării, Editura Ars Docendi The Danube Delta Biosphere Reservation, Ars Docendi Publishing House), Bucuresti, pp.27-28.



## THE DYNAMICS OF THE NUMBER OF FOREIGN TOURISTS WHO HAVE ACCESSED TOURIST PACKAGES THROUGH THE "VACANȚE MINUNATE" AGENCY DURING THE PERIOD 2008-2015

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### Abstract

*The study of the tourist activity of an agency requires a careful analysis of all the components of this activity. The role of the tourism agency in tourism activity is the promotion and development of tourist products, this being the most important. The present paper analyzes the main aspects regarding the touristic activity of a tour operator, as well as its organization and functioning (conditions for the marketing of the tourist products, organizational modalities, the main tourist services offered and possibilities for their diversification for promotion and development tourism). In this paper there were mainly analyzed the tourist offerings and the number of foreign tourists arriving through the agency during 2008-2015. This analysis is very necessary in national and international tourism and the travel agency must have the necessary means to continuously upgrade its tourist product offerings. The main activity of the tourism agency both internally and externally, are the total economic and financial results of society, which are largely influenced by the tourism activity, which in turn depends on many conjunctural factors on the domestic and international market. For the detailed analysis of the indicators, we processed data provided by the "Vacanțe Minunate" Agency, related to foreign tourists, during 2008-2015. As a research methodology, we used the data provided by the Vacanțe Minunate Agency, which we processed, analyzed and interpreted, observing the tourist flows provided by the agency.*

**Key words:** foreign tourists, offers, demand, discounts, Romania

### INTRODUCTION

“Tourism is the whole of the relationships and phenomena that result from the movement and stay of people outside its home, as long as it is not a permanent establishment.

It is a strong economic and social phenomenon involved in the life of society at national and international level”. [8]

It has the role of mobilizing innumerable reserves and material and material availability of people, expanding them and enhancing their cultural horizons; thus it becomes an important factor of education, approach and understanding between people. [9]

This represents a new dimension of tourism with profound human meanings that immobilizes an activity that is a component of social, national and international life. [6]

“To this end, a great variety of actions is

needed to capitalize on the cultural heritage of each country, historical traditions”. [6]

### MATERIALS AND METHODS

As a methodology we used specialized bibliography but also data provided by the agency with reference to tourists' demand, agency offer, tourist flows, accommodation capacity, data that we have processed, analyzed and interpreted.

For the detailed analysis of the indicators, we processed data provided by the Vacanțe Minunate Agency, related to foreign tourists, during 2008-2015.

### RESULTS AND DISCUSSIONS

“The main activity of the tourism agency both internally and externally as well as the overall

economic and financial results of the society are influenced to a large extent by the tourism activity, which in turn depends on many conjuncturing factors on the domestic and international market". [2]

The company has the following object of activity:domestic tourism - contractual and occasional actions - by organizing domestic and foreign trips with Romanian tourists, as well as excursions for rest, health - treatment bases. [7]

International tourism - contract actions based on external contracts in the accommodation infrastructure of the seaside tourism companies and the development of these contracts, organizing tourist programs in the country and abroad organizing meetings, economic missions, symposiums, organizing exotic holidays, weekend programs, city tours, day trips around, unprecedented tours around the world, reservations of accommodation and places in public catering establishments. [4]

Travel Agency "Vacanțe Minunate" has as activity: reservations and airline sales on any route on all airlines with discounts for sailors and for organized groups; hotel reservations in Romania and anywhere in the world at contract rates; organizes meetings, conferences, professional meetings, rent-a-car (cars, minibuses, coaches);serving seafarers and passengers for foreign currency exchange, as well as local crew trips (Seaside Tour, Trips to the Danube Delta, Murfatlar Wine Tasting),organizes business or tourist trips including flight ticket, reservation at the hotel, airport transfers, rent-a-car, optional tours. [10]

**Tour Operator Features of the "Vacanțe Minunate"**

The Tour Operator is an agency that works with several travel agencies, the purpose of which is to organize and sell tourist packages at the lowest rates through various intermediaries. [1]

**Evolution of the number of foreign tourists who have accessed offers through the Agency "Vacanțe Minunate"**

The tourist flow of the agency includes many tourists, both Romanian and foreign, over a period of 15 years. The following are

presented data on the evolution of the number of foreign tourists during 2008-2015. [10]

Table 1. The number of foreign tourists arriving in accommodation facilities through the Agency for the period 2008 - 2015 in spa resorts

Year	Number of tourists
2008	2,730
2009	2,722
2010	2,280
2011	2,679
2012	2,988
2013	3,280
2014	3,678
2015	4,500

Source: Vacanțe Minunate Agency.

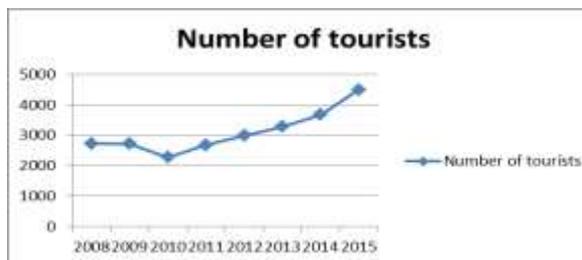


Fig. 1. The foreign tourists arriving in accommodation facilities through the Agency for the period 2008 - 2015 in spa resorts

Source: Own calculation.

Table 1 and Figure 1 show the number of foreign tourists who arrived through the agency in the tourist reception facilities in the spa resort area and benefited from the curative treatments in that area.

During the period 2008-2013 there was a very small flow of foreign tourists who turned to the agency, and starting in 2013, there is a considerable increase in the number of 4500 visitors annually by 2015.

Tourists chose during their stay to relax in spa resorts with good conditions of treatment and rest. The tourists chose the best accommodation structures:

Băile Olănești Resort: Hotel Tisa 3 \*, Hotel Stogu 3 \*

Resort Băile Felix: Hotel International 4 \*, Hotel Crisana 2 \*, Hotel Lotus Therm Spa & Luxury Resort 5 \*

Vatra Dornei Resort: Hotel Carol 4 \*, Hotel Intus 2 \*

The agency offered foreign tourists the possibility of making health or health rehabilitation in spa resorts. The program includes 10 days in the resort, 9 nights accommodation; full board during the stay, treatment of minimum 7 days, 2 procedures /

day; a medical consultation at the beginning of your stay. [10]

Table 2. Number of foreign tourists arriving in accommodation facilities through the Agency for the period 2008 - 2015 in the Danube Delta

Year	Number of tourists
2008	5,670
2009	5,000
2010	5,369
2011	7,400
2012	8,500
2013	8,300
2014	4,500
2015	5,700

Source: Vacanțe Minunate Agency, [11].

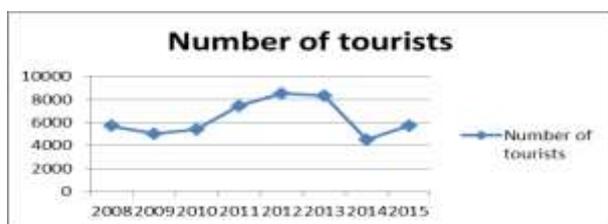


Fig. 2. Number of foreign tourists arrived through the agency in the Danube Delta during 2008-2015

Source: Own calculation.

The data showed that in the period 2008-2010 their number decreased and then increased and in 2012, there is an obvious evolution of the foreign tourists who used the accommodation offered by the agency.

Since 2014, their 4,500 numbers have begun to stagnate compared to 2012 when the number reached the threshold of 8,500 of tourists. Foreign tourists have accessed the agency's best travel packages. They preferred to stay in the best hotels and hostels in the Delta area. [11]

Murighiol:Complex Puflene 3\*,Complex Peninsula Resort 4 \*

Tulcea: Hotel Cristal 3 \*,Hotel Explanada 4 \*

Nufarul: Steaua Apelor 4 \*

Sfantu Gheorghe: Hotel Green Village 4 \*.

Table 3. Number of foreign tourists arriving in tourist accommodation establishments through the Agency during 2008 - 2015 in the mountain area

Year	Number of tourists
2008	6,500
2009	5,670
2010	6,980
2011	7,200
2012	4,579
2013	4,500
2014	3,400
2015	5,456

Source: Vacanțe Minunate Agency. [11].

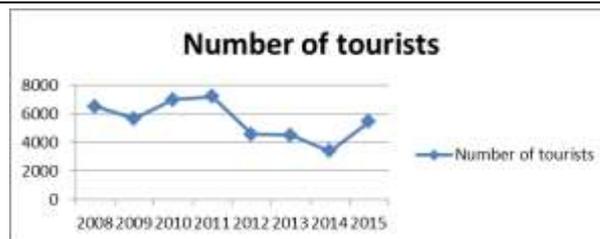


Fig. 3. Number of foreign tourists arriving through the agency in the mountain area during 2008-2015.

Source: Own calculation.

From the data from the agency it is noted that many tourists visited the mountainous area of our country and benefited from the offers made by the agency.

The best year from the point of view of the number of foreign tourists is 2011, they came in 7,200, most in the winter season.

Table 4. The number of foreign tourists arriving in tourist accommodation establishments through the Agency for the period 2008 - 2015 in the Black Sea coast

Year	Number of tourists
2008	8,900
2009	8,000
2010	7,500
2011	6,870
2012	9,000
2013	9,346
2014	7,640
2015	8,439

Source: Vacanțe Minunate Agency, [11].

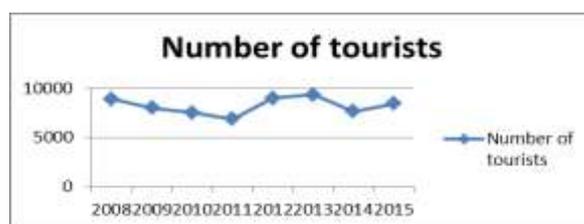


Fig. 4. Number of foreign tourists arrived by agency in the Black Sea coast in 2008-2015

Source: Own calculation.

At that time tourists could take advantage of the tourist packages of the agency, the accommodation offers offered by the agency. The tourist reception facilities have very good conditions at acceptable prices, foreign tourists taking advantage of this. The most requested hotels of foreign tourists were those in the resorts:

Poiana Brasov Resort: Hotel Edelweiss 4 \*, Hotel Ruia 3 \*

Predeal Resort: Hotel Piemonte 4 \*, Hotel Belvedere 3 \*, Hotel Carpati 3 \*

Moeciu resort: Cheile Gradistei Resort 4 \*.

The tourists chose the best accommodation hotels in Mamaia, Eforie Nord, Eforie Sud, Neptun, Jupiter-Cap Aurora.

Mamaia Resort: Resort Phenicia Holiday 4 \*, Hotel Phenicia Luxury 4 \*, Hotel Comandor 4 \*, Hotel Bavaria Blu 4 \*

Eforie Nord Resort: Hotel Mirage Medspa 4 \*, Hotel Apollo 3 \*, Hotel Ibiza 3 \*

Eforie Sud Resort: Hotel Splendid 3 \*, Complex Boutique Citadele 5 \*

Neptun Resort: Hotel Cocor 4 \* Hotel Recife 3 \*, Hotel Majestic 3 \*

Jupiter-Cap Aurora Resort: Hotel Meteor 3 \*, Hotel Opal 3 \*, Hotel Diamant 3 \*.

Most foreign tourists, from the analyzed period, 2008-2015, arrived in 2013, in a number of 9,346, according to the data provided by "Vacanțe Minunate" Agency.

Tourists often prefer Mamaia resort because it is the most populated, it has a lot of high standard accommodation, public catering and leisure facilities such as Aqua Magic Park, clubs and more.

Some analyzes show that most of the aliens who come through the Vacanțe Minunate are Israeli. [10]

The agency operated 3 flights a week on the Constanta-Tel Aviv route: Sunday, Tuesday and Thursday. The airline operates 4 flights to Bucharest, with tourists preferring the area mountain: Prahova Valley, Braşov and Poiana Braşov.

#### Agency Development Elements

The Agency has invested in the human resources department to make a selection of the best possible staff in the near future.

It doubled the number of contributors from 2014 to 2015.

The development of the booking system has been pursued so that it is as user-friendly as possible by both agency staff and partners.

The newsletter system has been internalized and the number of information has increased.

As plans for the future, the agency aims to implement the reservation system on mobile devices and online payments, refresh the company image, get the most profit and reinvest on multiple plans. [9]

Proposed objectives:

Strengthening and promoting tourism on the Romanian seaside and beyond.

Providing high-standard services for both maintaining and loyalty to customers through offers and promptness of services.

“Creating the best deals that exceed the expectations of the tourists and at affordable prices to all categories of tourists, both Romanian and foreign, so that they have as their favorite destination Romania”. [5]

#### CONCLUSIONS

Agency sales have an upward trend over the review period, 2008-2015.

Foreign tourists prefer the "Vacanțe Minunate" Agency because they meet their requests.

During the period 2008-2013 there was a very small flow of foreign tourists who turned to the agency, and starting in 2013, there is a considerable increase in the number of 4,500 visitors annually by 2015.

Foreign tourists have accessed the agency's best travel packages. They preferred to stay in the best hotels and hostels in the Delta area.

From the data from the agency it is noted that many tourists visited the mountainous area of our country and benefited from the offers made by the agency.

The 2011 Winter Season brings the largest number of foreign tourists, 7200, through the agency.

According to data provided by the "Vacanțe Minunate" Agency, most foreign tourists, on the Black Sea coast, in the analyzed period, 2008-2015, arrived in 2013 in a number of 9,346.

#### REFERENCES

- [1]Capota, V., Mihai, Ş., Costea, F., Vetemeanu, C., 2007, Organizarea agentiei de turism, Editura CdPress (The organization of the tourism agency. CdPress Publishing House), pp.22-26.
- [2]Cândeia, M., Bran, F., 2006, Organizarea, amenajarea și dezvoltarea durabilă a spațiului geografic (Organization, management and sustainable development of the geographical space), University Publishing House, Bucharest, pp.27-29.
- [3]Dinu, M., 2004, Geografia turismului (Tourism geography), Didactic and Pedagogical Press, Bucharest, pp.34-35.

[4]Draica, C., 1999, Ghid practic de turism international si intern (Practical guide of international and domestic tourism), ABC turism, pp.12.

[5]Gherasim,T., Gherasim, D., 1999, Marketing turistic, Editura Economica (Tourism marketing, Economica Publishing House), București, pp.48-53.

[6]Glăvan,V.,1995, Geografia turismului în România, Publisher of Tomorrow Foundation Romania Press, Bucharest.

[7]Iordache.M.C., Cebuc, I., 2009, Tehnica operațiunilor de turism, Editura Independența Economică (The technique of tourism operations, Economic Independence Publishing House), Pitești, pp.26-29.

[8]Istrate, I., 1988, Un fenomen in miscare, Editura Sport-Turism (A phenomenon in movement, Sport-Tourism Publishing House), pp.33.

[9]National Institute of Statistics, 2000-2015.

[10]Rădulescu, I., Herbst-Rădoi, A.,1986, Județele Patriei, (The counties of the country), Publishing Romanian Academy, Bucharest, pp.35.

[11]"Vacanțe Minunate" Agency, Statistical Reports.



## THE DYNAMICS OF THE NUMBER OF ROMANIAN TOURISTS WHO HAVE ACCESSED TOURIST PACKAGES THROUGH THE "VACANȚE MINUNATE" AGENCY DURING THE PERIOD 2000-2015

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### Abstract

*The study of the tourist activity of an agency requires careful analysis of all the components of this activity. The role of the tourism agency in tourism activity is the promotion and development of tourist products, this being the most important. The present paper analyzes the main aspects regarding the touristic activity of a tour operator, as well as its organization and functioning (conditions for the marketing of the tourist products, organizational modalities, the main tourist services offered and possibilities for their diversification for promotion and development tourism. This analysis is very necessary in national and international tourism and the travel agency must have the necessary means to continuously upgrade its tourist product offerings. For the detailed analysis of the indicators, we processed data provided by the Wonderful Vacations Agency, concerning the Romanian tourists, during 2000-2015. The research methods specific to geography were also considered: observation, analysis and synthesis, the means of operation (description, explanation, hierarchy) and the finite elements of the use of research methods (descriptive model, mathematical model or model cartographic). The main activity of the tourism agency both internally and externally, are the total economic and financial results of society, which are largely influenced by the tourism activity, which in turn depends on many conjunctural factors on the domestic and international market. Travel Agency "Vacanțe Minunate" has as activities: relations and discount flight sales for organized groups; hotel reservations in Romania and anywhere in the world at contract rate; organization of meetings, conferences, professional meetings, rent-a-car (cars, minibuses, coaches); serving of sea and passenger ships for foreign currency exchange, as well as for local crew trips (Seaside tour, trips to the Danube Delta, wine tasting at Murfatlar; organization of business or tourist trips including flight ticket, hotel reservation, airport transfers, rent-a-car, optional tours. The Agency is in constant development and adaptation to the requirements of the tourists and the partner agencies with which it collaborates, makes special efforts every year since 2000 when it was established for the promotion and sale of the offers belonging to the Romanian Seas as a tourist destination, this being reflected in the good results he has with the hotels he represents as an agency. The agency has contracts with most hotels on the Black Sea coast of the resorts: Mamaia, Eforie Nord, Eforie Sud, Costinesti, Neptun, Olimp, Saturn, Venus, Cap Aurora, Jupiter, Mangalia, Vama Veche and 2 May in the summer season for over 60,000 tourists.*

**Key words:** tourism, tourists, offers, competition, gain, increased profit

### INTRODUCTION

Tourism represents the whole of the relationships and phenomena that result from traveling and staying outside its home, as long as it is not a permanent establishment.

It is a strong economic and social phenomenon involved in the life of society at national and international level.

It has the role of mobilizing innumerable reserves and material and material availability of people, expanding them and enhancing

their cultural horizons; thus it becomes an important factor of education, approach and understanding between people. This represents a new dimension of tourism with profound human meanings that immobilizes an activity that is a component of social, national and international life.

To this end, a great variety of actions is needed to capitalize on the cultural heritage of each country, historical traditions.

The study of the tourist activity of an agency requires careful analysis of all the components

of this activity. The role of the tourism agency in tourism activity is the promotion and development of tourist products, this being the most important.

The travel agency is the main distributor of tourism products.

The agency may have the monopoly of sales because it has two great advantages over other forms of distribution: protection of tourists and financial guarantees provided by tourists and tour operators.

From an organizational point of view, the tourism enterprise is considered to be an autonomous human group that has a heritage and whose long-term development depends on the sale of a product, a service and the domestic activity and the receipts it has.

The tourist company places on the market a tourist service which is limited to informing, booking, transporting and accommodating a destination, restaurant services and short animation activities. [2]

## MATERIALS AND METHODS

Consultation of the specialized bibliography was the starting point for research carried out with simpler or more elaborate scientific papers, statistical information and data, some data requiring careful filtering.

Tourism is analyzed and tracked through a system of specific indicators, based on a methodology of calculation recognized and used worldwide (accommodation capacity, tourist traffic, tourist demand).

For the detailed analysis of the indicators, we processed data provided by Vacanțe Minunate Agency, concerning the Romanian tourists, during 2000-2015.

The research methods specific to geography were also considered: observation, analysis and synthesis, the means of operation (description, explanation, hierarchy) and the finite elements of the use of research methods (descriptive model, mathematical model or model cartographic).

For the present analysis, we have used data provided by the Vacanțe Minunate Agency, data on the number of foreign tourists and Romanian tourists who have accessed the tourist packages of the agency with reference

to spa tourism, seaside tourism and mountain tourism.

## RESULTS AND DISCUSSIONS

The tourist business has only a few characteristics:

- services in the service sector
- protects immediate contact between the manufacturer and the consumer
- can undergo changes according to the tastes and needs of tourists. [1]

Tourist companies may be:

hotel (similar or complementary) hotel is understood to mean accommodation and catering, transport companies, travel agencies and travel organizers.

A travel agency is composed of several sub-systems, in particular:

- Tourist sub-system (characteristics and motivation)
- Sub-system of information, promotion and communication
- Sub-system of transport to and to destination.
- Sub-system of tourist attractions.

The present paper analyzes the main aspects regarding the touristic activity of a tour operator, as well as its organization and functioning (conditions for the marketing of the tourist products, organizational modalities, the main tourist services offered and possibilities for their diversification for promotion and development tourism.

This analysis is very necessary in national and international tourism and the travel agency must have the necessary means to continuously upgrade its tourist product offerings.

The organization of the activity of a travel agency is reflected through the organizational structure representing the whole of the existing compartments in an enterprise and the relationship between those compartments in order to facilitate, use the resources and achieve the set objectives.

The organizational structure of a travel agency depends on the following factors: type of agency (tour operator or retailer), size of the travel agency (number of employees, complexity of the activity, legal framework and managerial competence).[4]

The organizational structure also represents the skeleton of a travel agency and includes 2 parts:

Managerial structure and management structure the operational or production structure. [5]

Travel Agency "Vacanțe Minunate" is a company with subscribed capital, it was established in 2000 as a limited liability company and is registered in the Trade Register.

The main activity of the tourism agency both internally and externally, the overall economic and financial results of the society are largely influenced by the tourism activity, which in turn depends on many conjuncturing factors on the domestic and international market. [3]

The company has the following object of activity:

-domestic tourism-occasional and contractual actions - by organizing domestic and foreign trips with Romanian tourists, as well as excursions for rest, health - treatment bases.

-international tourism-contractual actions based on external contracts in the accommodation infrastructure of the seaside tourism companies and the running of these contracts; organizing tourist programs in the country and abroad organizing meetings, economic missions, symposiums, organizing exotic holidays, weekend programs, city tours, day trips around the world, tours around the world, accommodation reservations and places in public catering establishments.

Travel Agency "Wonderful Vacations" has as object of activity: reservations and airline sales on any route on all airlines with discounts for sailors and for organized groups; hotel reservations in Romania and anywhere in the world at contract rates; organizes meetings, conferences, professional meetings, rent-a-car (cars, minibuses, coaches);servicing of sea and passenger ships for foreign currency exchange, as well as local crew trips (Seaside Tour, Trips to the Danube Delta, Murfatlar Wine Tasting), organizes business or tourist trips including flight ticket, hotel reservation, airport transfers, rent-a-car, optional tours.

### Tour Operator Features of the "Vacanțe Minunate"

The tour operator is an agency that works with several travel agencies, the purpose of which is to organize and sell tourist packages at the lowest rates through various intermediaries.

The "Vacanțe minunate" working as a tour operator, having the fastest development on the tourism market in recent years, being one of the main tour operators in Romania for the Romanian Black Sea Coast. [9]

The agency has contracts with most hotels on the Black Sea coast more precisely with the seaside resorts of Mamaia, Eforie Nord, Eforie Sud, Costinesti, Neptun, Olimp, Saturn, Venus, Aurora, Jupiter, Mangalia, Vama-veche and 2 Mai) annually especially in the summer season over 60,000 tourists.

In addition, the agency also offers tourist assistance services on all external destinations, travel insurance and flight ticket issuance.

Through the agency, thousands of tourists can benefit from services for other destinations than those mentioned.

Evolution of the number of Romanian tourists who have accessed offers through the agency "Vacanțe minunate".

The tourist flow of the agency comprises many tourists, both Romanian and foreign, over a period of 15 years. The following are presented tables showing the ascending and descending evolution of the number of tourists.

Table 1. The number of Romanian tourists arriving in tourist reception facilities through the Agency during 2000-2014 in spa resorts

Year	Number of tourists
2000	5,450
2001	6,005
2003	7,860
2004	9,890
2005	8,900
2006	8,567
2008	7,849
2009	8,000
2010	5,675
2011	4,960
2012	6,500
2013	9,040
2014	10,070

Source: Vacanțe Minunate Agency [11].

During the period 2000-2015 the tourists were accommodated for 2 to 10 days at different hotels or hostels.

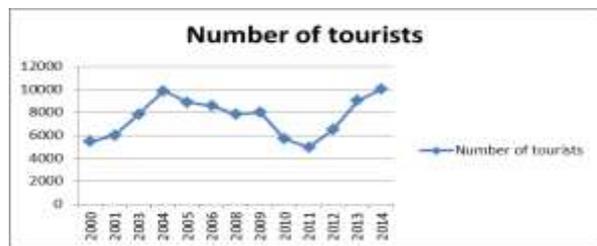


Fig. 1. Romanian tourists arriving in tourist reception facilities through the Agency during 2000-2014 in spa resorts

Source: Own calculation.

Observing the tables presenting the data from the period 2000-2014, periods with maximum flows and periods with minimal flows can be observed.

Among the resorts preferred by the tourists who use the agency are: Sovata, Baile Tusnad, Călimănești Căciulata, Baile Felix. These spa resorts are renowned for treating various diseases as well as relaxing.

At that time tourists benefited from different packages for the treatment and relaxation Romanian tourists at that time preferred to choose the best hotels in order to have an unforgettable rest and relaxation stay. This hotel stayed at 2 hotels, 3 or 4 \* each based on the allocated budget.

Sovata Resort: Hotel Danubius Health Spa Sovata Resort 4\*. It has used the best package packages, namely treatment offers or half board with medical treatment, optimal accommodation conditions.

Băile Tușnad Resort: Hotel O3Zone 4 \*. This hotel is renowned as the other treatment packages for treating various conditions with various accommodation and relaxation facilities.

Călimănești-Căciulata spa resort: Hotel Central 3 \*

Băile Felix Resort: 4 \* Hotel Crișana and 4 \* Hotel Internațional.

The tourists stayed for a period of 3 to 10 days, more exactly a few days' stay, during which they benefited from these accommodation and medical treatment facilities where they find outdoor thermal pools and special treatment bases.

Table 2. The number of Romanian tourists arriving in tourist reception facilities through the Agency during 2000-2015 in the Danube Delta and Tulcea

Year	Number of tourists
2000	2,300
2002	3,450
2001	2,590
2003	3,200
2004	5,670
2005	5,600
2006	4,300
2007	4,800
2008	5,789
2009	4,560
2010	4,320
2011	3,900
2012	5,690
2013	6,000
2014	4,500
2015	3,900

Source: Vacanțe Minunate Agency [11]

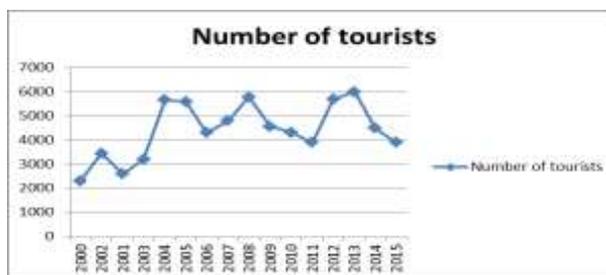


Fig. 2. Romanian tourists arriving in tourist reception facilities through the Agency during 2000-2015 in the Danube Delta and Tulcea

Source: Own calculation.

The statistical data show that many tourists visited the Danube Delta natural reserve, most tourists were in 6,000 in 2013. As it can be seen in 2000 there were the fewest tourists who occupied the tourist reception structures and who have used the services offered by the agency. In recent years, as can be seen from the tables, the number of Romanian tourists increased considerably, due to the capitalization of the Danube Delta reservation and the increase in the tourist reception capacity. [6]

The tourists preferred to choose standard tourist packages, they chose as the destination the following areas: Sulina, Murighiol, Nufaru, Tulcea, Sfântu Gheorghe and other accommodation facilities. With the time these accommodation capacity increased their capacity accommodation and have improved their accommodation conditions, then to be very frequented by tourists, as shown in the tables and graphs above.(Table 2 and Fig.2)

Most tourists preferred to stay for a short period of time, more exactly a stay or even longer. [9]

They chose to stay in:

Murighiol: Complex Peninsula Resort 4 \*

Sulina: Casa Sibiana 4 \*

Tulcea: Cristal Boarding House 3 \*, Hotel Expandada 4 \*

Sfantu Gheorghe: Hotel Green Village 4 \*

**Romanian tourists on the seaside**

Table 3. The number of Romanian tourists arriving in tourist accommodation structures through the agency in 2015 on the coastal area

Station	Number of tourists
Mamaia	8,000
Eforie-Nord	4,500
Eforie-Sud	5,000
Costinești	3,800
Venus	3,500
Vama-Veche	4,500
Neptun-Olimp	2,500

Source: Vacanțe Minunate Agency [11].

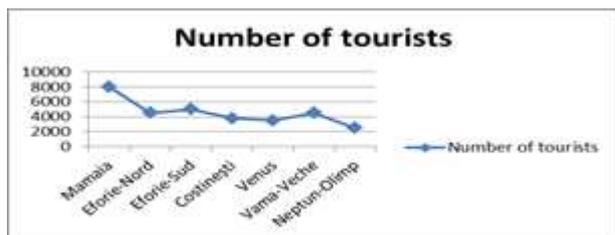


Fig.3. Romanian tourists arriving in tourist accommodation structures through the agency in 2015 on the coastal area

Source: Own calculation.

The statistical data in the table shows the number of Romanian tourists who appealed to the agency in the most recent year, the most favored resort on the seaside, which is the most popular, the resort of Mamaia, with 8,000 visitors per year, increase. [7]

Tourists have accessed in 2015 the best early booking offers, standard offer, treatment offer, special offers and holiday offers, all of which are most frequented by tourists who have turned to the agency.

The majority of tourists took advantage of long time before to get more affordable. The most overburdened tourist reception facilities were those in Mamaia resort and the other ones on the seaside. Below I will list which were the most requested accommodation facilities favored by tourists. [8]

The resorts and hotels where they were accommodated are the following:

Mamaia Resort: Hotel Ambasador 4 \*, Hotel Park 4 \* Hotel Astoria 3 \*, Hotel Voila 3 \*, Hotel Lido 3 \*, Hotel Tomis 3 \* Hotel Victoria 3 \*

Eforie Nord Resort: Hotel Complex Dunarea 3 \*, Hotel Europa 4 \*, Hotel Vera 3 \*

Eforie Sud Resort: Hotel Splendid 3 \*, Hotel Amurg 3 \*

Costinești Resort: Hotel Pierre 3 \*, Hotel Impact G 3 \*, Complex Vox Maris Grand Resort 4 \*

Venus Resort: Hotel Afrodita 4 \*, Hotel Melodia 4 \*, Hotel Corina 3 \*

Vama-Veche Resort: Hotel Laguna 2 \*

Neptun-Olimp Resort: Hotel Sara 3 \*, Turist Complex 3 \*

The Mamaia resort is famous for its large beaches, being the largest in Europe, stretching over a distance of about 10 kilometers, between the cities of Constanta and Navodari, and the width often reaches 200 meters. [10]

The beach is covered with fine sand, with no excess stones and shells, and the entrance to the water is smooth, the depth of the sea gradually increasing over a large distance. Most of the beach is equipped with sun beds and umbrellas that tourists can benefit from cost, but there are also areas where you can install free of charge with your own sunbeds. The resort's beach is full of bars and terraces, perfect places to hide from the summer heat with a cocktail or ice coffee or ice cream.

Mamaia resort, is preferred to tourists coming through the agency but also to the numerous high quality touristic reception facilities. [10]

The second very visited resort of Romanian tourists is Eforie Sud, with about 5,000 tourists annually.

These resorts are very famous due to the extensive beaches, the tourist reception structures as well as the public and recreational facilities. The least visited resort on the Black Sea coast is Venus resort has a number of 3,500 annual tourists coming through the agency.

"The seaside attracted in the season 2016 with up to 12% more tourists due to the investments made during the last years by

hoteliers, which led to the increase of the quality of tourism services, the increase of the beaches of Mamaia, Eforie Nord and Constanta, through a Company investment The Romanian Waters of Dobrogea-Litoral, but also the international conjuncture, which determined a larger number of Romanians to spend their holidays in domestic destinations, "ANAT communiqué shows.

Table 4.Number of Romanian tourists arriving in tourist accommodation structures through the agency in 2015 in mountain resorts

Station	Number of tourists
Sinaia	5,070
Bușteni	5,000
Predeal	5,600
Azuga	4,700
Păltiniș	4,980
Poiana Brașov	6,500
Maramureș	3,570
Brașov	8,000

Source: Vacanțe Minunate Agency [11]

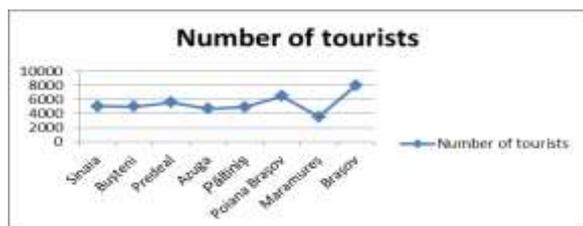


Fig.4 Romanian tourists arriving in tourist accommodation structures through the agency in 2015 in mountain resorts

Source: Own calculation.

Tourists appealed to the agency in 2015 and took advantage of the same prices of tourist packages during the winter season. The most popular touristic offers by the Romanian tourists in 2015 were the special ones, holidays, ski holidays and also standard offer. The tourists were accommodated, of course, at different times, at various tourist reception facilities and on certain categories of 2,3 and 4 \*.[9]

The most frequented hotels by the Romanian tourists in 2015 were:

Sinaia Resort: Hotel Palace 4 \*, Hotel Caraiman 3 \*, Hotel Cota 1400 3 \*

Bușteni resort: Bavaria 3 \* and Popasul Vânătorilor 4 \*

Predeal Resort: Hotel Belvedere 3 \* and Hotel Boulevard 3 \*

Azuga Resort: Holiday Villa Alma Azuga, Azuga Ski & Bike Resort3 \*, Trifoi Villa 3 \*

Păltiniș resort: Hotel Cindrel 3 \*, Victoria 3 \* Pension, Rafael Pension 4 \*

Poiana-Brașov Resort: Hotel Ruia 3 \*, Hotel Escalade 4 \*, Hotel Teleferic Grand 4 \*

Maramures resort: Hotel Diafan 3 \*, Hotel Carpati 4 \*

Brașov resort: Hotel Ramada Brașov 4 \*, Hotel Kronwell 4 \*, Coroana Brașovului 3 \*.

Analyzing chart and table no. 4 , we note that 8,000 tourists have called the Vacanțe Minunate Agency in 2015 due to the good offers and all inclusive services the agency has.

The second resort preferred by the tourists who use the agency is the Poiana Brașov resort due to the landscapes, the good conditions of accommodation, the public and leisure facilities. The Poiana-Brașov resort is a rest and treatment resort and is situated at the foot of Postăvaru Mountain, at an altitude of 1,030 m and 12 km from Brașov. In addition, it also draws on size, having the largest ski area in România.

The Sinaia resort is also one of the favorite tourist resorts. The Sinaia Station is at the foot of the Bucegi Mountains at 850 m altitude. The tourists here can visit Bucegi Mountains, Omu Peak, Babele and Sphinx or Peleş Castle and can also do hiking trails. It is famous for its slopes, chairlift, ski lift, cable car. [11]

As a means of leisure we have 12 ski slopes in our country (Olympic lanes, slopes for downhill and giant slalom, trampolines), lake, sledge, pedestrian, cable cars, a telegondola and 7 ski lifts, plus artificial snow. For those who are romantic there are also horses drawn by horses. These and others have made Poiana Brașov occupying the 1st place in the Top 10 Most Strong Mountain Resorts in Romania. [11]

## CONCLUSIONS

The study of the tourist activity of an agency requires careful analysis of all the components of this activity. The role of the tourism agency in tourism activity is the promotion and development of tourist products, this being the most important.

Travel Agency "Vacanțe Minunate" is a limited liability company and is based in Constanța.

The agency has the role of strengthening relationships with customers and business partners and the "excellence in travel" attribute has attracted through transparency, creativity, boldness and consistency of extraordinary results.

The main activity of the tourism agency both internally and externally, are the total economic and financial results of society, which are largely influenced by the tourism activity, which in turn depends on many conjunctural factors on the domestic and international market.

Travel Agency "Lovely Vacations" has as activities:

-relations and discount flight sales for organized groups.

-hotel reservations in Romania and anywhere in the world at contract rates

-organizes meetings, conferences, professional meetings, rent-a-car (cars, minibuses, coaches)

-serving of sea and passenger ships for foreign currency exchange, as well as for local crew trips (Seaside tour, trips to the Danube Delta, wine tasting at Murfatlar)

-organize business or tourist trips including flight ticket, hotel reservation, airport transfers, rent-a-car, optional tours.

The Agency is in constant development and adaptation to the requirements of the tourists and the partner agencies with which it collaborates, makes special efforts every year since 2000 when it was established for the promotion and sale of the offers belonging to the Romanian Seas as a tourist destination, this being reflected in the good results he has with the hotels he represents as an agency.

The agency has contracts with most hotels on the Black Sea coast of the resorts: Mamaia, Eforie Nord, Eforie Sud, Costinesti, Neptun, Olimp, Saturn, Venus, Cap Aurora, Jupiter, Mangalia, Vama Veche and 2 May) in the summer season over 60,000 tourists.

In addition, the agency also offers tourist assistance services on all external destinations, travel insurance and flight ticket issuance.

## REFERENCES

- [1]Capota, V., Mihai, Ș., Costea, F., Vetemeanu, C., 2007, Organizarea agentiei de turism,Editura CdPress (The organization of the tourism agency. CdPress Publishing House), pp. 26-28.
- [2]Cândea, M., Bran, F., 2006, Organizarea, amenajarea și dezvoltarea durabilă a spațiului geografic (Organization, management and sustainable development of the geographical space), University Publishing House, Bucharest, pp.35-36.
- [3]Dinu, M., 2004, Geografia turismului (Tourism geography), Didactic and Pedagogical Press, Bucharest, pp.47-49.
- [4]Draica, C., 1999, Ghid practic de turism international si intern (Practical guide of international and domestic tourism), ABC turism, pp.39.
- [5]Gherasim,T., Gherasim, D., 1999, Marketing turistic, Editura Economica (Tourism marketing, Economica Publishing House), București, pp.69.
- [6]Glăvan,V.,1995, Geografia turismului în România, Publisher of Tomorrow Foundation Romania Press, Bucharest
- [7]Iordache.M.C., Cebuc, I., 2009, Tehnica operațiunilor de turism, Editura Independența Economică (The technique of tourism operations, Economic Independence Publishing House), Pitești, pp.42.
- [8]Istrate, I., 1988, Un fenomen in miscare, Editura Sport-Turism (A phenomenon in movement, Sport-Tourism Publishing House), pp.61.
- [9]National Institute of Statistics, 2000-2015.
- [10]Rădulescu, I., Herbst-Rădoi, A.,1986, Județele Patriei, (The counties of the country), Publishing Romanian Academy, Bucharest, pp..25.
- [11]"Vacanțe Minunate"Agency, Statistical Reports.



## FOOD INTEGRITY CONCEPT IN WHEAT PROCESSING

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### Abstract

*The present paper aims to analyze the concept of "food integrity" from the perspective of wheat processing, in order to obtain flour. The analysis approaches concepts such as: safety, quality, authenticity and nutritional value of the products obtained to the main technological stages of the grinding process, food fraud concerning grinding products and minimization of the milling industry impact on global warming. Our data showed that mycotoxin contamination (DON and Ochratoxin A) was the cause of most alerts recorded in Europe. In United States, the main products withdrawals were caused by microbiological contamination (E. coli and Salmonella). In the area of food fraud, the main observed practice was that of over- or under-evaluation of the flour mineral content. Our conclusion is that although preventive programs, designed to minimize the risks of wheat milling products to consumers, are well described and implemented, there is room for improvement, especially as regards the selection and evaluation of suppliers and the control of certain microbiological risks in mills. Most of the problems are the cause of an inadequate description of the flow diagrams in the specific documentation of food management systems and of the underestimation of certain activities (e.g. rework), that are not treated as an integral part of the technological processes in mills. Most concerns to reduce the impact of wheat processing on global warming are compromised by a number of issues, such as large investments, in obtaining convenient and safer products (that require energy-intensive technologies and equipment), which are in contradiction with consumers' interest.*

**Keywords:** food integrity, wheat, wheat flour

### INTRODUCTION

The application of the food integrity concept to wheat and derived products is relatively complex due to the presence of specific conditions. The notion of food integrity is constantly redefining as both science evolves towards introducing new concepts and as to consumers' concerns about safety, quality and authenticity of food are added, namely: chain food transparency, nutritional value of food, environmental impact (life cycle assessment), cultural factors related to beliefs, traditions, social and geographic factors. The condition that determined the evolution of wheat processing in mills, in the industrial age, is of an economic nature, respectively to obtain the highest added value for the processed products [15]. This has led to a cyclical evolution in the industry. If at the beginning of the industrial era, the main objective was to

grind the grains, in order to obtain as much flour as possible (by using mainly whole flours), as the flour became more and more cheap, the companies turned to refine it, in order to obtain whitish flours, associated with the idea of purity and health [17]. Advanced cereals grinding is associated with loss of vitamins and minerals. At this moment, the evolution is contrary, the added value is sought in whole flours or in mixtures of flours, from different cereals or pseudo-cereals, with functional food attributes. Hyperprocessing food through innovation and creation of new technologies has transformed the food industry into an anteroom of the digestive system. It has been invested in foods that reduce the need for physiological processes that play a key role in food metabolism, such as mastication, food bowl formation and digestion. These processes have exponentially increased the vulnerability

of food to factors such as biological, chemical or physical contamination and have disturbed the consumer in relation to his traditional consumption habits. These vulnerabilities have raised concerns in researching and implementing ways to prevent and control the risks of production-related food safety, such as HACCP or ISO 22000, IFS, BRC, etc.

Practically, as the food industry has become an antechamber of the digestive system, concerns have also grown for building an adequate immune system to protect this system [18].

This paper aims to analyze the concept of “food integrity” in the wheat processing industry, in order to obtain one of the basic food, namely wheat flour.

## MATERIALS AND METHODS

This paper presents a review from the literature, on one of the most interesting concepts, namely “food integrity”. In this respect a large number of statistical data from public sources have been studied: alerts from the American Food and Drug Administration, FDA, from European Food Safety Authority EFSA, scientific papers relevant to food safety in industry, specific provisions of the main management systems (FSSC 22000, BRC, IFS etc.), related scientific work in the fields of consumers behavior, medical nutrition, ecology etc.

## RESULTS AND DISCUSSIONS

An analysis of food alerts on the RAFFS (European Commission's Food and Feed Safety Alerts) portal shows that out of over 48.000 alerts recorded between 2001 and 2017, only 1905 (3.94%) involved cereals and bakery products. Of these, only 76 (3.99%) involved wheat and wheat flour. The highest number of alerts were linked to the **contamination of wheat or flours with mycotoxins** (46%) (Fig.1). Of the mycotoxin alerts, 60.61% had as object deoxynivalenol (DON) contamination, 33.3% Ochratoxin A contamination, and 2 alerts were related to exceeding the quantity of total aflatoxins or to presence of *Claviceps Purpurea* ergot.

The second category of problems identified is related to **contamination with foreign bodies**, including infestation (insect larvae and mice). From the category of foreign bodies that have been subject to contamination, except for infestation (31.25%), most problems were related to the presence of ferromagnetic impurities (25%), copper yarns (12.5%), plastic, glass, stones or asbestos containing materials. Contamination with pesticide residues represents 10% of the total number of alerts (diclorvos, dithiocarbamates, fenitration, diazinona or permethrin). We have included in this category an alert related to benzo(α)pyrene and aromatic polycyclic hydrocarbons, whose source can be pesticides, although their major environmental impact is due to other sources. **Metallic contamination** (8% of the total number of alerts) had as object the exceeded limits allowed for Lead, Cadmium and Aluminum, especially for products imported from South East Asia (China, Thailand, Vietnam).

**Contamination with soybeans** (undeclared allergen) was a 7% alerts problem. Soybean contamination is more common in countries where bakeries use cereal flours mixtures or various seeds, to obtain specific bakery products.

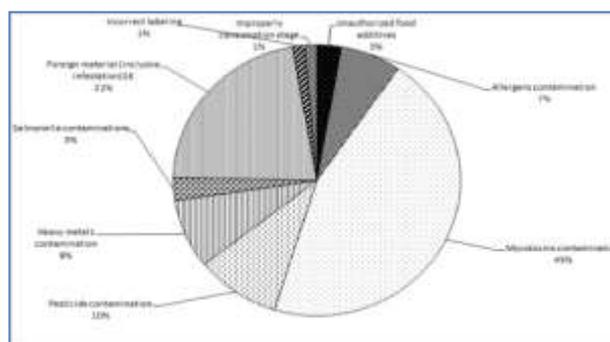


Figure 1. The main European food alerts on wheat flour  
Source: Our design based on literature data.

The **unauthorized additives** were the object of 4% of alerts. The presence of unauthorized additives such as benzoyl peroxide, chlorine, calcium peroxide etc., is a problem related to imports from USA, a country where their use in flours correction is allowed.

There have been two **Salmonella contamination** alerts in wheat flour from

Germany (29.01.2016) and in some cereals flours from Ghana (11.07.2005).

Two other alerts concerned the inappropriate labelling of Spelta wheat flour (Austria) and

also the improper stage for consumption of a red spring wheat coming from Canada. The main US alerts are shown in Table 1.

Table 1. Main food alerts in USA related to wheat flour

Company	Year	The alert type	Presentation
General Mills	2016	Microbial contamination (E coli)	General Mills withdrew between 4.5 and 7.0 million tons of flours infested with E Coli O121. The strain caused the illness of 68 people in 24 states, 17 of them requiring hospitalization and one developing hemolytic uremic syndrome. The source of the disease was contact or ingestion of raw dough prepared from wheat flour [2, 7]
Grain Craft	2016	Undeclared allergen (peanut proteins)	The traceability analysis showed that the flours came from wheat obtained in an area recognized for the intense cultivation of peanuts, in Georgia [6, 21]
T-Brothers Food and Trading Ltd	2016	Undeclared allergen / foreign bodies (milk powder and sesame seeds)	Mixtures of flours for domestic use [19, 8]
Morisson Milling Company	2016	Foreign bodies	Nylon threads from a mill sieve breakage
King Arthur Flour	2013	Foreign bodies	Presence in flour of some mill shakers (9 mm polyurethane balls used to facilitate the sifting process)
Arrowhead Mills Inc	2012	Undeclared allergen (milk powder)	Whole wheat flour grinded on a stone mill
Nestle	2010	Microbial contamination: E coli O157: H7	The source of the illness was a raw dough made by Nestle. It has led to the illness of 72 people in 30 US states [5]

Source: Our design based on literature data.

As can be seen in the table, the main issues in USA were related to microbiological contamination, contamination with allergens and to the presence of foreign bodies. The source of some of these problems is the raw materials used, respectively the poor management in their obtaining. The usual analyzes made at the cereals reception in the mills are not able to identify the risks mentioned above.

These analyzes focus on controlling technological potential of the raw material, but are limited concerning food safety problems, detectable by olfactory analysis of wheat samples. In Table 2 are presented the main analyzes that are made at the reception of wheat in the mills, respectively some comments on their adequacy in food safety management.

Table 2. The main methods of analysis used for the wheat reception in mills

Analysis method	Standard	Technological relevance	Relevance for food safety
Sensorial (smell, colour)	ISO 7970	Reduced	Essential, it can highlight processes of alteration, microbial proliferation, heating, contamination with pesticides or foreign substances, massive attack by <i>Fusarium</i> sp., <i>Tilletia tritici</i> , <i>Claviceps purpurea</i> , etc.
Infestation	ISO 6639	Prevents the infestation with larvae or adults	Essentially, it is a synthetic criterion of how cereals have been conditioned; insects can be vectors to transfer microbial pathogens from contaminated areas to uncontaminated areas of the mill.

Table 2. The main methods of analysis used for the wheat reception in mills (continued)

Analysis method	Standard	Technological relevance	Relevance for food safety
Foreign bodies (%)	ISO 7970	High impact, significantly influences the economic balance of the grinding process	High, prevents contamination of milling products with toxic seeds
Moisture (%)	ISO 711 ISO 712	High impact, influences the economic balance of the grinding process	High, the increase of the humidity over 14.5% leads to the intensification of the microbial metabolism, decreases the storage duration of the seeds
Hectolitic Mass (kg/hl)	ISO 7971	Certain scientific studies, but also a series of empirical evidences correlate the value of this parameter with extraction	Without significance
Falling Number (Hagberg, s)	ISO 3093	High, the parameter is correlated with the wheat baking potential. Granules with a low value of 180 s are considered unmatched due to intense amylase activity	Without significance
Protein content (%)	NIR method, ISO 16634-2:2016	High, the parameter is correlated with the wheat baking potential	Without significance
Wet gluten (%)	ISO 7495	High, the parameter is correlated with the wheat baking potential	Without significance
Gluten index	AACC 38-121	High, the parameter is correlated with the wheat baking potential	Without significance, very low values could be an indication of insect attack ( <i>Eurygaster</i> sp.)
Rheological analyzes (following the grinding of the wheat sample, whether conditioned or not, on a pilot mill and extraction of flour)	Farinograf - ISO 5530-1 Amylograph ISO 7973 Alveograf ISO 27971 Mixolab ISO 17718 Extensograf ISO 5530-2	High, strong correlation with the quality characteristics of the flour and the obtained products	Without significance, very low values of rheological parameters may be associated with high levels of enzyme activity, induced by insect attack or microbial contamination (fungi, bacteria)

Source: Our design based on literature data.

Since wheat flour is not considered to be a fully processed and ready-to-eat foodstuff, there is a tendency for none of the risks of the type mentioned in Figure 1 and Table 1 to be monitored by critical control points (CCP). Generally, the practice is to manage these risks in prerequisite and operational prerequisite programs such as: pest control, surface and machinery hygiene, control of environmental conditions in production and storage areas, water quality control, maintenance of equipment, control of

packaging conditions, transportation etc [4, 10].

There are sufficient opinions that consider the flour system to be a closed system, or with a minimum number of areas where product contamination can be achieved. In fact, there are at least three technological steps in which the product may be contaminated with non-wheat substances or microorganisms, namely: cereals conditioning, at which point wheat is mixed with water to achieve optimal moisture for the grinder; dosing the ingredients or additives used for the correction of flour;

packing, when the product comes into contact with the walls of bulk carriers or with the walls of the packages. In addition, in the absence of a truly effective pest control system, pathogenic microorganisms (e.g. Salmonella) are translocated by insects along the technological flow, due to their natural mobility [16, 20]. There are a multitude of studies that prove the vector status of insects in the mills, for pathogenic microorganisms, taking into account the context of ecological relationships involving insects. For example, the transfer of pathogenic microorganisms from birds, which have their geographic area in the area where the mill is built, to insects, should not seem unlikely [3, 22]. Insects have the ability to contaminate specific products at different stages of the flour production, creating a risk associated with the natural habitat characteristics for the mill (presence of nearby municipal waste, sewage treatments, landfills, etc.) (Fig. 2).

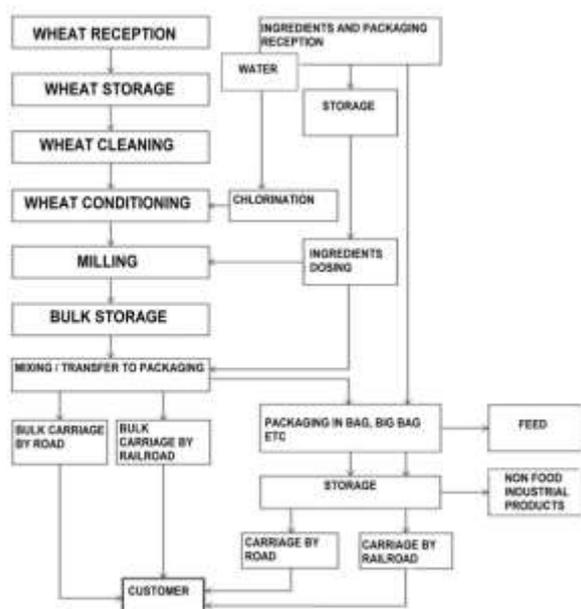


Figure 2. The technological scheme for wheat processing in the mills (after Mortimore and Wallace, 2013)

The tendency to eliminate critical control points from food management systems in wheat flour obtaining, given the fact that production processes are subjected to controllable risks through regular prevention programs, is a sign of industry and authorities superficiality. This is understandable if we

look at the issue in the context of the examples presented previously, for the European and North American markets.

For neither of the most common problems, food safety systems lack effective prevention and control tools. Contamination with mycotoxins, pesticides, heavy metals, allergens or potentially pathogenic microorganisms is a managed risk at merchandise reception, due to sensorial control, to the quality documents accompanying the product and the presumption that the agreed supplier was eventually audited and performs himself a specific control of the goods he sells.

Wheat reception in mills is limited to assessing the technological potential of raw material, the system being focused on quality assurance and less on account of ensuring consumer safety. Even specific legislation does not impose, for example, microbiological criteria appropriate to potential risks to the consumer. In Romania, the contamination with yeasts and molds (in fact, an insignificant criterion for the evaluation of the wheat microbiological safety) is still an obsession of the authorities, despite the fact that microbiological alerts in the world, concerning the flours, are mainly around the strains of Salmonella and E. coli [1]. From this point of view, there is certainly place for significant improvements.

We can appreciate that the most frequent problems, related to the management systems of food safety in the production of wheat flours, are based on important errors in the conception, implementation and maintenance of these systems. Many of these systems are too complicated and difficult to maintain. They are based on one person's control, process discrimination and the transfer of responsibility to a sufficient number of people is limited. Thus, there are problems related to the technological flow and to the evaluation of the viability and functionality of the food safety management system. On the other hand, certain flow diagrams are incorrect, because there is a tendency to simplify flow diagrams, to hide certain practices that may seem unethical, or may create complications in relation to authorities or third part auditors.

Such a case is the flours reprocessing, a practice whose necessity is sometimes determined by the characteristics of the technological flow (physical blockage of the transport routes in the mill, flour recovered from the packing unit, as a result of bags or sacks breakage etc.). The lack of this stage in the technological flow is vulnerable to the system and exposes it to unrated risks. From our point of view, it is obligatory to pass the reprocessed flours through impacting entoleters.

In many situations, for the water used in wetting purposes (wheat wetting), the need for chlorination is not specified. The quality of the water used in the mill must comply with the requirements of the drinking water legislation. Even under these circumstances, due to the microbial load of wheat grain, water chlorination is strictly necessary, precisely to limit the development of microorganisms in the wheat resting stage. This stage lasts 16-18 hours and ensures ideal humidity and temperature conditions for microorganisms multiplication.

Relevant research in the field, such as the addition of certain substances, like lactic acid or its salts, which could be useful in reducing microbial growth at this level, should be taken into account.

Certainly, proper hygiene and hygiene monitoring programs, for all the infrastructure used in this process, must be introduced, namely: dampening screws, transfer elevators, tempering silo, feeding bunks etc.

In many situations, we are dealing with a poor understanding of the intrinsic factors that ensure the consumption safety of the flour. Many millers believe that providing less than 14.5% humidity is a sufficient condition to eliminate the risks related to consumer safety. However, this moisture does not eliminate a potential infestation of flour with insects, in the egg stage or with microorganisms in the form of spores.

To these, a number of factors already mentioned in the literature are added as frequent sources of poor efficiency of food safety management systems, namely: poor attention paid to the verification process,

insufficient support from top management, lack of workers involvement etc [12].

One of the key issues in the field, at least in Romania, is related to **food fraud**. Specific legislation prohibits the use of the term "type" in the milling products labelling, for the final consumer (Government Decision, GD 106/2002 on food labelling) [11]. This prohibition leaves a wide maneuvering space to flour producers or users. A lot of food labels, food in which wheat flour is used, does not provide the consumer any element to suggest the technological conditions underlying it. The information are like: "white wheat flour", or "dark wheat flour", or "whole wheat flour". The problem is highlighted in one of our previous studies, where we found that in 50% of the flours available to Romanian end-users, the mineral content did not match with the names under which the flour was sold [24]. The problem particularly touches the extremes: a flour marketed as whole flour was found to be dark flour (Ash=1.21%), a flour marketed as dark flour was actually half-white flour (Ash=0.97%), and seven flours marketed as "flour 000" had ashes between 0.51 and 0.59 (ashes that correspond to 550 and 650 types flours).

These practices hide economic interests, namely: the sale of high extraction flours as low extraction flours, or the sale of some unsuitable flours as high value added flours, in the absence of suitable technologies to obtain them (dark flour sold as whole flour) [24]. The consumer's ability to notice the flour quality differences is minimal, because the colour of the flour is a parameter that does not necessarily and always depend on the extraction degree. Modern technologies, such as the use of the debranner, prior to the introduction of wheat to the grinding, these molina efficient cleaning, or even the addition of specific additives that can oxidize the flour pigments, can significantly influence the whiteness of the grain.

Another problem is related to how the milling industry is involved in the global issue of reducing energy costs, in the context of global warming concerns. Although most studies conclude that on the wheat-flour-bread production line, the majority of energy

consumption occur on the edges of this line (namely: phytotechnics and logistics related to wheat storage and transport to the mill, in the bread-making technologies and associated logistics to the consumer). This being said, it is seen that milling is far from being a small energy consumer [14]. The amount of energy consumed over the entire line exceeds 19,000 MJ/tonne of flour, equivalent to ,800 kg of CO<sub>2</sub> per tonne of flour. Flour production only is responsible for about 11-12% of this quantity of energy, of which the effective grinding has a share of 2-7% (361-1,186 MJ). At the level of the entire European Union, the energy consumption related to the wheat milling has a value of between 103 and 337 million euro (2.9-9.3 euro/tonne of flour and 0.7-2.2% of the domain turnover) [23].

Globally, the total energy consumption of wheat mills is estimated at 37.5 billion KW/h, representing 0.2% of total electricity consumption [9].

In Romanian mills, the current average consumption is estimated at 80-100 kWh per tonne of grinded wheat, which means that about 300 million kWh of electricity is consumed annually [13]. Energy consumption in mills is dominated by a number of technological features, namely: the total processing capacity (the size of the grinding section), the share of the pneumatic transport, the automation degree, the machinery mode of operation (individually, by groups etc.) and the total compressed air consumption. All of this may lead to significant differences between the specific energy consumption in mills.

Generally, modern technologies that allow to obtain higher extraction flours, as well as reduction of microbial load, contaminant quantities (pesticides, mycotoxins, heavy metals) or viable insect eggs from finished products, using wheat debranners and entoleters, require significantly higher energy consumption than conventional technologies. This is one of the issues where modern technologies, that can help the increase of consumer's food safety, do not necessarily reconcile with concerns for environmental preservation. As energy costs increase, mills will be interested in new

technologies that reduce energy consumption of the grinding process. This transition involves significant investments, and in some cases even the complete refurbishment of some sections: the transition from two-engines valves to single-engine valves, the replacement of compressors or fans with frequency control equipment, the replacement of pneumatic driving with electric ones, the use of high efficient-low energy electric motors etc.

Therefore, from the perspective of consumers expectations, to increase the safety of food products, the technological developments in industry, related to the possibility of reducing the impact on global warming, are relatively difficult to implement, as it involves significant investments to replace existing infrastructures.

## CONCLUSIONS

Although preventive programs aimed to minimize the risks for consumers, caused by wheat milling products, are well described and implemented, there is room for improvement, especially with regard to the selection and evaluation of suppliers and to the control of certain microbiological risks in the mills.

Most of the problems arises from an inadequate description of the flow diagrams, in the specific documentation of food management systems, i.e. the underestimation of certain activities (eg rework), which are not treated as a continuous and integral part of the technological processes in the mills. Some loopholes in the legislation allow deviations of finished products from standards.

In the field of food fraud, the sale of wheat flours with a mineral content of higher or less than the amount of mineral substances, required by the name of the product, is frequent.

Industry developments in terms of reducing energy costs, in order to diminish global warming, are relatively slow, as they need large investments and oppose efforts to increase food safety, that require high-energy equipment (wheat debranner, entoleter etc).

## REFERENCES

- [1] Aunt Jemima pancake mix recalled due to Salmonella health risk, <https://fooddemocracy.wordpress.com/2008/03/05/aunt-jemima-pancake-mix-recalled-due-to-salmonella-health-risk/>, Accessed on 7 January 2019.
- [2] Beach, C., 2016, General Mills recalls flour because of E. coli outbreak, <http://www.foodsafetynews.com/2016/05/general-mills-recalls-flour-because-of-e-coli-20-state-outbreak/#.WKdovPmLS00>, Accessed on 7 January 2019.
- [3] Berghofer, L., K., Docking, A. D., Miskelly, D., Jansson, E., 2003, Microbiology of wheat and flour milling in Australia, *Int. J. Food Microbiol.* 85:137-149.
- [4] El-Bayoumi, M. M., Heikal, Y. A., Abo-El-Fetoh, S. M., Abdel-Razik, M. M., 2013, Implementation of ISO 22000 as a food safety management tools in wheat milling industry, *World Journal of Dairy & Food Sciences*, 8(1): 27-37.
- [5] FDA Investigated Multistate Outbreak of Shiga toxin-producing E. coli Infections Linked to Flour, <http://www.fda.gov/Food/RecallsOutbreaksEmergencies/Outbreaks/ucm504192.htm>, Accessed on 8 January 2019.
- [6] FDA investigates low levels of peanut residue found in limited flour and flour products, <https://www.fda.gov/Food/RecallsOutbreaksEmergencies/SafetyAlertsAdvisories/ucm504002.htm>, Accessed on 8 January 2019.
- [7] Flynn, D., 2010, Flour investigated as E. coli source, <http://www.foodsafetynews.com/2010/08/test-hold-for-e-coli-might-not-work-for-flour/#.WKdrdvmLS00>, Accessed on 10 January 2019.
- [8] Food recall warning (allergen) - q. one brand wheat flour mixes recalled due to undeclared milk and sesame seeds, <http://www.inspection.gc.ca/about-the-cfia/newsroom/food-recall-warnings/complete-listing/2016-11-25-r11036/eng/1480530823759/1480530827078>, Accessed on 7 January 2019.
- [9] Gökdeniz, B., 2016, Energy efficiency in flour mills, <http://www.iaom-mea.com/wp-content/uploads/2016/07/DAY-2-5-BORA-GOKDENIZ.pdf>, Accessed on 10 January 2019.
- [10] Gaaloul, I., Riabi, S., Ghorbel, R. E., 2011, Implementation of ISO 22000 in cereal food industry "SMID" in Tunisia, *Food Control*, 22(1):59-66.
- [11] HG 106/2002, privind aprobarea Normei metodologice din 07/02/2002 privind etichetarea alimentelor publicat în MOF nr. 147 - 27/02/2002 (GD 106/2002 regarding the approval of the Methodological rules concerning food labelling, published in Official Monitor no.147-27/02/2002).
- [12] Mortimore, S., Wallace, C., 2013, HACCP: A practical approach, Springer Science & Business Media.
- [13] Nazâru, A.M., 2011, Researches on the energy optimization of the technological process of grain milling, PhD Thesis, Transilvania University, Braşov, Faculty of Food and Tourism.
- [14] Notarnicola, B., Tassielli, G., Renzulli, P. A., Monforti, F., 2017, Energy flows and greenhouses gases of EU (European Union) national breads using an LCA (Life Cycle Assessment) approach, *Journal of cleaner production*, 140:455-469.
- [15] OECD/Food and Agriculture Organization of the United Nations, 2015, OECD-FAO agricultural outlook 2015, [http://www.oecd-ilibrary.org/agriculture-and-food/oecd-fao-agricultural-outlook-2015\\_agr\\_outlook-2015-en](http://www.oecd-ilibrary.org/agriculture-and-food/oecd-fao-agricultural-outlook-2015_agr_outlook-2015-en), Accessed on 9 January 2019.
- [16] On, S., Lake, R., Hudson, A., 2010, Risk profile: Salmonella (non typhoidal) in cereal grains, Report, <http://ucfoodsafety.ucdavis.edu/files/172962.pdf>, Accessed on 9 January 2019.
- [17] Pollan M., 2009, *The omnivore's dilemma: the search for a perfect meal in a fast-food world.* Bloomsbury Publishing, p. 464.
- [18] Popa, N. C., 2017, Contribuții la înțelegerea integrității alimentare a produselor de morărit din grâu, al XXVI-lea Simpozion Anual al Asociației Specialiștilor în Morărit și Panificație din România, București, (Contributions to the understanding of food integrity of the wheat milling and bakery products, The XXVI Annual Symposium of Association of Experts in Milling and Bakery in Romania, Bucharest, <https://moraritsipanificatie.eu/2017/08/31/contributii-la-intelegerea-integritatii-alimentare-a-produselor-de-morarit-din-grau/>, Accessed on 11 January 2019.
- [19] Recall: the baker's scoop heb whole wheat flour, <http://wemakeitsafer.com/the-baker-s-scoop-heb-whole-wheat-flour-recall-12137604-15788050>, Accessed on 11 January 2019.
- [20] Richter, K. S., Dorneanu, E., Eskridge, K. M., Rao, C., 1993, Microbiological quality of flours. *Cereal Foods World*. 38:367-369.
- [21] Special report: what sparked the peanut-tainted flour recalls?, <http://allergicliving.com/2016/07/14/special-report-what-sparked-the-peanut-tainted-flour-recalls/>, Accessed on 7 January 2019.
- [22] Sperber, W. H., North American Millers Association, 2007, Role of microbiological guidelines in the production and commercial use of milled cereal grains: a practical approach for the 21st century. *J. Food Prot.* 70:1041-1053.
- [23] Steerneman, M., 2013, Energy saving, [http://www.flourmillers.eu/uploads/EEI\\_Steerneman\\_EFMConf\\_16072013.pdf](http://www.flourmillers.eu/uploads/EEI_Steerneman_EFMConf_16072013.pdf), Accessed on 11 January 2019.
- [24] Tamba-Berehoiu, R., Popa, C. N., Simion, V., Culea, R., 2016, Physico-chemical and microbiological characterization of wheat flours on Romanian market in relation to the shelf life, *Scientific Bulletin, Series F. Biotechnologies*, 20:218-221.

## TRENDS IN THE WORLD AND EU-28 MERCHANDISE TRADE

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### **Abstract**

*The paper analyzed the dynamics and the main trends in the world and the EU-28 trade with commodities in the period 2006-2107 using the WTO data. The data have been comparatively analyzed by regions, type of commodity groups mainly manufactured goods, and agro-food products, and also by Regional Trade Agreements, and in the top exporting and importing countries both at the world level and in the EU-28. World commodity trade have been developing in close connection with the economic growth, but it was affected by economic crisis, US dollar appreciation, low prices of commodities and fuels, inflation, yuan depreciation, low investments and other factors. In 2017, global trade succeeded to recover the exports of goods accounting USD 17.7 Trillion, being by 46.2 % higher than in 2006, while the imports were USD 18 Trillion, by 45.1 % more. The top traders of goods in the world are China, the EU-28, the USA, German, Japan, followed by United Kingdom, France, Republic of Korea, Italy, Netherlands Hong Kong China and Canada. Agro-food products represent 10 % of the world trade with goods and their volume is continuously growing, being commercialized by especially by the EU, USA, Netherlands, Germany, France, Brazil, China, Belgium, Spain, Italy, United Kingdom and Canada. Europe and Asia have the highest contribution to the global trade. The WTO 164 members are the key role in the world trade growth. The EU-28 was and still is an important "actor" in the international trade with manufactured goods and agro-food products. The EU top trading countries are: Germany, United Kingdom, France, Netherlands, Italy, Belgium, Spain, Poland, Austria, Sweden, Denmark, Czech Republic and Ireland. The development of a sustainable global trade requires new policies and strategies to support the economic growth and enhance trade with goods and services.*

**Key words:** merchandise trade, world, EU-28, export, import, trends, influence factors, top "trade players"

### **INTRODUCTION**

International trade plays an important role in sustaining the economic development both at the global, regional and national level. The dynamics of trade along the time has completely transformed the world economy, nowadays, more than 25 % of global output being traded [7].

The differences regarding the geographic conditions, natural resources, economic development, market evolution, currency systems, transfer expenses, the impact of climate change are the main factors with a deep influence on the dynamics of the international trade [8, 9].

The evolution of trade is closely related to the growth of the global economy in terms of real GDP.

However, the world economy has continuously to adapt to new challenges as happened in 2008 when the economic crisis

started to affect many countries and diminished the growth rate of real GDP and also the global trade. Despite the sustained efforts made during the last years, at last in 2017, the global economy recovered, In 2011, the economic growth rate reached 3 %, the highest level after the economic crisis.

The development of the world economy will continue but not as fast as before, and new short and long-term policies are required to avoid risks and potential challenges.

The key drivers of the sustainable economic development such as education, research, innovation, investments, reduction of unemployment, job creation, financial support, digitalization, could be taken into account by policy makers. Also, unemployment has to be reduced offering jobs to enhance the contribution to the labor productivity and gross output.

Only in this way, international trade could be developed and the increasing demand for

various goods and services to be better satisfied [3, 12, 15].

Grace to the liberalization of the engagements for becoming WTO members, at present this organization is the strongest in the world trade supporting its continuous development by allowing many countries to give their contributions [2].

The EU-28 is one of the most important exporter and importer of goods and services in the world grace to its economic growth [6].

Nowadays, the global trade is facing new changes concerning the "market players" and the distribution of economic powers, despite that the world trade is dominated by four countries: China, EU-28, USA, and Germany. In the 2030 prospect, is that the "main actors" in the global market will continue to keep their top positions as they will be able to produce more than 50 % of the global output [4].

However, a new trend in the global economy is the movement of the economic power from the USA and the EU to the large developing economies, so that in 2030 it is expected as China, the United States, India, Japan and Germany to be the main players in the world economy [1, 13].

Europe has to strongly fight to keep its position of leader of the world economy, otherwise it will pass on the 2nd position after Asia in the coming future.

But the growth rate of the world trade will continue to be a low one in accordance with the real GDP slow growth. This aspect is deeply determined by the low demand and its structure which is expected to continue in the coming years [16].

The development of global trade has been enhanced by the commercial services whose dynamics is extremely impressive mainly in the last decades. At present, the contribution of commercial services to the world GDP is over 70 % and even more in the high developed countries. The global export with services contributes by over 24 % to the global export. Among other services, tourism and transport have the highest contribution to the world exports and imports. However, the growth rate of services development exceeds

the growth of the trade with commodities [11].

The objectives of this study have been:

- (i) to analyze the evolution of the global commodity trade in the period 2006-2017;
- (ii) to analyze the dynamics of the main commodity groups in the same period;
- (iii) to point out the top 10 countries exporting and importing goods, mainly of manufactures commodities, agricultural products and food products;
- (iv) to evaluate the performance achieved by the Regional Trade Agreements and show their contribution to the global commodity trade;
- (v) to emphasize the role of the EU-28 as leader in the world economy and commodity trade;
- (vi) to identify the new "players" and new trends in the global trade with goods.

## MATERIALS AND METHODS

The study is based on the following indicators: volume of global trade with commodities, export and import values for merchandise, manufactured goods, agricultural products, food products, fuels and other commodities, the top countries regarding exports and imports of goods, the contribution of various geographical regions to the commodity trade, the contribution of various Regional Trade Agreements to the world trade, and the role and place of the EU-28 in the international trade with merchandises, by category of goods and by the top players in exports and imports.

The analyzed period was 2006-2017 and the empirical data were collected from WTO data base. The fixed indices were used to show the growth in the analyzed period, and also the market shares were determined for each region and each top country at the world and EU-28 level.

The results were tabled and graphically illustrated, and comparatively interpreted. Finally, the main ideas resulting from this research were presented as conclusions.

## RESULTS AND DISCUSSIONS

**World trade with goods.** The world merchandise trade has continuously developed. the growth rate in the period 2006-2017 being 45.95 % for the global exports and 44.97 % for imports.

Exports increased from USD 12.1 Trillion in 2006 to USD 17.7 Trillion in 2017, while imports raised from USD 12.4 Trillion to USD 18 Trillion in the same interval.

In 2017, the merchandise trade increased by 11 % compared to 2016. Asia registered the highest growth rate of the trade volume, 8.1 %, compared to other regions [18].

The general increasing trend of exports and imports in the analyzed period, 2006-2017, was deviated by the 2008 economic crisis, so that in 2009 export value was diminished by 22.3 % and import value by 22.9 % compared to the previous year.

Since 2010, the global trade has started to recover year by year till the years 2015 and 2016 when a decline affected its volume. This situation was caused by many factors, among which the reduction of fuel prices influenced the commodity prices which slowed down, except the prices of energy and food and beverages.

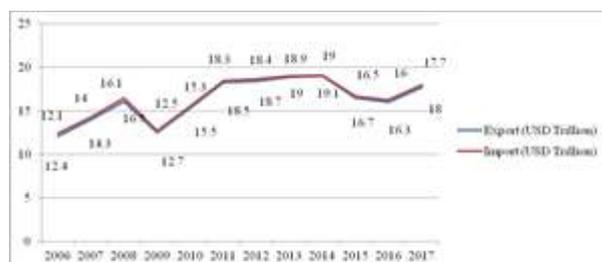


Fig.1. Dynamics of world merchandise export and import, 2006-2017 (USD Trillion)

Source: Own design based on the data from [20].

In 2017, the world trade recovered, increasing by 10.44 % in case of exports and by 10.8 % in case of imports compared to the 2016 level (Fig.1.) [17].

The decline of the global trade with goods in the years 2015 and 2016 was not as high as in the year 2009. But, this time it was caused by the low growth of the global economy and low prices of goods, which had a negative influence on the world demand.

The world economic growth in terms of GDP fell by 2.3 % in 2016 versus 2015 and by 2.7 % in 2015 versus 2014.

Also, the weak economic growth was affected by the low investment spending mainly in the most economically developed countries, such as the USA and China, which led the slowdown of the global trade with merchandises [17].

Also, the fall of export and import prices had a negative impact on the volume of the global trade in 2015 and 2016.

Therefore, the variations of the global economy determined important deviations of the merchandise trade from its general increasing trend.

In 2017, the world real GDP growth was 3.7 %, but it substantially fluctuated in the period 2006-2017, from 5.5 % in 2006 to 5.6 % in 2007, the maximum level, to -0.1 % in 2009, when the global economy was facing the economic crisis (Fig.2).

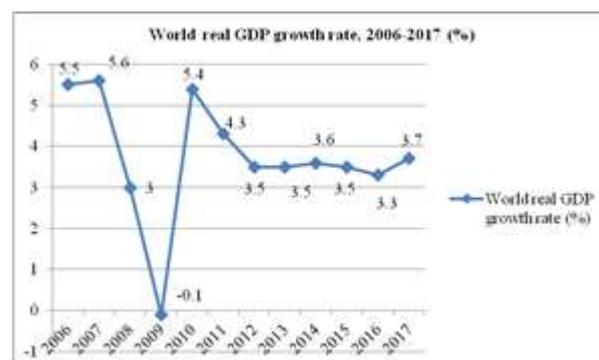


Fig.2. World real GDP growth rate, 2006-2017 (%)

Source: Own design based on the data from [5].

The statistics showed that at the beginning of the 90's, the trade growth rate was 2 times higher than GDP growth rate. Then, it deeply declined in 2009 due to the economic crisis, and after that, the ratio between the growth rate of the trade and the growth rate of GDP started to increase reaching the record of 3.4 in 2010, but then, it diminished again became equal to one in the period 2012-2015, but at present, this ratio is below 1, more exactly 0.6 (Fig.3.)

The appreciation of the US Dollar in 2015 led to lower commodity prices, a reason to restrain exports. The fall of prices affected mainly fuels, agricultural raw materials, commodities. However, the prices of agro-food products have slightly increased (+1.3 %).

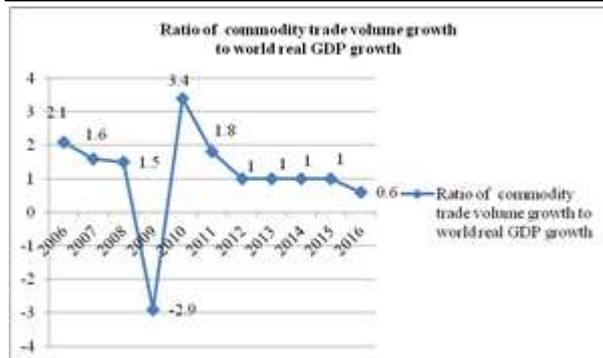


Fig.3. The ratio between the commodity trade volume growth and the world real GDP growth, 2006-2016  
Source: Own design based on the data from [19].

In 2016, the depreciation of the yuan, the Chinese currency, has also affected exports of goods.

Imports were negatively influenced by the slow growth of deliveries. In addition, the variations of the world economy development, the raise of inflation, the changes of the fiscal policies and the Brexit affected the volume of global trade.

As the economists affirm and the economic history proved, trade is closely related to economic growth. Any factors affecting the economic development have also an impact on trade dynamics.

The trade policies as well as the level of investment spending have an important role on the evolution of the trade volume [14].

**The merchandise trade by region**

Taking into account the geographical regions and their economic development, the global trade with commodities had the following situation in the year 2017:

-regarding exports of goods, the decreasing order of the regions and their market share are: Europe (36.7 %), Asia (36 %), North America (13.4 %), Middle East (5.3 %), South and Central America (3.3 %), CIS (2.9), and Africa (2.3 %);

-regarding imports, the descending order of the regions and their market share are: Europe (36.1 %), Asia (33.2 %), North America (18.2 %), Middle East (4 %), South and Central America (3.2 %), Africa ( 2.9 %) and CIS (2.2 %).(Fig.4.).

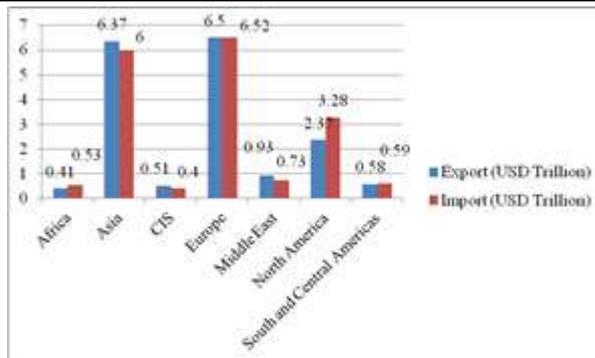


Fig.4. The merchandise trade, export and import by geographic region in 2017 (USD Trillion)  
Source: Own design based on the data from [20].

**World trade structure by commodity group**

The world trade is dominated by manufactures goods, whose share is about 73 %. The share of various commodities in world trade is the following one: manufactured goods 73 %, of which: 12 % chemicals, 11 % office and telecom equipment, 9 % automotive goods, 5 % clothing, 2 % iron and steel and 34 % other goods. On the 2nd position, there are situated fuels with 13 % share, agricultural products 10 %, and 4 % other products [17].

In the analyzed period, the trade with manufactures goods increased from USD 8.4 Trillion in 2006 to USD 11.5 Trillion in 2016, meaning +36.9 %. The trade with fuels registered a decline from USD 2.3 Trillion in 2006 to USD 2.1 Trillion in 2016, meaning by - 9.7 % less. On the 3rd position is the trade with agricultural products, which increased by 77.7 % from USD 0.9 Trillion in 2006 to USD 1.6 Trillion in 2006 [17].

**The top "players" in the world merchandise trade**

are four countries whose market share is the following one: EU-28 32.9 %, China 11.5 %, USA 11 % and Germany 7.3 %. These countries are followed by Japan, Netherlands, Rep. of Korea, Hong Kong China, France and Italy in case of exports, and in case of imports, by: Japan, United Kingdom, France, Hong Kong China, Rep. of Korea and Italy. However, their hierarchy was affected by changes of position in the analyzed period. The top 10 countries for exports represented 86.6 % in 2006 and 82.6 % in 2017 in the world exports with goods, while the top 10 countries for imports accounted for 90.9 % in 2006 and

81 % in 2017 in the world imports with commodities (Tables 1 and 2).

Table 1. The top 10 countries in the world export with goods, in 2017 compared to 2006

	2006		2017		
	US Trillion	Market share (%)	US Trillion	Market share (%)	
World	12.1	100.0	World	17.7	100.0
1. EU-28	4.60	37.9	1. EU-28	5.90	33.3
2. Germany	1.10	9.1	2. China	2.26	12.7
3. USA	1.02	8.4	3. USA	1.54	8.7
4. China	0.96	7.9	4. Germany	1.44	8.1
5. Japan	0.64	5.3	5. Japan	0.69	3.9
6. France	0.49	4.0	6. Netherlands	0.65	3.6
7. Netherlands	0.46	3.8	7. Rep. of Korea	0.57	3.2
8. United Kingdom	0.45	3.7	8. Hong Kong China	0.55	3.1
9. Italy	0.41	3.4	9. France	0.53	3.0
10. Canada	0.38	3.1	10. Italy	0.50	2.8
Total	10.51	86.6	Total	14.63	82.6

Source: Own calculations based on the data from [20].

Table 2. The top 10 countries in the world imports with goods, in 2017 compared to 2006

	2006		2017		
	US Trillion	Market share (%)	US Trillion	Market share (%)	
World	12.46	100.0	World	18.06	100.0
1. EU-28	4.87	39.0	1. EU-28	5.87	32.5
2. USA	1.91	15.3	2. USA	2.40	13.2
3. Germany	0.90	7.2	3. China	1.84	10.1
4. China	0.79	6.3	4. Germany	1.16	6.4
5. United Kingdom	0.61	4.8	5. Japan	0.67	3.7
6. Japan	0.57	4.5	6. United Kingdom	0.64	3.5
7. France	0.54	4.3	7. France	0.62	3.4
8. Italy	0.44	3.5	8. Hong Kong China	0.58	3.2
9. Netherlands	0.41	3.2	9. Rep. of Korea	0.47	2.6
10. Canada	0.35	2.8	10. Italy	0.45	2.4
Total	11.39	90.9	Total	14.7	81.0

Source: Own calculations based on the data from [20].

The figures from Table 1 and 2 showed how strong is the competition between the "main players" in the world trade, and also the decline of the export and import share in 2017 reflected that other countries have intensified

their transactions in the global market.

**The trade of the EU-28, China, USA and Germany** is comparatively presented in its dynamics in the period 2006-2017 in Table 3.

Table 3. Dynamics of commodity trade in the EU-28, China, the USA and Germany, 2006-2017 (USD Trillion)

	EU-28	China	USA	Germany
2006	4.73	0.88	1.47	1.00
2007	5.51	1.08	1.58	1.18
2008	6.15	1.27	1.72	1.31
2009	4.71	1.10	1.32	1.02
2010	5.30	1.48	1.62	1.15
2011	6.21	1.82	1.87	1.36
2012	5.87	3.86	1.94	1.27
2013	6.04	2.07	1.95	1.31
2014	6.15	2.15	2.01	1.35
2015	5.25	1.97	1.90	1.27
2016	5.36	1.85	1.85	1.19
2017	5.88	2.05	1.97	1.30
2017/2006 %	124.3	232.95	134.0	130.0

Source: Own calculations based on the data from [20].

The data from Table 3 reflect the differences between these four countries regarding the intensity of trade. The most dynamic trade was registered by China, + 132.9 %, followed by the USA + 34.09 %, Germany +30.5 and the EU-28 +24.3 %.

The EU-28 remained the leader of the world trade in all the analyzed years. Between 2006-2011, the USA came on the 2nd position. Since 2012, China passed on the 2nd position and the USA on the 3rd one. Germany maintained its 4th position. All these countries were affected by the economic crisis more or less in the years 2008 and mainly in 2009, but then they were able to recover their trade in the following years.

**The trade with manufactured goods** is carried out by the same group of countries mentioned above. In 2017, the decreasing order of these countries based on their exports was: the EU-28, China, Germany, the USA, Japan, Korea Rep. of, Hong Kong China, Netherlands, France and Italy, and for imports: the EU-28, the USA, China, Germany, Hong Kong China, France, United Kingdom, Japan, Netherlands, and Canada.

The exports of manufactured goods run by the top 10 countries in the world increased from USD 8.58 Trillion in 2006 to USD 12 Trillion in 2017 (+34.37%)(Table 4).

Between 2006 and 2017, some changes of position were observed among the top 10 countries exporting manufactured goods. Germany passed from the 2nd position to the 3rd position, while China moved on the 2nd position. The USA and Japan maintained their 4th and , respectively, 5th place. France lost its 6th position in 2006 and passed on the 9th place in 2017, while Italy also moved from the 7th position to the 10th. Hong Kong China intensified its exports and moved from the 9th position to the 7th position in 2017, and the Rep. of Korea has appeared on the 6th position among the top 10 exporters.

Regarding imports of manufactures commodities, the EU-28 and the USA remained on their 1st and respectively 2nd positions in 2017. Germany moved from the 3rd place to the 4th, while China passed on the 3rd position. The United Kingdom reduced its imports and moved from the 5th place in 2006 to the 7th in 2017. France and Japan kept their 6th and, respectively, 8th place. Hong Kong China intensified its imports passing from the 7th place in 2006 to the 5th place in 2017. Italy was not found among the top 10 importing countries in 2017, but Canada has appeared on the 10th position. The Netherlands went a position upward in 2017 (Table 4).

Table 4. The top 10 countries in the world trade with manufactured goods in 2017 versus 2006 ( USD Trillion)

2006				2017			
Export		Import		Export		Import	
1.EU-28	3.68	1.EU-28	3.50	1.EU-28	4.66	1.EU-28	4.32
2.Germany	0.95	2.USA	1.35	2.China	2.12	2. USA	1.87
3.China	0.89	3.Germany	0.65	3.Germany	1.26	3.China	1.15
4.USA	0.81	4.China	0.57	4.USA	1.12	4.Germany	0.88
5.Japan	0.58	5.United Kingdom	0.40	5.Japan	0.60	5.Hong Kong China	0.51
6.France	0.39	6.France	0.39	6.Korea Rep.of	0.51	6.France	0.47
7.Italy	0.35	7.Hong Kong China	0.30	7.Hong Kong China	0.47	7. United Kingdom	0.45
8. United Kingdom	0.34	8.Japan	0.29	8.Netherlands	0.43	8.Japan	0.39
9.Hong Kong China	0.30	9.Italy	0.28	9.France	0.42	9.Netherlands	0.38
10.Netherlands	0.29	10.Netherlands	0.27	10.Italy	0.41	10.Canada	0.33
Total	8.58	Total	8.00	Total	12.00	Total	10.75

Source: Own calculations based on the data from [20].

**The trade with agricultural products** registered an important growth in the analyzed period. The main "players" for exports are: the EU-28, the USA, Netherlands. Germany, Brazil, China, France, Canada,

Spain, Indonesia, Belgium, Italy and United Kingdom, and for imports: the EU-28, China, the USA, Germany, Japan, Netherlands, United Kingdom, France, Italy, Spain, Belgium and Canada.

The export with agricultural products carried out by the top 10 countries in the world increased by 62.35 % from USD 0.85 Trillion in 2006 to USD 1.38 Trillion in 2017. The imports achieved by the top 10 countries grew by 58.6 % from USD 0.93 Trillion in 2006 to USD 1.47 Trillion in 2017 (Table 5).

In the analyzed period, the rank of some countries changed from 2006 to 2017. Regarding the exporting countries, the EU-28, the USA, Netherlands and Germany maintained their first four positions in 2017. France lost the 5th position and passed on the 7th, and Canada also moved from the 6th place to the 8th place in 2017. Brazil exported more agricultural products and moved from the 7th position in 2006 to the 5th place in 2017. Belgium was not found any more among the top 10 exporters in 2017, but Spain

moved from the 10th place to the 9th. China exported more and more and passed from the 9th place to the 6th position in 2017. Indonesia has appeared on the 10th position in 2017 among the top 10 exporters of agricultural products,

Regarding the importers of agricultural products, China passed from the 6th position in 2006 to the 2nd place in 2017, after the EU-28, and the USA, Germany and Japan passed one position downwards. The United Kingdom reduced its imports and passed from the 5th position to the 7th in 2017, and Italy did the same, moving from the 7th to the 9th position. Netherlands increased its imports passing from the 9th place to the 6th in 2017. France and Spain remained on the 8th, and, respectively, on the 10th place (Table 5).

Table 5. The top 10 countries in the world trade with agricultural products in 2017 versus 2006 ( USD Trillion)

2006				2017			
Export		Import		Export		Import	
1.EU-28	0.41	1.EU-28	0.44	1.EU-28	0.64	1.EU-28	0.65
2.USA	0.09	2.USA	0.10	2.USA	0.17	2. China	0.18
3.Netherlands	0.07	3.Germany	0.07	3. Netherlands	0.11	3. USA	0.16
4.Germany	0.06	4. Japan	0.06	4. Germany	0.09	4.Germany	0.11
5. France	0.05	5.United Kingdom	0.05	5.Brazil	0.08	5. Japan	0.07
6. Canada	0.04	6. China	0.05	6. China	0.07	6. Netherlands	0.07
7.Brazil	0.04	7. Italy	0.05	7. France	0.07	7. United Kingdom	0.07
8. Belgium	0.03	8. France	0.04	8. Canada	0.06	8. France	0.07
9. China	0.03	9. Netherlands	0.04	9.Spain	0.05	9. Italy	0.05
10. Spain	0.03	10. Spain	0.05	10.Indonesia	0.04	10. Spain	0.04
Total	0.85	Total	0.93	Total	1.38	Total	1.47

Source: Own calculations based on the data from [20].

**Food trade** also has developed in the analyzed interval. The top 10 exporting countries are: the EU-28, the USA, Netherlands, Germany, Brazil, France, China, Spain, Canada and Italy, and the top 10 importing countries are: the EU-28, the USA, China, Germany, Japan, Netherlands, United Kingdom, France, Italy and Spain.

The food exports increased by 71.42 % from USD 0.7 Trillion in 2006 to USD 1.2 Trillion in 2017, while food imports raised by 63.15 % from USD 0.76 Trillion in 2006 to USD 1.24 Trillion in 2017 (Table 6).

In the analyzed period, various changes of positions of the top 10 exporters and importers was observed.

Concerning the exporting countries, Brazil passed from the 6th position in 2006 to the 5th

place in 2017, while China moved from the 9th place to the 7th. Germany passed from the 5th to the 4th position in 2017.

Belgium lost its 7th place in 2006 and was not found among the top 10 exporters in 2017. Spain and Italy remained on the same position, the 8th and respectively, the 10th. Canada appeared in 2017 on the 9th place.

Regarding the importing countries, China was not among the top 10 importers in 2006, but in 2017 it came on the 3rd place, while Germany and Japan went one position downwards.

The United Kingdom, France and Italy reduced their imports and passed one rank downwards in the analyzed period (Table 6).

Table 6. The top 10 countries in the world food trade in 2017 versus 2006 ( USD Trillion)

2006				2017			
Export		Import		Export		Import	
1.EU-28	0.34	1.EU-28	0.36	1.EU-28	0.56	1.EU-28	0.56
2.USA	0.07	2.USA	0.08	2.USA	0.14	2. USA	0.14
3.Netherlands	0.06	3.Germany	0.06	3. Netherlands	0.09	3. China	0.11
4. France	0.05	4. Japan	0.05	4. Germany	0.08	4.Germany	0.09
5. Germany	0.05	5.United Kingdom	0.05	5.Brazil	0.07	5. Japan	0.07
6. Brazil	0.03	6. France	0.04	6. France	0.06	6. Netherlands	0.06
7. Belgium	0.03	7. Italy	0.03	7. China	0.06	7. United Kingdom	0.06
8. Spain	0.03	8. Netherlands	0.03	8. Spain	0.05	8. France	0.06
9. China	0.02	9. Spain	0.03	9.Canada	0.05	9. Italy	0.05
10. Italy	0.02	10. Belgium	0.02	10.Italy	0.04	10. Spain	0.04
Total	0.7	Total	0.76	Total	1.2	Total	1.24

Source: Own calculations based on the data from [20].

**The trade with other goods.** The top 10 exporters in the world dealing with other goods and their exports in USD Trillion in 2016 were the following ones:

**-For fuels:** the EU-28 (0.37), Russian Federation (0.15), the USA (0.13), Saudi Arabia Kingdom (0.12), Australia (0.10), Canada (0.08), Norway (0.05), United Arab Emirates (0.05), China (0.05) and Qatar (0.04);

**-For iron and steel:** the EU-28 (0.12), China (0.05), Japan (0.02), Rep. of Korea (0.02), Russian Federation (0.01), the USA (0.01), Chinese Taipei (0.008), India (0.008), Brazil (0.008) and Ukraine (0.008);

**- For chemicals:** the EU-28 (0.89), the USA (0.19), China (0.12), Switzerland (0.09), Japan (0.06), Korea Rep. of (0.05), Singapore (0.04), India (0.03), Canada (0.03) and Chinese Taipei (0.03);

**- For office and telecom equipments:** China (0.54), the EU-28 (0.32), Hong Kong China (0.25), the USA (0.14), Singapore (0.11), Korea Rep. of (0.11), Chinese Taipei (0.110), Mexico (0.06), Japan (0.06) and Malaysia (0.05);

**-For automobiles:** the EU-28 (0.68), Japan (0.15), the USA (0.13), Mexico (0.09), Canada (0.06), Korea Rep. of (0.06), China (0.05), Thailand (0.02), Turkey (0.02) and India (0.01).

**-For textiles:** China (0.11), the EU-28 (0.06), India (0.02), the USA (0.01), Turkey (0.01), Korea Rep. of (0.01), Pakistan ( 0.009), Chinese Taipei (0.009), Hong Kong China (0.008) and Vietnam (0.007);

**-For clothing:** China (0.16), the EU-28 (0.12), Bangladesh (0.03), Vietnam (0.02), India (0.02), Hong Kong China (0.01), Turkey (0.01), Indonesia (0.0070, Cambodia (0.006) and the USA (0.006).

Table 7. The hierarchy of the RTAs based on their exports and imports of goods in 2017 ( USD Trillion)

	RTA's name	Acronym	Exports	Imports
1	Asia Pacific Economic Cooperation	APEC	8.80	8.95
2	European Union	EU	5.90	5.87
3	North American Free Trade Agreement	NAFTA	2.37	3.28
4.	Association of South Eastern Nations	ASEAN	1.31	1.25
5.	Gulf Cooperation Council	GCC	0.70	0.51
6.	South Asia Preferential Trading Agreement	SAPTA	0.37	0.60
7	Africa, Caribbean and Pacific Countries	ACP	0.34	0.41
8	MERCOSUR	MERCOSUR	0.32	0.26
9	Least Developed Countries	LDS	0.17	0.25
10	South African Developed Community	SADC	0.17	0.18
11	ANDEAN Community	ANDEAN	0.11	0.11
12	Common Market for Eastern and Southern Africa	COMESA	0.08	0.16
13.	Economic Community of West Africa States	ECOWAS	0.09	0.10
14.	Central American Common Market	CACM	0.04	0.06
15	Central European Free Trade Agreement	CEFTA	0.03	0.05
16	Economic Community of Central African States	ECCAS	0.06	0.04
17	West African Economic and Monetary Union	WAEMU	0.02	0.03
18	Central African Economic and Monetary Community	CAEMC	0.02	0.02
19	Caribbean Community	CARICOM	0.02	0.03

Source: Own concept based on the data from [20]

**The Regional Trade Agreements (RTA) and their contribution to the global merchandise trade.**

The RTAs concluded across the time between various countries have proved their efficiency contributing to the development of the international trade with goods destined to cover better and better the needs of each country.

On the top positions there are situated the following RTAs: WTO, APEC, EU, NAFTA, ASEAN, GCC, SAPTA, MERCOSUR, which intensified their trade during the last decade (Table 7).

**WTO- the most important trade organization in the world.** With 164 members, WTO is the most powerful organization dealing with merchandise trade. In 2016, the trade of WTO members achieved

USD 15.35 Trillion being by 34.59 % higher than in 2006.

The share of the WTO members in the global trade with commodities was 94.9 % in 2006 and reached 98.3 % in 2016 [17].

The contribution of various regions to the WTO trade in 2016 was the following one: Europe 37.8 %, Asia 32.1 %, North America 16.9 %, Middle East 3.9 %, South and Central Americas and Caribbean 3.3 %, Africa 2.3 % and Commonwealth of the Independent States-CIS 2 %.

In all the regions, the merchandise trade increased in 2016 compared to 2006, but the growth rate was different from a region to another. The CIS increased its trade 45 times, Asia registered +60.2 %, Middle East +46.92 %, Africa +37.6 %, South Central America and Caribbean +28.30 %, North America + 25.67 % and Europe +15.80 % (Table 8).

Table 8. The commodity trade of the WTO member states by region in 2016 versus 2006 (USD Trillion)\*

	Commodity trade (USD Trillion)		2016/2006 %	Market share in the world trade with goods (%)	
	2006	2016		2006	2016
Africa	0.26	0.35	137.6	2.1	2.3
Asia	3.12	5.01	160.2	26.0	32.1
CIS	0.007	0.32	4,511.2	0.1	2.0
Europe	5.09	5.90	115.8	42.4	37.8
Middle East	0.41	0.60	146.9	3.4	3.9
North America	2.10	2.64	125.6	17.5	16.9
South and Central America and the Caribbean	0.40	0.52	128.3	3.4	3.3
Total WTO	11.4	15.3	134.5	94.9	98.3

Source: Own calculation based on the data from [17].

\*Average data between export and import of commodities.

**The EU-28 commodity trade**

The EU-28 comes on the 1st position in the world merchandise trade, with a few exceptions depending on the group of commodities.

In 2017, its exports of goods were by 28.1 % higher than in 2006 and accounted for USD 5.9 Trillion, while the imports of goods was USD 5.8 Trillion, by 20.6 % higher than in the 1st year of the analyzed interval.

All the types of commodities groups commercialized by the EU registered an increased trade, regarding both export and import, except fuels, whose imports declined in 2017. The trade with manufactured goods increased by 26.5 % in case of exports and by 23.3 % in case of imports. The trade with

agricultural products increased by 56.3 % in case of exports and by 46.6 % in case of imports. The exports with food increased by 62.2 % and the imports by 54 %. The exports with fuels increased by 14.1 %, but the imports declined by 7.1 % in 2017 compared to 2006 (Table 9).

In 2017, the share of various commodity groups in the EU-28 export was the following one: 79 % manufactured goods, 10.9 % agricultural products, 9.5 % food, and 5.2 % fuels, and in case of import: 73.6 % manufactured commodities, 11 % agricultural products, 9.5 % food and 9.9 % fuels.

In 2017, the top EU countries exporting commodities, in the descending order of their market share, were: Germany (24.5%),

Netherlands (11 %), France (9%), Italy (7.2 %), Spain (5.4%), Poland (3.9%), Czech (8.5%), United Kingdom (7.4%), Belgium Republic (3%) and Austria (2.8%).

Table 9. The EU-28 commodity trade by main product groups in 2017 versus 2008 ( USD Trillion)

	Exports		2017/2006 %	Imports		2017/2006 %
	2006	2017		2006	2017	
EU-28 Commodity Trade	4.60	5.90	128.1	4.87	5.87	120.6
-Manufactured goods	3.68	4.66	126.5	3.50	4.32	123.3
-Agricultural products	0.41	0.64	156.3	0.44	0.65	146.6
-Food	0.34	0.55	162.2	0.36	0.56	154.0
-Fuels	0.27	0.30	114.1	0.62	0.58	92.9

Source: Own concept based on the data from [20].

**The EU top 10 exporting and importing countries of goods**

The top EU importing countries of goods in the decreasing order were: Germany (19.8 %), United Kingdom (10.9%), France (10.6%), Netherlands (9.7%), Italy (7.7 %), Belgium (6.9 %), Spain (5.9%), Poland (3.9%), Austria (2.9%) and Czech Republic (2.7%).

In 2017, all these 10 countries exported goods whose value was USD 4.9 Trillion, representing 83.2 % of the EU-28 exports of commodities in the global market. The value of the commodity imports made by the top 10 countries accounted for USD 4.8 Trillion, representing 82.3 % of the EU-28 imports (Table 10).

Table 10. The top 10 countries in the EU-28 merchandise trade in 2017 versus 2006 ( USD Trillion)

2006				2017			
Export		Import		Export		Import	
EU-28	4.60	EU-28	4.87	EU-28	5.90	EU-28	5.87
1. Germany	1.10	1. Germany	0.90	1. Germany	1.44	1. Germany	1.16
2. France	0.49	2. United Kingdom	0.61	2. Netherlands	0.65	2. United Kingdom	0.64
3. Netherlands	0.46	3. France	0.54	3. France	0.53	3. France	0.62
4. United Kingdom	0.45	4. Italy	0.44	4. Italy	0.50	4. Netherlands	0.57
5. Italy	0.41	5. Netherlands	0.41	5. United Kingdom	0.44	5. Italy	0.45
6. Belgium	0.36	6. Belgium	0.35	6. Belgium	0.43	6. Belgium	0.40
7. Spain	0.21	7. Spain	0.32	7. Spain	0.32	7. Spain	0.35
8. Sweden	0.14	8. Austria	0.13	8. Poland	0.23	8. Poland	0.23
9. Austria	0.13	9. Sweden	0.12	9. Czech Rep.	0.18	9. Austria	0.17
10. Poland	0.11	10. Poland	0.12	10. Austria	0.16	10. Czech Rep.	0.16
Total	3.9	Total	3.9	Total	4.9	Total	4.8
Market share (%)	84.9	Market share (%)	81.9	Market share (%)	83.2	Market share (%)	82.3

Source: Own calculations based on the data from [20].

**The EU top exporting and importing countries of manufactured commodities**

In 2017, the top exporters of manufactured goods in the EU-28 and their market shares were the following ones: Germany (27.1%), Netherlands (9.3%), France (9.1%), Italy (9%), United Kingdom (7%), Belgium (6.9%), Spain (4.8 %), Poland (3.9 %), Czech Republic (3.4%) and Austria (2.5%).

In the same year, the EU top importers of manufactured goods and their market share were: Germany (20.4%), France (11%), United Kingdom (10.6%), Netherlands

(8.9%), Italy (7.2%), Belgium (6.7%), Spain (5.6 %), Poland (4.1 %), Austria (3.1%) and Czech Republic (3.1%).

In 2017, all these 10 countries exported manufactured commodities whose value was USD 3.8 Trillion, representing 83.3 % of the EU-28 exports of manufactured commodities. The value of the manufactured goods imports achieved by the top 10 countries accounted for USD 3.5 Trillion, representing 81.2 % of the EU-28 imports of this category of merchandises (Table 11).

Table 11. The top 10 countries in the EU-28 manufactured commodity trade in 2017 versus 2006 ( USD Trillion)

2006				2017			
Export		Import		Export		Import	
EU-28	3.60	EU-28	3.50	EU-28	4.66	EU-28	4.32
1. Germany	0.95	1. Germany	0.65	1. Germany	1.26	1. Germany	0.88
2. France	0.39	2. United Kingdom	0.40	2. Netherlands	0.43	2. France	0.47
3. Italy	0.35	3. France	0.39	3. France	0.42	3. United Kingdom	0.45
4. United Kingdom	0.34	4. Italy	0.28	4. Italy	0.41	4. Netherlands	0.38
5. Netherlands	0.29	5. Netherlands	0.27	5. United Kingdom	0.32	5. Italy	0.31
6. Belgium	0.28	6. Belgium	0.25	6. Belgium	0.32	6. Belgium	0.29
7. Spain	0.16	7. Spain	0.22	7. Spain	0.22	7. Spain	0.24
8. Sweden	0.12	8. Austria	0.10	8. Poland	0.18	8. Poland	0.17
9. Austria	0.11	9. Poland	0.009	9. Czech Rep.	0.16	9. Austria	0.13
10. Ireland	0.009	10. Sweden	0.009	10. Austria	0.11	10. Czech Rep.	0.13
Total	3.1	Total	2.7	Total	3.8	Total	3.5
Market share (%)	85.0	Market share (%)	79.6	Market share (%)	83.3	Market share (%)	81.2

Source: Own calculations based on the data from [20].

**The EU top exporting and importing countries of agricultural products**

The EU-28 is the top country in the world exporting agricultural products, its market share accounting for over 40 % and also the top world importing country with about 37 % market share. Its main beneficiaries China, Saudi Arabia, and the USA, and its main suppliers of agro-food products are: USA, Canada, Japan, New Zealand, and Australia [10].

In 2017, the EU top exporters of agricultural products and their market shares were the following ones: Netherlands (16.6%), Germany (14.6%), France (11.2%), Spain (8.8 %), Belgium (7.5%), Italy (7.4%), Poland (5.1 %), United Kingdom (4.9%), Denmark

(3.5%), and Austria (2.5%).

In the same year, the EU top importers of agricultural products and their market share were: Germany (17.8%), Netherlands (11.4%), United Kingdom (10.6%), France (10.4%), Italy (8.8%), Spain (6.8 %), Belgium (6.7%), Poland (3.6 %), Sweden (2.9) and Austria (2.6%).

In 2017, the value of exports of agricultural products made by all these EU top 10 countries was USD 0.53 Trillion, representing 82.6 % of the EU-28 exports of this type of products. The value of the imported agricultural products by the top 10 countries in the EU accounted for USD 0.53 Trillion, representing 82 % of the EU-28 imports (Table 12).

Table 12. The top 10 countries in the EU-28 trade with agricultural products in 2017 versus 2006 ( USD Trillion)

2006				2017			
Export		Import		Export		Import	
EU-28	0.41	EU-28	0.44	EU-28	0.64	EU-28	0.65
1. Netherlands	0.07	1. Germany	0.07	1. Netherlands	1.07	1. Germany	0.11
2. Germany	0.06	2. United Kingdom	0.05	2. Germany	0.09	2. Netherlands	0.07
3. France	0.05	3. Italy	0.04	3. France	0.07	3. United Kingdom	0.06
4. Belgium	0.03	4. France	0.04	4. Spain	0.05	4. France	0.06
5. Spain	0.03	5. Netherlands	0.04	5. Belgium	0.04	5. Italy	0.05
6. Italy	0.02	6. Spain	0.03	6. Italy	0.04	6. Spain	0.04
7. United Kingdom	0.02	7. Belgium	0.03	7. Poland	0.03	7. Belgium	0.04
8. Denmark	0.01	8. Denmark	0.01	8. United Kingdom	0.03	8. Poland	0.02
9. Austria	0.01	9. Austria	0.01	9. Denmark	0.02	9. Sweden	0.01
10. Poland	0.01	10. Sweden	0.01	10. Austria	0.01	10. Austria	0.01
Total	0.35	Total	0.37	Total	0.53	Total	0.53
Market share (%)	84.9	Market share (%)	83.5	Market share (%)	82.6	Market share (%)	82.0

Source: Own calculations based on the data from [20].

**The EU top exporting and importing countries of food**

In 2017, the EU top food exporters and their market shares were: Netherlands (16.1%), Germany (14.5%), France (11.8%), Spain (9.5%), Italy (7.9%), Belgium (7.7%), Poland (5.3%), United Kingdom (5.2%), Denmark (3.5%), and Ireland (2.5%).

Also, in 2017, the EU top food importers and their market share were: Germany (17.2%), Netherlands (11.5%), United Kingdom

(10.8%), France (10.6%), Italy (8.4%), Spain (7%), Belgium (6.8%), Poland (3.6%), Sweden (2.9) and Austria (2.3%).

In 2017, the food export value carried out by all these EU top 10 countries was USD 0.47 Trillion, representing 84.6% of the EU-28 food exports. The value of the imported food by the top 10 EU countries accounted for USD 0.46 Trillion, representing 81.6% of the EU-28 imports (Table 13).

Table 13. The top 10 countries in the EU-28 trade with food products in 2017 versus 2006 ( USD Trillion)

2006				2017			
Export		Import		Export		Import	
EU-28	0.34	EU-28	0.36	EU-28	0.55	EU-28	0.56
1. Netherlands	0.05	1. Germany	0.06	1. Netherlands	0.09	1. Germany	0.09
2. France	0.05	2. United Kingdom	0.04	2. Germany	0.08	2. Netherlands	0.06
3. Germany	0.05	3. France	0.04	3. France	0.06	3. United Kingdom	0.06
4. Belgium	0.03	4. Italy	0.03	4. Spain	0.05	4. France	0.06
5. Spain	0.03	5. Netherlands	0.03	5. Italy	0.04	5. Italy	0.05
6. Italy	0.02	6. Spain	0.02	6. Belgium	0.04	6. Spain	0.04
7. United Kingdom	0.02	7. Belgium	0.02	7. Poland	0.03	7. Belgium	0.04
8. Denmark	0.01	8. Denmark	0.01	8. United Kingdom	0.03	8. Poland	0.02
9. Ireland	0.01	9. Sweden	0.009	9. Denmark	0.02	9. Sweden	0.01
10. Poland	0.01	10. Austria	0.008	10. Ireland	0.01	10. Austria	0.01
Total	0.30	Total	0.30	Total	0.47	Total	0.46
Market share (%)	87.7	Market share (%)	83.6	Market share (%)	84.6	Market share (%)	81.6

Source: Own calculations based on the data from [20].

**Developing economies and their role in the world trade**

In the world commodity trade, an important role is played by the developing economies. The volume of their trade has slowly increased, however their progress is remarkable mainly in the field of raw materials, agro-food products and textiles.

The agro-food sector offers new opportunities for the developing countries to increase production and exchange agro-food products joining the global value chains.

The small farms and enterprise where business is running in the developing countries could join along the product chain.

To develop production and processing and create more value added in the products, the developing countries need to assure the inputs in terms of seeds, fertilizers, pesticides, insecticides, machinery and specific tools. Also, the role of services in agro-food chain (research, innovation, education, consultancy,

transport, wholesale, retail etc) is more and more important in sustaining the developing countries to produce more and of higher quality and intensify their exports in the international market.

**CONCLUSIONS**

World trade with goods followed a positive trend in close connection with the global economic growth. However the ratio between trade growth and GDP growth became 0.6 at present compared to 2.1 in 2006.

World trade was facing various changes determined by the economic crisis which started in 2008, the US Dollar appreciation, which reduced the prices of goods, the low demand for commodities, the low prices of fuels, the depreciation of the yuan, the increase of inflation, the low investment spending etc, which caused a decline of trade in the year 2025 and 2016.

In 2017, at the global level the value of the exported goods accounted for USD 17.7 Trillion, being by 46.2 % higher than in 2006, while the value of the imported commodities was USD 18 Trillion, by 45.1 % more than in the first analyzed year.

The top countries trading goods in the world are the EU-28, China, the USA and Germany. The hierarchy of the top 10 countries both regarding exports and imports has suffered changes of positions in close relationship with the economic growth of each country but also due to the external factors influencing the global GDP and trade.

Besides China, USA, EU and Germany are countries such as: Japan, United Kingdom, France, Republic of Korea, Italy, Netherlands Hong Kong China and Canada sustain the exports and imports of goods worldwide. Also, they play the main role in the trade with manufactured commodities.

Agricultural and food products are mainly commercialized by: EU, USA, Netherlands, Germany, France, Brazil, China, Belgium, Spain, Italy, United Kingdom and Canada. An intensified trade with agro-food products was noticed during the last decade, so that the share of agro-food trade in the commodity trade exceeds 10 %.

The contribution of the geographical regions to the global export is given in the decreasing order of the market share by: Europe, Asia, North America, Middle East, South and Central America, CIS and Africa. Europe is the leader in world commodity trade, but its low growth rate is expected to pass Europe on the 2nd position after Asia.

The RTA contributed to the development of global trade grace to the facilities involved. The RTA with the highest contribution to the development of the global trade are: WTO, but also, APEC, EU, NAFTA, ASEAN, GCC and SAPTA.

The trade of WTO members exceeded USD 16 trillion in 2017, assuring the highest share over 98 % in the global trade.

The EU-28 has been the leader of the world trade for a long period of time. The EU top exporters and importers of goods are: Germany, United Kingdom, France, Netherlands, Italy, Belgium, Spain, Poland,

Austria, Sweden and Czech Republic. They are also the main players in the trade with manufactured goods. The top EU countries trading agricultural and food products are: Germany, Netherlands, United Kingdom, France, Spain, Italy, Belgium, Poland, Denmark, Austria, Sweden. and Ireland.

The exchange of goods among countries at the global level has been intensified during the last decade to cover better the market needs. An increased trade is running between the developing countries from the South part of the globe ( South-South trade) and also between the developed and the developing countries (North - South trade). Therefore, it is recognized the higher and higher contribution of the developing economies to the global trade.

In order to develop a sustainable international trade, new trade policies are required. As long as the production chains have become increasingly complex at the global level, new strategies should be set up to assure the economic growth and enhance trade.

Trade with goods is closely supported by services trade, a reason to stimulate the development of services as well.

## REFERENCES

- [1]Ahearn, R.J., 2011, Rising Economic Powers and the Global Economy: Trends and Issues for Congress, <https://fas.org/sgp/crs/misc/R41969.pdf>, Accessed on January 22, 2019.
- [2]Edwards, L.J., 2002, Emerging Trends in World Trade and Development, 4th World Conference of Trade Promotion Organizations: "TPO's in a turbulent New Business Environment", Beijing, China, May 15-17, 2002
- [3]EU, 2012, Has the crisis left a lasting mark on global trade?, [http://ec.europa.eu/economy\\_finance/publications/qr\\_euro\\_area/2012/pdf/qrea2\\_section\\_1\\_en.pdf](http://ec.europa.eu/economy_finance/publications/qr_euro_area/2012/pdf/qrea2_section_1_en.pdf), Accessed on January 22, 2019.
- [4]Gros, D., Alcidi, C., 2014, The Global Economy in 2030: Trends and Strategies for Europe, CEPS Papers 9142, Centre for European Policy Studies..
- [5]Knoema Atlas, 2019, World - Gross domestic product in constant prices growth rate, <https://knoema.com/atlas/World/Real-GDP-growth>, Accessed on January 22, 2019
- [6]Mucha-Leszko, B., Kałol, M., 2010, EU economic frontiers determined by its international trade position and trade Policy The Geopolitics of European

Frontiers, ed. by D.I. Dolghi, "Eurolimes", Vol. 10, Autumn 2010, pp. 151-162.

[7]Ortiz-Ospina, E., Beltekian, D., Roser, M., 2018, Trade and Globalization, <https://ourworldindata.org/trade-and-globalization>, Accessed on January 22, 2019.

[8]Popescu Agatha, 2012, Home and International Trade, Comunicare.ro and RawexComs Publishing House, Bucharest, pp. 120-126

[9]Popescu Agatha, 2015, Some considerations regarding the statement of the world commodity trade, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol.15, Issue 4/2015, p. 239-246

[10]Popescu Agatha, 2015, Some considerations on the world agri-food trade and the position of the EU-28, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol.15, Issue 4/2015, p. 247-256

[11]Popescu Agatha, 2015, Some considerations on the actual statement of the world trade in commercial services, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol.15, Issue 4/2015, p. 257-264

[12]Popescu Agatha, 2016, Research on the Relationship between GDP, Unemployment and Employment in the EU-28, Proceedings of 27th IBIMA Conference Innovation Management and Education Excellence Vision 2020: from Regional Development Sustainability to Global Economic Growth, Milan, Italy, May 4-5, 2016, pp.686-695.

[13]Rines, S., 2018, Meet the 5 Countries That Will Dominate the Global Economy in 2030, <https://nationalinterest.org/blog/buzz/meet-5-countries-will-dominate-global-economy-2030-38042>, Accessed on January 22, 2019.

[14]UNCTAD, 2018, Key statistics and trends in International Trade 2017, The status of World Trade, <https://unctad.org/en/pages/PublicationWebflyer.aspx?publicationid=2109>, Accessed on January 22, 2019.

[15]United Nations, 2018, World Economic Situation Prospects 2018, [https://www.un.org/development/desa/dpad/wp-content/uploads/sites/45/publication/WESP2018\\_Full\\_Web-1.pdf](https://www.un.org/development/desa/dpad/wp-content/uploads/sites/45/publication/WESP2018_Full_Web-1.pdf), Accessed on January 22, 2019.

[16]Wozniak, P., Galar, M., 2018, Understanding the Weakness in Global Trade, Economic Brief 033, EU, [https://ec.europa.eu/info/sites/info/files/economy-finance/eb033\\_en\\_0.pdf](https://ec.europa.eu/info/sites/info/files/economy-finance/eb033_en_0.pdf), Accessed on January 22, 2019.

[17]WTO, 2017, World Trade Statistical Review 2017, [https://www.wto.org/english/res\\_e/statis\\_e/wts2017\\_e/wts17\\_toc\\_e.htm](https://www.wto.org/english/res_e/statis_e/wts2017_e/wts17_toc_e.htm), Accessed on January 22, 2019.

[18]WTO, 2018, World Trade Statistical Review 2018, [https://www.wto.org/english/res\\_e/statis\\_e/wts2018\\_e/wts18\\_toc\\_e.htm](https://www.wto.org/english/res_e/statis_e/wts2018_e/wts18_toc_e.htm), Accessed on January 22, 2019.

[19]WTO, 2017, World trade and GDP growth in 2016 and early 2017, [https://www.wto.org/english/res\\_e/statis\\_e/wts2017\\_e/WTO\\_Chapter\\_03\\_e.pdf](https://www.wto.org/english/res_e/statis_e/wts2017_e/WTO_Chapter_03_e.pdf), Accessed on January 22, 2019.

[20]WTO, 2019, International Trade and Market Access Data,

[https://www.wto.org/english/res\\_e/statis\\_e/statis\\_bis\\_e.htm](https://www.wto.org/english/res_e/statis_e/statis_bis_e.htm), Accessed on January 22, 2019.

## COMPARISON REGARDING THE TOURISM IMPACT ON THE ECONOMY OF BULGARIA AND ROMANIA

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### Abstract

*The paper has comparatively analyzed the role of tourism in the economic growth of Bulgaria and Romania, using the specific system of indicators: GDP, employment, multiplier effect, efficiency, investments, visitor exports, and competitiveness. The methodology was based on the formulas provided by literature at present and the data were collected from UNWTO Data Base. Bulgaria and Romania are important tourism destinations grace to their rich cultural and historical heritage, beautiful landscapes, landmarks, tourism forms, service quality and hospitality. Bulgaria has more visitors and receipts than Romania, but in absolute value, tourism has a higher contribution to GDP in Romania, while in relative value, 11.5 % of GDP is produced by tourism and in Romania just 5.3 %. Tourism supports employment 3.7 times better in Romania than in Bulgaria regarding the number of jobs. The multiplier effect is almost similar in the both countries, proving that tourism growth stimulated the development of other economic sectors. Tourism increases labor productivity in the economy of the both countries, but 1.4 times more in Bulgaria. Visitor exports in Bulgaria are higher than in Romania, while investments in tourism are 4.5 higher in Romania than in Bulgaria. Tourism competitiveness is low in the both countries, but Bulgaria comes on a lower position than Romania in the international market. As a conclusion, both Bulgaria and Romania has to intensify the efforts to sustain tourism growth, its contribution to the development of the economy and become a more competitive sector. Bulgaria and Romania have to better evaluate all their resources, to diversify their offers, to improve service quality and increase tourism performance. Only in this way, a new tourism strategy could attract more visitors and increase the role of tourism in the economy and improve the image of each country in Europe and in the world.*

**Key words:** tourism, impact, GDP, employment, multiplier effect, efficiency, visitor exports, investment, competitiveness, Bulgaria, Romania

### INTRODUCTION

Tourism is a high dynamic sector of activity in the world economy. It is characterized by high growth rates regarding its development, injection of outflows of foreign currency in the payment balance, infrastructure modernization, tourism management, all these aspects having a positive impact on the economic and social development of various countries [23, 24, 49].

Tourism plays an important role in the economy and it could create a competitive advantage for a country in the world tourism market [40]. Also, tourism could be a landmark or a favorable image of a country,

as this activity is considered the most visible aspect [14].

Tourism could contribute to the economic development in many ways, and according to Tourism Satellite Accounting methodology, tourism could have: (i) *Direct contribution*, which includes: "goods related to accommodation, transport, entertainment and attractions), industries (accommodation services, food and beverages, retail trade, transportation services, cultural, recreational and sport services), all these being financial supported by residents' spending, business domestic travel spending, visitor exports, individual government spending on travel and tourism services"; (ii) *Indirect contribution*, which is given by: "investment spending in

tourism, government collective spending in tourism and impact of buying from suppliers"; (iii) *Induced contribution* refers to " spending of direct and indirect employees in food and beverages, recreation, clothing, housing, household goods etc"; (iv) *Total contribution to GDP and employment*, which is a the sum of the three components mentioned above [53].

Therefore, tourism is able to assure not only its own development but also to contribute the growth of the other economic activities related to tourism. "The dimension and quality of tourism services is closely connected vertically and horizontally to other sectors of activity" [59].

This aspect was named "the multiplier effect of tourism" by John Maynard Keynes who said that "the size of this indicator reflects the impact of a new monetary unit created in tourism on various economic branches which are situated on the routes where that monetary unit circulates through, till the moment it disappears"[22, 46].

Across the time, tourism has permanently contributed to the development of various economies, but at present it has become one of the key drivers in the world economy.

In 2017, the direct contribution of tourism to the world GDP accounted for USD 2.57 trillion (3.2%), the total contribution to GDP accounted for USD 8.3 trillion (10.4%). To the world employment, tourism has directly contributed by 118.4 million jobs (3.8% of total employment) and

the total contribution was 336.2 million jobs (9.9 %). Investments made in tourism accounted for USD 882.4 billion in 2017 (4.5 % of total world investments) and visitor exports reached USD 1.5 trillion, representing 6.5 % of global exports [54].

The EU is on the top in the world tourism due to its rich cultural and historical heritage, beautiful landscapes, high quality services and hospitality [21, 31].

Besides the most visited countries of the EU for years, the new member states which adhered during the last 15 years have become important more and more important tourist attractions on the tourist map of Europe. Tourism in the new EU member states has

been continuously developing bringing an important contribution to the economic development at the country level but also at the EU. Their efforts are focused on tourism development so that this sector to become more competitive [35].

Bulgaria and Romania have similarities but also differences regarding tourism. Tourism is continuously developing in these two countries and bring an important contribution to economic growth in terms of GDP and employment [50].

However, Bulgaria and Romania are still situated in general on lower positions than other EU countries in the world hierarchy of tourism competitiveness [39].

The economic impact of tourism in Bulgaria is a positive one regarding: "GDP, employment, income, infrastructure development, investment and standard of living, but also it has a negative impact regarding the dependence on other tourist markets, high price of commodities, income disparity, increase of land price, territorial concentration, seasonality and low performance indicators"[45, 48].

In this context, the present paper aimed to analyze the contribution of tourism to economic development in Bulgaria and Romania, which were accessed together into the EU on January 1st, 2007. The main aspects approached in this study have been: tourism contribution to GDP, employment, investments, exports both in absolute and relative values, the multiplier effect of tourism in the economy, the efficiency of tourism, the competitiveness of tourism. The study allowed to make a comparison among the two countries and identify the results of their efforts to strengthen tourism importance in the economy in the year 2017.

## MATERIALS AND METHODS

### Study area

#### Bulgaria

Bulgaria is situated in the Balkan Peninsula, bordering Romania in the North, Greece and Turkey in the South and Serbia and Macedonia in the West. Bulgaria has 110,994 km<sup>2</sup> surface and 7,153,784

inhabitants, of which 26.9 % live in the rural areas. The relief is represented by the Danube and Thracia Plain, hills and the Balkan and Rhodope mountains. The Danube River borders the largest part of the frontier with Romania. Bulgaria has exit to the Black Sea which favored the development of seashore tourism. The climate is Mediterranean and continental which assured a suitable environment for various plants and animal species. The biodiversity is one of the richest on the continent and is preserved in national parks, natural parks, biosphere reserves and many protected area.

Bulgaria has a large variety of natural and anthropogenic resources which have allowed the development of many forms of tourism such as: seashore, spa, health, cultural-historical, adventure, rural, agrarian, wine tourism. New orientations have appeared to support the development of sustainable tourism [1].

In Bulgaria, tourism is an essential generator of economic growth mainly during the last two decades. Bulgarian tourism has still many aspects which need improvement such as "the one-sided product mix, high territorial concentration, seasonality, limited number of tourist markets, the lack of exploitation of the whole potential resources [48].

Rural and agricultural tourism are new alternatives claiming the involvement of the rural population to valorize the local natural, cultural, human resources in an efficient way offering accommodation, board, recreational activities to visitors and this could contribute to the increase of income and living standard of the small towns, villages and suburban areas, transforming them in tourist attractions [9, 12].

It could be a tool for regional development, minimizing of the negative effects of tourism on natural landscapes, and environment, and also on local population [7, 11].

Besides the seaside, rural tourism is a niche market which has to be stimulated to develop in order to diversify the activities in the rural space, bring additional jobs, income and welfare to the local population [44].

The charming folk traditions, tasty cuisine, rural architectural features, the beauty and

diversity of the landscapes, the hospitality of the population are substantial arguments as Bulgaria to be visited by more and more tourists [8].

Among the top tourist attractions in Bulgaria there are: Cathedral St. Alexandr Nevski in Sofia, Cathedral of the Assumption of the Virgin in Varna, Rila Monastery, Old town in Plovdiv, the Palace of Queen Mary of Romania in Balchik, Ravadinovo Castle, Belogradchik Fortress, Krakra Fortress, Tsarecets Fortress, Archaeological Museum in Varna, Shipka Monument, Old Nessebar Vaya Beach Burgas, The Golden Sands, Sunny Beach Resort, Borovets Ski Resort, Rila National Park, Vitosha Mountain, Vratsa Mountain, Emen Waterfalls, Water Springs, Eco Museum and Aquarium, Gorica Zoo etc [51].



Fig.1. Bulgaria tourist map.

Source: [5].

## Romania

Romania is situated at the crossroads of Eastern, Central and South East part of Europe. Its borders are represented by Bulgaria, Serbia, Hungary, Ukraine, Moldova and the Black Sea. Its surface is 238,397 km<sup>2</sup> and has a population of 19,64 million inhabitants (2017). The climate is predominately a temperate-continental one. Flora and faune is of alrge variety, The relied if like an amphitheater, the Mountains are represented by the Carpathians, which are surrounded by the Moldavian and Transylvanian plateaus, the Carpathian basin and Wallachian plains. The Danube river flows into the Black Sea, forming the Danube Delta, a biosphere reserve and also an item of World Heritage Sites.

Romania has a large variety of natural, cultural, historical resources, which attract many tourists. Also, in the rural areas there is an important part of the population dealing mainly with agriculture, but rural tourism has begun to be a successful alternative for the ones wishing to spend their vacations in plain air and enjoying the rural life. At the same time, the local population and communities have the chance to be occupied to offer accommodation, traditional gastronomy, folklore and customs getting additional money to improve the living standard [44].

Both Romania and Bulgaria have a large range of tourist resources both natural and anthropogenic, which are insufficiently developed [20].

Tourism is continuously developing due to the increasing number of visitors. Investments in new tourist facilities, recreational alternatives, environment protection, and also in new information technology for booking, travelling and paying and nowadays important activities which sustain tourism growth.

Romania has large offer of tourism forms: cultural, historical, seashore, mountain, spa, thermal, health, religious, business, shopping, adventure, hiking, biking, rural tourism and agrotourism [25].

The number of tourist arrivals increased quickly year by year and tourism receipts as well, between these two indicators existing an important positive relationship [26, 27, 34].

In Romania's rural areas the population is dealing especially with agriculture, but during the last decades it is more and more involved in the development of rural tourism, agrotourism, ecotourism. The development of agrotourism is one of the most dynamic forms in Romanian tourism in terms of accommodation structures and their concentration in the territory [28, 36, 37].

The top tourist attractions in Romania are: Peles Royal Castle and Bran Castle, Transilvania's medieval fortresses and castles, Brasov and Sighisoara historical center, the Tower of the Council in Sibiu, the Bucovina monasteries, the Transfagarasan and Transalpina Roads, the Parliament House, the Herastrau Park, the Village Museum, Turda

Salt Lake, the caves of the Apuseni Mountains, the Merry Cemetery from Sapanta Maramures, the Black Church in Brasov with its largest organ pipe in the Eastern Europe, King Decebal's statue, the highest in Europe, the Astra Museum in Sibiu, the 2nd largest ethnographic open air museum in the world, the only gold museum in Europe, The Danube Delta- Biosphere reservation, National Park of the Retezat Mountains, the seashore with its numerous resorts [52].

An important number of tourist is interested to visit Transilvania and its heritage in terms of medieval fortresses, castles, villages, traditions. Also, Bucovina invited tourists to discover the religious architecture and art unique in the world, visiting its old monasteries. The Romania seashore offer wonderful vacations at the Black Sea, the top season being June-September when both Romanian and foreign tourist invade the beaches for laying in the sun swimming and entertainment [16, 18, 19, 38].

Tourism is relatively concentrated in the territory regarding accommodation offer, both in the cities and rural areas. The high concentration of population and the need of supplementary income sources stimulated the development of rural tourism [29, 33].

Tourism contribution to GDP and its efficiency is increasing year by year [30, 32].

However, compared to other states which adhered to the EU during the last decades, Romania has still many aspects to improve as its tourism to be more efficient and competitive in the international market [35, 39].



Fig.2. Romania tourist map  
Source: [43].

### Analyzed indicators

The study was achieved based on the following indicators:

(a) international tourist arrivals, international tourism receipts, tourism receipts per arrival, analyzed in the period 2009-2017.

(b) tourism contribution to GDP and employment both in absolute and relative values in 2017.

(c) tourism multiplier effect and tourism efficiency in 2017;

(d) tourism contribution to investments and exports in absolute and relative values in 2017.

(e) tourism economic competitiveness both in absolute and relative values in 2017.

### Data collection

The data were collected from the following official sources: UNWTO Tourism Highlights 2010-2018, UNWTO Tourism and Travel economic impact World 2018, UNWTO Tourism and Travel economic impact Bulgaria 2018, UNWTO Tourism and Travel economic impact Romania 2018 [55, 56, 57, 58].

### Methodological aspects

The methodology included a large variety of methods as follows:

*Significance analysis*, concerning the size of tourism and its share in GDP, and *Impact analysis* regarding the direct and indirect influence of tourism [10, 47].

The dynamics of international tourist arrivals, receipts and receipts per arrival was analyzed based on the calculation of the *Index with fixed basis*, taking into account the year 2009 as reference moment.

*The contribution of tourism to GDP* ( $TC_{GDP}$ ) was determined using the formula:

$$TC_{GDP} = TR / GDP,$$

where: TR = tourism receipts, and GDP-gross domestic product

*The contribution of tourism to Employment GDP* ( $TC_{Em}$ ) was determined using the formula:

$$TC_{Em} = TEm / Em,$$

where: TEm = tourism employment, and Em = employment in the economy

*The contribution of tourism to Exports* ( $TC_{Exp}$ ) was determined using the formula:

$$TC_{Exp} = T_{VExp} / Exp$$

where:  $T_{VExp}$  = tourism visitor exports Exp= Exports of goods

*The multiplier effect of tourism* ( $K_{GDP}$ ) was determined using the formula:

$$K_{GDP} = \frac{Direct\ GDP + Indirect\ GDP + Induced\ GDP}{Direct\ GDP}$$

The  $K_{GDP}$  was determined both using absolute values and relative values of tourism GDP, according to the formulas specified by [46, 6].

*The tourism efficiency (E) in the economy in terms of labour productivity* was determined using the formulas mentioned by [15, 6].

$$E =$$

$$\frac{Direct\ Employment + Indirect\ Employment + Induced\ Employment}{Direct\ Employment}$$

The indicators were comparatively studied in Bulgaria and Romania, considered study cases.

Also, the analysis of the economic competitiveness in tourism was based on the official data regarding the rankings at the world and EU levels and also in Bulgaria and Romania.

The results were graphically and tabled presented and correspondingly interpreted.

## RESULTS AND DISCUSSIONS

### Dynamics of international tourist arrivals

Both Bulgaria and Romania are countries of high tourist attraction reflected by their rich cultural and historical heritage, coastal resorts at the Black Sea, mountain resorts suitable in all seasons but mainly in winter season for specific sports, beautiful landscapes, medical tourism, spa and sport tourism, rural tourism. The international tourist arrivals increased year by year in the both countries.

In 2017, Bulgaria was visited by 8,883 thousand international tourists, by 54.7 % more than in the year 2009, while Romania received 2,769 visitors 2.16 times more than in 2009. Therefore, Bulgaria has 3.21 times more international arrivals than Romania. In the year 2015, Bulgaria registered a slight decline by about 3 % in the number of international visitors compared to the year

2014, but in 2016, the international arrivals increased by 15.4 % in comparison with the inbound tourism in 2015. (Fig.3.)

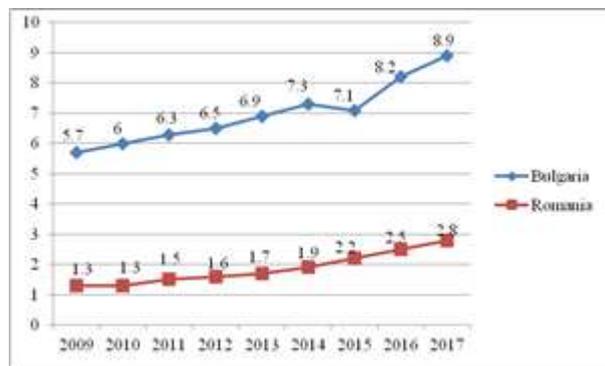


Fig.3. Dynamics of international tourist arrivals in Bulgaria and Romania in the period 2009-2017 (Thousand)

Source: Own design based on the data from [57, 58].

Tourist market in Romania is much larger than in Bulgaria. The countries of origin of the tourist visiting Romania are mainly: Germany, Italy, France, Hungary, United Kingdom, USA, representing about 44 % of inbound overnight stays. The tourist market of Bulgaria is limited in general to visitors coming from the neighbouring countries: Romania, Greece, former Yugoslavia, Macedonia, but also from Germany and Russian Federation, which all together account for about 50 % of tourist inflow. More than this 70 % of the tourism activity in concentrated in 5 % of the territory, mainly on the seashore [50].

**Dynamics of international tourism receipts**

The intensified international tourist flows to Bulgaria and Romania determined a growth in tourism receipts.

In 2017, Bulgaria achieved USD 4,045 million receipts, by 8.5 % more than in 2009. However, the general evolution of this indicator looks to be an ascending one, but marked in different years by growths and declines. More exactly, in 2010, the receipts were by 8.2 % lower than in 2009, then it was observed an increase by 14.7 % in 2011 compared to the previous year. In 2012, it appeared again a decline of 7.7 % compared to the level registered in 2011. In 2013, the receipts increased by 5.5 % and in 2014 by 8.3 % compared to the level of the year 2012.

The year 2015 registered the highest decline of the receipts, - 20.6 %, in the analyzed period, but after that the level of this indicator had only an ascending trend till 2017, when it was registered USD 4 Billion, by 29 % more than in 2015 and the highest level in the whole analyzed period.

Romania carried out a continuous increasing trend of international receipts without any significant inflexion in the analyzed interval. In 2017, its receipts accounted for USD 2,527 million, being 2 times higher than in 2009. However, in 2010, Romania registered a slight decline of 8.4 % compared to the level of 2009, but then, the receipts had only an ascending trend till 2014. In 2015, it was noticed again a slight decline of 5.6 % compared to the level of 2014 and in 2016, Romania received the same level of incomes from tourism like in 2015, therefore it was facing a stagnation. In 2017, the receipts reached the highest level, USD 2.5 Billion, by 47 % more than in 2016 and by 108 % more than in 2009 (Fig.4).

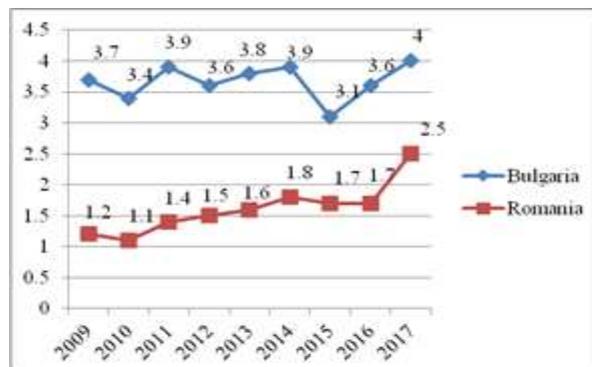


Fig.4. Dynamics of international tourism receipts in Bulgaria and Romania in the period 2009-2017 (USD Billion)

Source: Own design based on the data from [57, 58].

The variations regarding the level of receipts from international tourism both in Bulgaria and Romania were determined by the different number of visitors, the length of their stay, and the tourist services for which they applied, the amount of money they wanted to spend during their travels in the tourist chosen destination.

The level of international receipts of course had influenced the contribution of tourism to the economic growth in each country.

**Tourism receipts per international tourist arrival** varied from a country from another depending on the level of tourism income from international visitors and the number of arrivals.

At the first sight, the both countries registered a general descending trend.

Bulgaria recorded the highest level of receipts/arrival, accounting for USD 649.5 in the year 2009. Then, it registered a decline of 13.3 % in 2010. In 2011, the receipts/arrival has recovered and reached USD 626.8, by 11.2 % more than in the previous year. Since 2011, Bulgaria recorded a continuous decline of receipts/arrival till the year 2016, when it registered the deepest decline, reaching USD 400.3, by 9.7 % less than in 2015 and by 38.4 % less than in 2009. In 2017, the situation was much better, this indicator reaching USD 440.3 receipts/arrival by 10 % more than in 2016, but by 36.3 % less than in 2009.

In Romania, also, the receipts per arrival declined from USD 967 in 2009 to USD 915.5 in 2017, meaning minus 5.4 % in the whole period. However, the highest level of this indicator was USD 915.5, which was never attained in the analyzed period. The level of this indicator varied much more from a year to another in Romania than in Bulgaria. The lowest level, USD 700.5 receipts/arrival was registered in the year 2016, by 27.6 % less than in 2009. But, in 2017, it was registered an increase by 30.6 % compared to 2016, and the receipts per arrival reached USD 915.5.

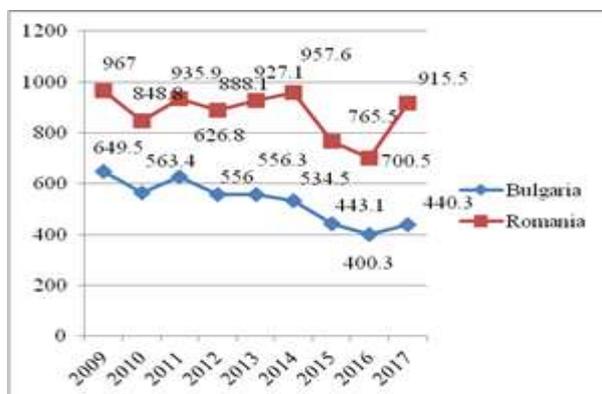


Fig.5. Dynamics of international tourism receipts per arrival in Bulgaria and Romania in the period 2009-2017 (USD)

Source: Own calculation and design.

Also, one may easily notice that, the receipts per arrival in Romania are higher than in Bulgaria. If the ratio between receipts per arrival in Romania versus Bulgaria was 1.48 in the year 2009, in 2017 this ratio became much higher, 2.07, reflecting that Romania's income from tourism is more dynamic than in Bulgaria.(Fig.5).

**Travel and Tourism contribution to GDP in absolute value**

Tourism plays an important role in the economy both of Bulgaria and Romania. This is proved, first of all, by its contribution to GDP in absolute value.

In Bulgaria, the GDP from tourism increased by 3.1 % in the period 2009-2017, from USD 6.4 Billion to USD 6.6 Billion. In Romania, the contribution of tourism to GDP was much higher and increased by 27.2 % in the studied period from USD 8.8 Billion in 2009 to USD 11.2 Billion in 2017.

Therefore, in 2017, Romania registered USD 11.2 Billion GDP from tourism, by 69.6 % more than Bulgaria. In 2009, the difference between the two countries was much smaller of only 37.5 % (Fig.6.)

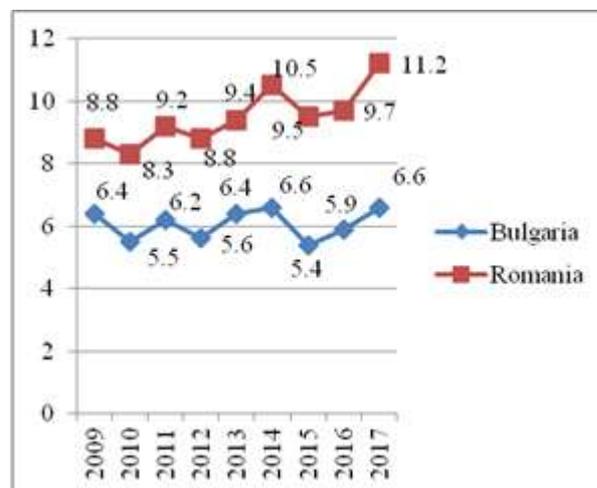


Fig.6. Dynamics of travel and tourism contribution to GDP in Bulgaria and Romania in the period 2009-2017 (USD Billion)

Source: Own design based on the data from the data from [3, 41].

However the contribution of Romania to GDP is smaller than in Austria and Hungary, and of course in other EU countries with a better developed tourism situated in the top [13].

**Travel and Tourism contribution to GDP in relative value**

Taking into account the GDP created in travel and tourism sector and GDP in the economy, the contribution of T & T in relative value to GDP varied between 12.4 % in 2009 and 11.5 % in 2017 in Bulgaria, and between 5.5 % in 2009 and also in 2017 in Romania.

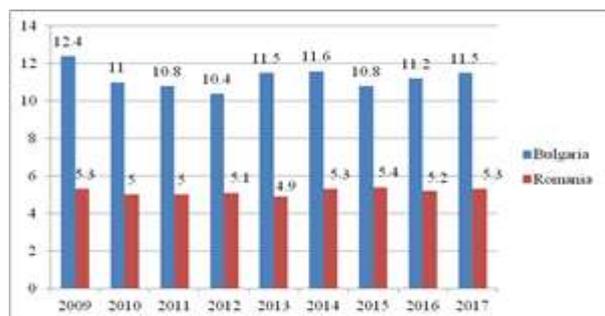


Fig.7. Dynamics of travel and tourism share in GDP of Bulgaria and Romania in the period 2009-2017 (%)  
Source: Own design based on the data from the data from [4, 42].

Therefore, in Romania, despite that the T & T contribution to GDP in absolute value is 1.6 times higher than in Bulgaria, the share of

GDP created in this sector of activity is 2.1 times smaller, reflecting that in Bulgaria tourism has a deeper impact in the economy than in Romania (Fig.7).

Similar results were found by [13] who affirmed that "tourism does not occupy an important place in Romania's economy" as long as its share in GDP is 5 % compared to Bulgaria where it is almost double.

**The direct and total contribution of T & T to GDP**

In 2017, in Bulgaria, the direct T&T contribution to GDP accounted for USD 1,756 Million (3.1 %), while the total contribution accounted for USD 6,591 Million (11.5%). For the year 2028, the forecast is that in this country, T&T sector will produce USD 2,551.9 directly and USD 9,367.8 totally.

In case of Romania, the direct contribution to GDP in 2017 accounted for USD3,024 million (1.4 %) and for USD 11,185 million totally. The forecast for 2028 is USD 3,878.4 million as direct contribution and USD 14,052 million as total contribution (Table 1).

Table 1. Direct and Total T & T contribution to GDP in 2017 and forecast for 2028 in Bulgaria and Romania

		Direct contribution to GDP		Total contribution to GDP	
		USD Million	% of total GDP	USD Million	% of total GDP
Bulgaria	2017	1,756	3.1	6,591	11.5
	2028 forecast	2,551.9	3.6	9,367.8	13.3
Romania	2017	3,024	1.4	11,185	5.3
	2028 forecast	3,878.4	1.5	14,052	5.5

Source: [57, 58].

In 2017, in Bulgaria, tourism total contribution to GDP consisted of 26.6 % direct contribution, 56.7 % indirect contribution and 16.7 % induced contribution. In the same year, in Romania, the contribution to GDP was structured: 27.2 % direct contribution, 54.5 % indirect contribution and 18.3 % induced contribution.

**T & T contribution to employment**

The development of tourism imposed to create new jobs and employ more people to face the higher and higher demand of tourism services. In this way, tourism could be considered a generator of work and labour force both in Bulgarian and Romanian economy.

In 2017, the direct T&T contribution to employment was 90 thousand (2.9 %), while the total contribution accounted for 335 thousand (10.7%) in Bulgaria. For the year 2028, the forecast is that in this country, T&T sector will employ 115 thousand people directly and 374 thousand as a total contribution.

In case of Romania, the direct contribution to employment in 2017 accounted for 208 thousand (2.5 %) and for 529 thousand people totally. The forecast for 2028 is 213 thousand employees working directly and for 536 thousand people as total contribution to employment (Table 2).

Table 2. Direct and Total T & T contribution to employment in 2017 and forecast for 2028 in Bulgaria and Romania

		Direct contribution to Employment		Total contribution to Employment	
		Thousand persons	% of total employment	Thousand persons	% of total employment
Bulgaria	2017	90	2.9	208	2.5
	2028 forecast	115	4.1	213	2.6
Romania	2017	335	10.7	529	6.3
	2028 forecast	374	13.4	536	6.5

Source: [57, 58].

In 2017, in Bulgaria, tourism total contribution to employment included 26.7 % direct contribution, 55.3 % indirect contribution and 18 % induced contribution. In Romania, the contribution to employment was structured: 39.5 % direct contribution, 44.8 % indirect contribution and 15.6 % induced contribution. If in case of the structure of the contribution to GDP there were not higher differences between Bulgaria and Romania, in case of tourism employment structure there are large discrepancies.

Therefore, tourism is an opportunity to diminish unemployment, absorbing personnel for the new jobs created in the field. It has a benefic impact in the small localities where people need to increase their income and living standard. [13]

**The multiplier effect of tourism in the economy in terms of GDP**

The results regarding the multiplier effect of tourism in the economy of Bulgaria and Romania in terms of GDP in 2017, using the formulas mentioned by Snak *et al* (2003) and Bulin *et al* (2014) who started from the

Keynesian model, are presented in Table 3.

In Bulgaria, in 2017, the ratio between the sum of Direct, Indirect and Induced T&T contribution to GDP, and Direct contribution to GDP, in absolute values, was 3.75, based on the formula mentioned set by Snak *et al* (2003) and also 3.71, calculated based on the formula mentioned by Bulin (2014),. Therefore, the both values were higher than 3, the reference value in literature, and this reflects that travel and tourism has a multiplier effect in the economy, meaning that the development of tourism stimulate the growth of other connected economic sectors [6, 46].

In case of Romania, in 2017, tourism proved to have a multiplier effect in the economy as well, as long as  $K_{GDP}$  was 3.69 calculated based on the formula mentioned by Snak *et al* (2003) and also 3.78, calculated using the formula mentioned by Bulin *et al* (2014), the both values being higher than 3 and reflecting the important role of tourism to the development of many other economic sectors.

Table 3. The multiplier effect of tourism in the economy of Bulgaria and Romania in terms of GDP in 2017

	Bulgaria		Romania	
	The multiplier effect of tourism $K_{GDP}$	Interpretation	The multiplier effect of tourism $K_{GDP}$	Interpretation
After Snak <i>et al</i> (2003)	3.75	$K_{GDP} > 3$ , tourism has a multiplier effect in the economy	3.69	$K_{GDP} > 3$ , tourism has a multiplier effect in the economy
After Bulin <i>et al</i> (2014)	3.71	$K_{GDP} > 3$ , tourism has a multiplier effect in the economy	3.78	$K_{GDP} > 3$ , tourism has a multiplier effect in the economy

Source: Own calculations based on [46, 6].

**Tourism efficiency in the economy** reflected the positive impact of this sector on the labor productivity. In case of Bulgaria, tourism efficiency, E, registered the value 3.73 after Oroian and Gheres (2013) [15] and 3.68 based

on the formula mentioned by Bulin *et al* (2014) [6]. These values being higher than 1 reflected a positive impact on labor productivity in the economy. In Romania, tourism efficiency recorded the E value also

higher than 1, more exactly 2.53, and, respectively, 2.52 (Table 4).

Table 4. Tourism efficiency in the economy of Bulgaria and Romania in terms of labor productivity in 2017

	Bulgaria		Romania	
	Tourism efficiency (E)	Interpretation	Tourism efficiency (E)	Interpretation
After Oroian and Gheres (2013)	3.73	E > 1, tourism is an efficient branch in the economy	2.53	E > 1, tourism is an efficient branch in the economy
After Bulin <i>et al</i> (2014)	3.68	E > 1, tourism is an efficient branch in the economy	2.52	E > 1, tourism is an efficient branch in the economy

Source: Own calculations based on [46, 6].

### Contribution of visitor exports to total exports

In Bulgaria, visitor exports accounted for USD 4.5 Billion representing 11.9 % of total exports, while in Romania visitor exports were USD 2.8 Billion, having a share of 3.3 % in total exports of the country.

The forecast for 2028 is that visitor exports to reach USD 6.5 Billion in Bulgaria and USD 3.7 Billion in Romania.

The figures reflect that in Bulgarian economy, tourism has a higher contribution to exports than in Romania. (Table 5).

Table 5. Contribution of visitor exports to total exports in 2017 and forecast for 2028 in Bulgaria and Romania

	Bulgaria		Romania	
	Visitor exports USD Million	% of total exports	Visitor exports USD Million	% of total exports
2017	4,502.9	11.9	2,871.7	3.3
2028 forecast	6,569.2	12.4	3,778.5	3.2

Source: [57, 58].

### Contribution of tourism to investments in the economy

T and T investments accounted for USD 0.84 Billion in Bulgaria and for USD 3.80 Billion in Romania in the year 2017. For the year 2028 it is expected as tourism investments to reach USD 1.2 Billion in Bulgaria and USD 5 Billion in Romania.

The relative contribution of tourism to

investments in the economy will increase from 7.4 % in 2017 to 7.7 % in 2028 in Bulgaria and from 8.1 % to 8.3 % in Romania.

Therefore in Romania, the value of investments in tourism are higher than in Bulgaria and the relative contribution to the investments in the economy as well (Table 6).

Table 6. Contribution of tourism investments to the investments in the economy in 2017 and forecast for 2028 in Bulgaria and Romania

	Bulgaria		Romania	
	Investments in tourism USD Million	% of total investments	Investments in tourism USD Million	% of total investments
2017	841.3	7.4	3,806.2	8.1
2028 forecast	1,200.3	7.7	5,063.3	8.3

Source: [57, 58].

In Bulgaria, investments registered a substantial growth during the last decades mainly in the seaside area, which is the top attraction. This determined an over dimensioned accommodation capacity than required, which determined as many owners

to sale their properties on the real estate market [13].

### Competitiveness rankings of Bulgaria and Romania based on tourism contribution to the economy

The centralized data reflecting the ranks kept by Bulgaria and Romania based on the level

of each indicator in absolute value characterizing tourism contribution to the development of the economy are presented in Table 7.

The ranks reflect a better position of Romania compared to Bulgaria in the hierarchy of tourism economic competitiveness for almost all indicators except the contribution of visitor export to total exports.

Also, if we compare the contribution of Bulgaria and Romania in the economy with the EU-28 average and even with the world average for each indicator, we could easily notice that in the two analyzed countries tourism is far away of being a branch with a high contribution to the economic growth (Table 7).

Table 7. Rankings of Bulgaria and Romania based on tourism contribution in absolute value to the economy in 2017

	World average	EU average	Bulgaria		Romania	
			Rank	USD Billion	Rank	USD Billion
Direct contribution to GDP	21.5	23.8	85	1.8	66	3
Total contribution to GDP	62.9	63.8	75	6.6	59	11.2
Direct contribution to employment	937.5	424.6	98	0.09	60	0.20
Total contribution to employment	2,341	975.2	83	0.33	63	0.52
Contribution to investments	4.8	6.3	71	0.8	38	3.8
Contribution of visitor exports to total exports	8.1	16.2	58	4.5	70	2.9

Source: [57, 58].

The centralized data reflecting the ranks kept by Bulgaria and Romania based on the level of each indicator in relative value characterizing tourism contribution to the development of the economy are presented in Table 8.

From this point of view, Bulgaria is placed on a higher position than Romania in almost all the cases, except the relative contribution of tourism to the capital invested in the economy. However, Bulgaria has a low competitiveness in the international tourist market [2].

Taking into account the average relative contribution in the EU-28, we may observe that Bulgaria exceeds this level only in case of total contribution to GDP, contribution to investments and visitor exports to total exports. But, Bulgaria also exceeds the world average relative level for total contribution to employment.

In case of Romania, it is easily to notice that only in case of investments contribution to the investments in the economy, the share is higher than the EU-28 average and the world average (Tabel 8).

Table 8. Rankings of Bulgaria and Romania based on tourism contribution in relative value to the economy in 2017

	World average	EU average	Bulgaria		Romania	
			Rank	%	Rank	%
Direct contribution to GDP	3.2	3.9	109	3.1	174	1.4
Total contribution to GDP	10.4	10.3	72	11.5	159	5.3
Direct contribution to employment	3.8	5.1	114	2.9	128	2.5
Total contribution to employment	9.9	11.7	77	10.7	133	6.3
Contribution to investments	4.5	5.1	72	7.4	63	8.1
Contribution of visitor exports to total exports	6.5	5.8	81	11.9	154	3.3

Source: [57, 58].

## CONCLUSIONS

The main aspects which deserve to be pointed out from this comparatively research are the following ones:

-Both Bulgaria and Romania are important tourism destinations on the map of Europe

grace to their rich cultural and historical heritage, beautiful sceneries, various forms of tourism, hospitality, service quality and attractive prices.

-However, Bulgaria receives more visitors than Romania and un doubt, it has higher receipts from tourism compared to Romania.

But, the receipts per arrival is higher in Romania than in Bulgaria.

-Tourism has an almost double contribution to Romania's GDP in absolute value compared to Bulgaria. But, in relative values, in Bulgaria this contribution is higher (11.5%) than in Romania (5.3 %).

-The contribution of tourism to employment is 3.7 times higher in Romania than in Bulgaria in terms of the number of employees and 3.3 times higher as share in total employment.

-The multiplier effect of tourism in the economy is almost similar in the both countries, being higher than 3, and reflecting that the activities run in tourism are close related to other economic sectors whose development is stimulated by tourism.

-Tourism efficiency in terms of labor productivity is over one in the both countries, reflecting that tourism contributes to the increase of productivity in the economy, but the level of this indicator is 1.4 times in Bulgaria than in Romania.

-Bulgaria has higher visitor exports than Romania, and as a consequence, the contribution to the payment balance is higher in Bulgaria.

-Investments in tourism are 4.5 higher in Romania than in Bulgaria at present. The low level of investments in Bulgaria is justified by the high investments made in the previous years when the accommodation capacity exceeded the demand.

-Tourism competitiveness is low in the both countries, but Bulgaria comes on a lower position than Romania in the international market.

All these aspects, reflect the actual status, but also the orientations to which each country should focus its efforts to enhance tourism development, its contribution to the economic growth and to become more competitive.

The both countries have not valorized their whole tourism potential. For this reason they have to better evaluate all the resources, to diversify their products and markets, to improve service quality and increase tourism performance to attract more visitors and increase the role of tourism in the economic development and improve the image of each country in Europe and in the world.

## REFERENCES

- [1]Aleksandrov, K., Kilimperov, K., 2018, The role of destination management organizations (DMOs) for sustainable rural tourism in Bulgaria, *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development* Vol. 18(2):11-160.
- [2]Boycheva, C., 2017, Innovation and Competitiveness in the Context of the Bulgarian Tourism Industry, *Economic Alternatives*, Issue 1, 137-148.
- [3]Bulgaria Contribution of Travel and Tourism to GDP in current prices, *World Data Atlas*, <https://knoema.com/atlas/Bulgaria/topics/Tourism/Travel-and-Tourism-Total-Contribution-to-GDP/Contribution-of-travel-and-tourism-to-GDP>, Accessed on Feb. 5, 2019
- [4]Bulgaria Contribution of Travel and Tourism to GDP as a share of GDP, <https://knoema.com/atlas/Bulgaria/topics/Tourism/Travel-and-Tourism-Total-Contribution-to-GDP/Contribution-of-travel-and-tourism-to-GDP-percent-of-GDP>, Accessed on Feb. 5, 2019
- [5]Bulgaria cultural map, <http://www.goldensands.bg/cultural/index-fi.html>, Accessed on Feb 5th, 2019.
- [6]Bulin, D., Miru, N., Gheorghe, G., 2014, The impact of tourism industry in the economy. The case of Black Sea region countries, *Knowledge Horizons - Economics*, Vol.6(2): 74–79.
- [7]Ilieva, E., 2018, Timeshare integration in rural tourism, *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development*, Vol.18(4):151-156.
- [8]Kilimperov, I., 2016, Week-end tourism in rural zones-the new tourist reality, *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development*, Vol.16(3):153-159.
- [9]Kilimperov, I., 2017, Promotion of rural and agricultural tourism in Bulgaria, *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development* Vol. 17(4):173-178.
- [10]Jackson, J. M., 2005, Innovations in Measuring Economic Impacts of Regional Festivals: A Do-It-Yourself Kit, *Journal of Travel Research*, 360-367.
- [11]Lulcheva, I., Aleksandrov, K., 2017, Research on the supply and consumer demand for rural tourism in Eastern Rhodopes, *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development*, Vol.17(4):179-185.
- [12]Lulcheva, I., Arseniou, S., 2018, Synergy-rural tourism and sustainable development of rural areas in Bulgaria, *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development* Vol. 18(3):243-250.
- [13]Moraru, C., 2012, Tourism Contribution to the Economic Growth of Romania; a Regional Comparative Analysis, *Romanian Statistical Review-Supplement*, Quarter II/2012, 161-168.

- [14]Nicolescu, L., 2008, Imaginea României sub lupă! Branding și rebranding de țară. (Romania's image under a magnifying glass. Country branding and rebranding).Bucharest, Romania, ASE Publishing House.
- [15]Oroian, M, Gheres, M., 2013, Economia si managementul turismului Tourism economy and management, Casa Cartii de Stiinta Publishing House.
- [16]Plesoianu, D.M, Eftei, I., 2016, Mangalia spas potential, a potential tourism resource of the Romanian Seaside, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol.16(3):349-356
- [17]Plesoianu, D.M., Sandu, C., Popescu, A., 2017, Aspects of cultural tourism in Brasov County with a special look at the period 2015-2016, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol.17(3):287-293,
- [18]Plesoianu, D.M, Grecu, E., Popescu, A., 2018, The heritage of traditions and tourism facilities in Transilvania, Romania, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol.18(1):325-336.
- [19]Plesoianu, D.M, Caraus, D., Popescu, A., 2018, Valorisation of the tourism and traditions potential of Bucovina, Romania, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol.18(1):349-356
- [20]Pop, R.E., 2018, Tourism impact activity over the labour market in the Romanian Danube Region counties, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol.18(3):325-330.
- [21]Popescu, A., 2013, Considerations on the main trends in the tourists, receipts and expenditures flows in the EU-27 Tourism, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol.13 (1):283-292.
- [22]Popescu, A., 2014a, Turism international, EIKON and Ed.RawexComs Publishing Houses, Cluj-Napoca, Bucuresti, 22-25.
- [23]Popescu, A, 2014b, Considerations on the trends of international tourist flows, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol.14(4):179-192
- [24]Popescu, A., 2014c, Considerations on the trends of international tourism receipts, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol.14(4):201-210.
- [25]Popescu, A., 2015, Considerations on the development of Medical Tourism at world level and in Romania, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol.15(3):241-252.
- [26]Popescu, A., 2016a, Research on the concentration of tourist arrivals in Romania, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol.16(1):425-430.
- [27]Popescu, A., 2016b, The correlation between international tourist arrivals and tourism receipts - a key factor of tourism efficiency, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol.16(4):299-306.
- [28]Popescu, A., 2016c, The position of tourist and agrotourist guesthouses in Romania's accommodation structures, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol.16(1):417-424.
- [29]Popescu, A., 2016d, Research on the dynamics and territorial dispersion of the occupied population in Romania's tourism in the period 2007-2015, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development Vol. 16(4):279-288.
- [30]Popescu, A., 2016e, Research on the economic efficiency in Romania's tourism, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol.16(1):411-416.
- [31]Popescu, A., 2017, Trends in tourism demand in the top visited European countries, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol.17(4):243-254.
- [32]Popescu, A., Plesoianu, D., 2017a, An Econometric Analysis between Tourism Income and Romania's GDP, Proceedings of the 30th IBIMA International Conference, pp.469-485, Madrid, November 8-9, 2017.
- [33]Popescu, A., Plesoianu, D., 2017b, Analysis of accommodation demand/offer in Romania's tourism, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol.17(3):339-346.
- [34]Popescu, A., Plesoianu, D., 2017c, Trends of tourist arrivals and overnight stays in the Maramures County, Romania, 2007-2016 and forecast for 2017-2021, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol.17(4):281-292.
- [35]Popescu, A., 2018a, Analysis of Tourism Trends in the New EU Member States, Proceedings of the 32nd IBIMA International Conference, Seville, Spain, Nov.15-16, 2018.
- [36]Popescu, A., 2018b, A statistical overview on the agro-tourist guesthouses versus tourist guesthouses of the Sibiu County, Romania, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol.18(2):347-358.
- [37]Popescu, A., 2018c, Analysis of Agro-tourism Concentration in Romania, Proceedings of the 32nd IBIMA International Conference, Sevilla Spain, Nov. 15-16, 2018.
- [38]Popescu, A., 2018d, Tourist arrivals concentration-A case study in Romania's Central area, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol.18(3):331-338.

- [39]Popescu, A., 2019, Tourism and Travel Competitiveness in the European Union new member states, Proceedings of the 33rd IBIMA International Conference, Granada, April 10-11, 2019.
- [40]Postelnicu, C., Dabija, D.C., 2018, Romanian Tourism: Past, Present and Future in the Context of Globalization, Ecoforum 14(1):84-89.
- [41]Romania Contribution of Travel and Tourism to GDP in current prices, World Data Atlas, <https://knoema.com/atlas/Romania/topics/Tourism/Travel-and-Tourism-Total-Contribution-to-GDP/Contribution-of-travel-and-tourism-to-GDP>, Accessed on Feb. 5, 2019.
- [42]Romania Contribution of Travel and Tourism to GDP as a share of GDP, <https://knoema.com/atlas/Romania/topics/Tourism/Travel-and-Tourism-Total-Contribution-to-GDP/Contribution-of-travel-and-tourism-to-GDP-percent-of-GDP>, Accessed on Feb. 5, 2019.
- [43]Romanian monasteries, <http://www.romanianmonasteries.org/romania>, Accessed on Feb.5th, 2019.
- [44]Saracin, V-C., Țirca, I. E. C., Constantin, L., 2017, An explanatory research on rural areas according to NUTS classification, in two neighboring countries: Romania and Bulgaria, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol.17(2):301-307.
- [45]Slavov, S., Impacts of tourism on the local community, Scientific Review of Physical Culture, Vol.5 (3):57-62, <http://62.93.45.40/srpc/Articles/Volume-5/Issue-3/6.aspx>, Accessed on Feb. 5th, 2019.
- [46]Snak, O., Baron, P., Neacsu, N., 2003, Economia turismului (Tourism economy), Export Publishing House, Bucharest, pp.72-74.
- [47]Stynes, D., 1999, Economic Impacts of Tourism, <https://msu.edu/course/prr/840/econimpact/pdf/ecimpv011.pdf>, Accessed on Feb.5th, 2019.
- [48]Stoilova, D., 2013, Tourism industry and economic development in Bulgaria, Romanian Economic Business Review, Vol.8(4.1.), 60-68.
- [49]Surugiu, C., 2009, The Economic Impact of Tourism. An Input-Output Analysis, [https://www.researchgate.net/publication/46557029\\_The\\_Economic\\_Impact\\_of\\_Tourism\\_An\\_Input-Output\\_Analysis](https://www.researchgate.net/publication/46557029_The_Economic_Impact_of_Tourism_An_Input-Output_Analysis), Accessed on Feb.5, 2019.
- [50]Tapescu, A.I.M., 2015, Romanian versus Bulgarian Tourism Labour Market Analysis, Procedia Economics and Finance 27:375 – 384.
- [51]Things to Do in Bulgaria, 2019, <https://www.tripadvisor.com/Attractions-g294451-Activities-Bulgaria.html>, Accessed on Feb.5th, 2019.
- [52]Top rated tourist attractions in Romania, 2017, <https://romaniatourstore.com/blog/top-rated-tourist-attractions-romania/>, Accessed on Feb.5th, 2019.
- [53]Tourism Satellite Account: Recommended Methodological Framework, 2008, [https://unstats.un.org/unsd/publication/seriesf/seriesf\\_8Orev1e.pdf](https://unstats.un.org/unsd/publication/seriesf/seriesf_8Orev1e.pdf), Accessed on Jan. 5th, 2019.
- [54]UNWTO Travel and Tourism economic impact. World, 2018. <https://www.wttc.org/-/media/files/reports/economic-impact-research/regions-2018/world2018.pdf>, Accessed on Feb. 5th, 2019.
- [55]UNWTO Tourism Highlights 2010-2018,
- [56]UNWTO Tourism and Travel economic impact World 2018,
- [57]UNWTO Tourism and Travel economic impact Bulgaria 2018,
- [58]UNWTO Tourism and Travel economic impact Romania 2018.
- [59]Zurub, H.H., Ionescu, A., Constantin, V.D., 2015, Measuring the Economic Impact of Tourism in European Emerging Markets, Procedia Economics and Finance 32 ( 2015 ): 95 – 102.

## DISCREPANCIES BETWEEN THE DEMAND AND OFFER ON THE SEASIDE TOURISM OF ROMANIA

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### Abstract

*The paper aimed to analyze the demand/offer ratio in the seaside tourism of Romania in the period 2007-2017 based on the official data provided by the National Institute of Statistics. The main indicators taken into account have been: number of units with function for tourist accommodation, number of places (beds), number of beds-days, number of tourist arrivals and overnight stays. The index method, structure index, correlation coefficient and regression analysis allowed to analyze the dynamics of these indicators and the relationships existing among them. The results pointed out an increase by 31.8 % of the arrivals, by 6.4 % of the overnight stays, but also a decrease by 16.7 % of the accommodation units and by 31.7 % of the number of beds. This unbalanced demand/offer ratio was confirmed by the weak correlation and regression analysis as well. The seaside tourism represents 9.8 % in the total accommodation tourism structures, 23.4% in the total number of places and 10.5 % in the total beds-days in Romania's tourism. About 77.7 % of tourism accommodation units and number of beds is represented by hotels, bungalows and tourist villas in Romania's tourism. For balancing the demand/offer ratio in the seaside area, the tourism strategy should be focused on investments in new accommodation units, creating jobs, increasing labour productivity, service quality, the comfort degree, diversifying the leisure and entertainment activities, managing the beaches, means of conveyance, parking places and access roads, and green spaces. In this way, the development of the tourism infrastructure and service quality could become important factors for increasing tourist arrivals and receipts on the Romanian seaside.*

**Key words:** seaside tourism, demand, offer, discrepancies, Romania

### INTRODUCTION

Tourism is an important activity for any country which could generate a competitive advantage by valorizing its natural and anthropic resources in proper landmarks and products. Tourism has a deep economic, cultural, social and environment impact as proved by the changes which have appeared during the last decades due to the "boom" of the international tourism [16].

Romania is recognized as a country with a high tourism potential grace to its natural resources such as the large variety of marvelous landscapes generated by the divers relief (mountains, hills, plateaus, plains, valleys arranged like an amphitheater), a favorable continental temperate climate with Mediterranean influences, a huge flora and fauna diversity, a hydrographic network, a

large variety of cure and treatment natural factors (thermal and mineralized waters, sludge etc) and to its anthropic resources represented by historical monuments, medieval castles and fortresses, religious architecture, archeological sites, museums, art galleries, memorial houses, villages with their folklore traditions and customs and people of high hospitality etc.

Tourism could be practiced in various forms such as: seaside tourism, mountain tourism, cultural tourism, spa and health tourism, religious and pilgrimage tourism, fishing and hunting tourism, rural tourism, business tourism, shopping tourism, tourism for taking part to various cultural, scientific and sport events etc [10].

Among the most attractive geographical items there are the Carpathians Mountains, the Danube river ending into the Danube Delta

and the charming seaside full of sunny beaches and warm waters of the Black Sea in the summer season [9].

The beginning of tourism on the Romanian seaside dates back in the 19th century, under the reign of his Royal Highness King Carl I, who sustained the development of seaside resorts as "urban improvisations, quasi-oriental flavor" with "natural mud, sunbathing, and hot bath treatments" and as affirmed himself had an "infrastructure which needs to be improved, and hotels and villas which must meet a better hygiene and comfort" [2].

The climate is favorable for tourism on the Romanian Black Sea Coast in the warm season, especially in the months are July, August and June, and in a less measure in May and September, when the sun brighten over 2,500 hours a year, an average identical to the one on the beaches of Croatia or other Mediterranean countries [8].

The seaside is situated in the top of tourism forms as in summer season a huge flow of tourist invade this part of Romania for enjoying laying in the sun, swimming, relaxation, leisure and entertainment to recover their forces during the holiday. However, since 2007, a new trend has appeared to spend vacations or week-ends on the seaside when the weather is fine even in May and September. Therefore, Romanians and even foreign tourists are aligned to the general trend in the world tourism to shorten the duration of stay but to make more travels a year [10, 11, 12].

Being situated in the Constanta County, the increased number of tourist arrivals had a positive impact on the development of the area. The growth and diversification of the tourism activities have created jobs and supported employment, incomes per family and the living standard of the local population raised, the turnover of the business men in the field of tourism and not only increased, stimulating investments and the modernization of buildings and infrastructure [15].

The increased number of tourist arrivals in the summer season and in week-ends has led to a sort of discomfort due to the crowded hotels,

beaches and restaurants in the top months on the seaside. For this reason, the question which arises is: "Is the tourism offer in the resorts of the Romanian seaside in terms of accommodation capacity able to cover the high tourist demand in terms of arrivals and overnight stays in summer season?"

In this context, the objectives of this study were:

- (i) to analyze the dynamics of the tourism offer in terms of accommodation units, places (beds), beds-days on the Romanian seaside;
- (ii) to analyze the dynamics of the tourism demand in terms of tourist arrivals and overnight stays on the Romanian seaside;
- (iii) to identify the connections existing between these indicators in order to evaluate if between tourism offer and demand it is a balanced relationship;
- (iv) to draw the right conclusions for tourism strategy for the development of tourism on the Romanian seaside in the future.

## MATERIALS AND METHODS

### Area of the study

Romania's Black Sea shore is 245 km length, lasting between the border with Ukraine in the North part and the frontier with Bulgaria in the South one. Of its total length, 163 km are occupied by the Danube Delta and the coastal lakes, and the remaining of 82 km, lasting between Midia Cape-Navodari and Vama Veche are represented by a beautiful chain of 16 resorts [19].

First of all it is about *Navodari*, the resort situated in the North part of the Romanian seaside, in a quiet place good for relaxation, with the longest beach (12-15 km) and also a large one (100-200 m), with fine sand and a wonderful sea water with a small depth (1-2 m) for a long distance entering the sea.

*Mamaia*, the pearl of the Romanian seaside has 8 km length of beach of over 250 m width, a fine sand, the most numerous hotels, villas etc, a large variety of entertainment places (clubs, disco, Aqua Magic Park, telegondola, "Ovidiu" Island, water fountains, double decked buses for tourists, Mamaia Holiday Village etc).

*Eforie Nord* is the spa and health resort, and also the children's resort.

*Eforie Sud* is characterized by the highest boardwalk, and Splendid Beach, one of the most beautiful beaches on the Romanian seaside

*Costinesti* is the youth resort full of opportunities for entertainment (concerts, clubs, disco) and terraces, and its important tourist objectives are the Shipwreck and the Obelisk.

*Olimp, Neptun, Jupiter, Venus, Saturn, Cap Aurora, and Jupiter* are important resorts at present under a continuous but slow modernization by investments in the competition to attract more tourists.

*Mangalia* has a narrow but pleasant beach and possibilities for treatment being considered another spa and health resort. Its tourist attractions are: the Byzantine edifice, Mangalia Stud farm which offer horse riding lessons, Esmahan Sultan Mosque, Callatis Museum of History and Archeology, the Marine Museum, the Mangalia Tourist Harbor.

*Vama Veche- 2 Mai* is a village-resort which offer quiet, discrete, nonconformist, isolated holidays in a "hippie" atmosphere with accommodation in rustic houses or even on the beach.

To all these resorts we have to add *Constanta Municipality* which also has a few beaches: the Modern Beach, The Three Slippers Beach and the North Boardwalk Beach and important tourist attractions such as: Aquarium, Dolphinarium, the Boardwalk and the Casino, the Roman edifice and mosaic, the Genoese Lighthouse, important Orthodox, Catholic, Greek, Turkish religious edifices, Gravity Park, Constanta Natural Micro-reservation, the Art Museum, the Museum of National History and Archeology Constanta, the "Ion Jalea" Sculpture Museum, the Romanian Marine Museum in Constanta, Tomis Tourist Harbor Constanta, Ovidiu's Statue, Mihai Eminescu's Statue, "Fantasio" Theater etc.

In the Constanta County, there are other important tourist attractions such as: "Histria" Citadel with its archeological site, "Tropaeum

Traiani" Museal Complex in Admaclisi [5, 6, 7, 12, 18].

The beaches of the Romanian seaside have in general 100-200 m width and a fine sand, the sea water is pleasant about 24<sup>0</sup> degrees in summer season, the salinity is low about 7-12 ‰, the tide is about 12 cm, the slope in the sea water is smooth and the sea currents are weak. The mild temperate continental climate and the sea breeze rich in aerosols offer wonderful conditions for laying in the sun, swimming and practicing nautical sports [3].

Besides all these, the Romanian seaside offers a large range of facilities. First of all a large variety of accommodation units like: hotels but also tourist villas, hostels, camping and bungalows, tourists guest houses and even accommodation to private houses of the local owners.

Also, on the seaside there are a lot of opportunities for leisure and entertainment, for spa and treatments based on mineralized waters and sludge, for eating in restaurants and terraces many of them being situated right on the beach, where tourists could enjoy tasting various meals from the traditional Romanian gastronomy and from the international one, for making sports (nautical sports, tennis, gulf, football, volleyball) [1].



Photo 1. The map of the Romanian Seaside including the main resorts.

Source:<http://forum.romeonet.ro/viewtopic.php?f=34&t=1159>, Accessed Feb.20th, 2019.

Seaside and spa tourism are among the most important forms of tourism which attract more and more tourist mainly in the summer months: June, July and August, and sometimes in extra season. This part of Romania is preferred by the visitors who love the sea and the seaside resorts offer a large range of opportunities and facilities to meet all the preferences and budgets.

#### Data collection

The data were collected from "Romanian Tourism Statistical Abstract, 2007-2018. These data are officially provided by the National Institute of Statistics for the resorts situated in the seaside area, excluding Constanta Municipality"[9].

The main indicators used in this study were the following ones:

(a) Indicators reflecting tourism offer regarding the accommodation capacity on the Romanian seaside: number of establishments with function for tourists' accommodation, the structure of these establishments, number of places (beds) in these accommodation units, number of beds-days reflecting the accommodation capacity in use;

(b) Indicators reflecting tourism demand on the Romanian seaside: tourist arrivals, total, Romanians and foreigners, tourist nights spent in establishments with function for tourist accommodation.

The applied methodology consisted of:

*Index method* used to analyze the evolution of each indicator during the period 2007-2017, and mainly to see in what measure in 2017 it was registered an increase or decrease of the indicators level. In this purpose, it was used the mathematical expression:  $I_{FB} = (X_i / X_0)100$ , where  $X_i$  = the analyzed variable with its values in the years  $i = 1, 2, \dots, 11$ .

*The structural index*,  $S\%$ , whose formula is:  $S\% = (X_i / X)100$ , where  $X_i$  = the value of  $i$  component of the indicator  $X$ .

*The Bravais - Pearson correlation coefficient* was used to identify the links existing between various pairs of indicators as follows: between tourist arrivals and accommodation units, tourist arrivals and number of places, between overnight stays and number of places. In this purpose it was utilized the mathematical well-known expression:

$$r_{xy} = \frac{n \sum xy - \sum x \sum y}{\sqrt{(n \sum x^2 - (\sum x)^2)(n \sum y^2 - (\sum y)^2)}}$$

For testing the significance of correlation coefficient it was applied "T" Test for  $\alpha = 0.05$  and degrees of freedom,  $df = n - 2 = 9$ . The formula of calculation was:

$$t = r \frac{\sqrt{n-2}}{\sqrt{1-(r)^2}}$$

*Regression analysis*, involving the equation  $Y = bX + a$  was utilized to check if there is any relationship between the pairs of indicators mentioned above.

The coefficient *R square* was determined to show how much of the variation of the independent variable influences the variation of the dependent variable.

The Excel facilities were used to make all the graphically illustrations and calculations.

## RESULTS AND DISCUSSIONS

### Tourism offer regarding the accommodation capacity

The number of establishments with function for tourist accommodation registered a general decreasing trend from 932 units in the year 2007 to 776 units in 2017, meaning -16.74%. However, in the period 2007-2011, it was noticed an ascending trend from 932 to 946 units in 2010 (+1.5%), but then in 2011, the number of accommodation units decreased to 625 (-33% compared to the 2007 level)(Fig.1.).

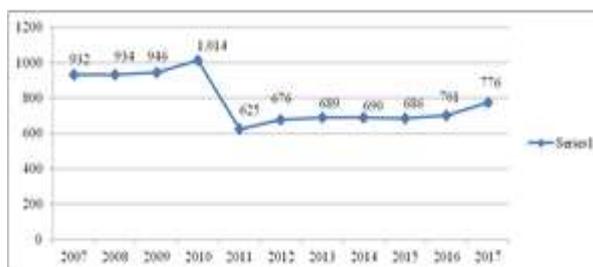


Fig.1. The dynamics of tourist accommodation units on Romania's seaside, 2007-2017.

Source: Own design based on the data from [9].

This was happened because the degree of degradation of the old buildings was enough high and they did not correspond to the

accommodation comfort standards and for this reason a part of them were closed.

The decline of the number of accommodation units in the seaside area is due to the fact that most of

investments were focused mainly to modernize the old accommodation structures and much less to built new constructions. More than this, the public investments in the seaside area represented just 4.3 % in total tourism investments [4].

But, since the year 2012, the accommodation units increased their number which reached the level of 776 units in 2017.

**The number of places (beds)** registered a reduction as a consequence of the dissolution of an important number of establishments. From 117,864 places in 2007, their number declined by -0.9 % in 2008 reaching 116,849 beds. Then, the number of beds increased so that in 2010 it accounted for 121,003, the highest level in the period 2007-2017. But, in 2011, the reduction of the number of accommodation units determined a decline in the number of places as well. In 2011, they accounted for 80,690 places, and then, their number increased till the year 2014, when they reached 83,625, meaning by 3.6 % more than in 2011. After 2014, the number of beds started to decrease again so that in 2017 there were 80,618 places, meaning by 0.1 % less than in 2011 and by -31.7 % less than in 2007(Fig.2).

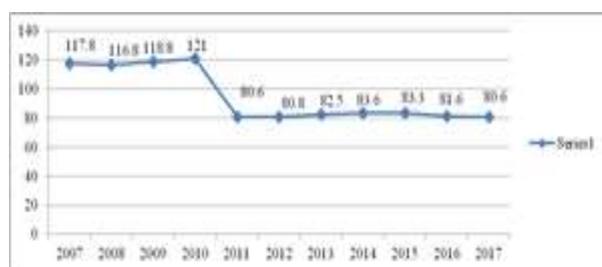


Fig.2.The dynamics of places in tourist accommodation units on Romania's seaside, 2007-2017 (Thousand)

Source: Own design based on the data from [9].

However, "in 2018, the chain of beautiful seaside resorts including Mamaia, Eforie Nord, Eforie Sud, Olimp, Neptun, Venus, Saturn, Cap Aurora, Costinesti, Mangalia, 2 Mai, and together with the Municipality of Constanta had a capacity of 56,595 units

providing over 121,280 places for tourists' accommodation and a large variety of offers to spend their holidays. About 64,987 places are in hotels (53.5%), and the remaining of 56,293 (46.5%) are in tourist villas, camping and hostels"[17]. Hotels are the main accommodation form preferred by tourists. "About 35 % of accommodation places in the hotels of three, four and five stars, and about 60 % places in the hotels of 1-2 stars were sold by tourism agencies and the remaining by other reservation systems" [17].

**The number of beds-days reflecting the accommodation capacity in use** varied between 8,872,433 in 2007 and 9,221,634 in 2017, when it was by 3.9 % higher than in the first year of the analyzed interval. The highest number of beds-days was registered was 10,284,146 in the year 2011, and the lowest level accounted for 8,571,021 in 2009. Analyzing the figures in the graphic below, one may notice a variation upward and downward almost from a year to another (Fig.3.).

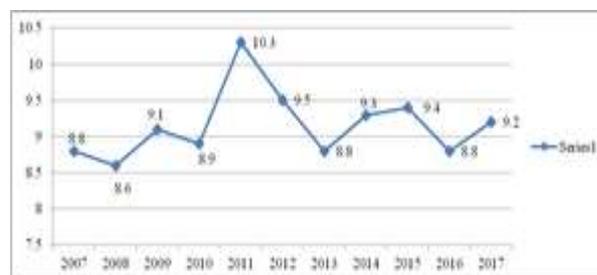


Fig.3.The dynamics of beds-days in tourist accommodation units on Romania's seaside, 2007-2017 (Million)

Source: Own design based on the data from [9].

**The weight of Romania's seaside tourism capacity in the total number of accommodation units, places and beds-days in the national tourism**

Based on the dynamics of the tourism offer on Romania's seaside and the situation of tourism offer at the country level, the contribution of the seaside tourism to the national tourism was the following one:

- On the seaside, the tourist accommodation units represented 9.8 % in 2017 compared to 19.8 % in 2007 in Romania's tourism accommodation units.

-On the seaside, the weight of the number of places for tourists decreased from 41.5% in 2007 to 23.4% in 2017 in the number of beds existing in the national tourism.

-In 2017, the weight of the number of beds-days on the seaside tourism in the number of beds-days in the national tourism decreased from 17.3% in 2007 to 10.5% in 2017 (Fig.3).

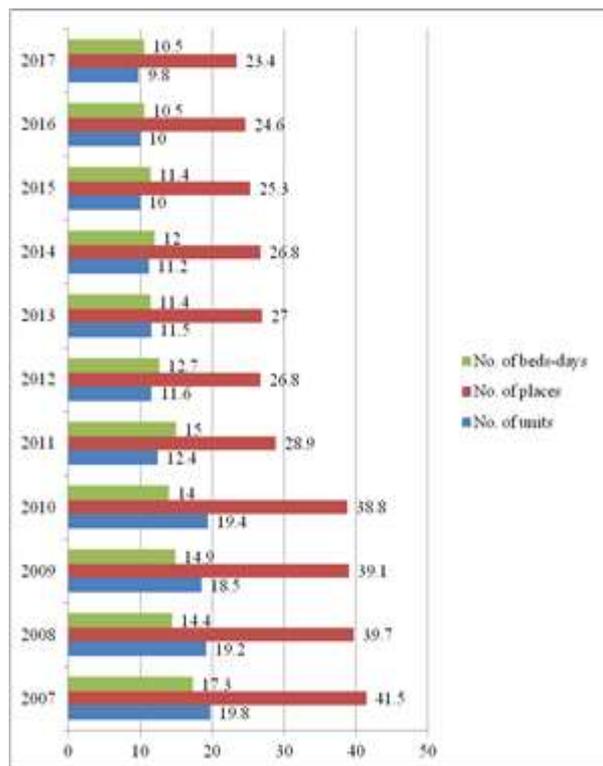


Fig.4.The dynamics of the share of seaside tourism offer in terms of accommodation units, places and beds-days in the national tourism offer, Romania, 2007-2017 (%)

Source: Own design and calculation.

**The structure of the accommodation capacity on the Romanian seaside tourism by category of unit**

Hotels represent the main form of accommodation establishments, being followed by bungalows, tourist villas and hostels. The structure of the accommodation units in 2007 was the following one: 302 hotels (32.4%), 296 tourist villas (31.7%), 206 bungalows (22%), 33 agro-tourism guest houses (3.5%), 30 tourist guest houses (3.2%), 27 tourist small houses (2.8%), 18 camping (1.9%), 13 scholars camps (1.4%), 6 hostels (0.6%), 1 motel (0.1%).

In 2017, the structure of accommodation units was as follows: the number of hotels declined to 287 (36.9%), the number of bungalows increased to 235 (30.2%), the number of tourist villas decreased to 160 (20.6%), the number of hostels increased to 52 (6.7%), the number of tourist pensions declined to 14 (1.8%), the number of camping declined to 10 (1.2%), the number of agro-tourist pensions decreased to 5 (0.6%), the camps for scholars declined to 3 (0.4%), and the motel remain 1 (0.1%).

Therefore, if in 2007, the highest share in the accommodation units' structure was kept by hotels, tourist villas and bungalows, in 2017, the decreasing order was: hotels, bungalows and tourist villas. The other forms of accommodation units had a lower weight during the analyzed period.

**The structure of the accommodation capacity in term of the number of places on the Romanian seaside tourism by category of establishment with function for tourist accommodation**

Compared to 2007 in 2017, the number of places declined in case of hotels by -16%, in bungalows by -54%, in camping by -77%, in camps for scholars by -88%, in tourist guest houses by -54%, in agro-tourist pensions by -76.5%, but the number of places increased in case of motels 6.9 times and hostels 13 times.

The distribution of the number of places by type of accommodation unit in 2007 was the following one: hotels 65%, camping 16%, camps for scholars 7%, tourist villas 5.5%, bungalows 3.2%, tourist small houses 2.5%, tourist pensions 0.7%, agro-tourist guest houses 0.6%, hostels 0.2%, and motels 0.03%.

In 2017, the highest share of the number of places by establishment category, in the decreasing order, was the following one: hotels 78.8%, tourist villas 5.6%, camping 5.4%, hostels 4.7%, bungalows 2.1% and the lowest share was registered by agro-tourist pensions 0.2%.(Table 1).

The share of the number of units by category and the weight of places by category of establishments with function for tourist accommodation is presented in Table 2.

Table 1. The evolution of the accommodation structure by establishment type in the Romanian seaside tourism in 2017 versus 2007

	Number of units			Number of places		
	2007	2017	2017/2007 %	2007	2017	2017/2007 %
Total	932	776	83.2	117,864	80,618	68.3
Hotels	302	287	95.0	75,488	63,535	84.1
Motels	1	1	100.0	42	291	692.8
Hostels	6	52	866.6	288	3,801	1,319.7
Tourist villas	296	160	54.0	6,561	4,534	69.1
Bungalows	206	235	114.1	3,804	1,763	46.3
Camping	18	10	55.5	18,894	4,366	23.1
Camps for scholars	13	3	23.0	8,200	1,012	12.3
Halting places	-	2	-	-	194	-
Tourist guest houses	30	14	46.6	810	372	45.9
Agro-tourist guest houses	33	5	15.1	781	184	23.5
Tourist small houses	27	-	-	2,996	506	16.8

Source: Own calculation based on the data from [9].

Table 2. The accommodation capacity structure in the Romanian seaside tourism in 2017 compared to 2007 (%)

	Number of units		Number of places	
	2007	2017	2007	2017
Hotels	32.4	36.9	64.0	78.8
Motels	0.1	0.1	0.03	0.4
Hostels	0.6	6.7	0.2	4.7
Tourist villas	31.7	20.6	5.6	5.6
Bungalows	22.0	30.2	3.2	2.2
Camping	1.9	1.2	16.0	5.4
Camps for scholars	1.4	0.4	6.9	1.2
Tourist guest houses	3.2	0.2	0.6	0.2
Agro-tourist guest houses	3.5	1.8	0.6	0.5
Tourist small houses	2.8	0.6	2.5	0.6
Halting places	-	0.2	-	0.2

Source: Own calculations.

**Tourism demand regarding the accommodation capacity on the seaside**

*The number of tourist arrivals* on the Romanian seaside increased in the analyzed period. In 2017, this growth accounted for 31.8 % in case of the total arrivals, and for 37.7% in case of arrivals of the Romanian tourists. In case of the foreign tourists' arrivals it was recorded a huge decline, - 42.2 %.

In 2017, the Romania seaside received 1,049,970 tourist arrivals, of which

Romanians 1,016,287 meaning 96.7 % and only 33,683 arrivals of foreigners representing 3.3 %.(Fig.5).

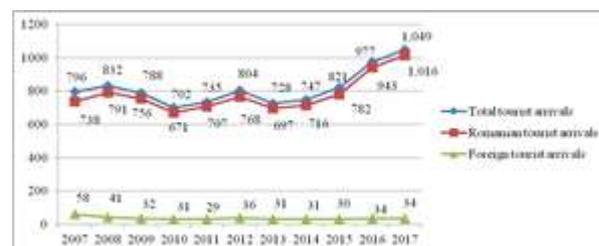


Fig.5.The dynamics of the number of tourist arrivals on the Romanian seaside, 2007-2017 ( Thousands). Source: Own design based on the data from [9].

The tourist arrivals fluctuated in the analyzed interval. The figures from Graphic 5 reflect that in 2009 and 2010 the number of tourists declined as an effect of the economic crises which increased unemployment, inflation, decreased income per households and demand for tourist services on the seashore and not only. In 2010, it was recorded the lowest number of arrivals, accounting for 702,566 tourists accommodated on the Romanian seaside. Then, the number of arrivals increased reaching 894,198 in the year 2012, but in the next year it was registered another decline to 728,798 arrivals. Since 2014 tourist arrivals recorded only a continuous increasing trend till 2017, when it reached 1,049,970 tourists.

Also, the figures from the Graphic 5 show that the number of Romanian tourists who spent their vacation on the Romanian seashore is dominant, and the evolution of this indicator was almost similar to the total number of arrivals.

Every year, the seaside season starts on May 1st when the first 28,000 tourists invade the hotels, mainly in Mamaia resort, where the net use of the accommodation capacity is 90 %.

The Romanian seaside is preferred first of all by Romanians. In 2018, the number of tourists was by 8.2 % higher than in 2017, due to the "Seaside for everyone" Programme and the early booking which led to a 50 % occupancy rate in the month of June. However, most of the tourists come to spend their holidays on the seaside mainly in July and August and even in September.

Despite of that, the low number of foreign tourist on the Romanian seashore and their decreasing trend in general, accounting for 33,683 tourists in 2017 by 46.2 % less than in 2007, reflect the weak promotion of the tourist offer on the seashore at the Black Sea, the weak service quality in relation to the high tariffs per night, as in the short period of the seaside season in Romania which usually lasts in June, July and August, the managers of tourist accommodation units and not only would like to recover their investments.

The foreign tourists spending their vacation on the Romanian seaside are from Germany, USA, Israel, France, Poland, United Kingdom, Italy, Belgium, Austria and Republic of Moldova [17].

**The share of tourists visiting the seashore of Romania in the total arrivals in Romania's tourism.** Of the total number of tourists visiting Romania and accommodated in tourist establishments, the share of the tourists spending their holidays on the Romanian seashore declined from 11.4 % in 2007 to 8.6 % in 2017. In 2017, the Romanians visiting the seashore represented 10.8 % compared to 13.6 % in 2007 in the total tourists in Romania. The weight of the foreigners spending their holidays on the Romanian seashore in Romania's visitors' number reached 1.2 % in 2017 in comparison with 3.7 % in 2007.

**The number of nights spent in the seaside accommodation units** went up by 6.4 % in the analyzed interval so that in 2017 they accounted for 4,316,379 versus 4,054,625 in 2007. The number of overnight stays belonging to the Romanian tourists increased by 12.8 % from 3,707,860 in 2007 to 4,183,458 in 2017. But, the nights spent by foreign tourists on the Romanian seaside declined by 61.67 % from 346,765 in 2007 to 132,921 in 2017 (Fig.6).

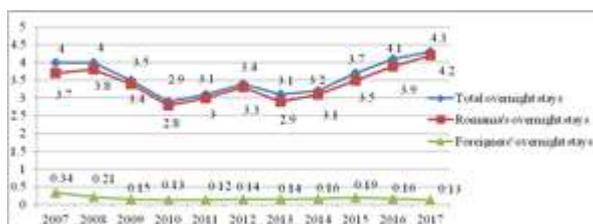


Fig.6. The dynamics of the number of the nights spent on the Romanian seaside, 2007-2017 (Million).

Source: Own design based on the data from [9].

The economic crisis determined an inflexion of the nights spent in their dynamics in the interval 2007-2017. And this happened due to the diminished income per family.

The decrease of foreigners' arrivals led to a reduction of their nights spent on the Romanian seashore.

**The weight of tourists' overnight stays on the seashore of Romania in the total nights spent by tourists in Romania**

The share of the number of overnight stays belonging to the tourists spending their holidays on the Romanian seaside in the total number of nights spent by tourists in Romania declined from 19.6 % in 2007 to 15.9 % in 2017.

Also, the share of the Romanians' nights spent on the seaside in the total overnight stays of the Romanians at the national level decreased from 21.8 % in 2007 to 19.2 % in 2017.

The highest decline was registered by foreign tourists' overnight stays on the seaside in the total number of nights spent by foreigners in Romania, as in 2017 they accounted for only 2.5 % compared to 9.6 % in 2007.

**The regression and correlation between the number of tourists and the number of accommodation units on Romania's seaside**

Between the number arrivals and the number of accommodation units on the seaside, it was found a weak relationship,  $r = 0.121$ . There is no significant connection between the number of tourist arrivals and the number of accommodation units as proved by the "T" Test for  $\alpha = 0.05$ . The two tailed T critical value = 2.262 for  $df = n - 2 = 9$  is higher than the calculated one. The  $T_{crit} > T_{calc} = 0.365$ .

Only 1.47 % of the variation in the tourists' arrivals is caused by the variation in the number of accommodation units as confirmed by the R square value ( $R^2 = 0.0147$ ).

An increase of the number of accommodation units determines a decline of -0.15 in the number of tourist arrivals as shown by b value in the regression equation  $y = -0.1583x + 917.29$  (Fig.7).

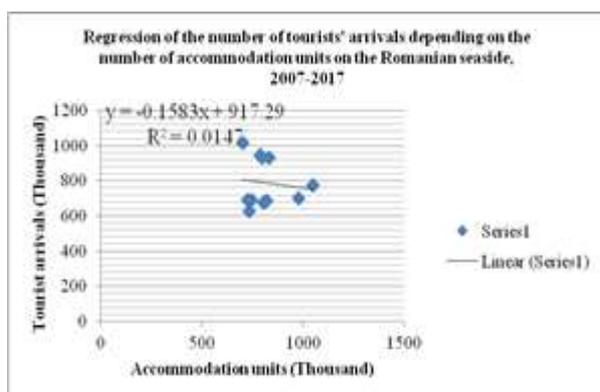


Fig.7. The regression of tourist arrivals in Romania's seaside depending on the number of accommodation establishments for tourists, 2007-2017.

Source: Own design.

### The regression and correlation between the number of tourist arrivals and the number of places in accommodation units for tourists

Between the number of tourist arrivals and the number of places in accommodation units on the Romanian seaside it is a weak and positive relationship as shown by the coefficient of correlation,  $r = 0.316$ . Applying the "T" Test for  $\alpha = 0.05$ , it was found the two tailed T critical value = 2.262 for  $df = n - 2 = 9$ . The critical value of T taken from tables,  $T_{crit} > T_{calc} = 0.999$ , reflecting that there is no significant relationship between the number of tourist arrivals and the number of places.

About 10 % of the variation in the tourists' arrivals is caused by the variation in tourism

capacity in terms of number of beds as  $R^2$  proved.

An increase of one place in accommodation units will determine a decline of 1.818 in the number of arrivals as shown by the regression equation  $y = -1.8189x + 0.9879$  (Fig.8).

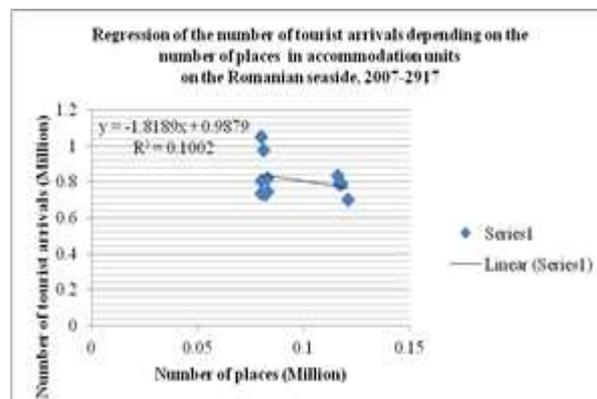


Fig.8. The regression of tourist arrivals in Romania's seaside accommodation structures depending on the number of places, 2007-2017.

Source: Own design.

### The regression and correlation between the number of overnight stays and the number of places in accommodation units for tourists

The coefficient of correlation,  $r = 0.0038$ , reflected a very weak, practically a non existing relationship between the number of overnight stays and the number of places in accommodation units for tourists on the seaside. For  $\alpha = 0.05$ , the two-tailed test proved that T critical value = 2.262 for  $df = n - 2 = 9$  is much higher than  $T_{calc} = 0.3162$ .

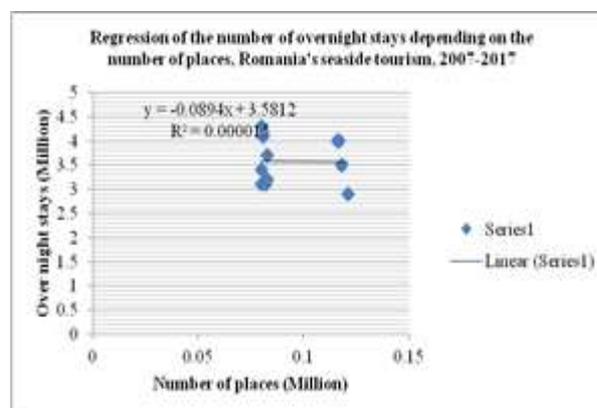


Fig.9. The regression of the nights spent by tourists on Romania's seaside accommodation structures depending on the number of places, 2007-2017.

Source: Own design.

There is no variation in the tourists' overnight stays determined by the variation in the number of beds as  $R \text{ square} = 0.000015$ .

The growth of the capacity with one place in accommodation units will determine a decline of 0.0894 in the number of overnight stays as reflected by the equation of regression,  $y = -0.0894x + 3.5812$  (Fig.9).

The results found in this study do not compile with the achievements in other studies regarding the relationships existing at the country level and also in the South East part of Romania between the number of tourist arrivals and overnight stays and the number of places as found by [13, 14].

## CONCLUSIONS

While the number of tourist arrivals on the seaside increases in average by 2.7 % annually, its share in the total number of tourists visiting Romania decreases and at present is 8.9 %. This happens because the mountain area has become the most dynamic tourism form in Romania.

In 2017, the tourist arrivals on the seaside were by 31.8 % higher than in 2007, but they represented just 8.6 % in total arrivals in Romania. The Romanian tourists spending their vacation on the seaside represent 10.8 % in the total Romanian tourists in the country.

The number of foreign tourists has deeply declined in the seaside area and at present it represents just 1.2 % of the total foreigners visiting Romania.

The nights spent by tourists in accommodation structures in the seaside area increased by 6.4 %, but in case of the overnight stays of the Romanian tourists increased by 12.8%, while in case of the foreign tourists their number decreased by 61.6%.

At present, the nights spent on the seaside represent 15.9% of the total overnights in Romania's tourism, and this share has a descending trend.

At the same time, the accommodation capacity in the seaside tourism in terms of establishments and places declined year by year compared to the high average growth rate, + 6.2 %, of the number of

accommodation units and places in the mountain area.

In Romania's tourism, the seaside tourism represents 9.8 % in the total accommodation tourism structures, 23.4% in the total number of places and 10.5 % in the total beds-days, and these shares continue to decline.

On the seaside, the highest share among the accommodation units with tourist function is kept by hotels (36.9%), bungalows (30.2 %) and tourist villas (20.6%), and the highest number of places are in hotels (64%), camping (6%) and camps (7%).

The correlation and regression analysis proved that there is very weak relationship between the accommodation capacity and the number of tourists and overnight stays.

The main problems the seaside tourism is facing in Romania are:

- The low investments in accommodation structures both in the public sector and in the private one which focused especially on the modernization of the actual buildings than in building new constructions;

- The lack of labor force mainly in the summer season but also in the extra season due to the changes of climate which have extended the season in September during the last years.

- In the peak of the season and mainly in the week-ends it is a lack of the accommodation capacity in the seaside resorts, especially in Mamaia, and for this reason the tourists are obliged to look for accommodation in private houses or apartments. In this case, the exact number of tourists is not known, the competition between the private owners and the classified tourism accommodation structure is high. More than that, many times the beaches and restaurants are full of tourists and this creates a discomfort atmosphere and a frustration feeling among the seaside visitors.

- The mini and supermarkets built in the seaside resorts are important competitors for the restaurants and fast food owners.

These problems could be solved by setting up an efficient master plan and strategy focused on the development of the seaside area by investments, creating jobs, increasing employment and productivity in tourism, diversifying the offer of leisure and

entertainment activities, applying a better management of the actual accommodation structures to increase the comfort degree, assuring a good management of the beaches, means of conveyance, parking places and access roads among and through the resorts, keeping the green spaces and improving the service quality in close relationship with price level per service.

All these are destined to assure a balanced offer/demand ratio in the seaside tourism, to attract more tourists to this wonderful destination of Romania and increase the tourism receipts.

## REFERENCES

- [1]Bodor, D., 2017, Romanian seaside (Litoralul românesc- the most exploited tourist area of Romania, <https://ad-turism.ro/litoralul-romanesc-1629/>, Accessed Feb. 20th, 2019.
- [2]Cristea, N., Tanase, G., The evolution of tourist resorts Constanta and Mamaia, 1878-1941, Proceeding of International Conference ISTM 2014, Vol.9, Special Issue of JIDEG, Sept.2014, 19-27.
- [3]Eco Marea Neagra, 2019, Romanian seaside (Litoralul romanesc), <https://ecomareaneagra.wordpress.com/litoralul-romanesc/>, Accessed Feb. 10th, 2019.
- [4]INCDT, 2019, Research studies regarding the development of public investments in the specific infrastructure of Romania in the period 2007-2016 and the main directions of their development (Studii de cercetare privind dezvoltarea investitiilor publice in infrastructura specifica din Romania in perioada 2007-2016 si directiile principale de dezvoltare a acestora), [http://turism.gov.ro/web/wp-content/uploads/2017/07/MPI-21.07\\_2017.pdf](http://turism.gov.ro/web/wp-content/uploads/2017/07/MPI-21.07_2017.pdf), Accessed Feb.20th, 2019.
- [5]Info Ghid Romania, Seaside resorts the Black Sea Romania, (Statiuni de litoral Marea Neagra Romania), [https://www.infoghidromania.com/statiuni\\_litoral.html](https://www.infoghidromania.com/statiuni_litoral.html), Accessed Feb. 20th, 2019.
- [6]Litoralul romanesc, 2019, About Romanian seaside (Despre Litoralul roimanesc), [https://www.litoralul-romanesc.ro/litoral.htm?gclid=EAiaIQobChMI5ee7gO\\_i4AIVSYuyCh0npAxzEAAYASAAEgKNEfD\\_BwE](https://www.litoralul-romanesc.ro/litoral.htm?gclid=EAiaIQobChMI5ee7gO_i4AIVSYuyCh0npAxzEAAYASAAEgKNEfD_BwE), Accessed Feb. 10th, 2019.
- [7]Litoralul romanesc, 2019, Seaside Tourist attractions (Obiective turistice litoral), [https://www.litoralul-romanesc.ro/obiective\\_turistice\\_litoral.htm](https://www.litoralul-romanesc.ro/obiective_turistice_litoral.htm), Accessed Feb. 20th, 2019.
- [8]Lungu, M.L., Ilies, D.C., Josan, I., Ungureanu, M., Prefac, Z., Gaceu, O., Mateescu, R., 2016, The climatic-touristic potential of the Romanian Clack Sea coast during summer, established according to the indices of Burnet, Clause-Guérout and Sarramea, *Cercetari marine*, Issue 46, 31-47.
- [9]National Institute of Statistics, 2019, Romanian Tourism Statistical Abstract, NIS, 2007-2018, <http://www.insse.ro/cms/en/content/romanian-tourism-statistical-abstract>, Accessed Feb. 20th, 2019.
- [10]Nichersu, I.I, Nichersu, I., Nanu, C.N., Bozagievici, R., 2016, Aspects of mass coastal tourism in the Black Sea Romanian coast, *Scientific Annals of the Danube Delta Institute*, Vol.22, 91-100.
- [11]Popescu, A. 2014, International Tourism, EIKON Publishing House Cluj-Napoca, coediting with RawexComs, Publishing House, Bucharest, 121-122.
- [12]Popescu, A., 2014, Tourism and rural Tourism in the European Union -28, EIKON Publishing House Cluj-Napoca, coediting with RawexComs, Publishing House, Bucharest, 47-148.
- [13]Popescu, A., 2016, The correlation between tourism accommodation capacity and tourist inflow by microregion of development in Romania, *Scientific Papers. Series "Management, Economic Engineering in Agriculture and rural development"*, Vol.16(4):289-298.
- [14]Popescu, A., Plesoianu, D., 2017, Analysis of accommodation demand/offer in Romania's tourism, *Scientific Papers. Series "Management, Economic Engineering in Agriculture and rural development"*, Vol.17(3):339-346.
- [15]Popovici, N., Moraru, C., 2017, Coastal Tourism and Its Impact on the Development of the Region, "Ovidius" University Annals, *Economic Sciences Series Volume XVII, Issue 1 /2017*, 113-117.
- [16]Postelnicu, C., Dabija, D.C., 2018, Romanian tourism: past, present and future in the context of globalization, *Ecoforum*, Vol.7, Issue 1(14), 2018, 1-14.
- [17]Press Release, 2018, The seaside had by 8 % more tourists in this summer season (Litoralul a avut cu 8% mai mulți turiști în acest sezon estival), 20 Sept.2018, *Info Sud Est*, <https://www.info-sud-est.ro/litoralul-a-avut-cu-8-mai-multi-turisti-in-acest-sezon-estival/>, Accessed Feb.10, 2019
- [18]Sima, E., 2016, Sustainable development in Dobrudgea by promoting tourism activities in rural areas, *Agricultural Economics and Rural Development*, New Series, Year XIII, no. 2, p. 239–252.
- [19]Wikipedia, 2019, Romanian seaside ( Litoralul romanesc),[https://ro.wikipedia.org/wiki/Litoralul\\_rom%C3%A2nesc](https://ro.wikipedia.org/wiki/Litoralul_rom%C3%A2nesc), Accessed Feb.10, 2019.



## COW RAW MILK QUALITY AND ITS FACTORS OF INFLUENCE IN RELATIONSHIP WITH MILK PRICE

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### Abstract

*The paper presents cow raw milk quality and its influence factors in connection with milk price based on a proper approach of the topic using analysis, synthesis, deduction which helped to establish "the state-of art" in the field of the authors' expertise, emphasizing on the particular factors which contribute to the improvement of milk quality which influence milk price in the EU, USA and other countries. Milk quality is determined by milk composition especially by fat and protein percentages, by the sensory, physical and chemical characteristics. Milk quality is assessed from a hygienic point of view in terms of Total Bacteria Counts (TBC) and Bulk Tank Somatic Cells Counts (BTSCC) whose level should be lower than the maximum thresholds mentioned by EU and USA standards in force, as well as regarding the aflatoxins and antibiotics content. The payment system for the quality of milk and the competition between suppliers and processors for milk supply encourages dairy farmers to produce more milk and of high quality. In this purpose, they have to improve breeding, feeding, hygiene and keep under control mastitis, treatments with antibiotics and other medicines and to produce high quality forages without aflatoxins. The reduction of TBC and BTSCC in raw milk will assure food safety and will increase shelf life of milk and dairy products. Business development in dairy farming has to keep pace with the changes in the internal and international markets. Farmers should become aware that they play an important role in raising milk demand and offer of high quality milk and dairy products.*

**Key words:** milk, quality, criteria of quality assessment, influence factors, milk price

### INTRODUCTION

Milk is a "basic and strategic food which improves life quality and assures food security" [37].

The importance of milk in diet is justified by its chemical composition including, besides water 87 %, 13 % high value nutrients: fats, proteins, carbohydrates, vitamins and minerals, and for this reason milk is considered a complete food recommended to be consumed by all the people [35, 47].

Besides human and animal consumption, milk is an important raw material for food industry, which is one of the most dynamic branch in the economy of many countries.

Milk and milk products are more and more consumed worldwide, being situated on the top of consumption and also among of the most marketed food products [26].

Consumers are aware of the importance of milk in their life and have become more and more interested as milk and milk products to be of high quality. Their perception on milk quality is linked especially to taste, smell, colour, health importance, convenience and production process [40] and also to a longer shelf life [69].

For this reason, both producers, milk processors and retailers pay a special attention to the complex of attributes characterizing milk quality along its food chain from cow to consumer's cup of milk or slice of cheese.

In this context, the purpose of this study was to analyze the actual situation of milk quality and of its determinant factors in dairy farms, the criteria which are taken into consideration for assessing cow raw milk quality in close relationship with milk price offered by processors and farmers' income and profit. The topic is approached not only in general,

but also pointing out specific situations in various countries.

## MATERIALS AND METHODS

The review is based on a large range of published books and articles, legal framework in force mainly in the EU and the USA, statistical data, official reports on the topic issued by important authorities in charge,

The authors' opinions and concepts are based on a critical evaluation of the studied materials.

The paper structure includes the following parts: (i) Introduction; (ii) Materials and methods (iii) The situation of milk production, export, import and milk consumption at the world level and in the EU and most important countries; (iv) Factors influencing milk quality at the farm level; (v) Criteria taken into consideration for assessing quality of milk as raw material; (vi) The milk quality standards in the EU and in the USA; (vii) Milk price and its factors of influence; (viii) Conclusions and (ix) References.

Finally the most important conclusions were drawn and also a few recommendation for dairy farmers were made in order to encourage them to improve milk quality and price.

## RESULTS AND DISCUSSIONS

### The situation of milk production, export, and import, and milk consumption

As long as the demand for milk and dairy products is growing up, dairy market has followed a continuous increasing trend.

In 2018, the world cow milk production reached 510.09 million metric tons being 9.31 % higher than in 2013 [102].

In the same year, the world dairy market output reached 829 million tons (milk equivalent) being by 3.6 % higher than in 2016, while the dairy export accounted for 73.5 million tons (milk equivalent) being by 8 % higher [17].

This positive trend was determined by the growth of milk production in the major producing countries: India, the EU, the USA, China and also due to the stimulating development strategies applied by Canada, China and Russian Federation. The increased output supported the expansion of dairy exports mainly provided by the EU, the USA, New Zealand, Australia, Argentina and Canada. The imports of dairy products was facilitates by the low self-sufficiency in China, Russian Federation, Mexico, Saudi Arabia, Algeria, Indonesia, United Arab Emirates and Japan (Table 1).

Table 1. World dairy production, export and import in the year 2017 (million tons, milk equivalent)

World dairy production			World dairy export			World dairy import		
Country	Million tons	Market share (%)	Country	Million tons	Market share (%)	Country	Million tons	Market share (%)
World	810.6	100.0	World	71.6	100.0	World	71.7	100.0
India	165.6	20.4	The EU	20.1	28.0	China	13.3	18.5
The EU	165.4	20.4	New Zealand	18.6	25.9	Russian Federation	4.1	5.7
The USA	97.7	12.0	The USA	10.5	14.7	Mexico	3.9	5.4
China	41.3	5.0	Belarus	3.7	5.2	Saudi Arabia	2.9	4.0
Pakistan	40.2	4.9	Australia	3.1	4.3	Algeria	2.8	3.9
Brazil	35.2	4.3	Saudi Arabia	1.4	1.9	Indonesia	2.7	3.7
Russian Federation	30.9	3.8				United Arab Emirates	2.5	3.5
New Zealand	21.3	2.6				Japan	2.2	3.0
Total	597.6	73.4	Total	56.4	80.0	Total	34.4	47.7

Source: Own calculations based on the data provided by [25].

At the world level, cow milk output accounted for 696 million tons in 2017, representing 85.6 % of the world dairy output. The contribution of various suppliers to cow milk production was: Asia 30 %, the EU-28 24 %, the Americas 27 %, Africa 6 % and Oceania 5 % (Table 1).

The world average milk consumption increased by 6.6 % from 106 kg in 2010 to 113 kg per capita in 2017.

The self-sufficiency rate exceeds 100 by 13 % in the EU, by 10 % in Europe, by 9 % in North America, by 189 % in Oceania, it is just equal to 100 in South America and below 100 in Asia (90%), Africa (84%), and Central America (79%) [115].

World milk producer price (USD/100 kg) in the major producing countries was the following one: 56.24 in China, 44.19 in India, 42 in Russian Federation, 40.75 in New Zealand, 39.37 in the EU, 38.8 in the USA, 33.75 in Brazil and 32.3 in Argentina [115].

The EU comes on the 2nd position as milk producer after India and is on the top position as milk exporter.

In 2016, the EU-28 cow milk output on farms reached 162.9 million tons, being by 20.7 % higher than in 2008. The market share of the main producing countries was the following one: Germany 20%, France 15.5 %, United Kingdom 9.1 %, the Netherlands 8.6 %, Poland 8.1 %, Italy 7.3 %, Spain 4.3 %, Ireland 4.2 %, Denmark 3.3 %, Belgium 2.3 % and Romania 2.3 %, all these 11 countries contributing by 85 % to the EU milk production [23].

In 2016, the collection of cow's milk by dairies in the EU accounted for 153.2 million tons, representing 94 % of the milk output. The contribution of various providers to this collection was: Germany 20.9 %, France 16 %, United Kingdom 9.6 %, the Netherlands 9.4 %, Italy 7.5 %, Poland 7.3 %, Spain 4.5 %, Ireland 4.5% and others 20.4 % [23].

Milk price in the EU-28 declined in 2016 after the dissolution of the milk quotas in April 2015. The decline of milk price was higher by 5.68% in 2016 compared to 2015 and by 15.9 % compared to the average registered in the period 2010-2015. However, in 2017, the average milk price in the EU was USD

39.37/100 kg, with the highest milk producer's price in the Netherlands 45.13, Germany 40.88, France 36.61 and Poland 35.72.

In 2017, the EU milk price increased by 25.1 % compared to 2016, in Germany by 38.2 %, in Poland by 31 %, in Netherlands by 28 % and in France by 16 % [115].

Romania comes on the 10th position as milk producer in the EU, contributing by 2.3 % to the EU output. In 2017, Romania achieved 46.6 million hl total milk, of which 40.6 million hl (87.1 %) was provided by cows and buffalos. However, Romania registered a decreasing trend of milk production in 2017, as milk output was by 21.1 % lower than in 2008 (59 million hl). Cow milk also declined by 23.4 % from 53 million hl in 2008 to 40.6 million hl in 2017. This was due to the reduction of cow livestock, despite that sheep and goat livestock had a positive influence [59].

#### **Factors influencing milk quality at the farm level**

Milk quality is influenced by a large range of factors which could be classified into two categories: (a) individual factors and (b) environment factors (Table 2).

##### ***(a) Individual factors influencing milk quality***

Among the factors connected to the animal which produce milk there are: species, breed, family, line, individuality, age, size and shape of the udder, the stage of lactation, and pregnancy.

*(i) Species.* Milk quality is different from a species to another. Cow milk has 3.8 % fat compared to buffalo (7.5 %), sheep (7.8) and goat milk (3.8). Cow milk has 3.3 % protein compared to 4.8 % in buffalo, 3.6 % in goat, and 5.8 in sheep [101].

*(ii) Breed, family, line.* Milk quality differs from a breed to another. There are breeds with more fat and protein and also breeds with less fat and protein. This is caused by the genetic inheritance. The two traits: fat and protein have a specific heritability ( $h^2$ ). For instance, in Wallon Holstein,  $h^2 = 0.395$  for fat % and  $h^2 = 0.447$  for protein % as found by [3].

Milk of Holstein breed from the USA had 3.6 % fat and 3.2 % protein and 4.7 % lactose for

a period of 15 years in the period 1970-1985 [117].

Fat % varies the most from a breed to another, while lactose % varies the least [53, 114].

Jersey and Guernsey breeds have a higher protein %, while Holstein breed has a lower casein % compared to other breeds [36, 53].

A negative correlation,  $r = -0.3$ , was found between milk yield and fat percentage which determines as the two characters to be taken into consideration at the same time in selection programmes [36, 53].

In Romania, it was found that Romanian Maramures Brown breed has a higher protein % and a higher dry matter % compared to Romania Black Spotted breed and Romanian Spotted breed. But, the Romanian Black Spotted breed has the highest lactose % and casein % and the lowest fat %, protein % and dry matter % compared to the other two Romanian breeds. Finally, the milk from the Romanian Spotted breed has the highest fat % [98].

The average fat % in the Romanian cattle breeds is the following one: Romanian Spotted 3.8 %, Romanian Black Spotted 3.8 %, Romanian Brown 3.75 %, Transilvanian Pinzgau 3.85 %, Friesian 4.05 %, Simmental 4 % [1].

The American Federation of Cooperatives Select Sires Inc. specified for the following heritability for milk constituents: 0.58 for fat %, 0.51 for protein %, 0.43 for lactose %, 0.10 for somatic cell score, 0.06 for incidence of mastitis. Also, the same source indicated the heritability for udder and teats shape and dimensions as follows: 0.28 for rear udder height, 0.23 for rear udder width, 0.24 for udder cleft, 0.28 for udder depth, 0.26 for teat placement, 0.26 for teat length [42].

Another information source provide the following heritability percentages for a number of traits related to milk quality: 0.5 for protein %, 0.5 for butterfat, 0.10 for mastitis, 0.10 for udder quality, 0.12 for fore udder attachment, 0.10 for fore udder length, 0.25 for rear udder height, 0.7 for rear udder length, 0.33 for suspensory ligament, 0.38 for teat diameter and 0.36 for teat placement [107].

Regarding the influence of family on milk composition and quality, [52] affirmed that the mean values of milk fat, SNF, and protein content are significantly different in case of the groups of paternal half-sisters.

(iii)*Individuality*. Each animal has its own body development, constitution type, metabolism, functional capacity of the internal organs which could influence milk yield and quality [38].

(iv)*Animal age* determines first of all milk yield. At the 1st lactation, milk yield is lower and then it increases from a lactation to another up to the 4th lactation and then it declines, a reason to cull the cow as it is not economically effective to keep it. Milk constituents have a high repeatability from a lactation to another,  $R=0.67$ , Jersey cows having the highest level,  $R= 0.71$  compared to other breeds where the repeatability ranges between 0.51-0.57 [36, 53].

Also, milk protein declines at the cows which are older than three years [48, 53].

(v)*The shape, dimensions and the volume of the udder and teats* are very important for assuring a corresponding milk yield and quality. Any deficiency regarding these udder aspects is a reason to cull the cow as mechanical milking can not be done.

(vi)*The stage of lactation*. Linn (1988) found that "in the first days of lactation when the cow produces colostrum, milk fat percentage is higher, then it declines during the first two months of lactation, and after that, it increases from a lactation to another. The protein percentage has a high value in colostrum and then it declines reaching the level of the normal milk. After ten weeks of lactation, milk protein percentage reaches the minimum level, but then it increases during the lactation and pregnancy"[53].

Fat % is higher in early and late stages of lactation compared to the middle stage. Protein content was not so much affected by lactation stage, but lactose % was seriously affected by pregnancy. [41].

Milk content in minerals such as: Ca, Ph, and Mg has the highest level in colostrum but then it reaches the level of the normal milk [48, 53].

(vii) *Pregnancy*. This stage of the reproductive cycle could influence the percentage of various milk components. It was noticed that at the beginning of the pregnancy, cow milk has an increased fat and protein percentage, while the lactose percentage is lower [38].

The Holstein Friesian cows pregnant during the three months have a lower milk, fat, protein and lactose yield, while the ones pregnant for eight months registered higher losses due to the pregnancy effect. [65].

(b) *Environment factors influencing milk quality*

Among the major environment factors which influence milk quality there are: season, temperature level, humidity and rains, soil chemical composition in relation to the cultivated forages and pastures and meadows, the stages of milking, the milking times per day, animal health, nutrition, watering, hygiene condition of the animal and udder, shed, milking equipments, tools, milkers, maintenance systems of the cows etc.

(i) *Season* is related to milk quality and also with cow feedstuffs whose content in nutrients could determine various levels of fat, protein, fatty acids, minerals etc in milk composition. In summer season, milk fat percentage is lower than in winter season [48, 53].

Milk protein percentage is higher during autumn and winter season and lower in spring and summer seasons [49, 53].

Seasonal changes of fat, protein, sugar content and microbial load in milk were also noticed. In summer, milk is richer in total solids and is poorer in microbes than in winter.[58]. Summer season could reduce the saturated fatty acids compared to the non saturated acids, and for this reason summer milk is more beneficial for humans than in winter season [35].

Milk yield is lower in winter and spring seasons and higher in summer and autumn, but fat and protein percentages are negatively correlated with milk production. Therefore, they are higher in winter and spring, and lower in summer and autumn.[61].

(ii) *High temperature, rains, moisture* could also affect milk composition. For instance, Toušová *et al*, (2017) noticed that at a high air

temperature, daily milk yield and protein percentage had the highest level in Friesian cows (35.94 kg/day and respectively 3.41 % protein). At a lower temperature, it was noticed the reverse. Air humidity has a lower influence on milk quality.[109].

Heat stress in dairy cows could affect milk yield and composition and also milk quality [118].

Bernabucci *et al* (2002) noticed that "the diminished milk protein content in the summer milk was due to the reduction of the casein content, which, in its turn, was determined by the decline of  $\alpha$ -casein and  $\beta$ -casein content. This aspect explains why cheese properties are affected in summer[7].

(iii) *Soil chemical composition* in close relationship with the cultivated crops and pastures and meadows could influence milk quality regarding the content in vitamins, minerals etc.[106].

(iv) *The stages of milking*. At the beginning of milking, fat % is low but then it becomes higher and higher.[38, 53].

(v) *The milking times*. There are differences between milking three and milking two times. When cows are milked three times, the fat % declines compared to milking two times. But, the opinions of various authors are controversial, as some researchers affirmed that there are no differences.[53].

The frequency of milking does not affect protein percentage.[48, 53].

In the evening milking, milk has a higher fat % compared to the morning milking. Within the same milking, milk has a low fat % at the beginning and then the fat increases to the end of the milking [53].

(vi) *Animal health* is a very important factor to assure milk production level and also milk quality. Cows could be affected by various diseases such as tuberculosis, brucellosis, mastitis, etc. Almost in all the cases, milk is not good for consumption and cows are milked separately in special hygiene conditions.

Mastitis is generated by low hygiene conditions in the animal shed, poor udder hygiene before and after milking, the non corresponding hygiene of milking equipment before and after milking [112].

Also, mastitis could be caused by oscillating vacuum during mechanic milking, blank milking, parsimonious feeding which reduces the body resistance to various pathogenic agents, udder deficiencies such as: hanging udder, weak ligaments, the non corresponding shape and dimensions of the teats. Also, the high performance cows are the most sensitive to mastitis and for this reason mastitis should be permanently monitorized [96].

Mastitis has two stages: *the subclinic stage*, when somatic cells count increases, the udder does not present visible changes and the treatment could be successfully applied, and *the clinic stage*, when the udder is swollen, it has a higher volume and it is sensitive and milk presents changes for which it can not be used for consumption or processed.[92]

Mastitis is the disease which affects udder health and obviously milk yield and quality.

Milk yield could be diminished by 30-40 % and costs with veterinary services are higher than usual [57, 96].

Mastitis changes milk composition, affecting lactose, protein, casein and fat content [50, 53].

Regarding milk minerals, mastitis decreases Ca, Ph [50] and increases Na and Cl [70].

Mastitis affect cow performance, but also farmer's income and profit as it is the most costly disease of dairy cows [8, 93].

Mastitis could be also determined by farmers' non sufficient knowledge on animal nutrition and feed ratio balance. And also, it could affect not only milk composition, but also to shorten shelf life of marketed milk and dairy products.[57]

Mastitis is one of the most widespread diseases in dairy farms, its frequency varying according to the country, region, production system, and control measures of the disease [116].

Mastitis determines an increased total number of bacteria (TBC) and somatic cells (SCC) in milk, which could affect human health and for this reason milk is tested for the level of TBC and SCC and if the level of these indicators exceeds the milk quality standards established by national authorities, milk is not good for consumption, and has no the corresponding

properties for being processed in dairy products [24, 31, 32, 33, 34].

(vii)*Nutrition*. Feeding is considered one of the most important factors for achieving milk yield and producing high quality milk [58].

A balanced nutrition assures a high quality milk. But, a high performance cow needs a diet rich in energy which could lead to the so called "low-milk-fat syndrome" as affirmed [97].

Sutton (1980) cited by Linn (1988) affirmed that milk composition is affected by "the ratio between forages and concentrates, the type of sugars in cow diet, the form of diet (hay, compound food, silage, green grass etc), the processing of the diet items, the presence of additives, the feeding frequency and method".[53, 105]

Milk protein could be improved using a moderate amount of nondegradable protein, and also using various mixtures of ruminally protected methionine and lysine in high performance dairy cows. An additional 6-7 % fat in the cow diet could lead to the decline both of milk yield and fat and protein content [44].

A balanced diet in minerals could maintain the normal level of minerals in milk. For achieving a high milk yield and quality, maintaining cow health and reproductive performance it is needed to cover cow needs in minerals and vitamins [39].

Feedstuff offered to milking cows has to be of high nutritive value and hygienic. The forage quality could be affected by various factors such as: "plant variety, high temperatures or humidity, insects, spore load, technological deficiencies along the forage chain including harvesting, transportation, storage, handling" as mentioned by [9, 11].

Maize is one of the most used ingredients in dairy cows feeding (silage, compound food etc).

Climate change in Europe has led to an increased risk and occurrence of maize contamination with various fungi, especially with *Aspergillus flavus* and *Aspergillus parasiticus* in the Southern countries of the continent (Italy, the Balkan states) as affirmed [9, 18, 73, 111].

These fungi produce aflatoxins which have a negative impact on feed intake, reproductive performance, milk yield and quality. The B1 and M1 aflatoxins are considered genotoxic, hepato-toxic and carcinogenic for animals and humans [46, 71].

The aflatoxins are stable to heat, cold and light and remanent even in UHT products.[11] For these reasons, in over 100 countries, there were adopted regulations providing the maximum thresholds for B1 and M1 aflatoxins in animal feed and human food.

The international regulations were issued by Joint FAO/WHO Expert Committee of Food Additives (JEFKA) and in the EU, the Directive 2002/32EC, consolidated version, 27 Feb. 2015 was set up based on the recommendations provided by European Food Safety Authority (EFSA). [111]

(viii) *Animal watering* should be normal. The lack of water as well as too much water could change milk composition and quality. As long as milk contains 87 % water it is important as a cow to drink a corresponding amount of water to maintain milk content in this nutrient. Water intake depends on cow milk yield, physiological stage, body weight, diet structure, dry matter intake, movement, air temperature, water salinity, etc. Water should be edible and of high quality, not to contain abnormal sulphates, chlorides or nitrates and to have a normal temperature for assuring cow production and milk quality [5].

(ix) *Hygiene conditions* are very important regarding animal, shed and milking to assure a high quality milk. Cows should be daily cleaned on the back, legs, croup, tail, the udder should be correspondingly washed before and after milking. The shed should be cleaned every days removing the manure, the dirty bedding straw or carpets, urine etc. Milking rules regarding hygiene of the milkers (washed hands, cleaned jumpsuits), milking hygiene (the udder cleaned and washed well, disinfected, rewashed, dried, the massage, the first jets of milk to be collected separately before milking, the perfect hygiene of the milking equipment and parlour before and after milking), the milk tanks to be cleaned, washed, disinfected and to operate at

the corresponding temperature during the milk storage till the moment of delivery [6].

(x) *Cows' maintenance*. Milk yield and quality depends on the cow maintenance system applied in the farm.

The maintenance system has to assure a high comfort to dairy cows and for all their activities: feeding, resting, moving, droppings releasing, milk producing and releasing etc, to assure optimal technological flows, to maintain hygiene and sanitary veterinary conditions, to assure the optimal level of materials and energy consumption, a high quality milk and production and to reduce caretakers and milkers' efforts [38].

Table 2. The factors affecting cow milk quality at the farm level

Individual factors	Environment factors
1.Species	1.Season
2.Breed	2.Temperature level
3.Family	3.Humidity level
4.Line	4.Soil chemical composition related to cultivated forage crops and pastures and meadows
5.Individuality (body development, constitution type, metabolism type, functional capacity of the internal organs)	5.The stages of milking
6.Age	6.The milking times
7.Udder volume, shape, health condition, ligament	7.Animal health (tuberculosis, brucellosis)
8.Teats dimensions, shape, health condition	8.Udder and teats health (mastitis)
9.The stage of lactation	9. Nutrition (diet structure and balance, amount, times of administration, feedstuff quality, aflatoxin limits)
10.Pregnancy	10.Watering ( amount, times, water quality)
	11.Hygiene conditions (animal and udder hygiene, equipments and tools hygiene, shed hygiene - cleaning and disinfecting, milkers hygiene etc)
	12.Cows' maintenance systems (indoors or outdoors, fixed or free systems)

Source: Own conception based on the studied literature.

During winter season, when usually cows stay in the shed, there were noticed health problems mainly regarding deformed hoofs and lameness due to the long period of stay on uncomfortable stalls, and limited movement. In summer time, animals had less health problems as they went out of the sheds. Shed hygiene is very important to maintain animal health and milk production and quality [37].

Milk quality could be influenced by the maintenance system practice in the farm: the fixed or free system of maintenance indoors or free system outdoors. In Germany, comparing the results regarding fat % and protein % registered by two breeds: Rotbunte and Schwarzbunte grown in the indoors in two systems: fixed systems and free system, there were found the following results: in the fixed system the fat percentage was lower (3.87 % and, respectively, 3.97 %) compared to the free system (3.82 % and, respectively, 3.95 %).

The protein percentage was higher in the fixed system (3.49 %) and lower in the free system (3.46 %) for Rotbunte breed, while in case of Schwarzbunte breed, the protein percentage was smaller in the fixed system (3.45 %) and the same (3.46 %) in the free system [21].

(xi) *Milk storage temperature.* After milking, milk has to be stored in the tank whose hygiene and functionality has to be perfect to assure a corresponding temperature till milk delivery to processors. Usually, the storage temperature should be between 2°C and 4°C. At a higher temperature than 4°C, the bacteria could develop and the casein fraction could also increase after 72 hours of storage compared to milk stored at 2°C.

#### **The major characteristics and parameters which reflect the quality of raw milk**

As raw material milk has to be of a high quality according to milk processors' requirements for enabling them to process milk in various dairy products of high quality and with a long shelf life to cover consumers' needs the best.

The major characteristics and parameters which reflect the quality of raw milk are:

##### **(a) Milk chemical composition.**

Sorentino (2010) affirmed that milk composition consists of 87.3 % water, 4.7 % sugars, 3.8 % fats, 3.3 % proteins, 0.9 % minerals and vitamins [101].

In Kliem and Givens' opinion (2011), the chemical composition of whole milk consists of water 88%, protein 3.2 %, fat 3.3 %, carbohydrates 4.8 %, vitamins and minerals. Of all these nutrients, the essential ones for humans are: protein, calcium, phosphorus, iodine, riboflavin, niacin, potassium, A and B12 vitamins [51].

There are many studies on milk composition reflecting milk quality, but almost all the authors pointed out the same components more or less in a similar proportion depending on breed, sample size, region, feeding type etc Milk composition could be affected by various factors: genetic inheritance, breed, lactation stage, milking, environmental factors of which feeding and hygiene are the most important [7].

**(b) Sensory characteristics** which could be easily identified are: aspect, consistency, colour, taste, smell.

A high quality milk has to fulfil the following requirements regarding sensory features:

- *aspect:* milk has to be a homogenous opaque liquid, lacked of visible impurities and sediments;

- *consistency:* milk has to have a normal fluid consistency;

- *colour:* milk colour has to be white or frosted white or white and slightly yellow, if milk contains a higher percentage of fat or carotenoid pigments from the forages ingested by the cow. Other colours such as: blue, yellow, pink-red (caused by some specific plants included in the diet or by udder infections), black or with black points etc are considered abnormal, because their appearance is determined by infections and administrated medicines;

- *taste:* milk has to have a specific sweetish taste and flavour of fresh milk due to the content in lactose; when cows are fed with non hygienic forages (altered or affected by fungi) or treated with medicines, milk could have a different taste, a reason not be accepted for consumption; the abnormal tastes are: bitter (due to specific plants used in the diet),

salted (when the udder is affected by infections) etc.

*-smell*: milk has to have a specific smell of freshness; under an non proper hygiene conditions, the smell and even the taste could vary from normality; the strange smells could come from forages, manure etc. Also, during the storage period, milk could get a slight acidulous taste and smell due to the fat oxidation. The milk with strange smells and tastes is non used in consumption [21].

**(c)Physical characteristics** are the following ones:

*-density*: milk density varies between  $1.026 \text{ g/cm}^3$  and  $1.034 \text{ g/cm}^3$  at the temperature of  $20 \text{ }^\circ\text{C}$ ; a normal density indicates that milk is of high quality reflected by a normal chemical composition: 87-88% water and 12-13 % total solids, of which fats 4 % and 9 % solids-non-fat (SNF) which includes: proteins, lactose, minerals and vitamins etc. If milk density is lower than the minimum normal value milk could be suspected of water addition. It is known that 10 % water added to milk could decrease its density by  $0.003 \text{ g/cm}^3$  [67].

*-viscosity* is important as it is linked to the milk flow properties and also for the appearance and consistency of dairy products; the normal values of viscosity are: 1.74-2.4 cP (centi-poise); the variations of viscosity are determined by milk protein, casein, fat content and temperature. The milk absolute viscosity is 2 cP for whole milk and 1.8 cP for skimmed milk [85].

*-opacity* is given by the substances existing as a suspension; the higher the fat content in milk, the higher the opacity; opacity could be lower when milk is adulterated with water or forages are rich in water (green grass, grazing, silage etc);

*-specific heat capacity* of milk ranges between  $0.92\text{-}0.94 \text{ cal/g}$  in the conventional system or  $3,935.6 \text{ J/kg K}$  or  $0.94 \text{ (Btu/(lb }^\circ\text{F))}$  ( $\text{Kcal/kg }^\circ\text{C}$ );

*-boiling point* of milk varies between  $100.2 \text{ }^\circ\text{C}$  and  $117 \text{ }^\circ\text{C}$  or  $212.3 \text{ degrees }^\circ\text{F}$  (Fahrenheit) at the pressure of 760 mm col Hg; these interval is determined by the content of lactose and minerals; a boiling point lower than the normal value and close to

$100 \text{ }^\circ\text{C}$  reflects milk adulteration by adding water;

*-cryoscopic point* of milk is  $-0.550 \text{ }^\circ\text{C}$  in average, with limits between  $-0.530 \text{ }^\circ\text{C}$  and  $-0.560 \text{ }^\circ\text{C}$ ; it should be corrected in addition if milk acidity is 7-8 SH degrees and in minus if the acidity is lower than 8 SH degrees. Any deviation from these limits reflects the adulteration of milk [66].

*-refractive index of milk, RI*, is 38.5-40.5 refractometric points; it is lower when water is added; also, in case of tuberculosis, the refractive index is by 7-10 degrees smaller than the normal level; also, its limits of variation could be expressed as 1.3422-1.3429, if the refractive index is determined with Zeiss refractometer;

*-superficial tension of milk* ranges between  $50 - 55 \text{ dyne/cm}^2$ ; it could be higher than  $55 \text{ dyne/cm}^2$  when water is added.

*-specific resistivity of milk or electric conductivity* varies between  $175\text{-}200 \text{ } \Omega$  (Ohm) at  $25 \text{ }^\circ\text{C}$ ; when the value of this resistivity is smaller, it indicates added water, mastitis or a long length of storage [27, 110].

**(d)Chemical properties of milk are:**

- *acidity or pH*, which varies between 6.33-6.59 due to the content in proteins and minerals; the fresh milk is slightly acid; the alkaline milk after milking reflects that it is infected with proteolytic bacteria; pH level depends on the milk origin, the stage of lactation, being higher at the end of the lactation, cow health and udder health, milkers' hygiene, collection and transportation conditions, and diseases; in case of mastitis, milk had pH over 7.

- *total acidity or titrable acidity* ranges between  $16.5\text{-}19 \text{ }^\circ\text{T}$  (Thörner) or  $6.8\text{-}7.8 \text{ }^\circ\text{SH}$  (Soxhlet-Henkel) or  $16\text{-}18 \text{ }^\circ\text{D}$  (Dornic);

*-impurity percentage* is 1, but if there are more impurities this is caused by the non hygienic conditions during milking when dust, and small particles of forage and waste s could pass into milk; a milk with impurities could be suspected to be infected by bacteria [21, 108, 110].

**(e)Hygienic milk quality**

Hygienic milk quality is related to: Total bacteria counts (TBC), somatic cell counts

(SCC), Aflatoxins levels and Antibiotics level.

TBC and SCC are the main parameters taken into consideration for assessing milk quality from a hygienic point of view [76].

TBC is an indicator of hygiene of the animal and udder, milking, shelter, and milk storage conditions. The TBC test is used for screening the bacteria level.

SCC is an indicator of udder health and SCC test is used for screening mastitis [56, 68].

The main contamination sources are: animals, arthropods, humans and environment (air, dust, forages, equipments, tools, shelter, storage temperature etc) [21].

Also, season could influence TBC and SCC. TBC was found higher in winter and spring seasons and lower in summer and fall seasons, while SCC was identified lower in spring, but the highest in autumn [68].

Milk obtained from healthy animals has normally a content of bacteria such as:

Staphylococcus, Streptococcus etc [21].

After a hygienic milking, "the TBC level varies between 100- 5,000 cfu. mL<sup>-1</sup> and SCC is lower than 250,000 mL<sup>-1</sup> " as affirmed [19, 68].

TBC could be "higher than 107 cfu. mL<sup>-1</sup> and SCC could be over 106 mL<sup>-1</sup>" when milk is obtained in bad hygiene conditions as mentioned [67, 99].

A high TBC and SCC have a negative impact on milk quality, milk technological properties [68], shelf life of the pasteurized milk [95], sensory features of cheese [10] and production [103].

For the reasons mentioned above, in many countries are established quality standards for milk hygienic quality.

Despite that there are some differences from a country to another, the standards have a single purpose to assure a high quality milk and milk production for human consumption and food safety and security.

Table 3. The main characteristics and parameters reflecting raw milk quality

Chemical composition	Sensory characteristics	Physical characteristics	Chemical characteristics	Hygienic quality
-Fat %	-Aspect	-Density	-Acidity (pH)	-Total Bacteria Counts (TBC) or Bactoscan
-Protein %	-Consistency	-Viscosity	-Titrable acidity	-Bulk Tank Somatic Cell Counts (BTSCC)
-Water %	-Color	-Opacity	-Dry matter	-Aflatoxin level
-Carbohydrates %	-Taste	-Specific heat capacity	-Impurities	-Antibiotics level
-Minerals	-Snell	-Boiling point		
-Vitamins		-Freezing point		
		-Refractive index		
		-Superficial tension		
		-Specific resistivity		

Source: Own design.

**The milk hygienic quality in the EU countries** is based on a legal framework including the following regulations: Council Directive 92/46/EC/1992 [14], Council Directive 94/71/EC/2013 [15] amending Directive 92/46/EC/1992, Council Directive 2002/99/EC [16], Regulation (EC) No 178/2002, [86], Regulation (EC) No 852/2004 [86], Regulation (EC) No 853/2004 [88], Regulation (EC) No 854/2004 [89], Regulation (EC) 882/2004 [90], EU

Commission Regulation No.1662/2006 amending Regulation (EC) No. 853/2004 [24], Commission Regulation (EC) No 1664/2006 amending Regulation (EC) No 2074/2005 [12], Commission Regulation (EU) No 605/2010 [13].

This legislation is in force in all the EU member states [43], but also in other European countries (Norway and Switzerland), Australia [15], New Zealand [100] and Canada [100].

In the EU, the milk quality standards for milk hygienic quality are:

**(a) maximum 100,000 TBC/ml** or 100,000 cfu.mL<sup>-1</sup> (5.00 log 10 cfu.mL<sup>-1</sup>) in bulk tank. In Bactoscan units, this means maximum 100 units for bactoscan/mL in the collected milk (1 unit of bactoscan = 1,000 bacteria/mL).

However, TBC should be maintained below 15,000 bacteria/mL or 15 units of bactoscan to reduce the risk of mastitis, to improve milk quality, to prolong the milk products shelf life and to strengthen the ability of milk to be processed into cheese.

The total bacteria counts (TBC) in the EU 100,000 bacteria/mL is also the superior threshold for Grade A milk in the USA [2].

**(b) maximum 400,000 mL<sup>-1</sup> BTSCC** is the limit adopted in the EU, Australia, New Zealand and Canada.

In Brazil, the maximum BTSCC level is 1,000,000 cells/mL<sup>-1</sup>. [20, 43, 54, 55, 91, 100]. Since May 16, 2018, the EU established the Hygiene Regulations with regard to the testing of raw milk for Plate Counts (TBC) and SCC.

For cow raw milk, the Plate count is determined at 30 C degrees per ml and should be  $\leq 100,000$  per mL and should be determined rolling geometric average over a two-month period with at least two samples per month.

The SCC is determined rolling geometric average over a three-month period with at least one sample per month, unless the competent authority specifies another methodology to take into account of seasonal variations in production levels. The maximum limit is 400,000 cells/mL [20].

**In the USA, the milk quality standards were and are regulated by the following legal framework:** FDA. 1991. Actions of the 1991 National Conference on Interstate Milk Shipments, August 22 memorandum from Milk Safety Branch [29], the ordinances issued by US Department of Health and Human Services, Public Health Service, Food and Drug Administration. Washington, DC: FDA. 1993. Grade "A" Pasteurized Milk Ordinance, 1993 Revision. US Department of Health and Human Services, Washington, DC [30], FDA. 2009. Pasteurized Milk Ordinance,

PMO, Grade "A" Pasteurized Milk Ordinance, 2009 Revision [31], FDA, 2011, Grade "A" Pasteurized Milk Ordinance 2011[32], FDA, 2013, Grade "A" Pasteurized Milk Ordinance [33], FDA, 2015, Grade "A" Pasteurized Milk Ordinance 2015 [34, 63].

According to the regulations in force, the milk hygienic quality standards in the USA are:

**(a) maximum 100,000 cfu for Grade A milk and maximum 300,000 cfu for Grade B milk**  
**(b) maximum 500,000 cells/ML for Grade A milk and 750,000 cells/mL for Grade B milk.**

Taking into consideration the importance of milk quality for food safety, and to compile with the EU standards for facilitating the trade with dairy products, in the USA there are made efforts to reduce the threshold of 750,000 SCC/mL.

Norman *et al.*, (2000, 2011) mentioned that in the most herds SCC is much below legal bulk tank thresholds and could easily meet lower limits, for instance: 500,000 - 400,000 cells.mL, therefore it is possible to reduce the current legal limit of 750,000 SCC/mL [62,63].

However, a few American states diminished the maximum threshold of BTSCCs as follows: to 600,000 in California, 400,000 in Idaho, 500,000 in Oregon and 400,000 in Washington.

In milk shipments, in the USA, BTSCCs are monitored based on the standards established by U,S, Pasteurized Milk Ordinance (PMO) which provides maximum 750,000 cells/mL for Grade A milk shipments [20, 34].

Because the EU regulations do not compile with the American regulations regarding BTSCC, there are some problems regarding the milk products which are subject of export/import between the two trade partners. Despite the efforts made to diminish the maximum threshold from BTSCC 750,000 to 400,000 cell/mL, the PMO did not change the legal framework, and this created problems to the exports of dairy products from the USA to the EU.

For this reason, Norman *et al.*, (2011) affirmed that the U.S. milk producers have four consecutive rolling three-month SCC means greater than the 400,000 cells/mL limit cannot

export milk to the EU unless derogation is requested and approved. If derogation is not approved, the milk supplier must suspend, segregate or discontinue certification" [63].

Also, Norman *et al*, (2011) observed that despite both in the EU and in the USA the bacterial limit TBC is the same, 100,000 cells/mL, the method of calculation does not compile. In the EU, it is used a 2-month geometric mean based on a minimum of two standard plate counts performed per month. The EU bacterial limit 100,000 cells/MI is the limit for Grade A milk in the USA, but in the U.S. the calculation is made differently [63].

Despite that in 2011, it took place the National Conference on Interstate Milk Shipments (NCIMS), on this occasion it was not taken any decision to reduce the current BTSCC maximum limit, but there were discussed and issued promising outcomes on two topics: "reasonable regulations in the Pasteurized Milk Ordinance (PMO) that will

allow it to align with pending requirements of the Food Safety Modernization Act (FSMA)" and "sampling criteria and rapid test methods to expand the requirements for testing raw milk for additional drug residues".[60].

In the USA, based on the results obtained within the Dairy Herd Improvement (DHI) somatic cell testing during the year 2017, Norman *et al*, (2017) [64] affirmed that in 2017 compared to the year 1995, the number of herd test-days was 149,130 by 44 % lower, the average herd size was 202.5 cows/herd 4.05 times higher, the average daily milk yield reached 78.1 lb (pounds) being by 19.6 % higher, the national average herd test-days was 197,000 cells/MI by 26 % lower, and the the percentages of the herd test-days higher than the 4 groups of SCC thresholds 750,000, 600,000, 500,000 and 400,000 was 1.6 %, 3.2 %, 5.7 % and, respectively 10.8%, much lower than in 1995 (Table 4).

Table 4. Comparative results regarding the average herd test-days, average herd size, average SCC/herd and the percentage of herd test-days over 4 SCC thresholds in the USA in 2017 versus 1995 based on the data of the herds enrolled in Dairy Herd Improvement Programme

	2017	1995	2017/1995%	Annual trend in the period 1995-2017 based on linear regression
Number of herd test-days	149,130	265,844	56.09	-6,011
Average herd size (cows/herd)	202.5	50	405.00	7.3***
Average daily milk yield (lb/herd)	78.1	65.3	119.60	0.6***
Average SCC per herd (cells/mL)	197,000	304,000	64.80	-6.8***
Percentage of herd test-days with SCC higher than:				
750,000 cells/mL	1.6	4.1	30.02	-0.2***
600,000 cells/mL	3.2	9.3	34.40	-0.4***
500,000 cells/mL	5.7	16.0	35.62	-0.7***
400,000 cell/MI	10.8	27.2	39.70	-1.0***

\*\*\*Significant for p<0.001.

Source: Own adaptation based on [64].

These positive results reflected the efforts of the dairy farmers to improve farm management and apply a severe culling to reach a higher milk quality.

The same authors found that there are differences among the states determined by climate conditions, especially concerning temperature and moisture, but also due to farm size and the practices used for mastitis control. The Northern, Eastern and Western

states of the USA registered lower SCC/mL than the national average level, while the South-Eastern states recorded a higher SCC [64].

**Milk price and its factors of influence**

Milk price is influenced by many internal and external factors (Table 5).

(a)The internal factors influencing milk price are:

(i) **Milk quality** regarding *sensory features, physical and chemical properties, chemical composition* especially concerning fat and protein percentages, as discussed in the previous paragraphs, and also *milk hygienic quality* given by a smaller TBC and BTSCC than the maximum limits admitted by the standards in force, reflecting a good animal health and welfare, a corresponding feeding with high quality forages without aflatoxins, a rigorous mastitis and antibiotics control, a corresponding hygiene of the cow shelters, animals, milking and storage.

Raw milk price depends on milk quality, as it is a close relationship between these two indicators which are of high interest to farmers who have to permanently improve milk quality in order to get a better price destined to cover production cost and assure profit.

Milk quality differs from a farm to another and as a result milk price as well [113].

The improvement of milk quality is obviously a compulsory goal of dairy farmers, because they could get incentives ( bonuses, premiums etc) helpful from an economic point of view [8].

Erickson (2016) and Bewley (2018) consider that "the level of bonuses, premiums etc, farm size and milk yield are the triad which could increase the dairy farmers' income and profit" [22].

(ii) **The amount of marketed milk** in close relationship with milk yield and the number of milking cows in the farm could influence milk price. Higher amounts of commercialized milk based on the contracts concluded with milk processors could attract higher milk prices. However, the quantity of sold milk varies according to season which also has a deep impact on milk composition as mentioned in the above discussions [72, 80].

(iii) **The marketed milk pattern** is another factor influencing milk price. When the variations of the amounts of sold milk are smaller from a delivery to another, the dairy farmers could benefit of a higher price. For this reason, dairy farmers have to take measures to assure a flat production trend and at the same time to keep production costs

under control as milk price to cover them [78].

(iv) **Farm management** depending on knowledge, managerial skills, practical experience of the dairy farmer regarding applied technologies (cropping, breeding, reproduction, feeding, production etc) and financial aspects regarding gross income, gross margin, production costs, profit [74, 75, 79].

(v) **Milk marketing strategy** is closely linked to marketed milk, milk quality and market price [45, 82, 83].

(b) **The external factors** influencing milk price are:

(i) **Geographical area** where the farm is situated and is operating which has a deep influence on milk supply from a quantitative and qualitative point of view due to the specific climate and soil conditions, and all these could influence milk price.

(ii) **Milk supply pattern** in the area is another determinant of milk price. Milk supply should be consistent during the year as the domestic market requires. Any variation in milk offer could induce a different milk price.

(iii) **Competition among dairy farmers** operating in the same area is also an incentive to increase milk supply and get a better price at delivery. The difference of milk price could be 10-20 % from a farmer to another even they sell milk to the same processor [113].

(iv) **Milk payment system** including incentives (bonuses, premium, penalties etc).

*The incentives offered for milk yield* stimulate dairy farmers to produce and commercialize more milk. *The incentives offered for milk quality* have also a positive effect on milk price and farmers' income. *The loyalty incentives* are also in the benefit of the farmers enabling them to continue to produce and deliver milk of high quality to the same processor and increase their income.

*The penalties* for exceeding the maximum thresholds of the quality standards for TBC and BTSCC have the reason to encourage dairy farmers to improve milk quality.

Milk payment system continue to have a substantial effect on the reduction of TBC and BTSCC and a higher and higher percentage of dairy farmers deliver raw milk according to

the quality standards and below them.[63, 94, 104].

(v) *Milk processors financial situation* regarding milk processing costs, sales, profit and profitability rate in close relationship with milk supply volume attested by the delivery contracts concluded with dairy farmers and milk payment strategy which has to assure a balance between the shareholders' profit and the payments to dairy farmers which are destined to maintain a secure supply level.

From this point of view, each processor has to make a deep analysis of milk market before making the decision what milk price to offer in order to manage the competition among processors for milk supply. Therefore, milk processors themselves are interested as dairy

farmers to produce more milk and of higher quality and their business to be profitable in order to benefit of a permanent delivery to processing industry.

(vi) *Milk price trends in the domestic and international market* could influence the decision of milk processors regarding milk price offer to their suppliers.

The international trade with dairy products, the demand/offer ratio, the export/import ratio on various markets have a impact on prices. For this reason, processors have to be permanently informed on the evolution of world prices before making the decision how much to pay for raw milk supply [77, 80, 84, 113].

Table 5. Milk price factors of influence

On-farm factors	Off-farm factors
-Milk quality	-Geographical area
-Marketed milk	-Milk supply pattern
-Marketed milk pattern	-Competition among dairy farmers
-Farm management	-Milk payments system
-Milk marketing strategy	-Milk processors' financial situation
	-Milk processors price offer
	-Milk price trends on the domestic and international markets

Source: Own design.

## CONCLUSIONS

The paper emphasized the importance of raw milk quality and its factors of influence in connection with milk price. The purpose was to identify the reasons why milk price is different between countries, regions, farms and processors.

Also, this analysis pointed out what dairy farmers have to make to improve milk quality in order to get a better and satisfactory price for covering milk cost and assure a profit.

The study allowed to issue the following recommendations to dairy farmers to improve milk quality and price:

- to improve breeding programmes in their herd by a high selection pressure and corresponding mating;
- to produce and administrate high quality forages and a balanced diet to dairy cows for increasing production and fat and protein percentages;

-to assure a corresponding comfort and hygiene in the shelters, for cows and udder, milk equipments, milking, storage;

-to keep permanently under control the treatments with antibiotics and other medicines remaining in milk and apply a rigorous control of mastitis;

-to increase milk yield and cow livestock in order to deliver a higher amount of high quality milk;

-to compensate the seasonal variation of milk production by producing a high quality of milk richer in fat and protein and with TBC and BTSCC below the maximum thresholds imposed by the regulations in force;

to entirely respect the regulations regarding milk quality;

-to be aware of the stronger and stronger competition on milk market among suppliers and processors for a high quality offer;

-to keep an eye on the milk price trend both on the internal and external markets in order

to establish a more effective strategy for developing their business under profitable condition.

As a final conclusion, each dairy farmers should be aware of his role in increasing milk demand and supply of high quality milk and dairy products.

## REFERENCES

- [1]Acatincai, S., 2004, Cattle breeding (Cresterea bovinelor), Timisoara, Eurobit Publishing House, 32-59.
- [2]Bactoscan issues in dairy farm, CID LINES, <http://www.cidlines.com/en-INT/bactoscan-issues-dairy-farm>, Accessed December 20, 2018
- [3]Bastin, C., Gengler, N., Soyeurt, H., 2011, Phenotypic and genetic variability of production traits and milk fatty acids content across days in milk for Walloon Holstein first parity cows. *J. of Dairy Sci*, 94(8):4152-4163.
- [4]Battilani, P., Toscano, P., van der Fels-Klerx, H.J., Moretti, A., Camardo Leggieri, M., Brera, C., Rortais, A., Goumperis, T., Robinson, T., 2016, Aflatoxin B1 contamination in maize in Europe increases due to climate change. *Scientific Reports* 6, Article number: 24328, <https://www.nature.com/articles/srep24328>, Accessed December 20, 2018.
- [5]Beede, D., 1994, Water -The most important nutrient for dairy cattle, 31st Florida Conference Dairy Production, Gainesville, University of Florida, USA, April 12-13, 1994, <http://dairy.ifas.ufl.edu/dpc/1994/Beede.pdf>, Accessed December 20, 2018.
- [6]Bensaha, H., Arbouche, F., 2017, How can the staff hygiene practices influence the milk healthy quality? Case of study from M'zab dairy, *International Journal of Veterinary Sciences and Animal Husbandry*, Vol.2, Issue 6, Part A.
- [7]Bernabucci, U., Lacetera, N., Ronchi, B., Nardone, A., 2002, Effects of the hot season on milk protein fractions in Holstein cows, *Anim. Res.* 51 (2002) 25–33.
- [8]Bewley, J., *Improving Milk Quality When Milk Prices are Low*, University of Kentucky, USA, Cooperative Extension Service. [https://afs.ca.uky.edu/files/improving\\_milk\\_quality\\_when\\_milk\\_prices\\_are\\_low.pdf](https://afs.ca.uky.edu/files/improving_milk_quality_when_milk_prices_are_low.pdf), Accessed December 20, 2018.
- [9]Bryden, W. L., 2007, Mycotoxins in the food chain: human health implications. *Asia Pac J Clin Nutr.* 16 Suppl 1: 95-101.
- [10]Chen, S. X., Wang, J. Z., Van Kessel, J. S., Ren, F. Z., Zeng, S. S., 2010, Effect of somatic cell count in goat milk on yield, sensory quality, and fatty acid profile of semisoft cheese. *Journal of Dairy Science*, 93 (4), 1345-1354.
- [11]Churchill, K.A., Kochendoerfer, N., Thonney, M.L., Brown, D.L., 2016, Aflatoxin concentrations in milk from high-producing US Holsteins fed naturally-infected maize and milked 3x per day, Cornell University, USA, [https://ecommons.cornell.edu/bitstream/handle/1813/44748/4ChurchillBrown\\_Manuscript.pdf?sequence=1](https://ecommons.cornell.edu/bitstream/handle/1813/44748/4ChurchillBrown_Manuscript.pdf?sequence=1), Accessed December 20, 2018.
- [12]Commission Regulation (EC) No 1664/2006 of 6 November 2006 amending Regulation (EC) No 2074/2005 as regards implementing measures for certain products of animal origin intended for human consumption and repealing certain implementing measures, <https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:320:0013:0045:EN:PDF>, Accessed December 20, 2018.
- [13]Commission Regulation (EU) No 605/2010 of 2 July 2010 laying down animal and public health and veterinary certification conditions for the introduction into the European Union of raw milk and dairy products intended for human consumption; <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32010R0605&from=EN>, Accessed December 20, 2018.
- [14]Council Directive 92/46/EC/1992 of 16 June 1992 laying down the health rules for the production and placing on the market of raw milk, heat-treated milk and milk-based products, <https://publications.europa.eu/en/publication-detail/-/publication/37321618-2366-4497-8b0e-381135dd7492/language-en>, Accessed December 20, 2018.
- [15]Council Directive 94/71/EC of 13 December 1994 amending Directive 92/46/EEC laying down the health rules for the production and placing on the market of raw milk, heat-treated milk and milk-based products, <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:31994L0071&from=EN>, Accessed December 20, 2018.
- [16]Council Directive 2002/99/EC of 16 December 2002 laying down the animal health rules governing the production, processing, distribution and introduction of products of animal origin for human consumption, <https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:018:0011:0020:EN:PDF>, Accessed December 20, 2018.
- [17]Dairy Global - FAO: More milk and more international trade, <https://www.dairyglobal.net/Market-trends/Articles/2018/8/FAO-More-milk-and-more-international-trade-321132E/>, Accessed December 15, 2018.
- [18]De Rijk, T., van Egmond, H., van der Fels-Klerx, H.J., Herbes, R., de Nijs, M., Samson, R., Slate, A., van der Spiegel, M., 2015, A study of the 2013 Western European issue of aflatoxin contamination of maize from the Balkan area. *World Mycotoxin J.* 8:641–651.
- [19]Desmasures, N., Bazin, F., Gueguen, M., 1997, Microbiological composition of raw milk from selected farms in the Camembert region of Normandy. *J. Applied Microbiology*, 83(1), 53-58.

- [20]Determining US Milk Quality Using Bulk-Tank Somatic Cell Counts, 2012, <http://www.thecattlesite.com/articles/3353/determining-us-milk-quality-using-bulktank-somatic-cell-counts/>, Accessed December 20, 2018
- [21]Diaconescu, C., Vidu, L., Urdes, L., Dragomir, N., 2011, Tehnici avansate de aprecierea calitatii laptelui si a produselor lactate, Editura Valahia University Press
- [22]Erickson, P., 2016, Managing With Low Milk Prices, University of New Hampshire Cooperative Extension, Dairy Herd, <https://www.dairyherd.com/article/managing-low-milk-prices>
- [23]Eurostat Statistics Explained, Milk and milk product statistics in 2016, Cow milk production on farms (Million tonnes), [https://ec.europa.eu/eurostat/statistics-explained/index.php/Milk\\_and\\_milk\\_product\\_statistics](https://ec.europa.eu/eurostat/statistics-explained/index.php/Milk_and_milk_product_statistics), Accessed December 20, 2018
- [24]EU Commission Regulation No.1662/2006 of 6 November 2006 amending Regulation (EC) No. 853/2004 of the European Parliament and of the Council laying down specific hygiene rules for food of animal origin, <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32006R1662&from=EN>, Accessed December 20, 2018
- [25]FAO: Dairy Market Review, April, 2018, <http://www.fao.org/3/I9210EN/i9210en.pdf>, Accessed December 15, 2018.
- [26]FAO, IFCN, 2008, Dairy Report. Chap.2.2. Global Dairy Sector: Status and Trends, <http://www.fao.org/docrep/012/i1522e/i1522e02.pdf>, Accessed December 20, 2018.
- [27]FAO Milk analysis, <http://www.fao.org/3/au135e.pdf>, Accessed December 20, 2018.
- [28]Frelich, J., Ślachta, M., Hanuš, O., Špička, J., Samková, E., Węglarz, A., Zapletal, P., 2012, Seasonal variation in fatty acid composition of cow milk in relation to the feeding system, Animal Science Papers and Reports.,30(3), 219-229.
- [29]FDA. 1991. Actions of the 1991 National Conference on Interstate Milk Shipments, August 22 memorandum from Milk Safety Branch.
- [30]FDA. 1993. Grade “A” Pasteurized Milk Ordinance, 1993 Revision. US Department of Health and Human Services, Washington, DC.
- [31]FDA. 2009. PMO Grade “A” Pasteurized Milk Ordinance, 2009 Revision. US Department of Health and Human Services, Public Health Service, Food and Drug Administration. Washington, DC.
- [32]FDA, 2011, Grade “A” Pasteurized Milk Ordinance, Including Provisions from the Grade “A” Condensed and Dry Milk Products and Condensed and Dry Whey--Supplement I to the Grade “A” Pasteurized Milk Ordinance. Public Health Service/Food and Drug Administration.
- [33]FDA, 2013, Grade “A” Pasteurized Milk Ordinance, Including Provisions from the Grade “A” Condensed and Dry Milk Products and Condensed and Dry Whey--Supplement I to the Grade “A” Pasteurized Milk Ordinance. Public Health Service/Food and Drug Administration.
- [34]FDA, 2015, Grade “A” Pasteurized Milk Ordinance 2015, U.S. Department of Health and Human Services Public Health Service Food and Drug Administration, <https://www.fda.gov/downloads/food/guidanceregulation/guidancedocumentsregulatoryinformation/milk/ucm513508.pdf>, Accessed December 20, 2018.
- [35]Frelich, J., Ślachta, M., Hanuš, O., Špička, J., Samková, E., Węglarz, A., Zapletal, P., 2012, Seasonal variation in fatty acid composition of cow milk in relation to the feeding system, Animal Science Papers and Reports.,30(3), 219-229.
- [36]Gaunt, S. N. 1980. Genetic variation in the yields and contents of milk constituents. Int. Dairy Fed. Bull. Doc.125:73
- [37]Gaworski, M., Kowalska, M., 2013, Effect of maintenance system on the selected aspects of dairy cattle health, Annals of Warsaw University of Life Sciences – SGGW, Agriculture No 62 (Agricultural and Forest Engineering) 2013: 63–70.
- [38]Georgescu, G., Calin, I., Maraginean, G., Diaconescu, S., Custura, I., 1999, Laptele și produsele lactate, Ed.Ceres, București
- [39]Grant, R.J., 1992, G92-1111 Mineral and Vitamin Nutrition of Dairy Cattle, University of Nebraska, USA, <http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1440&context=extensionhist>, Accessed December 20, 2018.
- [40]Grunert, K., Furst, T., Connors, M., Bisogni, C., 2000, Food quality and safety: consumer perception and demand. European Review of Agricultural Economics 32930:369-391.
- [41]Gurmessa, J., Melaku, A., 2012, Effect of Lactation Stage, Pregnancy, Parity and Age on Yield and Major Components of Raw Milk in Bred Cross Holstein Friesian Cows, World Journal of Dairy & Food Sciences 7 (2): 146-149.
- [42]Heritability of traits, Select Mating Service, (SMS), [www.selectsires.com/programs/heritabilityoftraits.html?version20180803](http://www.selectsires.com/programs/heritabilityoftraits.html?version20180803), Accessed December 20, 2018.
- [43]Hillerton, J.E., Berry, E.A., 2004, Quality of the milk supply: European regulations versus practice. Proceedings 43rd NMC Annual Meeting, pp. 207–214.
- [44]Hullár, I., Brand, A., 1993, Nutritional factors affecting milk quality, with special regard to milk protein: a review, Acta Vet Hung. 41(1-2):11-32.
- [45]Improving your milk price, AHDB Dairy, <https://dairy.ahdb.org.uk/market-information/milk-prices-contracts/milk-calculator-and-contracts/improving-your-milk-price/#.XDK62FUzaUk>, Accessed December 20, 2018.
- [46]International Agency for Research on Cancer . IARC Monographs on the Evaluation on Carcinogenic Risks to Humans: Aflatoxin M1. Volume 56 International Agency for Research on Cancer; Lyon, France: 1993

- [47]International Dairy Foods Association, IDFA, 2018, Importance of milk in diet, [www.idfa.org/news-views/media-kits/milk/importance-of-milk-in-diet](http://www.idfa.org/news-views/media-kits/milk/importance-of-milk-in-diet), Accessed December 15, 2018
- [48]Jenness, R., 1985, Biochemical and nutritional aspects of milk and colostrum. Ch. 5 in Lactation, B. L. Larson, editor. , ed. Ames: Iowa State University Press.
- [49]Keown, J. F., Everett, R.W., Empet, N.B., Wadell, L.H., 1986, Lactation curves. *J. Dairy Sci.* 69:769
- [50]Kitchen B. J., 1981, Bovine mastitis: Milk compositional changes and related diagnostic tests. *J. Dairy Res.* 48:167.
- [51]Kliem, K.E., Givens, D.I., 2011, Dairy products in the food chain: their impact on health. *Annual Rev.Food Sci. Technol.* 2: 21-36.
- [52]Laben, R.C., 1963, Factors Responsible for Variation in Milk Composition, *J. of Dairy Sci*, Volume 46, Issue 11, 1293–1301.
- [53]Linn, J.G., 1988, Factors Affecting the Composition of Milk from Dairy Cows, *Designing Foods: Animal Product Options in the Marketplace*. Washington, National Academies Press, <https://www.ncbi.nlm.nih.gov/books/NBK218193/>, Accessed December 20, 2018.
- [54]Milk Act R.R.O.1990, Regulation 761, Milk and milk products, with the amendments made on May 1st, 2018, <https://www.ontario.ca/laws/regulation/900761>, Accessed December 20, 2018.
- [55]More, S.J., 2009, Global trends in milk quality: implications for the Irish dairy industry, *Ir.Vet.J.*, 62(Suppl 4): S5–14.
- [56]Murphy, S.C., Boor, K.J., 2010, Sources and Causes of High Bacteria Counts in Raw Milk: An Abbreviated Review, <https://articles.extension.org/pages/11811/sources-and-causes-of-high-bacteria-counts-in-raw-milk:-an-abbreviated-review>, Accessed December 20, 2018.
- [57]Musliu, A., Gjonbalaj, M., Sharifi, K., Meqe, M., 2009, Economic losses related to raw milk quality on commercial dairy farms in Kosovo, *New Medit*, No.3, 49-53.
- [58]Nateghi, L., Yousefi, M., Zamani, E., Gholamian, M., Mohammadzadeh, M., 2014, The effect of different seasons on the milk quality, *European Journal of Experimental Biology*, 2014, 4(1):550-552.
- [59]National Institute of Statistic, NIS, Tempo online data base, <http://statistici.insse.ro/shop/>, Accessed December 20, 2018.
- [60]NCIMS Attendees Pass Positive Proposals on PMO, Drug Residue Testing, <https://www.idfa.org/news-views/headline-news/article/2015/05/07/ncims-attendees-pass-positive-proposals-on-pmo-drug-residue-testing>, Accessed December 20, 2018.
- [61]Neciu, F.C., Csiszter, L.T., Neamț, R.I., Ilie, D.E., Costin, L., 2012, Influence of season on raw milk yield and quality in a dairy farm, *Lucrări Științifice - Seria Zootehnie*, vol. 58, 269-272.
- [62]Norman, D., Miller, R., Wright, J.R., Wiggans, G.R., 2000, Herd and State Means for Somatic Cell Count from Dairy Herd Improvement, December 2000, *Journal of Dairy Science* 83(12):2782-8
- [63]Norman, H.D., Lombard, J.E., Wright, J.R., Kopral, C.A., Rodriguez, J.M., Miller, R.H., 2011, Consequence of alternative standards for bulk tank somatic cell count of dairy herds in the United States, *J. Dairy Sci.* 94 :6243–6256.
- [64]Norman, H.D, Walton, L.M., Dürr, J, 2017, Somatic cell counts of milk from Dairy Herd Improvement herds during 2017, Council on Dairy Cattle Breeding, <https://queries.uscdcb.com/publish/dhi/current/sccx.html>, Accessed December 20, 2018
- [65]Olori, V., Brotehrstone, S., Hill, W.G., McGuirk, B.J., 1997, Effect of gestation stage on milk yield and composition in Holstein Friesian dairy cattle, *Livestock Production Science* 52(2):167-176
- [66]Otieno, K., 2017, Here’s Why Freezing Point is More Dependable Than Lactometric Method in Determining Milk Adulteration, <http://dairytechnologist.com/freezing-point-of-milk-determination/>, Accessed December 20, 2018.
- [67]Paar, A., 2017, Density measurement of milk and dairy products, <https://www.theengineer.co.uk/supplier-network/product/density-measurement-of-milk-and-dairy-products/>, Accessed December 20, 2018.
- [68]Pasic, V., Tudor Kalit, M., Salajpal, K., Samarzija, D., Havranek, J., Kalit, S., 2016, The impact of changes in the milk payment system and season on the hygienic quality of milk, *Journal of Central Eastern Agriculture*, 17(3):629-639.
- [69]Patterson, M.E., 2016, Assessment of consumers' perceptions, preferences, behaviour and values with fluid milk packaging, code date and new product concepts. Dissertation thesis, Yowa State University, pp.1-9.
- [70]Peaker, M., Faulkner, A., 1983, Soluble milk constituents. *Proc. Nutr. Soc.* 42:419
- [71]Pirestani, A., Toghyani, M., 2010, The effect of aflatoxin levels on milk production, reproduction and lameness in high production Holstein cows, *African Journal of Biotechnology* Vol. 9(46), pp. 7905-7908.
- [72]Pirvutoiu, I.,Popescu Agatha, 2012, Research concerning standard gross margin depending on yield in dairy farming, *Scientific Papers Animal Science and Biotechnologies*, Vol.45(2):339-342.
- [73]Piva, G., Battilani, P., Pietri, A., 2006, Emerging issues in Southern Europe: Aflatoxins in Italy. In: Barug D., Bhatnagar D., van Egmond H.P., van der Kamp J.W., van Osenbruggen W.A., Visconti A., editors. *The Mycotoxin Factbook*. Wageningen Academic Publishers; Wageningen, The Netherlands.pp. 139–153.
- [74]Popescu Agatha, 2006, Financial management in dairy farms, Dominor Publishing House, Bucharest.
- [75]Popescu Agatha, 2009, Analysis of milk production and economic efficiency in dairy farms, *Scientific Papers Animal Science and Biotechnologies*, Vol.42(1):507-512.
- [76]Popescu Agatha, Angel, E., 2008, Analysis of milk quality and its importance for milk processors,

- Scientific Papers Animal Science and Biotechnologies, Vol.41(1):695-701, Timisoara.
- [77]Popescu Agatha, 2011, Research concerning the correlation between demand and offer in the Romanian milk market, *Scientific Papers Animal Science and Biotechnologies*, 44(2):504-607.
- [78]Popescu Agatha, 2014, Research on profit variation depending on marketed milk and production cost in dairy farming, *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development* Vol. 14(2):223-230.
- [79]Popescu Agatha, 2014, Research on milk cost, return and profitability in dairy farming, *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development* Vol. 14(2):219-222.
- [80]Popescu Agatha, 2015, Research on the trends in Romania's milk and dairy products foreign trade, *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development* Vol. 15(1), 387-392.
- [81]Popescu Agatha, 2015, Research on the trends in milking livestock and milk production in Romania, *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development* Vol. 15(1), 377-386.
- [82]Popescu Agatha, 2015, Multiple correlation and regression in predicting milk price, *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development* Vol. 15(4):231-238.
- [83]Popescu Agatha, 2016, The milk market concentration and competition thresholds in Romania, *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development* Vol. 16(2):247-252.
- [84]Popescu Agatha, 2017, Trends in milk market and milk crisis impact in Romania, *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development* Vol. 17(2), 281-289.
- [85]Postnov, D.D., Moller, F., Sosnovtseva, O., 2018, Dairy products viscosity estimated by laser speckle correlation, *PLoS One*, 2018; 13(9): e0203141.
- [86]Regulation (EC) No. 178/2002 of the European Parliament and of the Council, 28 January 2002, laying down the general principles and requirements of food law, establishing the European Food Safety Authority and setting up the procedures in matters of food safety, <https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSL:EG:2002R0178:20080325:EN:PDF>, Accessed December 20, 2018.
- [87]Regulation (EC) No. 852/2004 of the European Parliament and of the Council, 29 April 2004, on the hygiene of foodstuffs, <https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2004:L39:0001:0054:en:PDF>, Accessed December 20, 2018.
- [88]Regulation (EC) No. 853/2004 of the European Parliament and of the Council, 29 April 2004, laying down specific hygiene rules for on the hygiene of foodstuffs, <https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2004:L39:0055:0205:EN:PDF>, Accessed December 20, 2018.
- [89]Regulation (EC) No. 854/2004 of the European Parliament and of the Council, 29 April 2004, laying down specific rules for the organisation of official controls on products of animal origin intended for human consumption, <https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2004:L226:0083:0127:EN:PDF>, Accessed December 20, 2018.
- [90]Regulation (EC) No. 882/2004 of the European Parliament and of the Council, 29 April 2004, on official controls performed to ensure the verification of compliance with feed and food law, animal health and animal welfare rules, <https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2004:L165:0001:0141:EN:PDF>, Accessed December 20, 2018.
- [91]Rodrigues, C.O., Cassoli, L.D., Machado, P.F., 2005, Milk quality and new regulations in Brazil. *J Dairy Sci* 88:272.
- [92]Rolands G.J., Booth J.M., 1988, Methods of data collection and analysis for cases of clinical bovine mastitis. *Proceedings of the Society for Veterinary Epidemiology and Preventive Medicine*, 116-125.
- [93]Ruegg, P., 2018, Premiums, Production and Pails of Discarded Milk How Much Money Does Mastitis Cost You?, University of Wisconsin, USA, <https://milkquality.wisc.edu/wp-content/uploads/sites/212/2011/09/how-much-money-does-mastitis-cost.pdf>, Accessed December 20, 2018.
- [94]Samaržija, D., Zamberlin, S., Pogačić, T., 2012, Psychrotrophic bacteria and milk and dairy products quality. *Mljekarstvo*, 62 (2), 77-95.
- [95]Santos, M. V., Ma, Y., Barbano, D. M., 2003, Effect of somatic cell count on proteolysis and lipolysis in pasteurized fluid milk during shelf-life storage. *Journal of Dairy Science*, 86 (8), 2491-2503.
- [96]Serban, D., 2010, Milk quality and milking hygiene (Calitatea laptelui si igiena mulsului), <http://agroromania.manager.ro/articole/stiri/calitatea-laptelui-si-igiena-mulsului-6686.html>, Accessed December 20, 2018.
- [97]Shimada, Y.1991, Low milk fat syndrome and magnesium oxide supplementation, *Magnes Res*, Sep-Dec, 4(3-4):177-184,
- [98]Silaghi-Dumitrescu, R., Tomoioga, N., Jurco, E., 2018, Variability in biochemical composition of milk among three representative breeds of dairy cows from Romania, *Sudia UBB Chemia*, LXIII, 1, 2018, pp. 55-62.
- [99]Slaughuis, B., 1996, Sources and significance of contaminants on different levels of raw milk production. *International Dairy Federation, Book of Abstracts of Symposium on Bacteriological Quality of Raw Milk*. Wolfpassing, Austria, March 12-13, 1996.
- [100]Smith, K.L., Hogan, J.S., 1998, Milk Quality - A Worldwide Perspective. *Proceedings 37th National Mastitis Council Annual Meeting*, pp 3-9.

- [101]Sorentino, E., 2010, Microbiology of dairy products, *Course notes*, Universita del Molise, Italia, Ed. Creative Commons Public License
- [102]Statista, 2018, Cow milk production worldwide from 2013 to 2018(million metric tons), [www.statista.com/statistics/263952/production-of-milk-worldwide](http://www.statista.com/statistics/263952/production-of-milk-worldwide), Accessed December 15, 2018.
- [103]Summer, A., Franceschi, P., Formaggioni, P., Malacarne, M., 2015, Influence of milk somatic cell content on Parmigiano-Reggiano cheese yield. *Journal of Dairy Research*, 82 (2), 222-227.
- [104]Suteu, L., 2009, Managementul calitatii laptelui si a produselor din lapte de la producator la consumator, Ph.D. Thesis, University of Agricultural Sciences and Veterinary Medicine, Cluj-Napoca, Romania.
- [105]Sutton, J. D., 1980, Influence of nutritional factors on the yield and content of milk fat: Dietary components other than fat. *Bulletin, International Dairy Federation* 1980 No.125 pp.126-134.
- [106]Swensson, C., Lindmark- Månsson, H., 2007, The prospect of obtaining beneficial mineral and vitamin contents in cow's milk through feed, *J. of Animal and Feed Science*, 16 (Suppl. 1):21-41.
- [107]The heritability percentage of a number of traits-Kinne.net, Maxine Kinne, 2000, <http://kinne.net/heritcht.htm>, Accessed December 20, 2018.
- [108]The physico-chemical characteristics of milk (Caracteristicile fizico-chimice ale laptelui), 2015, Pro alimente dincolo de ambalaj, <http://proalimente.com/caracteristicile-fizico-chimice-laptelui>, Accessed December 20, 2018.
- [109]Toušová, R., Ducháček, J., Stádník, L., Ptáček, M., Pokorná, S., 2017, Influence of temperature-humidity relations during years on milk production and quality. *Acta Universitatis Agriculturae et Silviculturae Medeliane Brunensis*, Vol.65(1):211-218.
- [110]Tudor, L., 2013, The control of milk quality and milk products (Controlul calitatii laptelui si produselor lactate), ID Project: POSDRU/81/3.2./S/58833, Perfectionarea resurselor umane in medicina veterinara, <https://www.edu-veterinar.ro/files/download/prezentari/siguranta-alimentelor/Controlul-calitatii-laptelui-si-produselor-lactate.pdf>, Accessed December 20, 2018.
- [111]Van der Fels-Klerx, H.J., Camenzuli, L., 2016, Effects of Milk Yield, Feed Composition, and Feed Contamination with Aflatoxin B1 on the Aflatoxin M1 Concentration in Dairy Cows' Milk Investigated Using Monte Carlo Simulation Modelling, *Toxins (Basel)* 8(10): 290.
- [112]Vintila, C., 2012, Let produce only high quality milk (Sa producem in permanenta lapte de calitate), <https://www.revista-ferma.ro/articole/alimentatie/sa-producem-in-permanenta-lapte-de-calitate>, Accessed December 20, 2018.
- [113]What influences farm gate milk prices ?, Australian Government, RM Consulting Group Pty Ltd trading as RMCG, <http://www.agriculture.gov.au/milkpriceindex/Docume>nts/what-influences-your-milk-price.pdf, Accessed December 20, 2018.
- [114]Woodford, J. A., Jorgensen, N.A., Barrington, G.P., 1986, Impact of dietary fiber and physical form on performance of lactating dairy cows. *J. Dairy Sci.* 69:1035
- [115]World Dairy situation at a glance, 2018, Bulletin of the International Dairy Federation 494/2018, <https://store.fil-idf.org/wp-content/uploads/2018/10/WDS2018Preview-1.pdf>, Accessed December 20, 2018
- [116]Yalcin, C., 2000, Cost of Mastitis in Scottish Dairy Herds with Low and High subclinical Mastitis Problems. *Turkish J. of Vet. Anim Sci*, 24:465-472.
- [117]Young, C.W., Hillers, J.K., Freeman, A.E., 1986, Production, consumption and pricing of milk and its components, *J. Dairy Sci.*, 69:272.
- [118]Zeinhom, M.M.A., Abdel Aziz, R.L., Mohammed, A.N., Bernabucci, U., 2016, Impact of Seasonal Conditions on Quality and Pathogens Content of Milk in Friesian Cows, *Asian-Australas J Anim Sci.*, 2016, Aug. 29(8):1207-1213.



## TRENDS IN THE TOP RETAIL TRADE IN ROMANIA

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### **Abstract**

*The paper analyzed the retail trade in Romania during the last decade, 2008-2017, pointing out the performance achieved by the top 10 retailers Kaufland, Carrefour, Lidl, Auchan, Mega Image, Profi, Metro, Selgros, Rewe and Cora Hypermarket, based on the number of stores, turnover, net profit, market share and average number of employees. Romanian market proved to be a good business environment for retailers as long as consumption is increasing determined by the growth of wages and reduction of VAT. Both hypermarkets, supermarkets, discount stores and minimarkets have appeared on Romania's map and their number continue to grow as expected in the near future. The number of square meters commercial space per inhabitant is enough high as long as Romanians like shopping. For this reason, the retailers have to develop new strategies to strengthen their business and cover much better consumers' needs. Important efforts should be made to develop the minimarket network in the smaller cities and even in the rural localities, the commercial space should be modernized and offer a pleasant and attractive environment for shopping, e-commerce should be extended as a modern purchasing alternative, the offer should be diversified including more Romanian products as preferred by consumers, organic products should be more visible on the shelves which have to offer healthy products to the clients, a more intensive advertising should be useful for a better information of the consumers and for increasing sales and profit of the retailers.*

**Key words:** top retail, turnover, net profit, market share, trends, Romania

### **INTRODUCTION**

The modern trade is a complex, integrated and flexible system consisting of a large range of subsystems such as: retail network, wholesale network and import-export commercial trade which are operating on various markets.

The trade has a more and more important role in the regulation of the market mechanisms, the offer/demand ratio, in the strategic development of the modern economy and also for satisfying the best the population's needs in various goods and services [15, 18, 24].

Retail commerce plays the key role at the end of the movement of goods, achieving the resale of goods ready to be used in small amounts by various categories of beneficiaries for the purpose of supply consumers or end-users. It supposes three processes strongly interconnected: supply, storage and sale of goods to the final consumer. To fulfil its role, the retail trade develops close relationships with the producers and wholesalers informing them on the market needs, and informing the

consumers on what they need to buy to satisfy the best their requirements.

The retail network is continuously developing, and new strategies are adopted regarding the market requirements, consumers' needs, emplacement and dimension of the commercial spaces, the types of shops (hypermarket, supermarket, discount, minimarket etc), logistics, distribution of goods, selling forms, the internal organization of the selling space, the volume, structure and quality of the offer of goods, the merchandising techniques, the purchasing environment, advertising, e-commerce in order to attract more clients, increase consumption, sales and profit [19].

The retail market is increasingly competitive, a challenge for any company which is looking after a higher number of clients, turnover and profit.

The development of the retail market at the world level is consequently watched and assessed by specialized services firms, which

establish every year the hierarchy of the largest retail companies.

In 2016, the top 10 retailers worldwide in the decreasing order of their revenue in US Billion, were: Wal-Mart Stores, Inc (482.1), Costco Wholesale Corporation (116.2), The Kroger Co. (109.8), Schwarz Unternehmenstreuhand KG Germany (94.4), Walgreens Boots Alliance, Inc. (89.6), Home Depot, Inc. US (88.5), Carrefour S.A. France (84.9), Aldi Einkauf GmbH & Co. oHG Germany (82.1), Tesco PLC UK (81), Amazon.com, Inc US (79.2) [14].

Despite that Walmart, the US Company is on the top at the world level, many European companies occupy an important position among the top 50 based on their revenue achieved in 2016 in US Billion. It is about Schwarz Group, Germany ranked the 4th in the world (99.2), Aldi Group Germany ranked the 8th (84), Carrefour France ranked the 9th (84.1), Ahold Delhaize, Netherlands ranked the 14th (68.9), Metro AG Germany ranked the 16th (64.8), Auchan Holding SA France ranked the 18th (57.2), Edka Group German ranked the 19th (53.5), Rewe Group Germany ranked the 22nd (44.6), Casino Guichard-Perrachon S.A. France ranked the 24th (39.8), and Centres Distributeurs E. Leclerc France ranked the 25th (39.6) [6].

In Europe, the retail sector is dominated by 15 companies, whose position based on the decreasing level of their turnover in Euro Billion is: Schwarz Germany (97.), Aldi Germany (59), Carrefour France (57), Tesco UK (56), Edeka Germany (56), Rewe Germany (54), Amazon USA (45), E Leclerc France (37), Les Mousquetaires France (37), Auchan France (34), Metro Germany (33), Sainsbury UK (33), Asda Walmart UK (25), Migros Switzerland (25) and Ahold Delhaize Netherlands (24) [11, 27].

In Romania, the most important retailers are: Kaufland, Germany, Carrefour- France, Lidl-Germany, Metro-Cash and Carry - Germany, Auchan SA France, Mega Image Belgium Delhaize, Selgros Cash and Carry France, Rewe Romania (Penny Market and XXL Mega Discount) Germany, Profi- Enterprise Investors Poland, and Cora France-Belgium [16].

In 2016, according to the balance sheets, the top 10 retailers in Romania reached all together Euro 10 Billion sales and Euro 321 Million profit. These figures are by 10 % higher and, respectively, by 15 % higher than the levels registered in 2015. These reflects how important are the retailers on the Romanian market to satisfy population's consumption especially with food and beverages and also proved that retailing is a good deal for the companies [26].

In this context, the purpose of the paper was the analysis of the top retail trade sector in Romania in the last decade, 2008-2017 in order to identify the current status and the main trends, as well as the principal directions of development in the future.

In this purpose, the financial status in terms of turnover, net profit and market share of the top 10 retailers operating in Romania Kaufland, Carrefour, Lidl, Metro, Auchan, Mega Image, Selgros, Rewe, Profi and Cora Hypermarket have been studied and the role of each retailer on the Romanian market was assessed by Point Method based on these three criteria.

## MATERIALS AND METHODS

The study is based on a large range of information regarding the retail trade at the world level, but also in Europe in order to identify the main "players".

Also, for characterizing the top retail trade in Romania, various information sources were used to create a comprehensive image on the retail business operated by the top 10 retailers: Kaufland, Carrefour, Lidl, Metro, Auchan, Mega Image, Selgros, Rewe, Profi and Cora Hypermarche.

In this purpose, three financial indicators: sales, net profit and market share were analyzed in their dynamics in the period 2008-2017 in order to identify the main trends for the business developed by each top retailer on the Romanian market.

The financial data have been collected from the balance sheets of the 10 retailers, and then they were tabled and processed.

For each financial indicator it was established the cumulated value during the whole interval

of analysis, as well as the average for the same period.

The statistical average was determined using the formula:

$$\bar{X} = \frac{\sum_{i=1}^n x_i}{n}$$

$x_i$  = the financial indicator analyzed separately for each retailer, where  $i=1,2,3$  for sales, net profit and market share, in their evolution for the year 1,2,3...n;

$n=10$ , the number of top retailers taken into consideration.

Finally, it was established the hierarchy in the final year of the analysis, 2017, for the top 10 retailers based on the three criteria: sales, net profit and market share, using the Point Method. In this purpose, there were allocated points in the scale 1-5 for each criterion, 1 point meaning the 1st position, 2 points meaning the 2nd position a.s.o. Then the points for each criterion were added. Based on the cumulated points, it was assessed the decreasing order of the retailers, establishing at the end their new positions.

The results were tabled and also illustrated in suggestive graphics. Finally, the main trends identified in this study were presented in the paragraph of conclusions.

## RESULTS AND DISCUSSIONS

### A brief presentation of the retail sector in Romania

The increase of wages and pension point, the reduction of VAT from 24 % to 19% and even to 9 % for the delivery of food and beverages destined to human consumption etc, and the growth of the employment have determined a higher consumption of the population and, as a consequence the raise of sales and profit of the retailers.

The higher sales and profit have been an opportunity for extending the retail market in terms of new hypermarkets, supermarkets and minimarkets, and new square meters for the commercial surface, the improvement of the merchandising techniques and creating a more pleasant environment for shopping.

The largest retailers operating in Romania are: Kaufland, Carrefour, Lidl, Metro,

Auchan, Mega Image, Selgros, Rewe, Profi and Cora Hypermarche.

**Kaufland** was founded in Romania in 2003. Together with Lidl, it belongs to Schwarz Gruppe, a huge German hypermarket chain. It operates more than 1,250 stores in Germany, Czech Republic, Slovakia, Poland, Romania, Bulgaria, Rep. of Moldova and Australia.

In 2017, it had in Romania 119 stores, its sales accounted for Lei 10.88 Billion and the net profit for Lei 670 Million, these being the highest levels reached during the last 10 years. Its market share in 2017 was 7.58 % and the average number of employees is 13,519.

Kaufland is the top retailer in Romania during the last 5 years and for its best services for its clients, it received the distinction "Customers Friend" from the International Institute ICERTAS [8, 26].

**Carrefour SA** is a French multinational retailer, one of the largest hypermarket chains in the world. It has over 12,300 self-service shops of which 1,528 hypermarkets and 456,000 employees worldwide. It operates in 30 countries in Europe, the Americas, Asia and Africa.

In Romania, Carrefour branch was founded in 1999 and since that time it has continuously developed its network, which at present consists of 317 stores, of which 33 hypermarkets, 231 supermarkets and 42 Express and 10 Contact proximity shops, and an online shop: [www.carrefour-online.ro](http://www.carrefour-online.ro). In 2016, Carrefour bought Billa network including 86 supermarkets, a decision which has strengthened its business.

In 2017, Carrefour Romania registered Lei 6.7 Billion sales, Lei 209.7 Million net profit, 5.07 % market share and 9,939 average number of employees [2, 4, 26].

**Lidl Stiftung & Co. KG** is a German discount supermarket chain, operating over 10,500 stores in Europe and the USA. It has stores in almost all the EU countries, except Latvia and Estonia, and it is also present in Serbia and Switzerland. Together with Kaufland, it belongs to Schwarz Gruppe.

In Romania, Lidl came in 2007, and since that time it established a strong network of over 200 discount stores. In 2010, it bought Plus

stores, which have contributed to the extent of Lidl network. In 2017, Lidl recorded Lei 6.5 Billion sales, Lei 352.7 Million net profit, 0.01 % market share and 4,815 average number of employees [9, 26].

**Metro Cash and Carry** is a German international self-service wholesaler operating in Europe and also in some Asian and Northern African countries. Compared to Carrefour and Kaufland, its business is targeted especially towards professional customers, but also in a smaller measure to final consumers. It operates in over 2,000 locations in 32 countries.

Metro was the 1st international wholesaler-retailer which was founded in 1996 in Romania, at present having over 30 units.

It occupies the 4th position in Romania after Kaufland, Carrefour and Lidl, based on its turnover. In 2017, Metro registered Lei 4.72 Billion sales, Lei 116.1 Million net profit, 19.88 % market share and 3,908 average number of employees [13, 26].

**Auchan SA** is a French international retail group and a multinational corporation. It owns 639 hypermarkets and 2,874 supermarkets, and has over 338,000 employees worldwide. It is operating in France and other 15 countries: China, Hungary, India, Iraq, Italy, Luxembourg, Poland, Portugal, Romania, Russia, San Marino, Spain, Ukraine and Vietnam.

In Romania, Auchan came in 2005, and at present it has 33 hypermarkets totalizing 280,000 squares meters commercial spaces. Its business was enlarged in 2014, when Auchan purchased 20 Real hypermarkets from the German Group Metro

In 2017, Auchan registered Lei 5.22 Billion turnover, Lei 74.99 Million net profit, 3.93 % market share and 9,290 average number of employees. Despite that its turnover increased, in some years during the last decade, Auchan registered losses, but since 2016, it has recovered [1, 26].

**Mega Image** is a chain of proximity supermarkets established in Romania since 1994. It belongs to Ahold Delhaize Dutch Company. It operates 599 stores in Bucharest, Brasov, Cluj-Napoca, Constanța, Ploiești, Brașov, Timisoara, Târgoviște and other cities

under the brands Mega Image, Shop&Go, and Gusturi Românești (Romanian tastes).

In 2017, Mega Image recorded Lei 4.91 Billion turnover, Lei 201.77 Million net profit, 3.69 % market share and 9,313 average number of employees [5, 12, 26].

**Selgros** is a large cash & carry network in Europe owned by Coop Switzerland. It has over 96 supermarkets in Switzerland, Germany, Austria, Poland, France, Romania and Russia. In Romania, Selgros was open the 1st time in 2001 in Brasov, and at present it has 22 hypermarkets, in Brasov, Bucharest, Constanta, Targu Mures, Timisoara, Iasi, Craiova, Arad, Oradea, Ploiesti, Bacau, Suceava, Galati, Braila, Alba Iulia and Bistrita.

In 2017, Selgros registered Lei 3.64 Billion sales, Lei 48.81 Million net profit, 15.32 % market share and 4,341 average number of employees [25, 26].

**Rewe Group** is a German diversified retail and tourism cooperative, consisting of a network of independent retailers. Besides Edeka, the Rewe Group is the 2nd largest supermarket chain in Germany. It operates in 15 European countries and has over 12,000 stores.

Rewe came in Romania in the year 1999, when it opened the 1st Billa store in Bucharest, in 2001 it brought Selgros opening the 1st store in Brasov and then in 2005 it extended the Penny market network.

At present it operates many Penny market Discount and XXL Mega Discount stores. In 2018 it opened 25 new Penny markets and its target is that in 2015 to reach 400 discount stores in Romania.

A significant fact is that Penny markets commercialize 60 % Romanian products contributing to the development of agro-food sector and a better consumers' satisfaction [22].

In 2017, Rewe Romania registered Lei 2.99 Billion turnover, Lei 19.1 Million net profit, 2.25 % market share and 4,190 average number of employees [21].

**Profi Rom Food SRL** is a discount supermarket network spread in several European countries. At the beginning it was owned by Delhaize Group, then, the 67

supermarkets operating in Romania were bought by Polish Enterprise Fund VI (PEF VI), and in 2016, 500 Profi stores were purchased by MEP Retail Investments, which is part of the Mid Europa Partners [3].

At present, Profi owns around 800 proximity stores in Romania where it sells a large range of more than 5,000 food and non-food products. In order to satisfy consumers need in the cities and in the rural areas as well, it operates units in the standard, city and loco formats. [3].

In 2017, Profi Romania registered Lei 4.73 Billion turnover, Lei 130.86 Million net profit, 3.56 % market share and 11,662 average number of employees [20].

**Cora Hypermarket** is a retail group of hypermarkets with locations in France and elsewhere in Europe. It operates in France, Belgium, Luxembourg, Romania, Egypt and Bahamas, owning 91 stores.

Cora came in Romania in in 2002, and in 2018 it has only 11 hypermarkets, 4 in Bucharest, and the remaining in Constanta, Cluj Napoca, Baia Mare, Ploiesti, Bacau, Drobeta Turnu Severin. It is the least extended retail network in the local commerce.

The sales had an ascending trend during the last decade, but the company got profit till the year 2012 and then it registered important losses in the period 2013-2016. However in 2017, it ended the financial year with profit.

In 2017, Cora Romania registered Lei 1.77 Billion turnover, Lei 3.74 Million net profit, 1.33 % market share and 3,951 average number of employees [23].

The huge networks of stores reflect that Romanian market is a good opportunity for the development of retail trade sector.

Besides the large stores hypermarkets and supermarkets it was opened and continue to be created a new network of minimarkets which has proved its utility and efficiency during the last years.

Among the most active retailers from this point of view there are Profi, Mega Image, Lidl and Kaufland which proceeded to the extent of the proximity network in various districts of the capital and in other cities in the country as well.

However, the minimarkets of proximity sell the goods at a price by 17-20 % higher than in hypermarkets or supermarkets [7].

The number of minimarkets per inhabitant has intensively increased, placing Romania next to Turkey, Russia, France and Italy, but not enough to reach the average level in the EU.

The retail market, especially food retail market, in Romania accounted for about Euro 40 Billion, of which Kaufland, Carrefour, Metro and Auchan all together have 60 % market share.

A special attention has been paid to the products of Romanian origin which are the most preferred by consumers, mainly regarding food and beverages. In this purpose, for enlarging the offer and the market segments, the retailers have developed a better partnership with their suppliers based on contracts concluded for a large range of products [17].

The largest retailers like Carrefour, Kaufland and others had the initiative to set up regional centres where the products carried out by the local producers to be collected.

More than this, the merchandising techniques have been permanently improved to attract more clients, a fact which is unanimously confirmed by the slogan that "shopping is a "sport" in Romania".

While Lidl and Profi pay more attention to the extent of the network in the smaller cities, Carrefour, Kaufland and Selgros are more oriented to the modernization and reorganization of the commercial spaces which stimulate consumers to spend more time for shopping. But, compared to other developed countries, where the large retail keeps 90 % of the market, in Romania this sector accounts for just 62.4 %.

E-commerce has become a more and more efficient tool for purchasing different goods being practiced especially by the clients who would like to save their time. From this point of view, Carrefour, Metro and Selgros have displayed online platforms which could be visualized by clients and from where they could choose, order and pay the products they need [28].

**The dynamics of turnover of the top 10 retailers**

The development of retail sector is confirmed by the positive evolution of the turnover of the top retailers in Romania.

The increasing trend from a year to another for all the top retailers reflects their continuous concern to develop their business and satisfy better consumers' needs. This aspect was stimulated by the increased consumption grace to the growth of the salaries and income/household in the last years.

The cumulated turnover in the analyzed period 2008-2017 allowed to establish the hierarchy of the retailers, which in the decreasing order is: Kaufland, Metro, Carrefour, Selgros, Lidl, Auchan, Mega Image, Rewe, Profi and Cora Hypermarche.

In the period 2008-2017, the turnover increased by +1,251.42 % for Profi, by +902.04 % for Mega Image, by +538.23 % for Lidl, by +411.76 % for Auchan, by +252.79 % for Kaufland, by +139.09 % for Rewe, by +77.36 % for Carrefour, by +20.40 % for Cora Hypermarche, by +15.18 % for Selgros. Despite that Metro is on the 2nd position, its turnover declined by 27.30 % in 2017 compared to 2008.

In 2017, the top 10 retailers all together achieved a turnover of Lei 51.34 Billion Lei, equivalent to about Euro 11 Billion. The importance of each retailer to this figure is given by their descending order: Kaufland, Carrefour, Lidl, Auchan, Mega Image, Profi, Metro, Selgros, Rewe and Cora Hypermarche (Table 1, Fig.1).

Table 1. The turnover dynamics for the top retailers operating in Romania, 2008-2017 ( Lei Billion)

	Kaufland	Carrefour	Lidl	Auchan	Mega Image	Profi	Rewe	Cora Hypermarche	Metro Cash & Carry	Selgros Cash & Carry
2017	10.09	6.74	6.51	5.22	4.91	4.73	3.00	1.77	4.73	3.64
2016	9.69	5.67	5.58	4.90	4.32	3.55	2.86	1.74	4.35	3.30
2015	9.17	5.15	4.72	4.44	3.56	2.55	2.65	1.72	4.49	2.93
2014	8.00	4.56	3.89	3.77	2.81	1.84	2.33	1.71	4.48	2.83
2013	7.26	2.89	3.37	2.30	2.34	1.46	2.19	1.64	4.73	3.09
2012	6.44	4.29	-	1.97	1.76	1.16	1.93	1.46	5.03	3.43
2011	5.59	4.03	1.68	1.58	1.22	0.93	1.75	1.38	4.96	3.41
2010	4.67	3.92	1.45	1.50	0.88	0.62	1.62	1.37	5.28	3.22
2009	3.69	4.35	1.31	1.30	0.61	0.49	1.56	1.39	5.75	3.04
2008	2.86	3.80	1.02	1.02	0.49	0.35	1.26	1.47	6.01	3.16
Total 2008-2017	67.46	45.40	29.53	28.00	22.90	17.68	21.15	15.65	49.81	32.05
Average turnover 2008-2017	6.75	4.54	2.95	2.80	2.29	1.77	2.11	1.56	4.98	3.20
Turnover growth rate 2017/2008 %	352.79	177.36	638.23	511.76	1,002.04	1,351.42	239.09	120.40	78.70	115.18

Source: Own calculation based on the data from [1, 2, 8, 9, 10, 12, 13, 20, 21, 23, 25 ].

### The dynamics of the net profit for the top 10 retailers in Romania

Kaufland, Carrefour and Profi registered profit every year in the analyzed period. The other retailers registered both profit and losses in this interval.

In 2017, Kaufland recorded Lei 670.3 Million net profit, being followed by Lidl with Lei 352.7 Million, Carrefour Lei 209.7 Million, Mega Image Lei 201.7 Million, Profi Lei 130.8 Million, Metro Lei 116.1 Million, Auchan Lei 74.9 Million, Selgros Lei 48.8

Million and Cora Hypermarche Lei 3.7 Million.

Taking into consideration, the profit obtained during the whole period 2008-2017, the hierarchy is the following one: Kaufland, Carrefour, Metro, Selgros, Mega Image, Profi, Lidl, Cora Hypermarche, and Rewe. Auchan is an exception as during the ten year of activity, 2008-2017, it achieved a loss of Lei -137.2 Million.

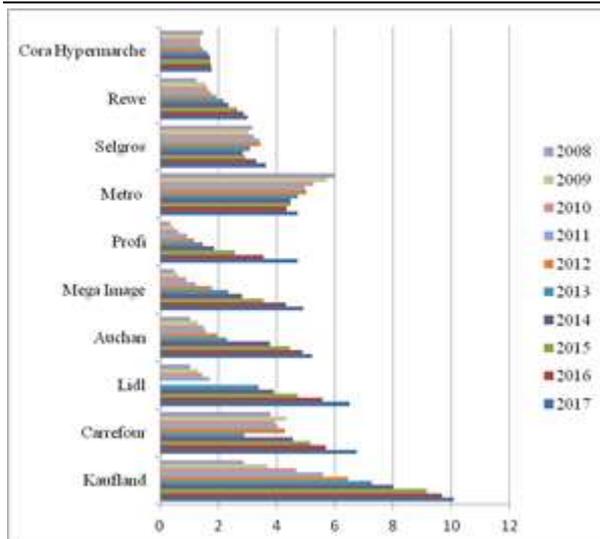


Fig.1. The dynamics of the top 10 retailers in Romania ( Lei Billion)

Source: Own design based on the data from [1, 2, 8, 9, 10, 12, 13, 20, 21, 23, 25 ].

Metro also occupies the 3rd position with Lei 116.1 Million profit, despite that in 2014 it registered a loss of Lei -1.2 Million.

Selgros comes on the 4th position with Lei 690.5 Million profit. Compared to the net profit in the year 2008, Metro registered a profit lower by 37.72 % and Selgros a profit lower by 66.07 %.

The most difficult financial situation was recorded by Auchan, which in the period 2008-2017 registered Lei -137.2 Million losses. This was due to the cumulated profit of Lei 131 Million in 2012, 2015 and 2017, which could not cover the cumulated losses accounting for Lei - 268.2 Million in the other years.

Also, Lidl was facing financial difficulties. The whole net profit in the period 2008-2017 was Lei 247.6 Million. But the losses registered in the period 2008-2012 accounted for Lei - 675.1 Million and only in the period 2013-2017 it was accumulated a profit of Lei 923.5 Million.

Mega Image registered Lei 595.2 Million profit in the whole 2008-2017 period, but the cumulated losses in 2008 and 2009 accounted for Lei -16.9 Million.

The highest growth rate of the profit was registered in the analyzed period by Profi, as the profit level in 2017 was 186.85 times higher than in 2008, then comes Mega Image, whose profit increased 695.51 times and finally Kaufland with a profit 489.2 times higher than in 2008.

Rewe registered Lei 166.4 Million profit, but in 2012, it had a loss of Lei -6.5 Million.

Table 2. The net profit dynamics for the top retailers operating in Romania, 2008-2017 ( Lei Million)

	Kaufland	Carrefour	Lidl	Auchan	Mega Image	Profi	Rewe	Cora Hypermarche	Metro Cash & Carry	Selgros Cash & Carry
2017	670.3	209.7	352.7	74.9	201.7	130.8	19.1	3.7	116.1	48.8
2016	653.3	164.1	217.7	-23.9	134.8	126.8	23.7	-5.8	103.4	25.2
2015	649.9	127.7	171.9	52.8	102.8	52.5	12.8	-39.8	35.4	43.2
2014	409.7	119.2	60.0	-61.7	55.7	27.3	11.4	-25.0	-1.2	15.2
2013	331.0	144.3	121.2	-90.5	55.1	26.8	0.5	-14.5	43.6	53.9
2012	274.5	104.7	-	3.3	46.7	13.1	-6.5	24.5	66.5	68.6
2011	167.6	133.7	-283.4	-7.1	13.1	13.2	5.1	39.9	95.2	86.7
2010	172.1	140.7	-247.4	-19.3	2.2	3.6	30.8	66.0	139.5	100.5
2009	78.8	88.0	-73.1	-41.0	-14.0	22.4	39.9	84.6	127.1	104.6
2008	13.7	74.1	-70.9	-24.7	-2.9	0.7	29.6	72.5	186.4	143.8
Total 2008-2017	3,419.9	1,306.2	247.6	-137.2	595.2	417.2	166.4	206.1	912	690.5
Average net profit 2008-2017	341.9	130.6	24.7	-13.7	59.5	41.7	16.6	20.6	91.2	69.0
Net profit growth rate 2017/2008 %	4,892.70	282.99	597.46	252.2	6,955.17	18,685.71	64.52	5.10	62.28	33.93

Source: Own calculation based on the data from [1, 2, 8, 9, 10, 12, 13, 20, 21, 23, 25 ].

Cora Hypermarche registered Lei 206.1 Million profit in the period 2008-2017, but consisting of a cumulated profit Lei 291.2 Million in the period 2008-2012 plus 2017, and the losses totalizing Lei - 85.1 Million in the period 2013-2016 (Table 2, Fig.2 ).

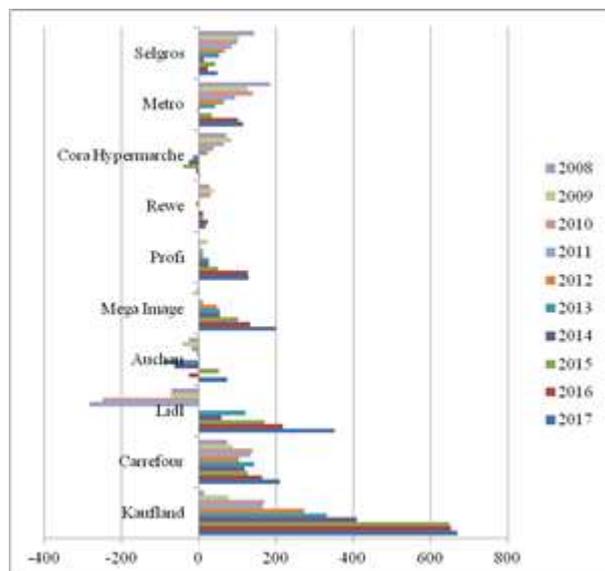


Fig.2.The dynamics of the top 10 retailers net profit (Lei Million)

Source: Own design based on the data from [1, 2, 8, 9, 10, 12, 13, 20, 21, 23, 25 ].

**The dynamics of the market share for the top 10 retailers in Romania**

The highest market share in 2017 was 19.88 % for Metro and 15.32 % for Selgros. However, while Metro recorded a general declining trend of the market share, Selgros registered an increased trend since 2014 after a decrease from 2011 to 2015.

Also, the other retailers in the decreasing order of their market share are: Kaufland 7.58 %, followed by Carrefour 5.07 %, Auchan 3.93 %, Mega Image 3.69 %, Profi 3.56 %, Rewe 2.25, Cora Hypermarche 1.33 5 and Lidl 0.01 % ( Fig.3, Table 3).

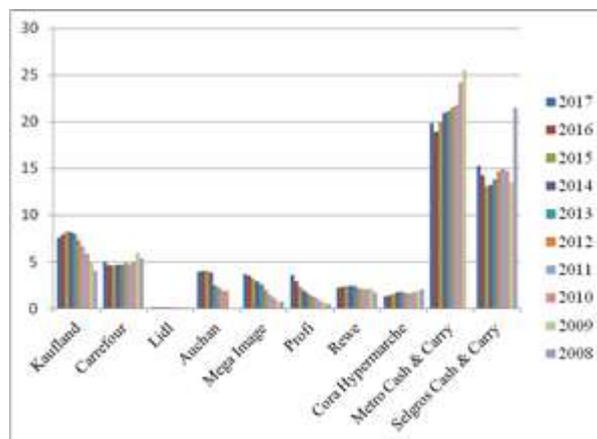


Fig.3.The dynamics of the top 10 retailers based on their market share (%)

Source: Own design based on the data from [1, 2, 8, 9, 10, 12, 13, 20, 21, 23, 25 ].

Table 3. The market share of the top retailers operating in Romania, 2008-2017 ( % )

	Kaufland	Carrefour	Lidl	Auchan	Mega Image	Profi	Rewe	Cora Hypermarche	Metro Cash & Carry	Selgros Cash & Carry
2017	7.58	5.07	0.01	3.93	3.69	3.56	2.25	1.33	19.88	15.32
2016	7.92	4.64	0.01	4.0	3.54	2.90	2.34	1.43	18.89	14.29
2015	8.25	4.63	0.01	4.0	3.20	2.29	2.39	1.55	20.05	13.09
2014	8.19	4.67	0.01	3.86	2.88	1.89	2.39	1.75	20.98	13.24
2013	7.97	4.71	0.01	2.53	2.57	1.60	2.41	1.80	21.14	13.81
2012	7.31	4.87	0.01	2.24	1.99	1.31	2.19	1.66	21.53	14.65
2011	6.68	4.82	0.01	1.89	1.46	1.12	2.09	1.65	21.76	14.94
2010	5.91	4.96	0.01	1.90	1.12	0.78	2.05	1.74	24.13	14.72
2009	5.04	5.94	0.01	-	0.82	0.67	2.13	1.90	25.53	13.52
2008	4.04	5.36	0.01	-	0.68	0.49	1.77	2.07	-	21.42

Source: Own calculation based on the data from [1, 2, 8, 9, 10, 12, 13, 20, 21, 23, 25 ].

**The classification of the top retailers based on their turnover, net profit and market share**

In 2017, based on the criteria: turnover, net profit and market share, the decreasing order established by Points Method was the following one: Kaufland, Carrefour, Metro,

Lidl, Mega Image, Auchan, Selgros, Profi, Rewe and Cora Hypermarche. One may notice that based on these three criteria, Lidl and Mega Image have cumulated the same number of points, 15, and consequently are ranked the 4th as seen in Table 4.

Table 4. The classification of the top retailers using the Point Method based on turnover, net profit and market share in 2017

	Points for:			Total points	Rank
	Turnover	Net profit	Market share		
Kaufland	1	1	3	5	1
Carrefour	2	3	4	9	2
Metro	6	6	1	13	3
Lidl	3	2	10	15	4
Mega Image	5	4	6	15	4
Auchan	4	7	5	16	5
Selgros	7	8	2	17	6
Profi	6	5	7	18	7
Rewe	8	9	8	25	8
Cora Hypermarche	9	10	9	28	9

Source: Own calculation.

## CONCLUSIONS

Retail sector is among the most dynamic ones in Romania. The leaders in the field are: Kaufland, Carrefour, Lidl, Auchan, Mega Image, Profi, Metro, Selgros, Rewe and Cora Hypermarche.

The retail network has been continuously extended both in the capital and main cities, by creating supermarkets and mainly minimarkets of the proximity.

This trend will continue but being oriented especially to smaller cities and even rural localities with less than 15,000 inhabitants in order to bring goods, especially food and beverage closer to consumers. This policy will be practiced by Prof, which has been very active so far, but also, Mega Image, Carrefour and Auchan which have developed new shops and provided new square meters of commercial surface.

The techniques of merchandising should be improved in order to support a better interaction between clients and the commercialized goods.

The purchasing environment should be also modernized by creating new facilities in the buying process.

E-commerce should become an important tool for the modern consumer having at his disposal a computer or a smart phone to study the offer and order and pay online all he needs, in this way saving time for doing other things.

The retailers should expand their offer based on the contracts concluded with their

suppliers. The diversification of the commercialized goods could develop new preferences and needs and increase the chance for selling and grow the turnover and profit.

The retailers should take into account that Romanian consumers prefer the products carried out by the local producers, and for this reason they have to increase the share of Romanian products in the offer structure. This is related not only to food (vegetables, fruit, eggs, meat and meat products, milk and milk products, bakery products) and beverages, but also to other products.

More than this, the modern consumer is much more interested to take care of his health and eat healthy food. Therefore, the shelves of the mini or supermarkets should offer a larger variety of organic products.

More information and promotion means are needed to help consumers to know what should they consume, how, when, how much, and which are the benefit for their organism.

Consumer's preference should be carefully watched in order to set up new and more effective marketing strategies in the retail sector.

## REFERENCES

- [1] Auchan Romania SA, <https://www.listafirme.ro/auchan-romania-sa-17233051/>, Accessed January 10, 2019.
- [2] Carrefour Romania SA, <https://www.listafirme.ro/carrefour-romania-sa-11588780/>, Accessed January 10, 2019.
- [3] Consiliul Concurenței a avizat cea mai mare tranzacție din retailul românesc. Magazinele Profi trec

în portofoliul Mid Europa Partners (The competition Board approved the largest transaction in the Romanian retail. Profi stores will pass in the portfolio of Mid Europa Partners), [http://www.economica.net/consiliul-concurentei-a-avizat-cea-mai-mare-tranzactie-din-retailul-romanesc-magazinele-profi-trec-in-portofoliul-mid-europa-partners\\_132998.html](http://www.economica.net/consiliul-concurentei-a-avizat-cea-mai-mare-tranzactie-din-retailul-romanesc-magazinele-profi-trec-in-portofoliul-mid-europa-partners_132998.html), Accessed January 10, 2019.

[4]Dalar Stanca, M., 2018, Carrefour România, a doua cea mai mare creștere la nivel de grup, în 2017, <https://www.magazinulprogresiv.ro/stiri/carrefour-romania-doua-cea-mai-mare-crestere-la-nivel-de-grup-2017>, Accessed January 10, 2019

[5]Dragomir, A., 2018, Mega Image, la doar un pas distanță de 600 de magazine, <https://www.magazinulprogresiv.ro/stiri/mega-image-la-doar-un-pas-distanta-de-600-de-magazine>, Accessed January 10, 2019

[6]Farfan B., 2018, The Biggest European Retail Chains List, <https://www.thebalancesmb.com/biggest-european-retail-chains-list-2892256>, Accessed January 10, 2018

[7]How much pay the Romanians for proximity or schopping at the block stairs: In commerce, "close to the house" means more expensive by 17-30 % than buying in the largest supermarkets (Cat platesc romanii pentru proximitate sau cumparaturi la scara blocului: In Comert, "aproape de casa" inseamna mai scump cu 17-30% fata de magazinele mari), 2018, <https://www.zf.ro/companii/cat-platesc-romanii-pentru-proximitate-sau-cumparaturi-la-scara-blocului-in-comert-aproape-de-casa-inseamna-mai-scump-cu-17-30-fata-de-magazinele-mari-6571356>, Accessed January 10, 2018.

[8]Kaufland Romania SCS, <https://www.listafirme.ro/kaufland-romania-scs-15991149/>, Accessed January 10, 2019.

[9]Lidl Discount SRL, <https://www.listafirme.ro/lidl-discount-srl-22891860/>, Accessed January 10, 2019.

[10]Lista firmelor active din Romania cu informatii complete, [www.listafirme.ro](http://www.listafirme.ro), Accessed January 10, 2019.

[11]Major retailers in Europe, rankings and profiles, <https://www.retail-index.com/>, Accessed January 10, 2019

[12]Mega Image SRL, <https://www.listafirme.ro/mega-image-srl-6719278/>, Accessed January 10, 2019.

[13]Metro Cash & Carry Romania SRL, <https://www.listafirme.ro/metro-cash-carry-romania-srl-8119423/>, Accessed January 10, 2019.

[14]Papadopoulos, A., 2017, Giants Of Retail: The World's 25 Largest Retailers By Revenue, Money & Wealth Insider, January 24, 2017, <https://ceoworld.biz/2017/01/24/giants-retail-worlds-25-largest-retailers-revenue-2017/>, Accessed January 10, 2019.

[15]Patriche, D., Stănescu, I., Grigoresu, M., Felea, M., Bazele comerțului, Ed. Economică, București, 1999, pp.42-56.

[16]Petcana, A.M., 2016, Top retailul modern din Romania s-a apropiat de pragul de afaceri de 10

miliarde Euro in 2015, an in care si-a dublat profitul, <http://www.profit.ro/povesti-cu-profit/retail/top-retailul-modern-din-romania-s-a-apropiat-de-pragul-de-afaceri-de-10-mld-euro-in-2015-an-in-care-si-a-dublat-profitul-15493597>, Accessed January 10, 2019.

[17]Pop, I., 2017, The largest retailers in Romania: Kaufland, Carrefour, Metro and Auchan, (Cei mai mari retaileri din România: Kaufland, Carrefour, Metro și Auchan), Capital, 12 Dec.2017, <https://www.capital.ro/cei-mai-mari-retaileri-din-romania-kaufland-carrefour-metro-si-auchan.html>, Accessed January 10, 2019.

[18]Popescu Agatha, 2010, Home and International Trade, Dominor Publishing House, Bucharest, pp. 35-40.

[19]Popescu Agatha, 2012, Home and International Trade, 2nd Ed., Comunicare.Ro & Rawexcoms Publishing Houses, Bucharest, pp.40-53.

[20]Profi Rom Food SRL, <https://www.listafirme.ro/profi-rom-food-srl-11607939/>, Accessed January 10, 2019.

[21]Rewe SRL, <https://www.listafirme.ro/rewe-srl-13348610/>, Accessed January 10, 2019.

[22]Rewe Romania va deschide 25 de magazine Penny market in 2018. Investitii de 80 milioane de Euro. <https://www.retail-fmcg.ro/retail/rewe-romania-25-magazine-penny-market.html>, Accessed January 10, 2019.

[23]Romania Hypermarche SA, <https://www.listafirme.ro/romania-hypermarche-sa-14374293/>, Accessed January 10, 2019.

[24]Rusu C., Popescu Agatha ,Tepoi Magda, Zichil V., Rusu M., Hossu T., Veres Daniela Lavinia, Dragoi Raiuca Petronela, Abrudean Roxana, Pascal F.C., 2002, Hone and International Trade (Comert intern si international), Dacia Publishing House, Cluj-Napoca, pp. 59-64.

[25]Selgros Cash & Carry Romania SRL, <https://www.listafirme.ro/selgros-cash-carry-srl-11805367/>, Accessed January 10, 2019.

[26]Topul retailerilor: Kaufland rămâne lider în comerțul românesc, cu afaceri de 2,1 miliarde euro în 2016

RETAIL <https://www.profit.ro/povesti-cu-profit/retail/topul-retailerilor-kaufland-ramane-lider-in-comertul-romanesc-cu-afaceri-de-2-1-miliarde-euro-in-2016-17026341>, Accessee January 10, 2019

[27]Turnover of the leading 15 retailers in Europe in 2017 (in billion euros), <https://www.statista.com/statistics/642417/retail-turnover-top-retailers-europe/>, Accessed January 10, 2018.

[28]Zamfir, R., 2018, Euler Hermes estimate modern Romanian retail market at maximum EUR 20 billion, Business Review, <http://business-review.eu/business/retail/euler-hermes-estimate-modern-romanian-retail-market-at-maximum-eur-20-billion-178886>, Accessed January 10, 2019.

## CONSUMER'S BEHAVIOUR TOWARDS HONEY PURCHASE-A CASE STUDY IN ROMANIA

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### Abstract

*The paper analyzed consumer behavior regarding honey purchase on a sample of 196 individuals at randomly selected from the visitors of the National Honey Fair held on September 14, 2018 in Bucharest. The responds to the 9 questions included in a structured questionnaire used in a face-to-face interview were statistically processed regarding frequency, percentages, average and standard deviation, and also Chi-squared test, Pearson and Cramer's correlation coefficients were used to establish the independence/dependence between age, education level and monthly income and honey purchase decision. Honey is bought in a higher proportion by people older than 45 years, married persons, high school leavers and university graduates, by people with a monthly income over Lei 3,000. The most preferred honey is polyfloral and acacia. Honey is purchased to be consumed at breakfast, next to a cup of coffee and tea or as a medicine, less as sweetener in the kitchen and for cosmetic goals. Honey is bought mainly several times a year and twice a year. Honey is bought mainly directly from beekeepers and honey fairs, less from agro-markets and supermarkets. The amount of 1-2 and 2-3 kg honey is frequently bought mainly by people of 36-50 years old, by the ones who have a higher education level and income level over Lei 3,000 per month. Between age, education level and income and honey type and amount of bought honey there is no relationship, but between the purchased amount and income level is a dependence link. Honey price, type, packaging and color are the significant criteria influencing purchasing decision. Beekeepers and honey fairs are the main information sources for buyers. As a final conclusion, beekeepers should improve their marketing strategies to better satisfy consumers' needs and increase, their sales and profit, and honey consumption per capita as Romania produces a high production of high quality honey.*

**Key words:** consumer habits, honey purchase, honey type, pricing, packaging, brand

### INTRODUCTION

Bee honey is a natural product of high nutritive value reflected by its chemical composition. 100 g honey contains: 0.4 % proteins ( of which major amino-acids such as: alanine, leucine, methionine etc); 81 % carbohydrates ( 38 % fructose, 31 % glucose, 6 % maltose, 5 % sucrose, etc), 3 % vitamins (0.038 g B2, 0.121 g B3), 0.121 g B5, 0.062 g B6, 0.01 g B9, PP, C, D etc), 0.2 % minerals (Ca, Na, Mg, Zn, Fe, Cu, Se, I, Cr) and other microelements (beryllium, gallium, vanadium, zirconium, titanium, nickel, tin, and silver), 0.2 % fibers, 15-17% water, enzymes (amylase, sucrase, saccharase, glucose oxidase, catalase, acid phosphatase, protease, esterase,  $\beta$ -glucosidase), and vegetal pigments

(beta-caroten, xanthophyll, chlorophyll). Honey generates an important quantity of energy, in 100 g honey being 335 calories by 25 % less than in a similar amount of sugar. Honey chemical composition varies according to honey type, region and the flora from where the nectar was picked up by bees. Due to its high nutritive value, honey is used in human diet. It is recommended as an adult to consume 50-70 g honey and a child 1-2 tea spoons daily. Honey could be consumed as such or with milk or tea or coffee, but for maintaining its nutritive and therapeutic properties it is needed as the temperature of the liquids not to exceed 38 Celsius degrees [12, 17, 18, 20, 40, 42]. Honey is food, a medicine utilized in the prophylaxis and therapeutics, and also an

ingredient in cakes and other food preparations etc. As a food, it is highly appreciated for its flavor, taste, color, perfume, consistence, and it is easily digested and assimilated. As medicine it is used in the treatment of digestive affections, hepatic-renal, gall, cardiovascular, respiratory, nervous system, nutrition, infectious diseases etc. [22].

Honey is mainly consumed by people who is aware of its nutritional and medical benefits and that it is a natural product not affected by any technological processing (Schneider, 2007; Ghorbani and Khajehroshanaee, 2009). [13, 37].

For this reason, beekeeping and its products could be a field of activity with an important contribution to the sustainable economic development, involving a close relationship between the apiary management and innovation in setting up available strategies to better satisfy consumers' needs and improve business profitability [14].

Therefore, there are many reasons explaining why honey consumption has continuously increased.

The highest daily consumption per capita was noticed in the following countries: 9.62 g in Central African Republic, 5.55 g in New Zealand, 4.4 g in Slovenia, 4.24 g in Greece, 3.87 g in Switzerland, 3.62 g in Austria, 3.33 g in Turkey, 3.15 g in Ukraine, 3.02 g in Slovakia and 3.01 g in Montenegro [10].

In the EU, the major honey consumers are United Kingdom, France, Spain, Greece and Poland, but consumption is also increasing in Ireland, Latvia, Romania, Croatia, Estonia and Malta [41].

The world honey production has continuously raised, accounting for 1.8 million tonnes in the year 2016, being by 42 % higher than in the year 2000. The top producers of honey are China, the EU and Turkey, whose market share is 28 %, 13.2 % and, respectively, 6 %. In the EU, the major producers are Spain, Hungary, Germany and Romania [19, 34].

In the EU, honey demand is high and internal offer is not able to cover it, which justify as 40 % of consumption to come from import. [41].

Romania is one of the major producers of honey in the EU, in 2015, achieving 35,000

tonnes, the top output in the EU. However, honey consumption in Romania is still low, about 0.66 kg per capita/year and for this reason, most of honey production is exported mainly in the Western EU countries where the demand is higher [23,26,27,28,29,30,31,32,33].

Honey consumers have different reasons to buy and consume honey, and the gap of consumption level from a country to another is determined by many factors among which the most important are: the varied consumers' knowledge about honey nutritive value and benefits, the differences regarding honey promotion by media, the varied concern of the beekeepers to understand consumers' preferences, the gaps in marketing strategies adopted by honey producers, regarding product quality, packaging, labeling, branding and pricing, consumers' age, education and income level, traditions, attitudes, habits [3,7,16,38, 39,43].

For this reasons, various marketing studies were focused on consumer's behavior towards honey and other bee products.

Consumers' decision to purchase honey depends on various criteria and determinant factors, whose importance and hierarchy is different from a country to another.

The studied literature presents the following results obtained by various researchers regarding the key factors which determine honey purchasing: in Australia "brand reputation, origin, value for money and ethnicity of the buyers" (Batt and Liu, 2012) [2]; in China "attitudes, perceived behavior control, subjective norms, health consciousness, trust and awareness of possible issues" (Zhang, 2018) [44]; in Hungary "honey quality, packaging, price and honey type" (Vanyi *et al*, 2009) [39];

in Czech Republic "price, origin and quality of organic honey" (Sanova *et al*, 2017) [36]; in Poland "medical properties, natural product, flavor and tradition in consumption" (Roman *et al*, 2013) [35];

in Italy "organic attributes and country of origin" (Cosmina *et al*, 2015) [9]; in Croatia "mild flavored and brighter colored honey, especially acacia and other flower types" are preferred by consumers and the reasons to buy

and consume honey are "for health and medical benefits" (Bršćić *et al.*, 2017) [3]; in Turkey "age, knowledge on honey, quality and brand" Demircan *et al* (2017) [11]; in Malaysia "medical condition, product quality, brand reputation and price" (Yeow *et al.*, 2013) [43]; in Congo "married persons and with at least secondary education prefer domestic forest and savannah honey, while people older than 30 years prefer imported honey" (Gyau *et al.*, 2014) [16]; in Iran "type of honey, packaging, color, flavor and protraction" (Ghorbani and Khajehroshanaee, 2009) [13]; in the Kingdom of Saudi Arabia "medicinal and nutritional values" (Ismaiel *et al.*, 2014) [21]; in Germany, "honey consumption depends on consumer preferences and different dietary patterns" and "honey demand has effects along the product chain and that the profitability in beekeeping depends on the interaction of supply, demand and price" (Schneider *et al.*, 2007) [37].

In Romania, there are a few studies on consumers' habits regarding honey purchase and the results are different depending on the studied area, objectives of the research, and sample characteristics. The main findings are: "honey quality as natural product, medical benefits and sweet taste" (Pocol and Marghitas, 2008) [24], "physical properties in terms of aroma, color, taste and texture of honey" (Arvqnitoyannis, and Krystallis, 2010) [1] and "income level" (Pocol, 2011) [25].

In China, Romania, Italy, Hungary and Croatia consumers' prefer to buy honey directly from the local beekeepers and not imported honey [3, 9, 25, 44].

In this context, the purpose of the paper was to analyze consumers' behavior towards honey purchase among the visitors of the National Honey Fair organized in September 2018 in Bucharest, the capital of Romania.

The objectives of this study have been:

- (i) to analyze the socio-demographic characteristics of the individuals at randomly included in this survey based on a face-to-face structured interview;
- (ii) to identify the respondents' behavior toward purchasing honey in relation to their age, education and income level;

- (iii) to identify the major criteria the honey buyers use when they decide to buy honey;
- (iv) to draw the right conclusions for honey producers in order to enable them how to better understand consumers' needs, to develop new the marketing strategies and increase their profit and at the same time to bring consumers the expected satisfaction.

## MATERIALS AND METHODS

The study is based on a field survey carried out on a sample of individuals at random selected from the visitors of the Honey Fair, September 14, 2018 organized by the Romanian Beekeepers Association.

The sample size, SS, was determined using the formula:

$$SS = \frac{(Z\text{-score})^2 * p * q}{e^2}$$

where:

Z-score = the value taken from T tables for 95 % confidence level;

p = the probability of the event presence, more exactly of the visitors who came to buy honey from the Fair, p= 85 %, or 0.85 %.

q = the probability of the event absence or q= 1-p, therefore the probability of the visitors who had no incentive to buy honey, i.e. 15% or 0.15;

e<sup>2</sup> = the error rate accepted for the sample, usually 5 % or 0.05.

The sample size was 196 individuals, of which 167 came at the fair to buy honey.

The main demographic characteristics of the individuals considered in this study have been: gender, age, marital status, education level, occupational status and monthly income.

For all the demographic characteristics have been recorded the frequencies and also the percentages have been calculated.

For the quantitative characteristics such as: age and monthly income, it was determined the central tendency by estimating the statistical average and standard deviation, according to the formulas:

$$\bar{X} = \frac{\sum_{i=1}^n x_i}{n} \quad \text{and} \quad \delta^2 = \sqrt{\frac{\sum_{i=1}^n (x_i - \bar{X})^2}{n-1}}$$

where:

x<sub>i</sub> = the quantitative characteristic;

n=the number of individuals.

The individuals included in the sample answered the questions of a structured questionnaire, whose content consisted of two types of questions:(a) questions regarding the socio-demographic profile of the respondents and (b)questions concerning respondents' habits in relation to honey purchase.

The second category of questions included 9 questions as follows: Q1-What type of honey do you prefer to buy? Q2-Which are the reasons why you buy honey? Q3-Which are the purposes for which you buy honey? Q4-How many times do you buy honey per year? Q5-Where do you purchase honey from? Q6-Which is the amount of honey you buy per year? Q7-Which is your opinion on honey price? Q8-Which are the criteria taken into consideration when you decide to purchase honey? Q9-Which are your information sources about honey?

The answers of the respondents have been statistically processed, pointing out the frequency for each event as well as the percentage, which were mentioned in the tables.

Also, the mean and standard deviation were calculated as specified above.

Considering that age, education level and income level are the key features which contribute to the purchase decision, Karl Pearson's Chi-squared was determined using the formula [15]:

$$\chi^2 = \sum_{i=1}^n \frac{(O_i - E_i)^2}{E_i} = N \sum_{i=1}^n \frac{(O_i / N - p_i)^2}{p_i}$$

where:

$\chi^2$ = Pearson's cumulative statistic test having a chi-squared distribution;

$O_i$ = the number of observed values of i type;

$N$ = the total number of the observed values;

$E_i = Np_i$ = the expected theoretical values of the i type;

$p_i$ = the fraction of the i type in the population;

$N$ = the number of cells in the table of contingency.

Two types of hypothesis were established as follows:

$H_0$ - X, Y are statistically independent items; in this case, X and Y were considered the couples of socio-economic-characteristics

(age, education level and monthly income) and the habits regarding honey purchase.

$H_1$ - X,Y are statistically dependent or associated items.

On the study the both types of contingency tables were used:  $h \times k$  for X = a quantitative item and Y= a qualitative item, 2 by 2 tables for X,Y being qualitative items.

The  $\chi^2$ calculated value were compared to the  $\chi^2$  tabled critical value for  $\alpha = 0.05; 0.01; 0.001$  for the degrees of freedom,  $df = (h-1)(k-1)$ , where: h= the number of rows and k= the number of columns.

The interpretation of the  $\chi^2$  test results was based on the following rationale:

-If  $\chi^2 < \chi^2_{\alpha=0.05}$ , the  $H_0$  is accepted, therefore, X,Y are statistically independent items;

- If  $\chi^2 > \chi^2_{\alpha=0.05}$ , the  $H_0$  is rejected, and  $H_1$  is accepted, therefore, X,Y are statistically dependent or associated items. In this case, it could be possible to face the following situations:

(i) If  $\chi^2 \in [\chi^2_{\alpha=0.05}; \chi^2_{\alpha=0.01})$ , X and Y are significant dependent items;

(ii) If  $\chi^2 \in [\chi^2_{\alpha=0.01}; \chi^2_{\alpha=0.001})$ , X and Y are distinctly significant dependent items;

(iii) If  $\chi^2 > \chi^2_{\alpha=0.01}$ , X and Y are very significantly dependent items [4].

Also, in the study, it was determined Pearson's correlation coefficient using the well known formula, as well as Cramer's correlation coefficient, V, which was calculated with the formula [8]:

$$V = \sqrt{\frac{\chi^2}{N(L-1)}}$$

where: L = the lowest number of rows and the number of columns from the contingency table.

Likert scale was also used in order to establish the hierarchy of honey type, brand, price and packaging based on Likert scores [5,6].

The results were correspondingly presented in tables and finally interpreted.

## RESULTS AND DISCUSSIONS

### The socio-demographic profile of the respondents

**Respondents structure by gender.** Of the 196 individuals included in the survey, 55.1 % were females and 44.9 % were males (Table 1). **Respondents' distribution by age group.** The age structure of the questioned individuals was the following one: 24.5 %

were of 21-35 years old, 40.8 % belonged to the 36-50 years group, 26 % were of 51-65 years old and 8.7 % were of 66 years and over. Therefore, the age group 36-50 years is the most representative. The average age of the sample is 45.8 years (Table 1).

Table 1. The socio-demographic characteristics of the respondents

	Frequency	Percentage	Mean	St. Dev.
<i>Gender</i>				
Female	108	55.1		
Male	88	44.9		
<i>Age</i>				
21-31	48	24.5	45.83	13.58
36-50	80	40.8		
51-65	51	26.0		
66 and over	17	8.7		
<i>Marital status</i>				
Married	129	65.8		
Unmarried	48	24.5		
Widowed	8	4.1		
Divorced	11	5.6		
<i>Education level</i>				
Gymnasium	26	13.3		
High school	95	48.4		
University	75	38.3		
<i>Occupational status</i>				
Employed	164	83.6		
Unemployed	10	5.1		
Pensioner	16	8.2		
Student	6	3.1		
<i>Monthly income level (Lei/month)</i>				
1,000-2,000	18	9.2	3,826.53	1,368.32
2001-3,000	30	15.3		
3,001-4,000	65	33.2		
4,001-5,000	48	24.5		
5,001-6,000	20	10.2		
6,000 and over	15	7.6		

Source: Own processed results based on respondents answers, Survey, 2018

**Respondents' distribution by marital status.** Of the total number of individuals in this survey, 65.8 % were married, 24.5 % unmarried, 5.6 % divorced and 4.1 % were widowed (Table 1).

**Respondents' structure by education level.** Of the total number of respondents, 48.4 % were high school leavers, 38.3 % graduated a faculty and 13.3 % attended a gymnasium (Table 1).

**Respondents' occupational status** is the following: 83.6 % are employed, 5.1 % are unemployed, 8.2 % are pensioners and 3.1 % are students (Table 1).

**Respondents' structure by monthly income.** Of the total number of respondents, 50.5 % earn between Lei 3,000-4,000/month, 24.5 % earn between Lei 4,000-5,000/month, 8.2 % earn between Lei 5,000-6,000/month. About

4.1 % have the lowest income. i.e. below Lei 2,000 and 4.5 % have the highest income over Lei 6,000 per month. The average monthly income is Lei 3,826.53 (Table 1).

**Respondents' answers to the questions included in this survey**

First of all, each individual was asked the following question: **"Do you consume honey?"** and from the 196 interviewed persons, 167 said "Yes", meaning 85.2 %.

For this reason, the 29 individuals who answered " No" were asked to answer the question: **"Why you do not consume honey?"** The following types of answers were received: "I do not like honey" (27.6 %), "I do not consume honey because it makes me feel acidity in the stomach and have pains (24.2 %), "I am ill of diabetes and the doctor has interdicted me to consume sweets" (17.2 %)

and "I would like to consume honey, but honey is more expensive than sugar" (31%).

For the answers mentioned above, the 29 individual who do not consume honey have been eliminated from the sample, and the survey continued with 167 respondents.

**At Q1 "What type of honey do you prefer to buy ?"**, 52.1 % individuals answered polyfloral honey, 24.6 % said acacia honey and 23.3 % mentioned other types of honey (Fig.1.).

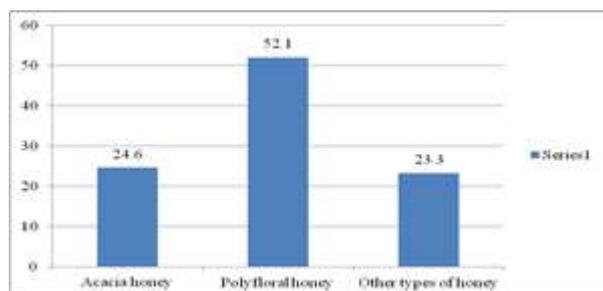


Fig.1. Respondents preference for the type of honey (%)  
Source: Own design based on the respondents' answers.

Therefore, the preference of the buyers for the type of honey, in the decreasing order is: polyfloral, acacia and other types. The multifloral honey is the most preferred, as this type of honey is a mixture of nectar taken by bees from various flowers on the occasion of the pickings, it is a honey with a high nutritive value, a special color, flavor, smell and taste. Another reason is the fact that polyfloral honey is a little cheaper than acacia honey and also because, acacia honey production is much smaller than polyfloral production, and the chance as multifloral honey to be more frequently bought is higher.

**(i) Analyzing the preference of the respondents of various ages for the type of honey.**

The  $H_0$  -the preference for the honey type, X, and the age of the buyers, Y are independent variables.

The  $H_1$ - the preference for the honey type, X and the age of the buyers, Y are dependent variables.

The obtained results have been the following ones: Polyfloral honey is mainly preferred by the individuals belonging to the 36-50 age group (23.95 %), by the 51-65 age group

(14.37 %) and by the 21-35 age group (10.17 %).

Acacia honey is preferred first of all by the 36-50 age group (34.4 %), followed by the 21-35 years group (29.2 %) and the 51-65 year group (21.9%).

The calculated  $\chi^2$  was 4.559, a value much lower compared to the  $\chi^2$  critical value 12.59, found in the table of  $\chi^2$  distribution for  $df=6$  and  $\alpha=0.05$ . Therefore, in this case, the  $H_0$  was accepted, because the preference for the honey type, X, and the age of the buyers, Y are statistically independent variables.

The Pearson correlation coefficient was  $r=0.162$ , reflecting a weak and negligible relationship between the two variables, X and Y. Also, Cramer's correlation coefficient was  $V=0.116$ , meaning a moderate relationship between the two variables.(Table 2).

**(ii) Analyzing the preference of the respondents with various education levels for the type of honey.**

The  $H_0$  -the preference for the honey type, X, and the buyers' education level, Y are independent variables.

The  $H_1$ - the preference for the honey type, X and the buyers education level, Y are dependent variables.

The obtained results have been the following ones: Of the 81 respondents who graduated a high school, 60.4 % prefer to buy polyfloral honey, 23.4 % prefer other type of honey and 16.2 % prefer acacia honey. Of the 70 respondents who graduated a faculty, 45.7 % prefer polyfloral honey, 32.8 % prefer acacia honey and 21.4 % prefer other types of honey. Of the 16 respondents who attended a gymnasium, 37.5 % prefer multifloral honey, 31.7 % prefer acacia honey and 31.8 % prefer other honey.

The calculated  $\chi^2$  was 7.42 lower compared to the  $\chi^2$  critical value 9.49 for  $\alpha=0.05$ , for  $df=4$ . As a result, the  $H_0$  is accepted, attesting that X,Y are independent variables.

The Pearson correlation coefficient, r was 0.206, very small, reflecting a weak positive relationship between the preference for the honey type and the buyers' education level.

Cramer's correlation coefficient V was 0.149. (Table 3).

Table 2. The respondents' preference for honey type depending on their age group

		Acacia honey	Polyfloral honey	Other types of honey	Total
21-35	O	12	17	8	37
	E	(9.1)	(19.3)	(8.6)	37
36-50	O	14	40	16	70
	E	(17.2)	(36.5)	(16.3)	70
51-65	O	9	24	10	43
	E	(10.6)	(22.4)	(10.0)	43
66 and over	O	6	6	5	17
	E	(4.2)	(8.9)	(3.9)	17
Total	O	41	87	39	167
	%	24.6	52.1	23.3	100
Obtained results			Interpretation		
$\chi^2 = 4.55 < 12.59$ $\chi^2$ critical value for $\alpha=0.05$ , for $df= 6$ .			The $H_0$ is accepted, therefore, the preference for the type of honey and the age of the buyers are independent variables.		
Pearson correlation coefficient, $r = 0.162$			As $0.1 < r < 0.19$ , it is a negligible relationship between the preference for the honey type and the age of the respondents.		
Cramer's correlation coefficient, $V = 0.116$			As $0.11 < V < 0.15$ , it is a moderate relationship between the preference for the honey type and the age of the buyers.		

Note: O=observed values; E=expected theoretical values.

Source: Own calculations based on the survey, 2018.

Table 3. The respondents' preference for honey type depending on their education level

		Acacia honey	Polyfloral honey	Other types of honey	Total
Gymnasium	O	5	6	5	16
	E	(3.9)	(8.3)	(3.8)	16
High school	O	13	49	19	81
	E	(19.9)	(42.2)	(18.9)	81
University	O	23	32	15	70
	E	(17.2)	(36.5)	(16.3)	70
Total	O	41	87	39	167
	%	24.6	52.1	23.3	100
Obtained results			Interpretation		
$\chi^2 = 7.42 < 12.59$ $\chi^2$ critical value for $\alpha=0.05$ , for $df= 4$ .			The $H_0$ is accepted, therefore, the preference for the type of honey and the education level of the buyers are independent variables.		
Pearson correlation coefficient, $r = 0.206$			As $0.2 < r < 0.29$ , it is a weak positive relationship between the preference for the honey type and the education level of the respondents.		
Cramer's correlation coefficient, $V = 0.149$			As $0.11 < V < 0.15$ , it is a moderate relationship between the preference for the honey type and the buyers' education level.		

Note: O=observed values; E=expected theoretical values.

Source: Own calculations based on the survey, 2018.

***(iii) Analyzing the preference for the type of honey of the respondents with various monthly income per month.***

The  $H_0$  -the preference for the honey type, X, and the buyers' monthly income level, Y are independent variables.

The  $H_1$ - the preference for the honey type, X and the buyers' monthly income level, Y are dependent variables.

The obtained results have been the following ones:

Of the 87 respondents who prefer polyfloral honey, 41.3 % earn between Lei 3,000-4,000 per month, 19.5 % belong to the Lei 4,000-5,000 income group, 16 % earn between Lei 2,000-3,000 per month and the other individuals to the other income categories.

Of the 41 respondents who prefer acacia honey, most of them, that is 24.3 % earn

between Lei 4,000-5,000 per month, 21.9 % earn between Lei 3,000-4,000, and 14.6 % belong to both to the Lei 2,000-3,000 income group and Lei 5,000-6,000. The other income categories either with the highest monthly income or with the lowest one prefer acacia honey in a lower proportion.

About 25.6 % of the 39 respondents, who prefer other types of honey belong to the middle income category, Lei 3,000-4,000 per month and 20.5 % to the income group Lei 4,000-5,000.

For the respondents with the highest income, over Lei 6,000, the preference percentage is equal, 33 %, no matter the type of honey.

For the respondents with the lowest income, the most preferred honey is multifloral, probably because it has a lower price in

comparison with acacia and other types of honey.

The value of the calculated  $\chi^2$  was 8.22 lower compared to the  $\chi^2$  critical value 18.31 for  $\alpha=0.05$ , for  $df= 10$ . Therefore, the  $H_0$  is accepted, attesting that X,Y are independent variables, more exactly that the preference for

the honey type, X, and the monthly income, Y, are statistically independent variables.

The Pearson correlation coefficient was  $r = 0.216$ , meaning a weak positive link between the preference for the honey type and the buyers' monthly income.

Cramer's correlation coefficient was  $V=0.156$ . (Table 4).

Table 4. The respondents' preference for honey type depending on their monthly income

Monthly income (Lei)		Acacia honey	Polyfloral honey	Other types of honey	Total
1,000-2,000	O	5	8	5	18
	E	(4.4)	(9.4)	(4.2)	18
2,000-3,000	O	6	14	6	26
	E	(6.4)	(13.5)	(6.1)	26
3,000-4,000	O	9	36	10	55
	E	(13.5)	(28.7)	(12.8)	55
4,000-5,000	O	10	17	8	35
	E	(8.6)	(18.2)	(8.2)	55
5,000-6,000	O	6	7	5	18
	E	(4.4)	(9.4)	(4.2)	18
6,000 and over	O	5	5	5	15
	E	(3.7)	(7.8)	(3.5)	15
Total	O	41	87	39	167
	%	24.6	52.1	23.3	100
Obtained results		Interpretation			
$\chi^2= 8.22 < 12.59$ $\chi^2$ critical value for $\alpha=0.05$ , for $df= 4$ .		The $H_0$ is accepted, the preference for the type of honey and the buyers' monthly income are independent variables.			
Pearson correlation coefficient, $r = 0.216$		As $0.2 < r < 0.29$ , it is a weak positive relationship between the preference for the honey type and the buyers' monthly income of the respondents.			
Cramer's correlation coefficient, $V= 0.156$		As $0.15 < V < 0.25$ , it is a strong relationship between the preference for the honey type and the monthly income of the respondents.			

Note: O=observed values; E=expected theoretical values.  
 Source: Own calculations based on the survey, 2018.

At Q2 "Which are the reasons why you buy honey?", all the respondents affirmed that they buy honey because it is a healthy food (100 %), 95.8% confirmed that they buy honey as it is rich in high value nutrients, 14.4 % said that they buy honey as it is a tasty product and 3.6 % had other reasons (Fig.2).

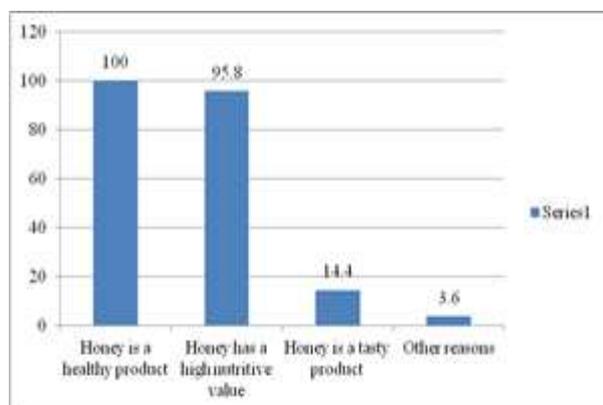


Fig.2.Respondents' reasons to buy honey (%)Source: Own design based on the respondents' answers.

At Q3 "Which are the purposes for which you buy honey?".

The answers given by respondents reflected that 35.3 % individuals buy honey to consume it as such, mainly at breakfast on a slice of bread and butter.

Another group of respondents, representing 28.7 % of the whole sample, said that they buy honey to use it as a treatment when they are ill, especially when they got a flu or have another diagnostic for which the doctor recommended them to eat honey.

Other respondents, representing 18 % of the questioned individuals, affirmed that they buy honey because they like to use it in the company of a cup of coffee or tea.

About 9 % of the respondents, it is about women, said that they like to include honey as a sweetener in cakes and even various salads and meals, as honey gives a special taste and do not produce too many calories like sugar.

Other 9 % of respondents, also women said that they buy honey to use it as a cosmetic

mask as it has a benefic effect of the face skin.(Fig.3).

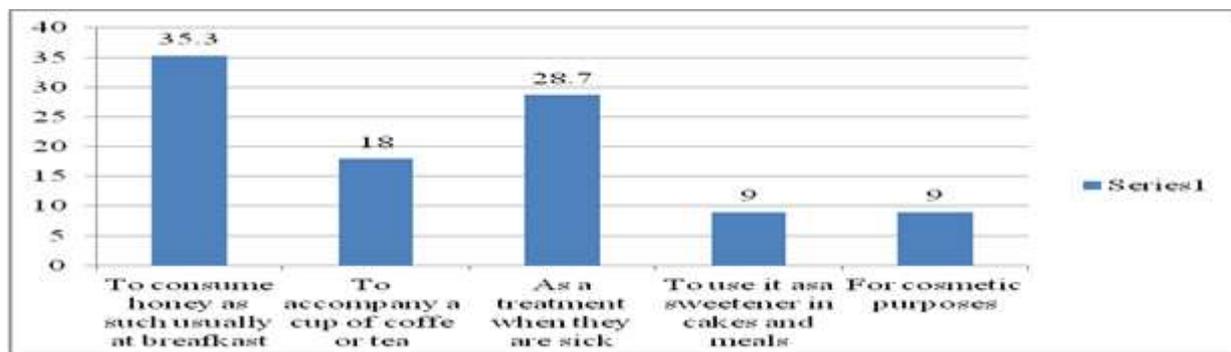


Fig.3.The purposes for which the respondents buy honey (%)

Source: Own design based on the respondents' answers.

At Q4 "How many times do you buy honey per year?", the answers have been: 44.9 % respondents buy honey several times a year, 34.7 % buy twice a year and 20.4 % buy only once a year (Fig.4).

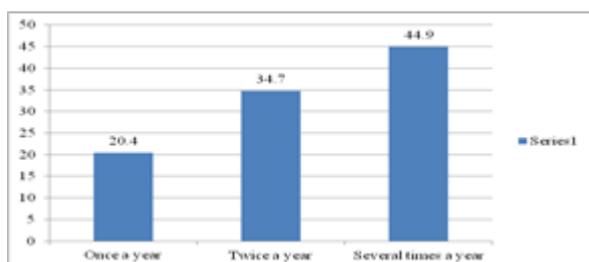


Fig.4.The distribution of respondents based on the frequency they buy honey during a year (%)

Source: Own design based on the respondents' answers.

At Q5 "Where do you buy honey from?"

At this question, it was found that 55.1 % of the respondents prefer to buy honey directly from a beekeeper that they know very well and whose honey is of high quality, has a good taste and flavor.

About 25.1 % respondents affirmed that they buy honey from honey fairs, where the beekeepers come to offer a large variety of honey products which are for sure natural and of high quality.

About 9 % respondents used to buy honey from the shops belonging to the Romanian Beekeepers Association (RBA), because these shops commercialize honey collected from beekeepers by RBA and the jars contain high quality honey. In addition, honey shops are closer to their house, a reason to go there and buy quickly what they need.

About 6 % respondents buy honey from an agro-food market, where they meet a beekeeper who is able to offer them honey in various jars capacity at a convenient price, and another reason is that the agro-food market is close to their home.

Finally, 4.8 % respondents buy honey from a supermarket when they go shopping, in this way they could buy all they need for the family in the fastest way (Fig.5.).

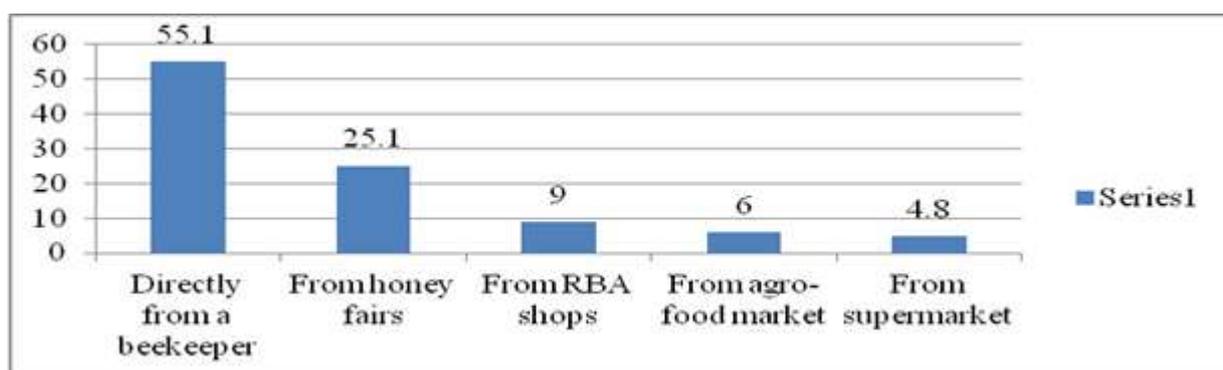


Fig.5.The distribution of respondents based on the place from where they prefer to buy honey (%)

Source: Own design based on the respondents' answers.

**At Q6 "Which amount of honey do you buy per year for your own use?"**

At this question, most of the respondents, more exactly 49.1 % answered 1-2 kg, 32.9 % said that they buy 2-3 kg and 18 % affirmed that they buy 3-4 kg per year (Fig.6).

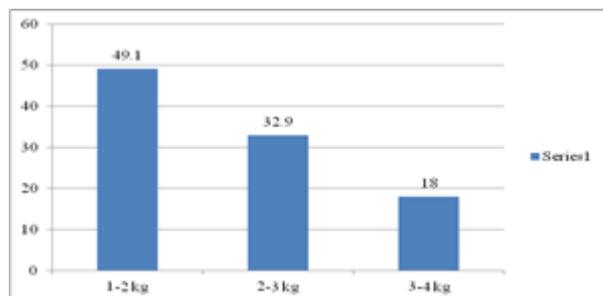


Fig.6.The distribution of respondents based on the amount of honey they buy per year for their own consumption (%)

Source: Own design based on the respondents' answers.

**(i)Analyzing the amount of honey bought per year depending on the respondents' age,** there were considered the two hypothesis:

The H<sub>0</sub> -the amount of honey purchased per year for the own consumption, X, and the age of the buyers, Y are independent variables.

The H<sub>1</sub>- the amount of honey purchased per year for the own consumption, X, and the age of the buyers, Y are dependent variables.

The obtained results have been the following ones:

The total of 82 respondents who use to purchase 1-2 kg honey per year, most of them, more exactly 36.5 % belong to the age group of 36-50 years, 30.4 % belong to the 51-65 age group and 24.3 % belong to the 21-35 age group.

Of the 55 respondents who buy 2-3 kg honey for their own needs, 50.9 % belong to the 36-50 age group, 20 % belong to the youngest category, 21-35 years and also to the 51-65 age group.

Of the 30 respondents who use to purchase 3-4 kg honey per year, 40 % belong to the 36-50 age group, 23.3 % belong to the 51-65 age group and 20 % to the youngest age group, 21-35 years old.

The value of the calculated  $\chi^2$  was 4.94 lower compared to the  $\chi^2$  critical value 12.59 for  $\alpha=0.05$ , for  $df= 6$ . Therefore, the H<sub>0</sub> is accepted, attesting that X,Y are independent variables, more exactly that the amount of purchased honey per year for own consumption, X, and the age of the respondents, Y, are statistically independent variables.

The Pearson correlation coefficient was  $r = 0.169$ , meaning that the relationship between the two variables is negligible.

Cramer's correlation coefficient was  $V=0.121$ . (Table 5).

Table 5. The amount of honey purchased by respondents for their own consumption per year depending on their age group

Age group (years)		1-2 kg	2-3 kg	3-4 kg	Total
21-35	O	20	11	6	37
	E	(18.2)	(12.2)	(6.6)	37
36-50	O	30	28	12	70
	E	(34.4)	(23.0)	(12.6)	70
51-65	O	25	11	7	43
	E	(21.1)	(14.1)	(7.8)	43
66-80	O	7	5	5	17
	E	(8.3)	(5.6)	(3.1)	17
Total	O	82	55	30	167
	%	49.1	32.9	18.0	100
Obtained results		Interpretation			
$\chi^2= 4.94 < 12.59$ $\chi^2$ critical value for $\alpha=0.05$ , for $df= 6$ .		The H <sub>0</sub> is accepted, the amount of honey bought per year for own needs and the respondents' age are statistically independent variables.			
Pearson correlation coefficient, $r = 0.169$		As $0.1 < r < 0.19$ , it is a negligible relationship between the amount of honey bought per year for own needs and the respondents' age.			
Cramer's correlation coefficient, $V= 0.121$		As $0.11 < V < 0.15$ , it is a moderate connection between the amount of honey bought per year for own needs and the respondents' age.			

Note: O=observed values; E=expected theoretical values.

Source: Own calculations based on the survey, 2018.

**(ii)Analyzing the amount of honey bought per year for own consumption depending on**

**the education level of the respondents,** the hypothesis has been:

The  $H_0$  - the amount of honey bought per year for own consumption, X, and the buyers' education level, Y are independent variables.

The  $H_1$ - the amount of honey bought per year for own consumption, X and the buyers' education level, Y are dependent variables.

The obtained results have been the following ones:

Of the 82 respondents who affirmed that they buy 1-2 kg honey for their own needs, most of them, more exactly 56 % are high school leavers, 36.5 % graduated a faculty and 7.5 % attended a gymnasium.

Of the 55 respondents who use to purchase 2-3 kg honey per year for their own consumption, 54.5 % graduated a faculty, 36.3 % are high school leavers and 9.1 % are a gymnasium leavers.

Of the 30 respondents who affirmed that they purchase 3-4 kg honey per year, 50 % graduated a high school, 33.3 % graduated a faculty and 16.7 % are gymnasium leavers.

The value of the calculated  $\chi^2$  was 8.04 lower compared to the  $\chi^2$  critical value 9.49 for  $\alpha=0.05$ , for  $df= 4$ . Therefore, the  $H_0$  is accepted, attesting that X,Y are independent variables, more exactly that the amount of purchased honey per year for own needs, X, and the education level of the respondents, Y, are statistically independent variables.

The Pearson correlation coefficient was  $r = 0.214$ , meaning a weak positive connection between the two analyzed variables. Cramer's correlation coefficient was  $V=0.155$ , reflecting a strong relationship between these two variables (Table 6).

Table 6. The amount of honey purchased by respondents for their own consumption per year depending on their education level

Education level		1-2 kg	2-3 kg	3-4 kg	Total
Gymnasium	O	20	11	6	37
	E	(18.2)	(12.2)	(6.6)	37
High school	O	30	28	12	70
	E	(34.4)	(23.0)	(12.6)	70
Faculty	O	25	11	7	43
	E	(21.1)	(14.1)	(7.8)	43
Total	O	7	5	5	17
	%	(8.3)	(5.6)	(3.1)	17
Obtained results			Interpretation		
$\chi^2= 4.94 < 9.49$ $\chi^2$ critical value for $\alpha=0.05$ , for $df= 4$ .			The $H_0$ is accepted, the amount of honey bought per year for own needs and the respondents' education level are statistically independent variables.		
Pearson correlation coefficient, $r = 0.214$			As $0.2 < r < 0.29$ , it is a weak positive connection between the amount of honey bought per year for own needs and the respondents' education level.		
Cramer's correlation coefficient, $V= 0.155$			As $0.15 < V < 0.25$ , it is a strong connection between the amount of honey bought per year for own needs and the respondents' education level.		

Note: O=observed values; E=expected theoretical values.

Source: Own calculations based on the survey, 2018.

***(iii) Analyzing the amount of honey bought per year for own consumption depending on the monthly income of the respondents,*** the hypothesis have been:

The  $H_0$  - the amount of honey bought per year for own consumption, X, and the buyers' monthly income, Y are independent variables.

The  $H_1$ - the amount of honey bought per year for own consumption, X and the buyers' monthly income, Y are dependent variables.

The obtained results have been the following ones:

Of the 82 respondents who purchase 1-2 kg honey per year, 42.6 % belong to the Lei

3,000-4,000 income class per month, 18.3 % belong to the Lei 4,000-5,000 per month, 9.7 % belong to the Lei 5,000-6,000 and also to the Lei 1,000-2,000 income per month.

The income structure of the respondents who affirmed that they buy 2-3 kg honey per year for their own needs is the following one: 27.2 % earn Lei 3,000-4,000 per year, other 27.2 % earn Lei 4,000-5,000, 18.1 % earn Lei 2,000-3,000, and 9.1 % have the lowest income Lei 1,000-2,000 and also other 9.1 % have the highest income Lei 6,000 and over.

The 30 respondents who purchase 3-4 kg honey per year are equally distributed by income classes, more exactly 16.6 %.

The value of the calculated  $\chi^2$  was 7.96 lower compared to the  $\chi^2$  critical value 18.31 for  $\alpha=0.05$ , for  $df= 10$ . Therefore, the  $H_0$  is accepted, attesting that X,Y are independent variables, more exactly that the amount of purchased honey per year for own needs, X,

and the monthly income of the respondents, Y, are statistically independent variables.

The Pearson correlation coefficient was  $r = 0.213$ , meaning a weak positive connection between the two analyzed variables. Cramer's correlation coefficient was  $V=0.154$ , reflecting a strong relationship between these two variables (Table 7).

Table 7. The amount of honey purchased by respondents for their own consumption per year depending on their monthly income

Monthly income (Lei)		1-2 kg	2-3 kg	3-4 kg	Total
1,000-2,000	O	8	5	5	18
	E	(8.8)	(5.9)	(3.3)	18
2,000-3,000	O	11	10	5	26
	E	(12.8)	(8.6)	(4.6)	26
3,000-4,000	O	35	15	5	55
	E	(27)	(18.1)	(9.9)	43
4,000-5,000	O	15	15	5	35
	E	(17.2)	(11.5)	(28.7)	35
5,000-6,000	O	8	5	5	18
	E	(8.8)	(5.9)	(3.3)	18
6,000 and over	O	5	5	5	15
	E	(2.4)	(4.9)	(7.7)	15
Total	O	82	55	30	167
	%	49.1	32.9	18.0	100
Obtained results		Interpretation			
$\chi^2= 7.96 < 18.31$ $\chi^2$ critical value for $\alpha=0.05$ , for $df= 10$ .		The $H_0$ is accepted, the amount of honey bought per year for own needs and the respondents' monthly income are statistically independent variables.			
Pearson correlation coefficient, $r = 0.213$		As $0.2 < r < 0.29$ , it is a weak positive connection between the amount of honey bought per year for own needs and the respondents' monthly income.			
Cramer's correlation coefficient, $V = 0.154$		As $0.15 < V < 0.25$ , it is a strong connection between the amount of honey bought per year for own needs and the respondents' education level.			

Note: O=observed values; E=expected theoretical values.

Source: Own calculations based on the survey, 2018.

**At Q7 "Which is your opinion on honey price?"**

Most of the questioned individuals, 51.5 %, said that honey price is appropriate taking into account the quality of the product, its nutritive value and as it is a healthy food. About 30.5 % respondents considered that honey price is low and 18 % said that it is high ( Fig.7).

*(i)Analyzing the opinion of the respondents on honey price depending on their age*, there were considered the two hypothesis:

The  $H_0$  -the opinion of the respondents on honey price, X, and the age of the respondents, Y are independent variables.

The  $H1$ - the opinion of the respondents on honey price, X, and the age of the buyers, Y are dependent variables.

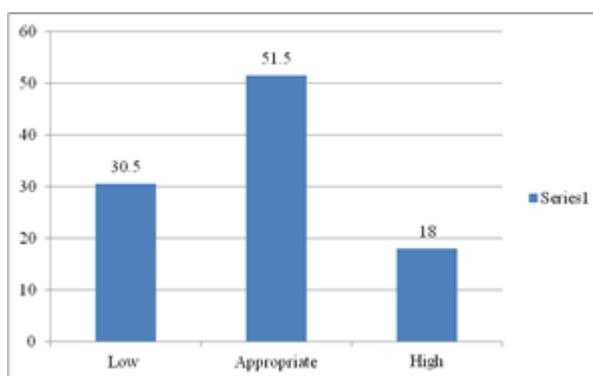


Fig.7.The distribution of respondents based on their opinion on honey price (%)

Source: Own design based on the respondents' answers.

The obtained results have been the following ones:

Of the 51 respondents who affirmed that honey price is low, most of them, 45 %, belong to the 36-50 age group, 25.4 % belong

to the 51-65 age group, 19.6 % belong to the 21-35 age group and 9.8 % to the oldest group of individuals.

Of the 86 respondents who considered that honey price is appropriate, 48.8 % belong to the 36-50 age group, 29 % belong to the 51-65 age group, 13.9 % belong to the youngest group, 21-35, and 8.1 % belong to the oldest group of age, 66 and over.

Of the 30 respondents who said that honey price is high, 50 % are the youngest with the age varying between 21-35 years, probably in connection with their income, 16.6 % belonged to the other age groups in equal proportion.

The value of the calculated  $\chi^2$  was 21.80 higher compared to the  $\chi^2$  critical value 12.59 for  $\alpha=0.05$ , for  $df= 6$ . Therefore, the  $H_0$  is rejected, and  $H_1$  is accepted, meaning that X,Y are dependent variables, more exactly that the respondents opinion on honey price, X, and their age, Y, are statistically dependent variables.

The Pearson correlation coefficient was  $r = 0.339$ , meaning a moderate positive relationship between the two studied variables. Cramer's correlation coefficient was  $V=0.255$ , reflecting a very strong relationship between these two variables (Table 8).

Table 8. The respondents' opinion on honey price depending on their age

Age group		Low	Appropriate	High	Total
21-35	O	10	12	15	37
	E	(11.3)	(19.0)	(6.7)	37
36-50	O	23	42	5	70
	E	(21.4)	(36.0)	(12.6)	70
51-65	O	13	25	5	43
	E	(13.1)	(22.1)	(7.8)	43
66-80	O	5	7	5	17
	E	(5.2)	(8.8)	(3.0)	17
Total	O	51	86	30	167
	%	30.5	51.5	18	
Obtained results			Interpretation		
$\chi^2= 21.80 > 12.59$ $\chi^2$ critical value for $\alpha=0.05$ , for $df= 6$ .			The $H_0$ is rejected, and $H_1$ is accepted, the respondents' opinion on honey price and their age are statistically dependent variables.		
Pearson correlation coefficient, $r = 0.339$			As $0.3 < r < 0.39$ , it is a moderate positive connection between the respondents' opinion on honey price and their age.		
Cramer's correlation coefficient, $V = 0.255$			As $V > 0.25$ , it is a very strong connection between the respondents' opinion on honey price and their age.		

Note: O=observed values; E=expected theoretical values.  
Source: Own calculations based on the survey, 2018.

**(ii) Analyzing the opinion of the respondents on honey price depending on their education level,** there were considered the two hypothesis:

The  $H_0$  -the opinion of the respondents on honey price, X, and their education level, Y are independent variables.

The  $H_1$ - the opinion of the respondents on honey price, X, and their education level, Y are dependent variables.

The obtained results have been the following ones:

Of the 51 respondents who said that honey price is low, 54.9 % graduated an university, 35.2 % graduated a high school and 9.9 % graduated a gymnasium.

Of the 86 respondents who affirmed that honey price is appropriate, 53.4 % graduated a

high school, 40.6 % graduated a faculty and 6 % graduated a gymnasium.

Of the 30 questioned individuals who said that honey has a high price, 56.6 % graduated a high school, 23.3 % graduated a faculty and 20.1 % graduated a gymnasium.

The value of the calculated  $\chi^2$  was 11.91 higher compared to the  $\chi^2$  critical value 9.49 for  $\alpha=0.05$ , for  $df= 4$ . Therefore, the  $H_0$  is rejected, and  $H_1$  is accepted, meaning that X,Y are dependent variables, more exactly that the respondents opinion on honey price, X, and their education level, Y, are statistically dependent variables.

The Pearson correlation coefficient was  $r = 0.258$ , meaning a weak positive relationship between the two studied variables.

Cramer's correlation coefficient was  $V=0.188$ , two variables (Table 9), reflecting a strong relationship between these

Table 9. The respondents' opinion on honey price depending on their education level

Education level		Low	Appropriate	High	Total
Gymnasium	O	5	5	6	16
	E	(4.9)	(8.2)	(2.9)	16
High school	O	18	46	17	81
	E	(24.7)	(41.7)	(14.6)	81
University	O	28	35	7	70
	E	(21.3)	(36.0)	(12.7)	70
Total	O	51	86	30	167
	%	30.5	51.5	18.0	100
Obtained results		Interpretation			
$\chi^2=11.91 > 9.49$ $\chi^2$ critical value for $\alpha=0.05$ , for $df=4$ .		The $H_0$ is rejected, and $H_1$ is accepted, the respondents' opinion on honey price and their education level are statistically dependent variables.			
Pearson correlation coefficient, $r = 0.258$		As $0.2 < r < 0.29$ , it is a weak positive connection between the respondents' opinion on honey price and their education level.			
Cramer's correlation coefficient, $V = 0.188$		As $0.15 < V < 0.25$ , it is a strong connection between the respondents' opinion on honey price and their education level.			

Note: O=observed values; E=expected theoretical values.  
 Source: Own calculations based on the survey, 2018.

(iii) Analyzing the opinion of the respondents on honey price depending on their monthly income, there were set up the two hypothesis: The  $H_0$  -the opinion of the respondents on honey price, X, and their monthly income, Y

are independent variables. The  $H_1$  - the opinion of the respondents on honey price, X, and their monthly income, Y are dependent variables.

Table 10. The respondents' opinion on honey price depending on their monthly income

Monthly income (Lei)		Low	Appropriate	High	Total
1,000-2,000	O	5	8	5	18
	E	(5.5)	(9.3)	(3.2)	18
2,000-3,000	O	5	15	5	26
	E	(7.9)	(13.4)	(4.7)	26
3,000-4,000	O	15	35	5	55
	E	(16.8)	(28.3)	(9.9)	55
4,000-5,000	O	20	10	5	35
	E	(10.7)	(18.0)	(6.3)	35
5,000-6,000	O	5	8	5	18
	E	(5.5)	(9.3)	(3.2)	18
6,000 and over	O	5	5	5	15
	E	(4.6)	(7.7)	(2.7)	15
Total	O	51	86	30	167
	%	30.5	51.5	18.0	100
Obtained results		Interpretation			
$\chi^2=22.19 > 18.31$ $\chi^2$ critical value for $\alpha=0.05$ , for $df=10$ .		The $H_0$ is rejected, and $H_1$ is accepted, the respondents' opinion on honey price and their monthly income are statistically dependent variables.			
Pearson correlation coefficient, $r = 0.342$		As $0.3 < r < 0.39$ , it is a moderate positive connection between the respondents' opinion on honey price and their monthly income.			
Cramer's correlation coefficient, $V = 0.257$		As $V > 0.25$ , it is a very strong connection between the respondents' opinion on honey price and their monthly income.			

Note: O=observed values; E=expected theoretical values.  
 Source: Own calculations based on the survey, 2018.

The obtained results have been the following ones:  
 Of the 51 respondents who affirmed that honey price is low, most of them, 39.2 %, earn Lei between 4,000-5,000 per month, 29.4

% belong to the income class Lei 3,000-4,000 and 11.7 % belong to the Lei 2,000-3,000 income interval, 9.8 % earn either the lowest income Lei 1,000-2,000 or Lei 5,000 and over.

Of the 86 respondents who said that honey price is appropriate, 40.6 % earn Lei 3,000-4,000 per month, 17.4 % earn Lei 2,000-3,000, 11.6 % belong to the Lei 4,000-5,000 income class, 9.3 % belong to the 1.000-2,000 income interval and also other 9.3 % to the 5,000-6,000 income class, and 6.2 % have the highest income.

The 30 individuals who considered that honey price is high are equally distributed by income class.

The value of the calculated  $\chi^2$  was 22.19 higher compared to the  $\chi^2$  critical value 18.31 for  $\alpha=0.05$ , for  $df= 10$ . Therefore, the  $H_0$  is rejected, and  $H_1$  is accepted, meaning that X,Y are dependent variables, more exactly that the respondents opinion on honey price, X, and their monthly income, Y, are statistically dependent variables.

The Pearson correlation coefficient was  $r = 0.342$ , meaning a moderate positive relationship between the two studied variables.

Cramer's correlation coefficient was  $V=0.257$ , reflecting a very strong relationship between these two variables (Table 10).

**At Q8 "Which are the criteria taken into consideration when you purchase honey?"**

At this question, the respondents had to appreciate the significance degree of the following criteria: honey type, brand, price, packaging and color. The significance they allotted to each criterion has been reflected by their choice from the following alternatives: 1

Very insignificant, 2 Insignificant, 3 Uncertain, 4 Significant and 5 Very significant, according to Likert scale.

Honey type was considered significant by 55.1 % respondents, very significant by 14.3 %, insignificant by 13.2 %, uncertain by 11.4 % and very insignificant by 6 %.

Honey brand is considered significant by 43.8 % questioned individuals, very significant by 25.2 %, uncertain by 21.5 %, insignificant by 7.2 % and very insignificant by 2.3 %.

Honey price is considered significant by 58.1 % respondents, very significant by 13.7 %, insignificant by 14.4 %, uncertain by 9 % and very insignificant by 4.8 %.

Honey packaging is significant for 53.9 % respondents, very significant for 17.9 %, uncertain for 13.2 %, insignificant for 12 % and very insignificant for 3 %.

The honey color is appreciated as significant by 52.1 % respondents, significant by 25.7 %, uncertain by 12.6 %, insignificant by 7.8 % and very insignificant by 1.8 %.

Therefore, most of the respondents considered that all these 5 criteria: type, brand, price, packaging and color are significant and very significant for the decision to buy honey.

According to Likert scale, the calculated scores for each criterion have been the following ones: 3.59 for honey type, 3.82 for brand, 3.62 for price, 3.72 for packaging and 3.92 for color. The total score for all the five criteria is 3.73 (Table 11).

Table 11. The respondents' answers regarding the significance level of the criteria taken into account when they purchase honey

		Significance level					Total	Score
		1 Very insignificant	2 Insignificant	3 Uncertain	4 Significant	5 Very significant		
Honey type	Frequency	10	22	19	92	24	167	3.59
	Percentage	6.0	13.2	11.4	55.1	14.3	100	
Brand	Frequency	4	12	36	73	42	167	3.82
	Percentage	2.3	7.2	21.5	43.8	25.2	100	
Price	Frequency	8	24	15	97	23	167	3.62
	Percentage	4.8	14.4	9.0	58.1	13.7	100	
Packaging	Frequency	5	20	22	90	30	167	3.72
	Percentage	3.0	12.0	13.2	53.9	17.9	100	
Color	Frequency	3	13	21	87	40	167	3.92
	Percentage	1.8	7.8	12.6	52.1	25.7	100	

Source: Own calculation.

**At Q9 "Which are your information sources about honey?"**

At this question, the interviewed individuals mentioned in the highest proportion, 71.8 %,

that they collect information directly from beekeepers because the producers are interested to give a lot of details about their products and answer any question the clients have.

Also, 55.1 % respondents affirmed that they collect information from honey fairs, as at the fair come the beekeepers with a large range of bee products that they are interested to sell and for this reason they explain the importance, content, qualities, uses etc of each product.

About 49.1 % respondents like to pick up information on honey, its nutritive value, uses, recipes etc reading articles published in various magazines and journals.

About 36.5 % respondents said that they look for getting information from various websites. Other 8.3 % respondents collect information from doctors and 5.9 % from nutritionists who make them useful recommendations.

About 5.9 % prefer to read the information written on the labels of the jars from the shelf of the supermarket when they use to purchase honey.

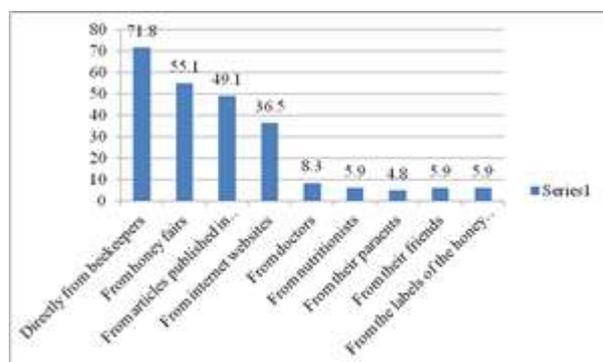


Fig.8.The distribution of respondents based on their source of information on honey (%)

Source: Own design based on the respondents' answers.

Finally, other 5.9 % respondents said that they decide to buy honey due to their friends who like to consume honey and are convinced of its benefits for human body and health and 4.8 % questioned individuals collect information from their parents.

Therefore, it was noticed that most of the honey buyers like to be informed very well on honey using various sources of information (Fig.8.).

## CONCLUSIONS

The study allowed to arrive at the following important conclusions:

- more women than men are interested in buying and consuming honey;
- the average age of the buyers is 45.8 years, as 40 % of the interviewees belonged to the 36-50 age group, 26 % belonged to 51-65 group and 24.5 % belonged to the 21-35 group;
- about 65 % of honey buyers are married, this means that the family of these individuals is accustomed to consume honey;
- honey is bought mainly by the people who graduated a high school and then by the one who graduated an university, but less by the ones with only a gymnasium level;
- honey is mainly purchased by people with an average income ranging between Lei 3,000-4,000 per month (about 50 %), and also by people who earn between Lei 4,000-5,000/month (24.5 %);
- the preference for the honey type, in the decreasing order is: polyfloral honey (52.1 %), acacia honey (24.6 %) and the remaining for other types of honey (23.3 %).
- depending on age group, polyfloral is preferred mainly by the buyers whose age belong to the age groups 36-50 and 51-65, while acacia honey is preferred by the ones whose age belong to the age groups 36-50 and 21-35;
- depending on the education level, polyfloral honey is purchased by 60.4 % of the high school leavers, 45.7 % of the graduates of a faculty, and 37.5 % of the ones with gymnasium; acacia honey comes on the 2nd position being bought mainly by people with higher education and gymnasium;
- depending on monthly income, polyfloral honey is mainly bought by people who earn between Lei 3,000-4,000 and Lei 4,000-5,000 per month, while acacia honey is more preferred by the income group Lei 4,000-5,000 and then by Lei 3,000-4,000;
- the results of the Chi-squared test confirmed that the purchase of honey and buyers age, education and income level are independent variables, and the Pearson and Cramer's

coefficients of correlation proved a low relationship between these pairs of variables;

-all the respondents affirmed that they buy honey because it is a healthy product, about 95 % are aware of its high nutritive value, and 14 % consider honey as a tasty food, and only 4 % have other reasons to buy honey;

-honey is bought for the following purposes: to be consumed at breakfast as affirmed 35 % of the interviewed visitors, to be used as a medicine as confirmed by 29 % of the respondents, to accompany a cup of coffee or tea as said 18 % of the respondents, to be utilized as a sweetener in the kitchen (9%) and for cosmetic goals (9%);

-honey is bought several times a year by most of the interviewed persons (45 %), twice a year by 35 % and once a year by the remaining;

-most of the respondents prefer to buy honey directly from beekeepers (55%) and from honey fairs (25 %) where they also meet beekeepers, and just a few purchase honey from agro-food market and supermarkets;

-most of the respondents, 49 %, buy between 1-2 kg honey per year, and about 33% respondents buy 2-3 kg and just a few people purchase more than 3 kg, an aspect which confirms the low average yearly consumption per capita.

-depending on age, it was noticed that the age group 36-50 followed by 51-65 are on the top when they decide to buy honey, no matter the amount; this is probably related to the consciousness of the mature and older people on the honey benefits and also due to the medical status or their need to prevent various diseases.

-a higher amount of honey is bought mainly by the respondents who graduated a faculty and a high school;

-a higher quantity of honey is mainly purchased by the respondents who earn Lei 3,000-4000, followed by the individuals with Lei 4,000-5,000 monthly income;

-the results of the Chi-squared test confirmed that the amount of bought honey and buyers age, education and income level are independent variables, an aspect which was also attested by the low positive Pearson and Cramer's coefficients of correlation;

-most of the respondents (50%) considered that honey price is appropriate, and they belong especially to the age groups 36-50 and 51-65 years; about 30 % interviewed persons said that honey price is low; about 50 % of the youngest persons (21-35 years) considered that honey price is high;

-depending on the education level, most of the respondents who graduated a faculty affirmed that honey price is low, while most of the respondents who graduated a high school affirmed that honey price is appropriate.

-the Chi-squared test proved that age and honey price, as well as education level and honey price are independent variables, while honey price and monthly income are dependent variables, the relationship between these two variables being a moderate positive Pearson correlation and a strong positive Cramers' correlation coefficient.

- the criterion considered "significant" by the most interviewed persons when they buy honey are, in the decreasing order, honey price, type, packaging and color; if we take into consideration their answers for "significant" and "very significant" options, the order of importance in the purchase decision is: color, price, packaging and honey type.

-The main sources of information about honey are the beekeepers and honey fairs, followed by magazines and journals and internet, and with a less importance are sources as doctors, nutritionists, parents, friends, jar labels.

Therefore, taking account the results of this study, honey producers should pay attention to the diversification of their products to satisfy better all the categories of potential clients with a large variation of income level. Also, they have to offer products mainly addressed to the mature and older people, but also to the young persons. Also, they have to produce more polyfloral honey, but not to ignore the importance of acacia honey and other sorts of honey. Of course, these aspects depend very much on the climate conditions during pickings. Beekeepers should intensify the promotion of their products and from this point of view, media should be more involved in increasing people's knowledge about the

nutritive value and medical benefits of the honey. Honey fairs should be more frequently organized in the capital, but also in other municipalities to enlarge the segment of potential clients.

As a final conclusion, new marketing strategies should be set up by beekeepers in order to increase honey sales and their profit and to satisfy better consumers' needs, to increase honey consumption in a country like Romania which has a high honey production and product quality.

## REFERENCES

- [1] Arvqnitoyannis, I., Krystallis, A., 2010, The development of a biochemical profile of acacia honey by identifying biochemical determinants of its quality. *Notulae Botanicae Horti Agrobotanici Cluj-Napoca*, 38(2), 84–90.
- [2] Batt, P.J., Liu, A., 2012, Consumer behavior towards honey products in Western Australia, *British Food Journal*, Vol.114(2):285-297
- [3] Bršćić, K., Šugar, T., Poljuha, D., 2017, An empirical examination of consumer preferences for honey in Croatia, *Applied Economics* 49(3):1-13.
- [4] Bock, D.E., Velleman, P.F., De Veaux, R.D., 2007, *Stats, Modeling the World*, pp. 606-627, Pearson - Addison Wesley, Boston.
- [5] Burns, A., Burns, R., 2008, *Basic Marketing Research*, 2nd Ed., New Jersey: Pearson Education. p. 245.
- [6] Churchill, Jr.G.A., 1987, *Marketing research, Methodological foundations*, 4th Ed., The Dryden Press International Ed., 327-331.
- [7] Ćirić, M., Ignjatijević, S., Cvijanović, D., 2015, Research of honey consumers' behavior in Province Vojvodina, *Economics of Agriculture* 3, 627-644.
- [8] Correlation Coefficient: Simple Definition, Formula, Easy Steps, <https://www.statisticshowto.datasciencecentral.com/probability-and-statistics/correlation-coefficient-formula/>, Accessed Dec.2, 2018.
- [9] Cosmina, M., Gallenti, G., Marangon, F., Troiano, S., 2015, Attitudes towards honey among Italian consumers: a choice experiment approach, *EAAE-AAEA Joint Seminar on "Consumer Behavior in a Changing World: Food, Culture, Society"*, March 25 to 27, 2015. 18 pages.
- [10] Countries that consume the most honey, <https://www.worldatlas.com/articles/countries-that-consume-the-most-honey.html>, Accessed Dec.12, 2018.
- [11] Demircan, V., Sarica, D., Dalgic, A., 2017, Determination of consumers' consumption levels and habits for bee products: A case study of Isparta Province, Turkey, *Scientific Papers*, Vol.60(1), *Agronomie Series*, pp.145-150.
- [12] Frank, R., 2013, Honey food and medicine, 101 delicious recipes with honey (Mierea aliment si medicament, 101 retete delicioase cu miere), MAST Publishing House, 9-12.
- [13] Ghorbani, M., Khajehroshanaee, N., 2009, The Study of Qualitative Factors Influencing on Honey Consumers Demand: Application of Hedonic Pricing Model in Khorasan Razavi Province. *Journal of Applied Sciences*, 9, 1597-1600.
- [14] Grigoras, M.A., Popescu Agatha, Holeab, C., Chedea, V., Merce, E., 2007, Bridging the innovation gap and the management of interdisciplinary project for sustainable development, XXXVII Annual Meeting of European Society for New Methods in Agricultural Research, ESNA, pp.10.
- [15] Greenwood, P.E., Nikulin, M.S., 1996, *A guide to chi-squared testing*. New York: Wiley, 304 pp.
- [16] Gyau, A., Akalakou, C., Degrande, A., Biloso, A., 2014, Determinants of Consumer Preferences for Honey in the Democratic Republic of Congo, *Journal of Food Products Marketing*, 476-490.
- [17] Honey food value, (Valoarea alimentara a mierii), <http://www.tainavie.ro/totul-despre-miere/valoarea-alimentara-a-mierii.html>, Accessed Dec.2, 2018.
- [18] Honey, 2018, The World Healthiest Foods, <http://whfoods.com/genpage.php?pfriendly=1&tname=znutrientprofile&dbid=53>, Accessed Dec.2, 2018.
- [19] Honey Market Presentation, Europa EU, [https://ec.europa.eu/agriculture/sites/agriculture/files/honey/market-presentation-honey\\_en.pdf](https://ec.europa.eu/agriculture/sites/agriculture/files/honey/market-presentation-honey_en.pdf), Accessed Dec. 12, 2018.
- [20] Ion A., 2012, Bee Honey nutritional profile, (Profilul nutritional al mierii de albine), <http://www.ziare.com/viata-sanatoasa/alimente/profilul-nutritonal-al-mierii-de-albine-1148764>, Accessed Dec.2, 2018.
- [21] Ismaiel, S., Al-Kahtani, S., Adgaba, N., Al-Ghamdi, A. A., Zulail, A., 2014, Factors That Affect Consumption Patterns and Market Demands for Honey in the Kingdom of Saudi Arabia. *Food and Nutrition Sciences*, 5, 1725-1737.
- [22] Marin, M., 1966, Food, dietetic and therapeutic value of bee products ( Valoarea alimentara, dietetica si terapeutica a produselor apicole), *Agro-Silvica Publishing House*.
- [23] Pirvutoiu, I., Popescu Agatha, 2011, Analysis of Romania's honey market, *Scientific Papers Animal Science and Biotechnologies*, 44(2): 500-503.
- [24] Pocol, C., Marghitas, L.A, 2008, A comparison between the segmentation of honey market in Romania and Ireland, *Bulletin UASVM, Horticulture* 65(2):279-282.
- [25] Pocol, C. B., 2011, Modelling the honey consumption behaviour in Romania by using socio-demographic determinants. *African Journal of Agricultural Research*, 6(17), 4069–4080.
- [26] Popescu Agatha, 2006, Study upon honey market in the EU countries, *Bulletin of USAMV Cluj-Napoca, Zootehnics and Biotechnology*, No.62, pp.215.
- [27] Popescu Agatha, 2012, Research on Beekeepers Income Estimation based on Honey Production,

Bulletin UASVM Animal Science and Biotechnologies 69(1-2)/2012, 185-191.

[28]Popescu Agatha, 2013, Study concerning the Trends in Romania's Honey Market, Scientific Papers-Series Animal Science, Vol. 59, 153-158.

[29]Popescu Agatha, 2013, Research concerning apiary size, honey yield and beekeepers' income in Teleorman County, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development Vol. 13, Issue 1, 293-299.

[30]Popescu Agatha, 2016, The effect of Honey Production on Beekeepers Income. A Study Case in South Muntenia Development Region of Romania, Proceedings of the 28th IBIMA International Conference, Sevilla, Spain, November 9-10, 2016, pp.919-934.

[31]Popescu Agatha, 2016, Regression and Elasticity of the Average Delivery Price and Honey Production in Romania, Proceedings of the 28th IBIMA International Conference, Sevilla, Spain, November 9-10, 2016, pp.935-944.

[32]Popescu Agatha, 2017, Bee honey production in Romania 2007-2015, and 2016-2020 forecast, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development Vol. 17(1): 339-349.

[33]Popescu Agatha, 2018, Honey production and trade before and after Romania's accession into the European Union, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol.18, Issue 4/2018, 229-248.

[34]Production volume of natural honey worldwide from 2010 to 2016 (1,000 metric tonnes), <https://www.statista.com/statistics/755215/natural-honey-production-volume-worldwide/>, Accessed Dec. 12, 2018.

[35]Roman, A., Popiela-Pleban, E., Kozak, M., 2013, Factors influencing consumer behavior relating to the purchasing of honey part 1. The buying process and the level of consumption, Journal of Apicultural Science 57(2):159-172.

[36]Sanova, P., Svoboda, J., Hroubcova, B., Serakova, P., 2017, Segmentation of Honey Buyers' Behaviour by Conjoint Analysis, Scientia Agriculturae Bohemica, 48 (1):55-62

[37]Schneider, K., Forchmann, K., Friedrichs, K., Haas, E. M., Interthal, M., Jänicke, K., Kühn, T., Mergler, B., Mertens, E., Raehse, J., Schrüffer, Y., Seelinger, N., Sölch, K., Weißenborn, C., Hoffmann, I., 2007, Honey consumption in Germany. Factors of influence and effects in their interlinkage. Apidologie, 38(5), 497.

[38]Sillani, S., Grillenzoni, F. V., 2007, Le politiche della qualità del miele e il pricing dei dettaglianti. Apoidea, 4(1):35-43.

[39]Ványi, G.A., Csapó, Z., Kárpáti, L., 2009, Evaluation of consumers' honey purchase habits in Hungary, 113th EAAE Seminar "A resilient European food industry and food chain in a challenging world", Chania, Crete, Greece, September 3 - 6, 2009, 12 pages.

[40]What are the enzymes present in raw honey? Why are they important?

<https://healthywithhoney.com/what-are-the-enzymes-present-in-raw-honey-why-are-they-important/>, Accessed Dec.2, 2018

[41]What is the demand for honey in Europe?, <https://www.cbi.eu/market-information/honey-sweeteners/trade-statistics>, Accessed Dec. 12, 2018.

[42]Which is the nutritional value of bee honey? (Ce valoare nutritionala are mierea de albina?), <http://poftademiere.ro/ce-valoare-nutritionala-mierea-de-albina.html>, Accessed Dec.2, 2018.

[43]Yeow, S.H.C., Chin, S.T.S., Yeow, J.A., Tan, K.S., 2013, Consumer Purchase Intentions and Honey Related Products, Journal of Marketing Research & Case Studies, Vol. 2013, 15 pages.

[44]Zhang, M., 2018, Consumer attitudes and behavior towards honey in China, [https://lib.ugent.be/fulltxt/RUG01/002/482/264/RUG01-002482264\\_2018\\_0001\\_AC.pdf](https://lib.ugent.be/fulltxt/RUG01/002/482/264/RUG01-002482264_2018_0001_AC.pdf), Accessed Dec.12, 2018.



## CHOOSING THE GENITORS - AN IMPORTANT MEASURE IN MAKING THE BREEDING WORKS BETTER AT THE SPRING BARLEY

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### Abstract

*Ensuring progress in improving barley's production and traits of interest is closely linked to the diversity and performance of the original material that can lead to increased genetic variability and new valuable cultivars. Thus, phenotyping of the genotyping collection is a first step in identifying the most valuable available genres and introducing them into hybridization programs, depending on the complementarity of the traits. The traits that have been quantified and used to determine the cognition degree of the cultivars studied are: plants height, ear length, number of grain / ear, grain weight/ear, TKW, protein and starch content. Genotypes have been identified that can be used in future amelioration works either to increase the fall resistance because plants height value are approximately 81 cm or for qualitative improvement, showing high TKW values (52 g), low content protein (less than 10.5%) and high starch content (approximately 60%).*

*Key words:* climate changes, Barley, morphological traits, cluster, genotype

### INTRODUCTION

One of the oldest plants in culture is barley, most of the archaeological evidence demonstrates this. This plant has played an important role in the development of human civilization, agronomic, physiological, genetic and plant amelioration sciences, being used by farmers since antiquity [2].

Probably in human food, barley was used in the raw form or as roasted bread, porridge or soup as in the case of gladiators who had a diet based on barley, peas or bean porridge to have power in the arena. Only later, barley was used as fodder or in the alcohol industry. At present, about 55-60% of barley production is used as fodder, 30-40% for malt, 2-3% for human food, and about 5% is used as seed for crop re-establishment [4].

Lately, the interest in barley in human food has increased due to the incidence of obesity growth and chronic diseases such as cancer. Research has shown that dietary fiber has many benefits to human health, barley being an excellent source of fiber and beta-glucans. The genetic background of barley can be classified into: genotypes, improved lines, local populations, wild species and genetic

stocks, depending on the breeding stage of the material [3].

Ensuring progress in improving barley's production and traits of interest is closely linked to the diversity and performance of the original material that can lead to increased genetic variability and new valuable cultivars. Thus, phenotyping of the genotyping collection is a first step in identifying the most valuable available genres and introducing them into hybridization programs, depending on the complementarity of the traits.

In this study, only a part of the results of a much wider experience will be presented by which the availability of national plant genetic resources was actually pursued.

### MATERIALS AND METHODS

The use in improvement schemes of genres in which the traits of interest or at least a large part of them are expressed at a favorable level as a result of previous improvement processes are important measures in accelerating the rhythm of obtaining new cultivation. In order to assess the variability of the features underlying the two-row spring barley improvement from ARDS Turda, a number of

66 genotypes differentiated from the point of view of the traits of interest were selected from the germplasm collection.

The traits that have been quantified and used to determine the degree of cognition of the cultivars studied are: plants height, ear length, number of grain/ear, grain weight/ear, TKW, protein and starch content. The duration of the experience was carried out during two years, 2016 and 2017, the location of which was the field of spring barley improvement from SCDA Turda. In order to reduce the field needed for this component of the improvement field, the collection is sown in 1m lengths, spaced at 25cm, each genotype having four rows. Every year, in the field of improvement we use the same doses of fertilizer and usually the same type of fertilizer. In order to determine the degree of kinship between the studied genitors, the cluster method was addressed using the "Statistics" program. Determination of chemical indicators was performed by spectrophotometry using the Tango Nir device.

## RESULTS AND DISCUSSIONS

Of the morphological traits, the plant's height occupies an important place within the amelioration objectives, being a criterion for selecting new lines from the early stages of improvement.

The remarkable differences between the minimum and maximum values of this traits presented in Table 1 show the existence of real possibilities in identifying valuable genes, complementary to genes of plant height reduction and possessing favorable quantitative qualities. Choosing very contradictory genes in plant height can extend the duration of selection processes and achieve the proposed objectives, given the polygenic nature of this property. By the values of the variation coefficients corresponding to the production components: grain weight/ear, ear length, grain number and TKW, it could be said that between the 66 genotypes analyzed there is quite limited variability in these traits. However, if we refer to the availability reflected between the

minimum and maximum values, we can notice the existence of appreciable variability. When including such genes in hybridization programs, we only need to resort to situations that are absolutely necessary. Thus, the useful portion of this variability that may be used is between the minimum and the average.

The values of the variation coefficients corresponding to the plant size, the grain weights and the protein content suggest that these three traits have a significant share in the differentiation of the analyzed genotypes.

Table 1. The variability indicators corresponding to the traits used for the cluster grouping (2016, 2017)

Trait	Average	Minimum	Maximum	Coefficient of variation (%)
Plant height (cm)	94	77	106	7
Length ear (cm)	9	7.7	10.5	6
Grains number/ear	27	23	30	6
Grains weight/ear (g)	1.39	1.16	1.62	7
TKW (g)	49.86	45.2	56.41	5
Protein (%)	11.12	9.39	12.88	7
Starch (%)	56.78	53.96	60.06	3

Source: original.

At the basis of the formation of the first cluster there were 17 genotypes of different origins, forming six groups. The variants 1, 5 and 15 represented by the Turdeana genotypes, Romanița (Romania) and Vienna (Germany), are represented by the first group of the cluster, with the average height of 94 cm (Table 2). Among the traits analyzed, the grain weight/ ear is the main component contributing to the differentiation of this group.

The difference between the first and the second group is achieved at the plant's height, grain weight/ ear and starch content. Thus, the second group is composed of four genotypes of three native (Daciana V2, Jubilee V4 and charm V7) and the old variety Thuringia (V21) is characterized by a smaller size of only 91 cm, compared with the first group, a low average grain weight/ear (1.33g) and a 55.48% starch content (Table 2).

The largest differences in the set of genotypes that form this cluster are recorded at the plant's height, so the group three records the highest values of the average height of plants (99 cm). If we compare the first and third groups we could say that the similarity between them is reflected in the average values of the protein and starch content (Table 2). This group (III) is represented by Romanian genotypes such as: Prima (V6), Adina (V8), Bogdana (V9) and Western European genotypes Alexis (V18) and Scarlet (V19).

Table 2. The average performance of the analyzed traits corresponding to genotypes in cluster 1

Cluster 1						
Average 2016-2017	I/3	II/4	III/5	IV/1	V/2	VI/2
Plant height (cm)	94	91	99	86	82	81
Length ear (cm)	10	9	9	10	9	8
Grains number/ear	28	27	28	26	24	24
Grains weight/ear (g)	1.46	1.33	1.35	1.20	1.36	1.18
TKW (g)	50.45	48.91	48.55	47.05	53.77	49.27
Protein (%)	10.95	11.17	10.96	11.60	9.72	10.00
Starch (%)	56.98	55.48	56.08	54.96	57.04	58.39

Source: original.

The Capriana spring barley (V3), SCDA Turda, forms the group number four, differentiated by the other groups of this cluster by the lowest values of grain weight/ear (1.20 g), TKW (47 g) and of the starch content (54.96%), but with the highest average protein content of 11.60%. (Table 2). The last two groups (V and VI) of the cluster one are the foreign genotypes: Sidney (V10), Victoriana (V16), Steward (V11) and Marthe (V17) (Figure 1). They can be used in future qualitative improvement and increase of fall resistance because they record the lowest waist values (82 and 81 cm), high TKW values, the lowest protein content and the highest starch content. Similarity of genotypes within these two groups is evident, with only 0.5 linkage units being differentiated.

For the formation of the second cluster, it was chosen to group the lines that have a genealogy of an old variety (Trumpf) which in the 70s and 80s occupy significant areas in

Romania and the Alexis genotype that also has this genealogy. The mean values of the 10 genotypes that form six cluster groups are shown in Table 3.

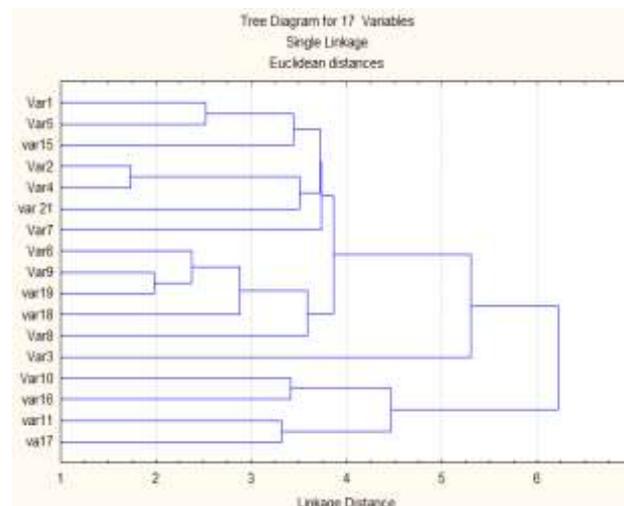


Fig. 1. Cluster presentation of variation some genotypes with regard on some morpho-productive and quality traits

Source: original, obtained through the statistical program.

The four lines forming the first group of the cluster record average plant height of 100 cm, protein and starch content is relatively high (12.10% and 57.38%).

Along with the four lines joins the Alexis genotype (V18) with some similarity to the above lines in terms of plant height, ear length, protein content, why the V18 would appear slightly separate from V103, V104, V106 and 107 s due to the grain weight/ ear (Figure 2). The variants of this group varied by one or two linkage units (Figure 2).

The other lines make up five separate groups with a high degree of similarity in the number of grain/ear, except the To 2270/10 (V108) line with the highest average of 30 grain/ear (Table 3).

A particular behavior that can be observed for variant 168, which differs from the rest of the groups by the highest mean plant height of 106 cm. In terms of protein content, group V is made up of variant 105 with the lowest values (10.56%) consisting of the Gritt and Trumpf barley genotypes (Table 3).

Although these lines have a common hereditary basis, the variability of the

analyzed features did not show a pronounced constraint (Figure 2).

Table 3. The average performance of the analyzed traits corresponding to genotypes in cluster 2

Cluster 2						
Average 2016-2017	I/5	II/1	III/1	IV/1	V/1	VI/1
Plant height (cm)	100	98	95	106	94	89
Length ear (cm)	10	9	9	10	10	10
Grains number/ear	27	30	26	29	26	29
Grains weight/ear (g)	1.30	1.40	1.46	1.50	1.47	1.43
TKW (g)	48.37	48.78	52.99	49.93	56.41	45.20
Protein (%)	12.10	12.53	11.88	11.77	10.56	11.08
Starch (%)	57.38	55.33	53.97	55.23	59.89	55.98

Source:original.

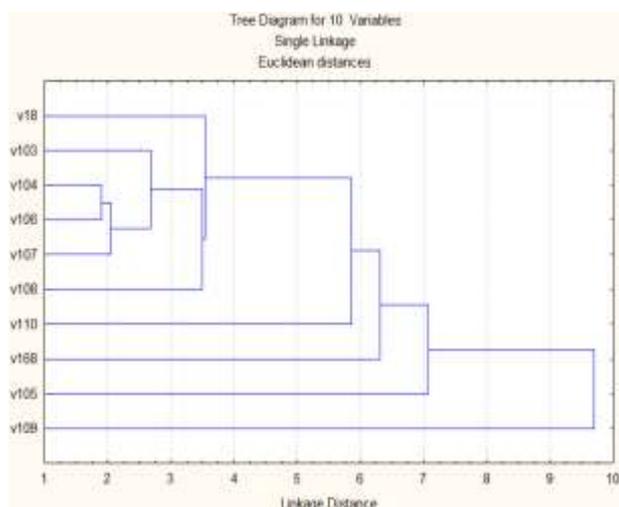


Fig. 2. Cluster presentation of variation some genotypes with regard on some morpho-productive and quality traits  
Source: original, obtained through the statistical program.

In the third cluster are presented Limagrain creations, Saaten-Union Western European breeding and SCDA Turda brand lines obtained between 1980 and 1990. Variants V77, V84, V85, V74, V75 AND V76, V82 and V73, represented by the lines created at SCDA Turda, are differentiated by 1, 2 or 2.5 linkage units, except lines To 3272/79 (V77) and To 2167/94 (V84) along with the Elisa genotype (V23), which form a separate group of cluster three, being quite similar in the analyzed traits (Figure 3) [1].

The differences in these lines are plotted by the mean values presented in Table 4, with

higher or lower oscillations for most traits, except for protein content ranging from 11.18% to 11.88%.

The differentiation between the first (I) and the second (II) group is at the level of the plant's height, the length of the ear and the protein content, also in the other three traits analyzed, the two groups are obviously similar [1].

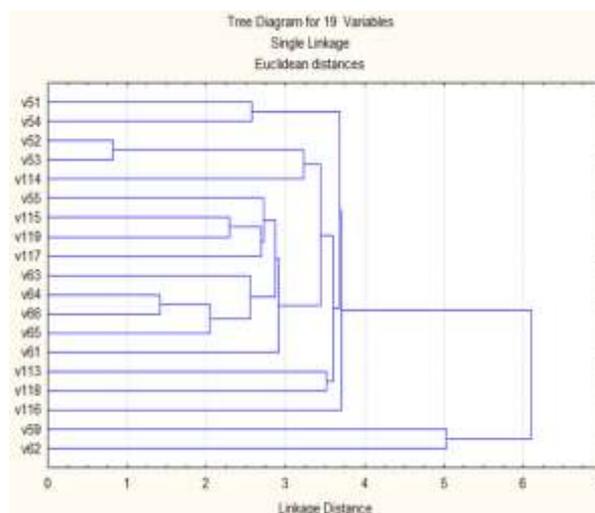


Fig. 3. Cluster presentation of variation some genotypes with regard on some morpho-productive and quality traits  
Source: original, obtained through the statistical program.

The group (IX) of the V83 and V24 variant is characterized by a low protein content of 10.86% and a superior starch content of 58.47%. The two variants, the Turda line and the Chronicle genotype, components of group IX, have similarities for most traits, except for the protein content (Table 4).

The Belgravia, Odissey, Overture, and Concerto genotypes represented by variants 25, 26, 27 and 28 form the group X of the present cluster, differentiated by the groups represented by the plant's size of 86 cm, with significant TKW values of 52, 52 g, and especially with the lowest protein content and the highest starch content (Figure 3).

Variants 25, 26, 27, and 28 could be used in future amelioration works as valuable drivers for line improvement.

Two other variants (31 and 67), which are part of this cluster and appear as two separate groups, are the Salome and Armada cultivars (Figure 3).

TKW is the main feature that makes the difference between the two variants and the rest of the genotypes in this cluster. The Salome genotype is ranked second as a low value of this trait and the Armada genotype records the highest values (Table 4).

The Armada genotype can be ranked as a valuable resource for improving grain size

and production capacity.

The group XIII include two genotypes, Tatum and Sulilly, represented by variants 29 and 30, similar in terms of protein and starch content to those of group X but totally different from the rest of the cluster genotypes in plant size (78 cm), the number of grain (the smallest 25) and the grain weight/ear (Table 4).

Table 4. The average performance of the analyzed traits corresponding to genotypes in cluster 3

Cluster 3							
Average 2016-2017	I/1	II/3	III/1	IV/1	V/1	VI/1	VII/1
Plant height	104	98	98	99	100	101	98
Length ear (cm)	8	10	10	9	10	9	9
Grains number/ear	28	28	27	30	27	29	28
Grains weight/ear (g)	1.39	1.43	1.43	1.47	1.41	1.48	1.33
TKW (g)	49.26	49.27	50.38	50.23	49.54	49.52	45.79
Protein (%)	10.68	11.52	11.18	11.50	11.63	11.46	11.88
Starch (%)	56.56	55.85	56.14	56.03	57.02	55.51	54.88
Cluster 3 (from group VIII-XIII)							
Average 2016-2017	VIII/1	IX/2	X/4	XI/1	XII/1	XIII/2	
Plant height	100	90	86	93	90	78	
Length ear (cm)	10	10	9	10	9	9	
Grains number/ear	30	28	26	29	27	25	
Grains weight/ear (g)	1.48	1.42	1.45	1.41	1.47	1.30	
TKW (g)	48.35	50.26	52.52	47.95	55.42	52.36	
Protein (%)	11.34	10.86	9.75	10.87	11.24	10.04	
Starch (%)	58.87	58.47	59.07	55.96	56.85	58.72	

Source:original.

The first two groups of five variants (51, 52, 53, 54 and 114) are similar in terms of chemical composition and differentiated to TKW, grain weight/ ear and plant height (Table 5).

The group placed in second place in terms of starch content (57.29) is the third, made up of variants 115, 117 and 119 (Figure 4) represented by the lines created by Turda and the Dutch cultivar Mazurka (V55) a separate version of this group having the highest TKW values. Although the variants (Tocada V63, Șteffi V64, Ditta V66 and Germina V65), which form the fourth class of this cluster, are very similar in terms of morphoproductive and quality traits, it can be noticed that between Tocada (V63) and Germina (V65) recorded some differences (Figure 4). Thus, variant 63 records the highest values for TKW and grain/spice weight, while variant 65 records the lowest values of grain weight/ear and the highest protein content of 11.73% (Table 5). The difference between the five and the previous group is based on the starch content which is 59.64% for the Xanadu genotype that forms the group.

In Group 6, variants 113 and 118 are represented by Turda lines which differ from the other lines created at Turda by higher plant height values at the level of this cluster, the lowest TKW and content high protein ratio of 12.19% (Table 5).

Tabelul 5. The average performance of the analyzed traits corresponding to genotypes in cluster 4

Cluster 4								
Average 2016-2017	I/2	II/3	III/4	IV/4	V/1	VI/2	VII/1	VIII/2
Plant height (cm)	91	98	97	93	96	101	97	86
Length ear (cm)	10	9	10	10	9	10	9	9
Grains number/ear	29	28	29	27	26	28	24	26
Grains weight/ear (g)	1.38	1.46	1.44	1.39	1.41	1.33	1.17	1.37
TKW (g)	47.05	52.17	49.81	49.87	51.01	46.97	47.73	48.82
Protein (%)	11.62	11.32	11.47	11.15	11.29	12.19	12.42	10.23
Starch (%)	55.88	54.87	57.29	56.47	59.64	55.73	56.50	57.80

Source: original.

The lowest grain/ear numbers, grain/ear weight and highest protein content are trait to variant 11, a Turda line forming group VII. Therefore, use these options in future amelioration work can be starting points for

the qualitative improvement of collection barely lines.

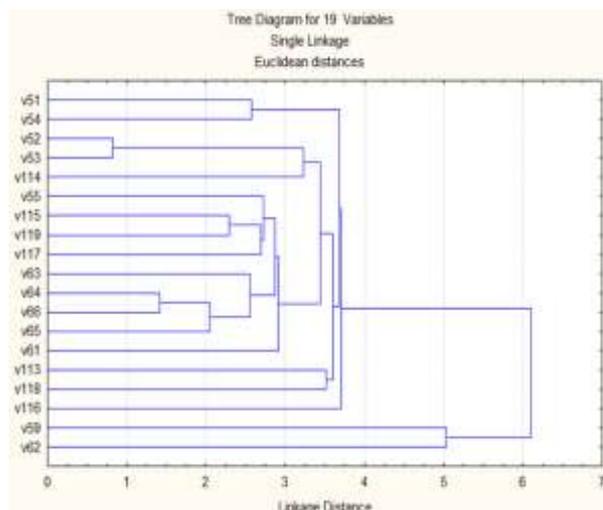


Fig. 4. Cluster presentation of variation some genotypes with regard on some morpho-productive and quality traits

Source: original, obtained through the statistical program.

Beatrix and Pasadena are components of group VIII, respectively variants 59 and 62, differentiated by the other components by one, two or even three linkage units (Figure 4), having the lowest protein content and the shortest dimension of 86 cm (Table 5). These traits recommend the use of these cultivars to improve the resistance to fall associated with the qualitative improvement of new cultivation.

## CONCLUSIONS

Grouping genotypes in the form of clusters based on the similarities and differences between genotypes, allowed to formulate recommendations based on morphoproductive and qualitative traits, in order to make future improvement works more efficient.

Cultures Sidney, Victoriana, Steward and Marthe can be used to increase the resistance to fall because the values of the plant height is about 81cm. The same cultivation is recommended to be used for qualitative improvement, showing high values of TKW (52g), the lowest protein content (less than 10.5%) and the highest content of starch (about 60%). Besides these, Belgravia,

Odyssey, Overture and Concerto can also be included as valuable genitors of the above-mentioned traits.

For the improvement of one of the most important components of the production, namely the weight of the grain/ear, the Romanian genotypes Turdeana and Romanița as well as the German variety of Vienna are recommended.

The size of the grain in particular and the production capacity in general can be improved by using the Armada cultivar in future hybridization works.

## REFERENCES

- [1]Porumb, I., 2018, Studiul variabilității unor caractere cantitative și calitative la orzul de primăvară, Teză de doctorat, (Study on the variability of some quantitative and qualitative traits in spring barley, Ph.D.Thesis ), University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca.
- [2]Pourkheirandish, M., Komatsuda, T., 2007, The importance of barley genetics and domestication in a global perspective. *Annals of Botany*,100: 999-1008.
- [3]Sato, K., Flavell, A., Russell, J., Börner, A., Valkoun, J., 2014. Genetic Diversity and Germplasm Management: Wild Barley, Landraces, Breeding Materials. Chapter 2. J. Kumlehn, N. Stein (eds.), *Biotechnological Approaches to Barley Improvement, Biotechnology in Agriculture and Forestry* 69.
- [4]Ullrich, S. E., 2011, *Barley: Production, Improvement and Uses*. By Blackwell Publishing Ltd.

## PERFORMANCE MEASUREMENT AS A COMPONENT OF PROFESSIONAL EDUCATION PERFORMANCE MANAGEMENT IN RELATION TO THE CONCERNS ABOUT EDUCATION FOR SUSTAINABLE DEVELOPMENT

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### *Abstract*

*The basic objectives of this paper were as follows: reflecting on the performance indicators of higher education institutions around the world; making a systematization of the performance indicators specific for the professional education institutions of the Republic of Moldova in relation to the tasks of education for sustainable development relevant for the vocational education established by the Incheon Declaration „Education 2030”. The achievement of these objectives was possible by analyzing a series of bibliographic resources on the performance indicators used in the world’s professional education and also making a detailed examination of the performance indicators applied in the quality management system of higher education and vocational-technical institutions of the Republic of Moldova. As a result, the aspects of performance measurement that require interventions to best contribute to the achievement of objectives of education for sustainable development have been identified.*

**Key words:** performance indicators, professional education, Republic of Moldova, sustainable development

### INTRODUCTION

The use of performance management in the field of private professional education system allowed „to borrow” several specific aspects: the system with its components (planning, action, monitoring, analysis), general principles of organization and monitoring, procedural approach etc. However, the specifics of professional education also imply certain characteristics that could be largely found in the mission and objectives pursued by each institution and professional education system as a whole and, implicitly, in the system of performance measurement in relation to the pre-set objectives. In this context, it should be noted that performance measurement is often associated with the performance management process, and there are intentions to reveal the separate essence of performance measurement. Lebas, for example, offers a separate definition for each of these two notions, noting that performance measurement consists of key indicators that provide contextual and case specific information, while performance management

includes activities that influence these contextual factors, such as training, management style, attitudes and incentives. The author also indicated that the two concepts could not be separated because performance management created the context for performance measurement, but it was influenced by the outcomes of the measurement process [14].

Even though, due to its essence and contents, performance management is wider than performance measurement, a key element of performance management is the choice of key factors of success and also performance indicators that can be used to estimate the extent to which they have been valorized [1,6,12]. Performance indicators, in turn, are designated as numerical values which provide a measurement for assessing the quantitative performance of a system [11], performance indicator meaning a number which can be calculated by a good statistician and which is seen as a surrogate for a measurement of what one is actually interested in [20].

In order to achieve a good functioning, performance indicators should possess the

following features:

a) to have the monitoring function, which is defined as „a series of information collected at equal intervals to track the performance of a system” [9];

b) to be quantitative [10];

c) to match the pre-set objectives [6].

With the objective of measuring the efficiency of public money invested in professional education, a concern that has driven economic thinking into professional education management, performance measurement and analysis is often expressed using the term „efficiency analysis”, meaning an instrument for estimating the efficiency of resource management involved in the professional training process. For this purpose, the results of institutions’ activity are examined in relation to the inputs, both components being expressed by a series of indicators that vary more or less from one country to another. Thus, the synthesis of several publications on the measurement of universities performance carried out by Cunha and Rocha in different countries has made it possible to point out that, in general, the institutions include in the group of inputs the number of students, teaching staff, financial resources used and the main expenses incurred. The number of graduates, the employment rate, the results of research activities (number of publications, citations, registered patents etc.) or even some rankings reflecting the institution’s position or reputation are used most frequently to assess the outputs (results). There are also mentioned specific types of efficiency: research efficiency, teaching efficiency etc. [7]

In USA for example, the approaches vary by state and it was noted that the most frequently used performance indicators are the following:

- Unit costs (per student);
- Faculty teaching workload rates;
- Student-staff ratios;
- Analysis of cohort progression and attrition;
- Rates of passage on professional licensure exams;
- Analysis of the ethnic, gender and social backgrounds of students;
- The outcomes of programmes in terms of the number of degrees awarded [16].

In the USA higher education sector, government uses the performance indicators in three directions: performance-based funding; performance-based budgeting; performance reporting. the performance-based funding process is based on a direct link between state financial support and institutional performance [2].

Performance-based budgeting implies a weaker relationship between institution performance and funding, when just one of several factors being used to determine the size of financial allocations.

Performance reporting has no direct financial implications, with the goal of determining institutions to identify weaknesses and directions for improving performance [17].

In Canada, the approaches in using performance measurement in professional education also vary between provinces, with some not using performance indicators at all and others (Alberta, in particular), where the funding of institutions is very strictly related to their performance. Approximately two percent of the operational grants offered by the Alberta government to universities and colleges are allocated in terms of performance. If an institution deviates from government priorities and/or demonstrates low performance in a government-targeted area, this may have a substantial negative impact on the activity of that institution.

Performance indicators set for universities and colleges in the Canadian state of Alberta have been classified into the following two groups:

*I. Component „Teaching”:*

- Graduate employment rate (within a specified period after study programme completion);
- Satisfaction level of the graduates with the quality of the offered studies;
- Business revenues (income without all government grants, sponsorships, capital contributions, etc.);
- Administrative expenses;
- Percentage change in enrollment from one period to another.

*II. Component „Research”:*

- Council monetary prizes - national ranking in terms of prize money on average per full-time faculty member (3-year average);

-Number of citations (national ranking) in relation to the number of scientific publications (5-year average);

-Support from the community and economic branches (national ranking) by sponsoring the research of a full-time faculty member (3-year average);

-National ranking of sponsored research income as a percentage of the Advanced Education and Career Development (AECD) subsidy department (3-year average) [16].

The development of performance indicators in higher education was pioneered in Europe by Great Britain: after many debates that were initiated in the 80s of the last century, it was only at the end of the 1990s when the indicators to express inputs, processes and outputs for each university have been designed. The development of performance indicators was based on several principles: the use of a standardized and consistent form (robust, secure and comparable between institutions and over time); objectivity (providing evidence for informing policy makers and statistical records); simplicity, clarity and corresponding to the objectives. The indicators originally developed in 1998 have evolved over time, with the largest revisions being made in 2006-2007 after the consultation with sector's beneficiaries. In the current version, the indicators adopted by the UK for the assessment of university performance are systematized on two levels: institutional and sectorial, and four areas: access/widening the participation of under-represented groups; non-continuity and completion rates of the module; employment; research results [17].

Given the existence of numerous approaches to the problem, the experimentation of numerous indicator systems, there is unquestionably acknowledged the existence of a series of difficulties related to the quantification of results of the professional education institutions. In order to highlight these difficulties as explicitly as possible, we will point out the information considered as necessary to quantify the performance of professional education [13]:

- outputs (results) that are intended to be obtained;

- inputs (resources) needed by institutions to achieve the expected results;

- quantitative measures for inputs and outputs;

- technical relationship between inputs and outputs.

In consequence, the performance of professional education should be expressed using a system of indicators that fully reflects the above-mentioned aspects. Among them, at least three of them are questionable: inputs, outputs and technical relationship between them.

Referring to the outputs, we cannot overlook the fact that the results of a professional education institution are multiple and, as Cave et al. [3] mentioned, many of them are difficult or even impossible to measure in monetary value or even physical form. Further on, we will refer to McMahan [15] who emphasizes the role of higher education in promoting democracy, sustainable growth, reducing crime, welfare costs of the state etc. and draws attention to an insufficient level of perceiving the measurable value of its non-monetary benefits. This idea is also supported by Tam [21] who mentions, as benefits that can not be quantitatively represented, the cultivation of talents and the dissemination of cultural values.

In the process of assessing inputs, we also encountered the following difficulties:

a) They occur in a short time horizon - usually 3-4 years (the average period of professional studies or a scientific project), while the time horizon in which the benefits of professional education are manifested is much longer, being practically impossible to appreciate it exactly (taking into account that the effects of education can be transmitted from one generation to another);

b) The same inputs lead to several results and, as Johnes and Taylor [13] mentioned, there is not always a clear way of assigning certain inputs to certain outputs. In this context, we note that, using the same elements of the technical-material base, the same human resources (scientific-teaching staff, etc.), a number of results are achieved simultaneously: qualified specialists for

various economic sectors, scientific and innovation products, extension services etc.).

In the light of the facts mentioned above, it can be logically inferred the difficulty in establishing the technical relationship between inputs and outputs.

The problems related to the accurate and objective measurement of the professional education performance continue to persist in the professional education management penetrating the interest area of the state bodies empowered to finance the institutions on the one hand and the institutions themselves on the other. Referring to professional education institutions abroad, we found out a particular concern for the equitable evaluation of their performance based on two circumstances:

(a) The achieved performance represents the milestone for obtaining funding;

(b) Depending on the performance recognized and exposed to the public, the ranking of the institutions is made depending to a large extent on their competitiveness and their sustainability on the educational services market respectively.

At the same time, even though there are countless attempts to improve performance measurement systems, in spite of the complexity of the field, multiple effects as well as other circumstances mentioned above, performance measurement of professional education remains an area with deep potential of investigation and interventions. Thus, we observed that Williams's affirmation made nearly three decades ago is still relevant: "Like all quantitative performance indicators, these figures raise more questions than answers" [22].

## MATERIALS AND METHODS

In order to achieve the objectives of our research, the following methods were applied: the synthesis of the theoretical approaches and best practices in measuring the performance of professional education on a global scale; the analysis of the system of performance indicators used in the higher education and technical vocational education in the Republic of Moldova at present; the diagnosis of vulnerable aspects in measuring the

performance of professional education in relation to the objectives of education for sustainable development; formulating conclusions and arguments for actions to be taken.

## RESULTS AND DISCUSSIONS

In order to elucidate the impact of professional education on the sustainable development of the rural environment in the Republic of Moldova, we will approach the system of performance indicators for the respective educational institutions related to the impact of the nominated influence.

The term of performance management has penetrated the academic language in the Republic of Moldova relatively recently, with extension in the marketization of professional education and the intensification of competition on the professional education market. Implicitly, the concept of „performance indicator” as a measure of the results obtained was introduced into the specific vocabulary of the educational institutions management system. At the same time, both a conceptual and a qualitative shift from one measurement system to another occurred.

Previously, for many decades, each professional education institution had the responsibility to present the results of activities carried out by means of some indicator systems that were mainly focused on the number and fluctuation of students/pupils, the number of teaching staff, administrative and auxiliary staff, student/pupils success, graduation rate, costs involved etc. The environment in which professional training took place (lack of competition between educational institutions, sufficient funding of the activities carried out etc.) attached to those indicators rather a reporting character than the criteria of success or failure.

The improvement of performance management system of professional education institutions has been made by transforming it from a source of information necessary for reporting into a system with double meanings and roles:

a) monitoring successes and failures;

b) ensuring the sustainability of institutions.

Although, unlike the USA and many other states, the Republic of Moldova is at an early stage in using performance indicators as criteria in allocating funding to institutions, we can't fail to recognize that currently used indicators differ substantially from the previous ones, both in terms of content and significance, and offer the opportunity to evaluate the results more broadly and multilaterally in relation to the institutional objectives and also the expectations of society.

Making an insight into the chronology of events that preceded the process of reviewing and improving the performance indicators system of professional education, we could mention that, in fact, a decisive role was played by the creation of institutional quality management systems followed by an intense process of elaborating normative acts and instruments for the evaluation and accreditation of educational institutions. Although the quality management system represents, by its very nature, the framework in which the performance management system is created and operated [18], its role in ensuring the performance of educational institutions is indisputable. Among the positive impacts of the quality management system in this respect, we can highlight in particular the establishment of performance indicators within ten performance standards [4,5] that, by their very essence, express milestones of immense value for each institution in directing efforts towards a successful activity. In order to assert that reasoning, we will refer to the new qualitative approach of the internal and external beneficiaries of the educational offer, to their role as active actors in the design and development of the study programmes in order to ensure their maximum relevance for the labour market and the areas of activity concerned [19].

It is possible to evaluate the extent to which the nominated indicators are able to contribute to achieving the sustainable development objective 4 of the Sustainable Development

Agenda 2030 ("Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all") only by examining them in correlation with specific tasks set out in the Incheon Declaration „Education 2030” [8] identified as appropriate to professional education (Table 1).

Making a generalization of the facts outlined in Table 1, we conclude the following:

-Being designed especially for the external evaluation of professional training study programmes, the quality standards and, implicitly, related performance indicators represent effective tools for monitoring the quality of the activities carried out by each professional education institution in order to achieve the expected performance. Thus, we can deduce their significance as contextual indicators designed to ensure an adequate level of quality in vocational training, so that the outputs expressed by the number and quality of graduates can best meet the expectations of the business environment;

-Making the synthesis of performance indicators (out of 51 for higher education and 38 for vocational-technical education), at least 28 performance indicators for higher education and 26 for vocational-technical education can be identified, the operationalization of which contributes to the achievement the tasks of education for sustainable development set out in the Incheon Declaration „Education 2030”;

- Although some performance indicators can simultaneously express two or three tasks of education for sustainable development, we should mention that task 4.7 (which requires, in line with relevant knowledge and skills, such important attitudes as respecting human rights, gender equality and cultural diversity, fostering the culture of peace and non-violence and its harnessing as a factor of sustainable development) can't be found in certain specific indicators. The indicators assigned to that task in the table reveal rather the opportunity to reflect that task by including certain provisions in the study programme, including those made at the

recommendation of the Ministry of competent ministries.  
Education, Culture and Research and

Table 1. Systematization of performance indicators specific to the professional education institutions of the Republic of Moldova in relation to the education tasks for sustainable development relevant for the professional education established by the Incheon Declaration „Education 2030”

<b>The content of performance indicators related to/established for the higher education institutions of the Republic of Moldova</b>	<b>The content of performance indicators related to/established for the vocational technical education institutions of the Republic of Moldova</b>
<b><i>Task 4.3 By 2030, ensuring equal access for women and men to qualitative and accessible technical, vocational, tertiary, including university education.</i></b>	
Recruiting and admitting students; Information management and access for students and employees to information regarding the study programme; Transparency of information on the study programme.	Recruiting and admitting pupils/students to the vocational training programme; The existence and operation of the information management system; Transparency of information on the vocational training programme.
<b><i>Task 4.4 By 2030, substantially increasing the number of young people and adults with relevant skills, including technical and professional skills, in terms of hiring, getting decent jobs and developing entrepreneurship.</i></b>	
Mission, objectives and curriculum of the study programme; The syllabus for each subject; Relevance of the study programme; Student-centered teaching-learning methods; Valorization of results of the scientific research and innovation activity of the academic staff in the context of the study programme; Using ICT tools in the teaching-learning-evaluation process; Organizing internships; Collaboration arrangements for internships; Academic mobility; Professional qualification of academic staff; Strategies/policies/measures for the academic staff development; Evaluation of the academic staff; Existence and use of educational and research spaces; Equipment and accessibility of educational and research areas; Material means, development and accessibility of the library fund for the study programme; Student assurance and access to curricular support; Financial means allocated to the educational process and to the research on the study programme; Information management and access for students and employees to information on the study programme; Transparency of information about the study programme; Monitoring and reviewing the educational offer and study programme; Monitoring of the teaching-learning-evaluation processes; Evaluation of the study programme by students, graduates, employers and other beneficiaries; Mechanisms to record the employment and evolution of graduates on the labour market; Professional orientation of graduates of the vocational training programme and their competitiveness on the labour market.	Mission, objectives and curriculum of the vocational training programme; The syllabus for each subject; Relevance of the vocational training programme; Student-centered teaching-learning methods; Using ICT tools in the teaching-learning-evaluation process; Organizing internships; Existence of cooperation agreements with institutions offering internships; Academic mobility; Professional qualification of the teaching staff; Strategies/policies/measures for the teaching staff development; Existence and use of educational spaces; Equipment and accessibility of educational spaces; Material means, development and accessibility of the library’s fund; Ensuring pupil/student access to curricular support; Funding the educational process within the vocational training programme; The existence and operation of the information management system; Transparency of information on the vocational training programme; Monitoring and reviewing the educational offer and the vocational training programme; Monitoring of the teaching-learning-evaluation processes and internships; Evaluation of the vocational training programme by pupils/students, graduates, employers and other beneficiaries; Institutional mechanisms for recording the employment of graduates of the vocational training programme; Professional orientation and competitiveness of graduates of the vocational training programme on the labour market.
<b><i>Task 4.5 By 2030, eliminating gender disparities in education and ensuring equal access for vulnerable people (including disabled and indigenous people as well as children in vulnerable situations) to all levels of education and vocational training.</i></b>	
Recruiting and admitting students; Student-centered teaching-learning methods; Access of disadvantaged groups to studies; Providing hostel facility to students.	Recruiting and admitting pupils/students to the vocational training programme; Student-centered teaching-learning methods; Access of disadvantaged groups and people with special educational needs; Providing hostel facility to pupils/students.
<b><i>Task 4.7 By 2030, ensuring that all trained people acquire the adequate knowledge and skills for sustainable development, including through education for sustainable development as well as sustainable lifestyles, and promoting such attitudes as respecting human rights, gender equality, cultural diversity, maintaining the culture of peace and non-violence and its harnessing as a factor of sustainable development</i></b>	
Syllabus for each subject; Monitoring and reviewing the educational offer and study programme; Implementing the provisions and recommendations of the Ministry of Education and the competent ministries.	Syllabus for each subject; Monitoring and reviewing the educational offer and the vocational training programme; Implementing the provisions and recommendations of the Ministry of Education and other competent ministries.

Source: Own elaboration based on: [4,5,8]

## CONCLUSIONS

Although it is difficult to accurately quantify the impact of professional education institutions on sustainable development, if not impossible, each institution can best target its efforts in this respect by maintaining performance standards established at national level.

Being designed especially for the external evaluation of professional training study programmes, the quality standards and, implicitly, related performance indicators represent effective tools for monitoring the quality of the activities carried out by each professional education institution in order to achieve the expected performance. At the same time, we note the necessity of interventions in the content of performance indicators by introducing additional indicators to reveal the orientation of the study programmes towards the achievement of specific skills (professional and transversal) for sustainable development.

## REFERENCES

- [1] Broadbent, J., 2006, Performance management systems in and of higher education institutions in England: professionalism, managerialism and management. <https://www.researchgate.net/publication/277805172>. Accessed on 9.12.2018.
- [2] Burke J. C., Minassians, H., 2001, Linking state resources to campus results: from fad to trend, 5th annual survey, higher education program, the Nelson A. Rockefeller Institute of Government, Albany NY. [HTTPS://ERIC.ED.GOV/?ID=ED456781](https://eric.ed.gov/?ID=ED456781), Accessed on 30.12.2018.
- [3] Cave, M., Hanney, S., Henkel, M, Kogan, M., 1988, The Use of Performance Indicators in Higher Education: The challenge of the quality movement, 3rd edn, London.
- [4] Chiciuc, A., Timco, C., Guvir, S., Sochircă, V., Banu, F., Vulpe, C., 2016, Ghid de evaluare externă a programelor de studii de licență, învățământul superior. Agenția Națională de Asigurare a Calității în Învățământul Profesional, (Guide of external evaluation of the study diploma programmes in higher education. National Agency for Quality Assurance in Vocational Training), Chișinău.
- [5] Chiciuc, A., Timco, C., Guvir, S., Sochircă, V., Banu, F., Vulpe, C., 2016, Ghid de evaluare externă a programelor de formare profesională în învățământul profesional tehnic. Agenția Națională de Asigurare a Calității în Învățământul Profesional, (Guide of external evaluation of the vocational training programmes in technical education. National Agency for Quality Assurance in Vocational Training), Chișinău.
- [6] Committee of Vice-Chancellors and Principals of the Universities of the United Kingdom and University Grants Committee (CVCP/UGC), 1986, Performance Indicators in Universities: A first statement by joint CVCP/UGC Working Group, London.
- [7] Cunha, M., Rocha, V., 2012, On the Efficiency of Public Higher Education Institutions in Portugal: An Exploratory Study. FEP Working Papers. No. 468.
- [8] Education 2030. Incheon Declaration and Framework for Action for the Implementation of Sustainable Development Goal 4, 2015. <http://unesdoc.unesco.org/images/0024/002456/245656E.pdf>, Accessed on 6.08.2018.
- [9] Fitz-Gibbon, C., 1996, Monitoring Education - Indicators, quality and Effectiveness. London.
- [10] Guenin, S., 1986, International study of the development of performance indicators in higher education, paper presented at OECD, IMHE Project, Special Topic Workshop.
- [11] Cuenin, S., 1987, The Case of Performance Indicators in Universities: An International Survey, International Journal of Institutional Management, Vol. 11 (2), pp. 117-139.
- [12] Higgins, J.C., 1989, Performance measurement in universities. European journal of operational research 38(3):358-368. Accessed on 30.12.2018.
- [13] Johnes, J., Taylor, J., 1990, Performance Indicators in Higher Education. Bingham, SRHE & Open University Press. 208 p.
- [14] Lebas, M., 1995, Performance measurement and performance management, International Journal of Production Economics 41(1):23-36.
- [15] McMahon, W.W., 2009, Higher Learning, Greater Good: The Private and Social Benefits of Higher Education Johns Hopkins University Press. 432 p.
- [16] OCUFA, 2006, Performance indicator use in Canada, the U.S. and abroad, Ontario Confederation of University Faculty Associations Research Paper. [https://ocufa.on.ca/assets/PI\\_Canada\\_and\\_abroad.pdf](https://ocufa.on.ca/assets/PI_Canada_and_abroad.pdf), Accessed 30.12.2018.
- [17] Pollard, E., Williams, M., Williams, J., Bertram, C., Buzzeo, J. Drever, E., Griggs, J., Coutinho, S., 2013, How should we measure higher education? A fundamental review of the Performance Indicators Part Two: The evidence report. NatCen. Social Research that works for society.
- [18] Prisăcaru, V., Litvin, A., 2017, Quality management in the higher education of the Republic of Moldova as a framework for university performance. Universitatea Alexandru Ioan Cuza, Scientific Annals of Economics and Business 64 (4), p. 431-446.
- [19] Prisăcaru, V., Caradja, A., 2017, Communication with business environment as a factor enhancing the impact of higher agricultural education on the sustainable rural development. Journal of Research on

Trade, Management and Economic Development,  
Volume 4, Issue 2(8), p. 129-138.

[20] Swinnerton-Dyer, P., 1991, Policy on Higher Education: The Rede Lecture, 1991, Higher Education Quarterly, 45(3): 204-218.

[21] Tam, M., Measuring Quality and Performance in Higher Education. Quality in Higher Education, 7:1, p. 47-54.

[22] Williams, G., 1992, British higher education in the world league. Oxford Review of Economic Policy, 8 (2), 146-158.

## RELATIONSHIP BETWEEN THE PERFORMANCES OF PROFESSIONAL AGRICULTURAL EDUCATION AND RURAL LABOUR MARKET IN THE REPUBLIC OF MOLDOVA

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### *Abstract*

*The main objective of this paper was to elucidate the relationship between the performance indicator of professional agricultural education „the number of graduates” and rural labour market in the Republic of Moldova. Carrying out an analysis of the statistical data regarding the number of graduates and the state of the labour market as well as making a synthesis of some studies focused on the rural labour market problems in the Republic of Moldova, the authors identified a series of problems related to the difficulties existing in the quantification of the impact of the professional agricultural education performance on the rural labour market, as well as its optimization. Consequently, some recommendations have been formulated in order to harmonize the relationship between professional education and labour market.*

**Key words:** agricultural education , labour market, rural environment, sustainable development

### INTRODUCTION

Under current circumstances, when the labour market of the Republic of Moldova is deeply affected by the demographic aging and massive population decline, increased labour force participation rate along with increased level of labour processes technologization and implicitly of the labour productivity, are considered as factors that could make an essential contribution to mitigating the created situation [1]. At present, professional education institutions of all levels are among the active players in the labour market, being, by their very nature, skilled labour force producers. Therefore, among the indicators rating the performance of a professional education institution, we identified the number of graduates as an indicator that should later be found in the qualified population employed - this already being a basic indicator of the labour market. In the same context, it is important to mention that, along with the quantitative recording of the professional education outputs, the quality of these outputs is also significant, as it is usually expressed in terms of competences held by the graduates and their contribution to

the performance of the sector/enterprise and organizations where they work after graduation.

Referring to the professional agricultural education, it is obvious that the main beneficiary of professional education is the rural environment, agriculture being the basic branch where the „finished product” arrives (or should arrive). However, the real situation is a precarious one, with a whole series of problems related to the transition from professional education to the labour market.

The importance of the issue of youth relations with the labour market in the context of concern for sustainable development is recognized globally. As confirmation, among the 17 Sustainable Development Goals (SDG) of the renowned Agenda 2030, we'd like to underline the content of Goal 8: „Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all” [10]. Among the target objectives of the SDG 8, we highlight those having a direct reference to the issue of young people's relationship with the labour market:

*Target 8.5* By 2030, to achieve full and productive employment, decent work and

equal pay for all women and men, including the young and disabled persons.

*Target 8.6* By 2030, substantially reduce the proportion of youth that are not employed or involved in education or training.

*Target 8.b* By 2030, develop and implement a global strategy focused on youth employment, and put into practice the provisions of the Global Jobs Pact of the International Labour Organization.

Thus, if SDG 4 of Agenda 2030 „Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all” is focused on the quality of education, we could assert that one of the key roles of the SDG 8 is to ensure the transfer of education products to the labour market.

## **MATERIALS AND METHODS**

In order to carry out the investigation, the following research methods and tools were used: the synthesis of some studies on the labour market in the Republic of Moldova in the context of concern for achieving the Sustainable Development Goals 4 and 8; the analysis of situation of the existing professional education both through the evolution of some quantitative indicators and problems related to the quality of training those specialists who meet the demands of the business environment; and formulating conclusions and judgments on possible interventions to solve the identified problems.

## **RESULTS AND DISCUSSIONS**

By adapting the Agenda 2030 and nationalizing the SDG in the Republic of Moldova [6], the criteria according to which the actions should to be taken in the context of the concern for sustainable development were identified. Referring to SDG 8 we note that this, together with the priorities of the National Development Strategy „Moldova 2020” and the provisions of the Association Agreement between the Republic of Moldova and the European Union, was taken into account as a reference point for the development and approval of the National Employment Strategy for the period 2017-

2021 [9]. In the context of the overall strategic goal of increasing formal employment based on economic competitiveness, adequate skills and qualifications, within the established priorities, we identified a number of specific objectives directly targeting young people, referring to: stimulating job creation; increasing the attractiveness, relevance and inclusion of the professional education system, strengthening the institutional capacity of actors responsible for developing, implementing and monitoring employment policy, and promoting decent employment opportunities through active labour market policies, as well as ensuring the rights and obligations of employees and employers with regard to non-standard forms of employment, etc.

Also, among the major targets of the National Employment Strategy for the period 2017-2021, we identified the direct approach of the young population in the provision on reducing the proportion of youth not in employment, education or training from 29.3% in 2015 to 26.8% in 2021 [9]. At the same time, we can't ignore the fact that the other targets of this strategy aimed at increasing the employment rate, including formal employment, reducing the unemployment rate, salary disparity, and so on also includes in its coverage the young population.

The increased attention paid to young people is a natural and justified one, as it involves a whole series of negative phenomena manifested in the quantitative and qualitative evolution of the qualified youth segment on the labour market. The surveys show that in the Republic of Moldova youth employment indicators are lower compared to the total active economic population [1]. Thus, it is estimated that only one third of Moldovan youth work, while at the EU level about 46% of youth is employed [5].

The first symptom indicating the problem is the tendency of reduced employment of qualified young people (as namely the age category of 15-24 years includes the majority of graduates of professional education institutions). Implicitly, by examining activity and employment rates over the period 2010-2017, we could state that they were

continuously reduced during the examined period (Table 1).

Table 1. Differences in the activity and employment rate of the young qualified population in the Republic of Moldova in the period 2010-2017, %

Indicators	2010	2017	Deviations (+,-)
Activity rate according to the level of training:			
Higher education	61.2	54.0	-7.2
Post-secondary technical vocational education institutions (centers of excellence and colleges)	46.9	32.5	-14.4
Secondary technical vocational schools (professional schools)	46.9	43.7	-3.2
Employment rate according to the level of training:			
Higher education	48.0	47.1	-0.9
Post-secondary technical vocational education	37.1	27.0	-10.1
Secondary technical vocational education	39.4	38.7	-0.7

Source: Own elaboration based on [11]

Even if the unemployment rate is declining among the population segments surveyed, this tendency can't be considered relevant, given the lack of accurate data on the real number of unemployed people.

The precarious situation of youth insertion on the labour market is also confirmed by the very low share of the number of qualified population in the total number of qualified population, as well as the decreasing tendency of the indicator (Table 2).

Table 2. Changes of the share of employed young qualified population in the total employed qualified population in the Republic of Moldova in the period 2012-2017, %

Indicators	2012			2017			Deviations (+,-)		
	total	urban	rural	total	urban	rural	total	urban	rural
The share of employed young people who graduated from higher education institutions in the total employed population with the same level of education	7.50	7.25	8.41	5.17	4.88	6.11	-2.33	-2.37	-2.3
The share of employed young people who graduated from post-secondary technical vocational education institutions in the total employed population with the same level of education	5.88	5.84	5.80	5.57	5.60	5.53	-0.31	-0.24	-0.27
The share of employed young people who graduated from secondary technical vocational schools in the total employed population with the same level of education	8.26	7.11	9.04	7.03	6.95	7.07	-1.23	-0.16	-1.97

Source: Own elaboration based on [11]

In order to emphasize the impact of professional agricultural education performance on the rural labour market, we will first of all highlight the difficulty of operating this activity itself. Thus, the data on the graduates' employment rate has a large margin of error because of the lack of effective mechanisms developed at national level that would allow for more accurate

evidence. Despite the fact that the existing quality management systems of educational institutions are in charge of keeping track of the employment status of their graduates as well as their career path, the existing databases are incomplete and can't provide an accurate overview of the situation. As a result, certain trends on graduates' employment can only be identified by correlating the data on

graduation rate and the evolution of the youth segment (aged up to 24), who completed study programmes in the relevant branches. In this context, we will initially present the evolution of the number of Bachelor's and

Master's degree graduates in the field of „Agricultural Sciences” and those who graduated from the Integrated Studies Programme „Veterinary Medicine” in the period 2010-2017 (Figure 1).

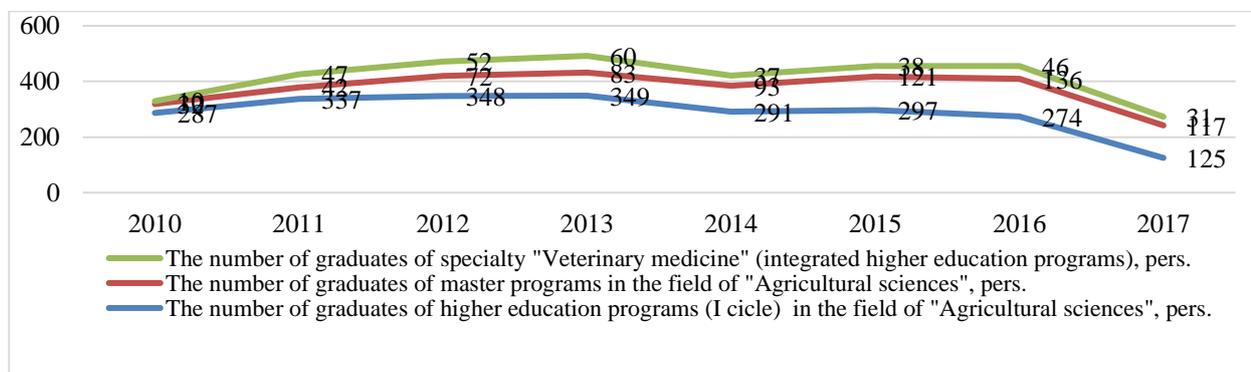


Figure 1. Evolution of the number of Bachelor's and Master' degree graduates in the field of „Agricultural Sciences” and graduates of the integrated degree programme in „Veterinary medicine” in the Republic of Moldova in the period 2010-2017

Source: Own elaboration based on [11]

According to data presented in Figure 1 we deduce a decrease in the number of graduates in the analyzed period. However, cumulatively, 263 specialists were provided to the national economy in the year 2017. Therefore, it is quite difficult to make accurate estimates classifying it as either good or bad. It is known that a part of Bachelor's degree graduates continue their master degree studies. Another part finds a job either in other branches, emigrates abroad or simply become unemployed. The rural areas are mostly affected by the consequences of such a situation. Thus, according to some studies conducted in 2015, it was found that while the average employment rate of young people

with higher education was about 53%, in the rural area this index constituted only 43%. At the same time, it was determined that in the rural area out of 10 unemployed people, 7 were young [1].

The assertion that a large number of graduates with higher education in the field of agricultural sciences and veterinary medicine are not employed in the agricultural enterprises is also confirmed by the low share of young specialists with higher education in the total number of population employed in that sector and also the lack of visible qualitative changes in the period 2010-2017 (Table 3).

Table 3. Differences in the share of qualified youth in the total population employed in the rural agricultural sector of the Republic of Moldova in the period 2010-2017

Indicators	2010	2017	Deviations (+,-)
Total employed population, thousand people	295.8	368.2	72.4
Including the young population, thousand people	25.7	24.1	-1.6
of them:			
- higher education	0.2	0.7	0.5
- post-secondary technical vocational education	0.6	1.4	0.8
- secondary technical vocational education	4	5.1	1.1
The share of employed youth with higher education level in the total employed population, %	0.07	0.19	0.12
The share of employed youth with post-secondary technical vocational education in the total employed population, %	0.20	0.38	0.18
The share of employed youth with secondary technical vocational education in the total employed population, %	1.35	1.39	0.03

Source: Own elaboration based on [11]

A similar situation was also observed in the evolution of the share of employed youth with the level of post-secondary and secondary technical vocational education. The precarious situation on this issue was also mentioned in the Concept on the reorganization of the research-innovation, rural education and extension system of the agri-food sector [4], emphasizing that starting with 2013, the employment rate of the graduates from the centers of excellence and colleges has been steadily decreasing, with the lowest share in 2017 - 31.9% of the total number of graduates. At the same time, it was stated that the highest employment rate (41.27%) was achieved in 2014. Another problem is the low level of employment according to the completed field of study. Thus, only 19.8% of the graduates 2017 are employed in the field of their professional training, while 10.2% have been employed in other fields, 1.9% work in their own or family business, 13.2% went abroad and 8.5% do not perform any activity [4].

In this context, the obvious question arises: what are the factors that determine, or, more precisely, suppress the desire to work in the field of completed professional studies? An opinion poll conducted in 2014 on a sample of 210 students enrolled at the State Agrarian University of Moldova in the last academic year highlighted the following reasons of choosing a job in the city at the expense of the agricultural sector: better opportunities to build a career (75% of respondents); better conditions for living and rest (35%); the possibility of continuing studies (30%); higher wages (23%) [7]. Among the most significant problems related to the employment of young specialists, the respondents mentioned: low wages (70%) and high requirements from employers (27%). Regrettably, further investigations [4,5] indicate the continuing presence of the same problems that hamper the insertion of young people into the labour market. Thus, among the difficulties identified, we'll mention that the agricultural sector doesn't allow the valorization of valuable knowledge gained by students in practice [4], the same problem being

expressed by the term „over-educated young people” [1].

Concomitantly, as paradoxical as it may seem, employers continue to indicate the lack of important skills to a large number of graduates in order to meet job requirements [4], fact also noted in the interviews with employers carried out by the evaluation committees of the professional education study programmes. It would be possible to solve the problem only through a more constructive dialogue with employers' representatives by involving them more effectively in the process of improving the quality of professional training programmes. This aspect is one of the most recommended by the national quality standards in the field of professional education and falls within the scope of institutional quality management systems [2,3]. However, the practical approach is a difficult one, with a number of problems identified, and namely: reduced availability of employers to cooperate, superficial approach by them of the problems related to the improvement of the programme, refusal to get involved in the practical training of students by providing conditions and support for internships [8].

On the basis of the above-mentioned facts, we deduce the clear need to harmonize and increase the efficiency of the cooperative relations between the actors of professional education and business environment. A possible solution would be to organize a cooperation directed by the competent ministry - the Ministry of Agriculture, Regional Development and Environment, so that in the framework of organized meetings, it would be possible to identify employers' requirements and carry out continuous updating of professional training programmes as required. Given that the efficiency of public money invested in education represents a more acute problem than ever before, we consider that the efforts of the competent ministry in this respect would be justified and would allow to turn the professional education performance into performance indicators of the sectors which receive the „final products” of the institutions performing professional training.

## CONCLUSIONS

The strategic provisions of the Republic of Moldova in order to achieve the targets of the sustainable development goals SDG 4 and SDG 8 are timely and argued especially by the precarious situation in the relationship between the professional training system and the segment of qualified young people on the labour market. Rural environment and, implicitly, agriculture are affected to a greater extent by the nominated problem.

Among the major problems related to the employment of agricultural specialists continue to persist the reduced attractiveness of the sector, the insufficient level of wages and living conditions. In addition, there are discrepancies in graduates skills and employers' requirements in terms of competence: while a large number of graduates find themselves over-trained for specific jobs, employers point to the lack of a range of skills.

Based on the above-mentioned facts, the following actions are recommended:

- to create a more efficient mechanism for recording the employability of graduates, which would allow for a more accurate record of their employment and would be a tool for monitoring educational offers;
- to harmonize and increase the efficiency of the cooperative relations between the actors of professional education and business environment through a communication directed by the Ministry of Agriculture, Regional Development and Environment.

## REFERENCES

- [1]Buciuceanu-Vrabie, M., Gagauz, O., 2017, Tinerii pe piața muncii din Republica Moldova: competențe și aspirații (Youth on the labor market in the Rep. of Moldova: competences and aspirations) Chișinău.
- [2]Chiciuc, A., Timco, C., Guvir, S., Sochircă, V., Banu, F., Vulpe, C., 2016a, Ghid de evaluare externă a programelor de studii de licență, învățământul superior. Agenția Națională de Asigurare a Calității în Învățământul Profesional, (Guide of external evaluation of the study diploma programmes in higher education. National Agency for Quality Assurance in Vocational Training), Chișinău.
- [3]Chiciuc, A., Timco, C., Guvir, S., Sochircă, V., Banu, F., Vulpe, C., 2016b, Ghid de evaluare externă a

programelor de formare profesională în învățământul profesional tehnic. Agenția Națională de Asigurare a Calității în Învățământul Profesional (Guide of external evaluation in technical education. National Agency of Quality Assurance in Vocational Education), Chișinău.

[4]Concep of vocational training programmes in ția privind restructurarea sistemului de cercetare-inovare, educație și extensiune rurală în domeniul agroalimentar. (Conception regarding the restructuring of the research-innovation, education and rural extension system in the agro-food sector), [https://cancelaria.gov.md/sites/default/files/document/attachments/proiectul\\_158.pdf](https://cancelaria.gov.md/sites/default/files/document/attachments/proiectul_158.pdf), Accessed on January 10, 2019.

[5]Ganta, V., Shamchiyeva, L., 2016, Tranziția tinerelor și tinerilor spre piața muncii în Republica Moldova. Rezultatele anchetelor din 2013 și 2015 privind tranziția de la școală la muncă (Youth transition on the labour market in the Rep. of Moldova. Results of the surveys in 2013 and 2015 regarding the transition from school to work). 2016. [https://www.ilo.org/wcmsp5/groups/public/---ed\\_emp/documents/publication/wcms\\_536294.pdf](https://www.ilo.org/wcmsp5/groups/public/---ed_emp/documents/publication/wcms_536294.pdf) Accessed 01.02.2019.

[6]Guvernul Republicii Moldova. United Nations Moldova. Expert Group, 2017. Naționalizarea indicatorilor pentru obiectivele de dezvoltare durabilă. Rezultatele procesului de consultare cu privire la adaptarea indicatorilor de monitorizare și evaluare a Agendei de Dezvoltare Durabilă 2030 la contextul Republicii Moldova (Government of the Rep. of Moldova. United Nations Moldova. Expert Group, 2017. The nationalization of the objectives of sustainable development. Results of the process of consulting on the indicators of adaptation of the monitorization and assessment of Agency of Sustainable Development 20130 in the context of the Republic of Moldova)

[7]Prisăcaru, V., Șevciuc, T., 2014, Employment difficulties experienced by young people in the rural areas of the Republic of Moldova. Scientific papers. Series „Management, Economic Engineering in Agriculture and Rural Development”, Volume 14 (2). 235-240.

[8] Prisăcaru, V., Caradja, A., 2017, Communication with business environment as a factor enhancing the impact of higher agricultural education on the sustainable rural development. Journal of Research on Trade, Management and Economic Development, Volume 4, Issue 2(8), p. 129-138.

[9] Strategia națională privind ocuparea forței de muncă pentru anii 2017–2021 ( National strategy regarding employment between 2017-2021). <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=369765>, Accessed on 02.02.2019.

[10]Sustainable Development Goals. <https://www.un.org/sustainabledevelopment/sustainable-development-goals/>. Accessed 29.12.2018.

[11]Statistics Office, Rep. of Moldova, [www.statistica.md](http://www.statistica.md), Accessed 01.02.2019.

## DRINKING WATER QUALITY OF SEVERAL PRIVATE WELLS AND PUBLIC SPRINGS FROM COVASNA AND SUCEAVA COUNTIES (ROMANIA) AND THE SEASONAL FLUCTUATION OF THEIR CHEMICAL QUALITY PARAMETERS

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### Abstract

*A total of 80 water samples were collected from several private wells (Sita Buzăului village – Covasna County) and public springs (Vatra Dornei area – Suceava County), during five sampling campaigns (November 2016, January – April 2017). The wells had a higher content of dissolved ions than the springs, while nickel was slightly higher in springs than in wells, due to the more acidic pH. The levels of the analyzed parameters were lower during January and February 2017 than in March 2017. Based on the water quality index, 75% of the investigated water sources can be classified as excellent quality status, 19% correspond to good status, while 6% have a poor water quality.*

**Key words:** Covasna County, drinking water quality, groundwater, Suceava County, water quality index

### INTRODUCTION

Water is one of the most important resources on the Earth and in some areas, especially the rural ones, the groundwater from wells and springs is the only drinking water source and therefore it is very important to be constantly monitored in order to assess its quality [2], [12], [14], [16]. In the last decades, the contamination of underground water caused by human activities (mainly rural) has become an important problem for many European countries [13]. Animal sewages, pesticides, fertilizers, or irrigations salts can infiltrate into the soil and contaminate the underground water, changing its chemical composition and quality and making it a vulnerable source [11], [13]. Groundwater pollution is associated with several unpleasant aspects such as taste, odor, color, hardness and the presence of dangerous/toxic chemical compounds or pathogenic organisms [3].

The objectives of the present study were: (1) to investigate the quality of several drinking waters sampled from nine private wells

(Covasna County – Romania) and seven public springs (Suceava County – Romania); and (2) to evaluate the monthly/seasonal fluctuations of water quality parameters.

### MATERIALS AND METHODS

During November 2016, January – April 2017, a total of 80 water samples were collected from nine different wells located in Sita Buzăului village (Covasna County – Central E of Romania) and from seven natural springs located in Vatra Dornei city (Suceava County – N of Romania) (Fig.1). The analyzed water sources are used for drinking, cooking, washing and agricultural purposes.

The analysed physico-chemical parameters were: pH, electrical conductivity (EC), oxidation-reduction potential (ORP), total dissolved solids (TDS) and salinity and they were measured *in situ*, using a portable multiparameter (WTW multi350i, Germany).

The waters used for dissolved ions and nickel analysis were sampled in polyethylene containers of 500 ml and transported to the

laboratory in cold (4°C) and dark conditions, where they were filtered through 0.20 µm pore syringe filters in order to remove the impurities, while the samples used for cations and nickel analyses were acidified with HNO<sub>3</sub> (65%) [4], [6], [15].



Fig. 1. Location of the investigated areas.

Source: Own determination.

The dissolved ions (NO<sub>2</sub><sup>-</sup>, NO<sub>3</sub><sup>-</sup>, Br<sup>-</sup>, F<sup>-</sup>, Cl<sup>-</sup>, PO<sub>4</sub><sup>3-</sup>, SO<sub>4</sub><sup>2-</sup>, Li<sup>+</sup>, Na<sup>+</sup>, NH<sub>4</sub><sup>+</sup>, K<sup>+</sup>, Mg<sup>2+</sup> and Ca<sup>2+</sup>) were analyzed by ion chromatography (IC 1500 Dionex system, SUA), while the nickel was analyzed by atomic absorption spectrometry (ZeeNIT 700 system, Analytik Jena, Germany) equipped with a single-element hollow cathode lamp, an air-acetylene burner and a graphite furnace.

The overall quality of the investigated water sources was evaluated by calculating the water quality index (WQI), based on the following equation [1], [7], [8], [17], [18], [20]:

$$WQI = \frac{\sum_{i=1}^n q_i \cdot W_i}{\sum_{i=1}^n W_i},$$

$$W_i = \frac{k}{S_i} = \frac{\frac{1}{\sum_{i=1}^n S_i}}{S_i} \quad ; \quad q_i = \frac{V_a - V_i}{S_i - V_i} \cdot 100$$

where: “W<sub>i</sub> is weightage factor; k is a constant value; S<sub>i</sub> is the standard value of the i<sup>th</sup> water quality parameter; n is the total number of water quality parameters; q<sub>i</sub> is the quality rating for the i<sup>th</sup> water quality parameter; V<sub>a</sub> represents the analysed value of the i<sup>th</sup> water quality parameter determinate experimentally; V<sub>i</sub> is the ideal value of the i<sup>th</sup> water quality (V<sub>i</sub> for pH = 7 and for the other parameter the V<sub>i</sub>

value is 0” [1], [7], [8], [17], [18], [20]. The standard values (S<sub>i</sub>) of the investigated parameters were the maximum permissible limits imposed by national legislation (Law 458/2002) and international legislation (BC Health Act Safe Drinking Water Regulation – BC Reg 230/92 Canada; World Health Organisation – WHO 1996).

## RESULTS AND DISCUSSIONS

The obtained results are summarized in Fig. 2 and Fig. 3. The natural springs proved to be more acidic (pH between 5.0 and 7.5) than the wells (pH between 6.1 and 7.2) [15]. A total of 69% from the analysed spring samples, respectively 15% from the wells samples, had a more acidic pH than the limits regulated by national legislation for drinking water (6.5 – 9.5) [9]. The redox potential was inversely correlated with the pH, having values between -32.1 and 33.1 mV for wells and between -41.2 and 116.2 mV for spring samples. The electrical conductivity (EC), total dissolved solids (TDS) and salinity levels were considerably higher in the wells (147 – 1242 µS/cm for EC, 94 – 788 mg/L for TDS and 0 – 0.6 ‰ for salinity) sampled from Sita Buzăului area than for the springs (54.1 – 201.1 µS/cm for EC, 35.1– 129.1 mg/L for TDS and 0 ‰ for salinity) sampled from Vatra Dornei area (Fig. 2).

These values reflect the presence of relatively high amounts of dissolved inorganic and organic salts in the wells. However, the EC for all the samples was within the national limit (2500 µS/cm) for drinking water [9].

High levels of EC can usually indicate the presence of calcium, magnesium, sodium, and potassium cations and carbonate, hydrogencarbonate, chloride, sulfate, and nitrate anions [19]. High levels of dissolved solids, may affect water taste [19]. The waters from all the springs and seven wells had the TDS < 300 mg/L, which give an excellent taste, while two of the wells (W3 and W9) had the TDS level between 600 and 900 mg/L, which lead to a fair water taste [19]. Generally, water with TDS concentrations below 1000 mg/L is usually acceptable to consumers, although TDS > 500 mg/L may

induce a specific taste and may lead to excessive scaling in water pipes, heaters, boilers, etc. [19].

The results indicated that both wells and spring waters had a relatively constant composition, with no significant monthly fluctuations. The waters sampled during February and April 2017 were slightly acidic, while the waters sampled in January and February 2017 had lower levels of EC, TDS and salinity compared to those registered in March 2017. These fluctuations can be correlated with the higher amounts of precipitations from March which enhanced the salts dissolution.

As it is shown in Fig. 3, the concentrations of dissolved ions were considerably higher in wells than in springs. The following ions were not detected in the analyzed samples:  $\text{Li}^+$ ,  $\text{NH}_4^+$ ,  $\text{NO}_2^-$ ,  $\text{F}^-$  and  $\text{PO}_4^{3-}$ . The levels of  $\text{Cl}^-$  (1.5 – 181.3 mg/L for wells and 0.5 – 13.1 mg/L for springs),  $\text{SO}_4^{2-}$  (2.5 – 43.8 mg/L for wells and 3.1 – 18.1 mg/L for springs) and  $\text{Na}^+$  (1.1 – 58.4 mg/L for wells and 3.1 – 9.1 mg/L for springs) were within the limits (250 mg/L for  $\text{Cl}^-$  and  $\text{SO}_4^{2-}$ , and 200 mg/L for  $\text{Na}^+$ ) imposed by national legislation for drinking water [9]. The nitrate content from spring waters (0.1 – 16.5 mg/L) was considerably lower than for wells (1.1 – 146.1 mg/L). A total of 22% from the wells samples had  $\text{NO}_3^-$  content above the national limit (50 mg/L).

High amounts of calcium were registered in some of the analyzed well samples (12.8 – 212.7 mg/L), which may be correlated with the presence of limestone and dolomite [5], [10] in the local geology. High levels of  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  may lead to high levels of hardness and can cause a bitter or salty taste and a slimy mouth feel [5], [10]. Well waters proved to have relatively high levels of potassium (up to 44.5 mg/l) (Fig. 3). Spring samples had higher nickel content (4.4 – 19.2  $\mu\text{g/L}$ ) than wells (5.2 – 16.1  $\mu\text{g/L}$ ), fact that can be correlated with the more acidic pH of spring [15], which enhance the heavy metals solubility. In all the analyzed samples, nickel concentrations were within the national limit (20  $\mu\text{g/L}$ ) for drinking water [9].

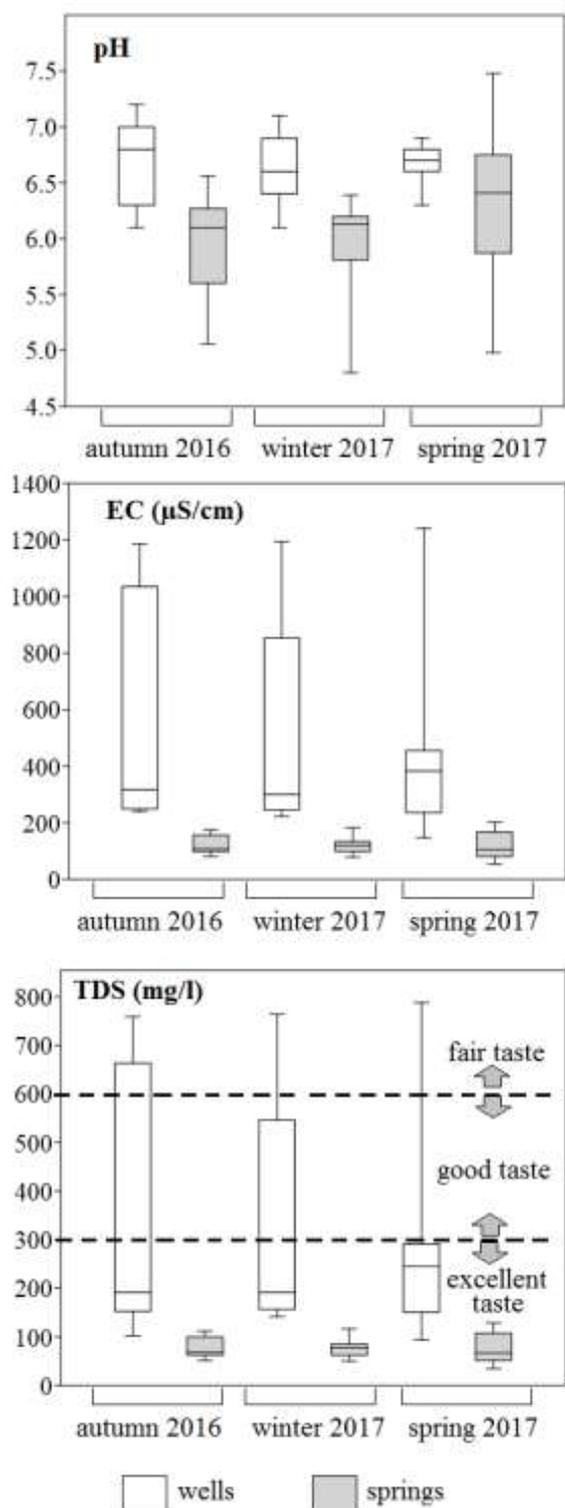


Fig. 2. Seasonal fluctuation of pH, EC and TDS for the investigated wells and springs. Source: Own determination.

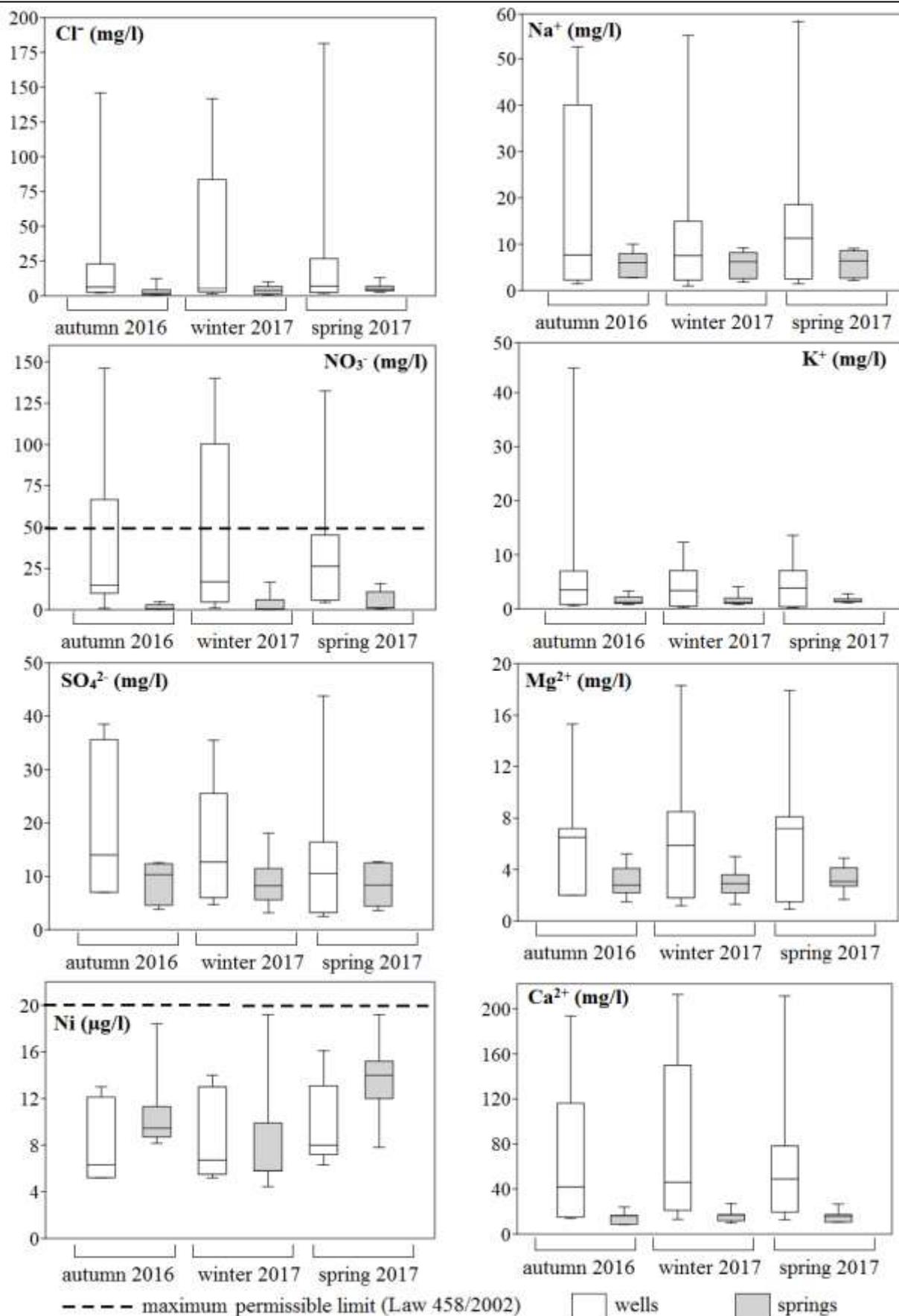


Fig. 3. The concentration of dissolved ions and nickel for both the investigated wells (Sita Buzăului) and springs (Vatra Dornei).

Source: Own determination

The concentrations of both dissolved ions and nickel were lower during January and February 2017 than in March 2017. These fluctuations can be correlated with the higher amounts of precipitations from March which enhanced the salts dissolution [15].

As it is shown in Fig. 4, the WQI had higher values for well water (2.4 – 69.1) than for spring water (4.6 – 18.7). A total of 75% of the investigated water sources had the WQI < 25, which correspond to an excellent quality status, while 19% of the water sources had the WQI between 25 and 50, which correspond to a good quality status. Only one well (W3), had the WQI between 50 and 75, being classified as poor water quality. This indicates that, with the exception of well W3, the overall chemical quality of the investigated water sources is suitable for drinking, cooking, agricultural or recreational purposes and do not represent a risk for consumers health.

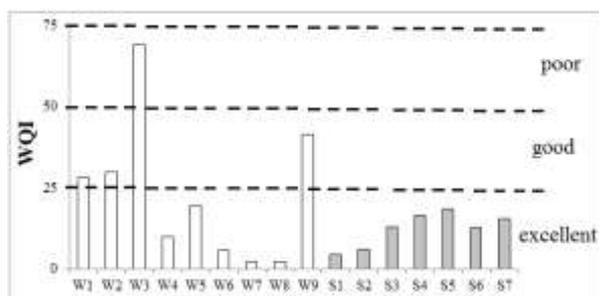


Fig. 4. Water quality status for the analysed wells (W) and springs (S), based on WQI value.

Source: Own determination

## CONCLUSIONS

Some of the analysed waters proved to have a more acidic pH than the national limits. All the analyzed waters had the levels for  $\text{Cl}^-$ ,  $\text{SO}_4^{2-}$  and  $\text{Na}^+$  within the limits imposed by national legislation for drinking water. The nitrate content from wells exceeded the national limits for 22% of the samples.

The nickel content was within the national limit for drinking water, being higher in springs due to the more acidic pH.

The levels of the analyzed quality parameters were lower during January and February 2017 than in March 2017, when the high amounts

of precipitations enhanced the salts dissolution.

Based on WQI, the overall chemical quality of most of the investigated water sources correspond to excellent and good status, being suitable for drinking, cooking, agricultural or recreational purposes.

## REFERENCES

- [1]Amadi, A.N., Olasehide, P.I., Okosun, E.A., Yisa, J., 2010, Assessment of the water quality index of Otamiri and Oramiriukwa Rivers. *Physics International*, Vol. 2: 116-123.
- [2]Cioroi, M., 2012, Studies on nitrate levels in drinking water of the Galati County private wells. *Journal of Environmental Protection and Ecology*, Vol. 13 (3): 1253–1260.
- [3]Cirtina, D., Capatina, C., Simonescu, C.M., 2016, Assessment of groundwater quality in areas affected by industrial activities in Gorj County. *Rev.Chim.* (Bucharest), Vol. 67 (3): 538-542.
- [4]EN 25667-2/1993 Water quality. Sampling. Guidance on sampling techniques
- [5]EPA 2015, Secondary Maximum Contaminant Levels: A Strategy for Drinking Water Quality and Consumer Acceptability, Web Report 4537, 69 p.
- [6]ISO 5667-3/2012 Water quality - Sampling - Part 3: Preservation and handling of water samples.
- [7]Iticescu, C., Georgescu, L.P., Topa, C.M., 2013, Assessing the Danube water quality index in the city of Galati, Romania. *Carpathian Journal of Earth and Environmental Sciences*, Vol. 8 (4): 155-164.
- [8]Kumar, A., Dua, A., 2009, Water Quality Index for assessment of water quality of river Ravi at Madhopur (India). *Global Journal of Environmental Sciences*, Vol. 8: 49-57.
- [9]Law no. 458 of 8 July 2002 on the quality of drinking water.
- [10]Lawless, H.T., Rapaki, F., Horne, J., Hayes, A., 2003, The taste of calcium and magnesium salts and anionic modifications. *Food Quality and Preference*, Vol. 14: 319-325
- [11]Marbooti, Z., Khavari, R., Ehya, F., 2015, Heavy metal contamination assessment of groundwater resources in Behbahan Plain Southwest Zagros. *Open Journal of Geology*, Vol. 5: 325-330.
- [12]Okoro, H.K., Adeyinka, A., Jondiko, O.E., Ximba, B.J., Kakalanga, S.J., 2012, Assesment of heavy metals contamination in groundwater: A case study of central industrial district in Ilorin, Kwara State, Nigeria. *International Journal of Physical Sciences*, Vol. 7 (28): 5078-5088.
- [13]Papadakis, N., Tsoumbaris, P., Sargiotis, G., Georgianos, P., Nikolaou, K., 2009, Hygienic evaluation of the water supply and sewerage systems in the Evros prefecture, Greece. *Journal of Environmental Protection and Ecology*, Vol. 10 (2): 351–358.

[14]Reddy, K.R., Patode, R.S., 2013, Assessment of groundwater quality - A case study of Kondapur Mandal, Medak District, Andhra Pradesh. *Current World Environment*, Vol. 8 (2): 267-273.

[15]Roba, C.A., Piştea, I.C., Neagoe, E., Matei, A.O., Roşu, C.D., 2017, Groundwater quality assessment from Sita Buzăului village (Covasna County) and Vatra Dornei area (Suceava County). Poster presentation – International U.A.B. – B.EN.A. conference Environmental Engineering and Sustainable Development, Alba Iulia, Romania, May 25-27, 2017.

[16]Roşu, C., Piştea, I., Roba, I., Nes, M., Ozunu, A., Groundwater quality and its suitability for drinking and agricultural use in a rural area from Cluj County (Floresti Village). Series "Management, Economic Engineering in Agriculture and rural development", Vol. 14 (2) 247 – 252.

[17]Roşu, C., Piştea I., Roba C., Ozunu, A., 2014, Water quality index for assessment of drinking water sources from Mediaş town, Sibiu County. *Air and water: components of the environment*, Vol. 2014 (1): 24-31.

[18]Sinivas, P., Pradeep, K.G.N., Srinivatas, P.A., Hemalatha, T., 2011, Generation of Groundwater Quality Index Map-A case study. *Civil and Environmental Research*, Vol. 1 (2): 9-21.

[19]WHO 2016, Total dissolved solids in Drinking-water Background document for development of WHO Guidelines for Drinking-water Quality, WHO/SDE/WSH/03.04/16, 8 pg.

[20]Yisa, J., Jimoh, T., 2010, Analytical studies on water quality index of river Landzu. *American Journal of Applied Science*, Vol. 7 (4): 453-458.

## AN ANALYSIS REGARDING THE BIOMASS PRODUCTION SECTOR IN ROMANIA - A BIOECONOMY POINT OF VIEW

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### Abstract

*Bioeconomy was defined as the economic sector which is based on sustainable use of bioresources (crops, wood, vegetal and microbial biomass), provided either by the soil or the aquatic environment, for producing food, materials and energy. The present paper is representing an overview of the opportunities and challenges surrounding green growth through the use of biomass as renewable raw material in the transition towards bioeconomy. Global and European data are provided, and Romanian situation is briefly described. In a broad sense, biomass is a general term, covering various biological materials that can be further used in the production of renewable energy or materials. The biomass signifies the biodegradable part of byproducts, wastes and residues of biological (vegetal and animal) origin from agriculture, silviculture, related industries and also urban activities. It came into the attention due to the increased potential as clean, affordable and renewable bioenergy source, with a particular interest on the production processes that imply agricultural and forest waste as those two possess a great potential throughout the whole world.*

**Key words:** biomass, bioeconomy, green growth, resources management, Romania

### INTRODUCTION

The EU Bioeconomy Strategy defines the Bioeconomy sector as “the sustainable production of primary biomass and the conversion of organic resources (primary or waste) into food, feed, bio-based products and bioenergy” [4]. Bioeconomy is seen through multi-sector approach, connecting multiple industrial sectors [5], such as: agriculture, food, fishery, forestry, energy, waste management, pulp and paper production, chemical industry) aiming to reach the goals of sustainable growth through recycling, recovery and circularity.

In this context, biomass residues from a broad range of industrial sectors are expected to play a major role in supplying the feedstock needed for sustainable bioeconomy pathways [14].

Biomass is a general term, covering various biological materials that can be used to produce food, materials or energy. The biomass signifies the biodegradable part of byproducts, wastes and residues of biological (vegetal and

animal) origin from agriculture, silviculture, related industries and also urban activities [6].

Biomass – the fourth largest energy source after coal, oil and natural gas - is the largest and

most important renewable energy option at present and can be used to produce different forms of energy [11].

Biomass includes any biological material that can be used as fuel or for industrial production.

Biomass is considered as organic material of non-fossil origin, including organic waste that can be converted into bio-energy. According to Eurostat official statistics based on data from 2016, more than 60% of EU-28 total primary energy production of renewable energy is generated from biomass sources (EUROSTAT, 2016)

Therefore, biomass production is an economic sector under exponential development due to increased interest in renewable sources of energy in the global context of circular bioeconomy strategies.

## MATERIALS AND METHODS

A comprehensive literature analysis was carried out to extract official data for the evaluation of the biomass potential.

Data sources and collection of information was performed through a detailed survey of providers on European (Eurostat, Faostat), global (World Energy Association) and National (National Institute of Statistics) level.

This paper presents an overview of biomass use for energy production starting from global level, going deeper to European area and surveying the national potential of the biomass production, with a especial emphasis on agricultural sources.

## RESULTS AND DISCUSSIONS

According to literature, among the renewable energy sources, biomass represents the largest renewable energy source, with a share of 13% in the global energy mix [9]. It is followed at long distance by hydropower (3%) and other renewable sources – solar (thermal, photovoltaic and concentrated), wind, geothermal, tidal etc. (2%) [20].

The World Energy Council defines bioenergy as the transformation of organic matter into an energy source based on the use of the following raw materials: traditional biomass (originating from forestry and agricultural residues) and modern biomass (industrial and municipal waste and biofuels [20].

### **Biomass sources - overview**

Biomass came into the attention due to the increased potential as clean, affordable and renewable bioenergy source, with a particular interest on the production processes that imply agricultural and forest waste.

Broadly, biomass is represented by plant organic matter, animal metabolic residues (manure) as well as microorganisms [9, 17].

Other studies consider that the supply of biomass can be classified into three sections – agriculture, forestry and waste.

In this sense, the *agricultural biomass* includes the secondary by-products obtained from vegetal production such as straw (sunflower, soybean, maize) leaves (beets), pods (soybeans,

beans), shells (nuts, peanuts), seeds (plums, peaches, apricots) as well as manure from livestock.

The sources of *forest biomass* are represented by the main and secondary material from the exploitation of forests such as dead trees, branches and tree stumps.

At this moment, besides the high dependence on fossil fuel, another major challenge of the global economy is arising from the preponderant share of biomass in the renewable energy sector. Moreover, deforestation and land conflicts are an important threat that has to be taken into account. The “food vs. fuel” conflict is mainly argued that the agricultural production of biomass for bioeconomic products (mainly biofuels) may be in competition with food and feed production [13, 19].

Many authors pointed ways of avoiding and controlling this competition, and one of those is that biomass for fuel or material applications should be derived from non-food crops, therefore avoiding direct competition for the same resource [13].

According to Sillanpää et al (2017), three main attributes may be involved in the biomass characterization: renewability, availability, and versatility, which are among the main prerequisite to implement bioeconomy on a sustainable ground [17].

The concept of bioeconomy as a multi-sectoral discipline is not yet well developed in our country although there are defined smart specialization direction in the national research and innovation strategies. For the moment there are several preoccupations in this direction, and hopefully the massive amount of biomass available will not remain un-exploited or under-exploited [1].

In Romania, there is a great potential of biomass, which can be used to produce energy, or conversion into biofuels and raw industrial materials. Romania's “Energy Strategy 2016-2030, with the perspective of 2050”, provides a special chapter regarding the strengthening of the role of biomass and waste materials towards the energy transition. It is estimated that the problem of waste management (agricultural, industrial and municipal) will be solved by transforming the

residues into energy products, biogas and energy-producing oils. However, it is considered that the resulting volume is lower than the potential of lignocellulosic plants [18].

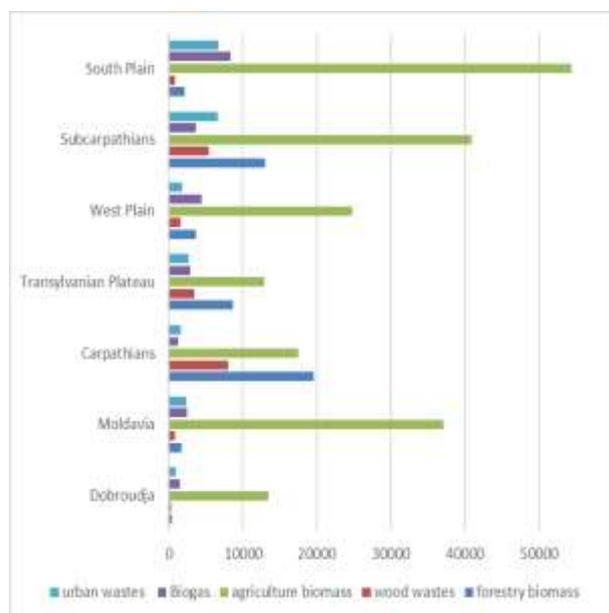


Figure 1. Biomass potential (TJ) in Romania, Source: Faostat data [2]

To estimate the potential use of different types of biomass to produce green energy the territory Romania was divided into 7 regions. As can be observed from the figure 1, agricultural biomass possesses the largest share in most regions of the country. Obviously, in the mountainous area of the Carpathians, the highest potential is owned by forestry biomass due to extended areas covered by forests. However, exposed data refer to biomass potential use in general, without subtracting data on primary crop biomass and secondary biomass, an approach of interest to ensure the sustainability of agricultural land and mountainous areas.

A paper published in 2011, describes a study presented by Scarlat *et al.*, reporting a detailed analysis of the potential of residues originating from in different industrial sectors. Overall, bioenergy potential from annual crop residues has the highest share (60.1%), followed by firewood (16.2%), wood processing residues (11.8%), permanent crop residues (7.6%) and forestry residues (4.4%) Figure 2 [15].

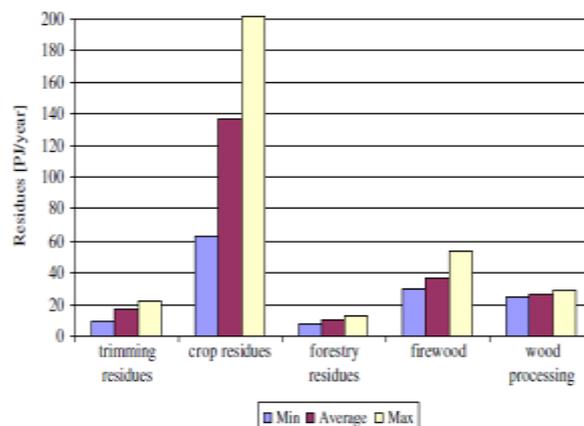


Figure 2. The biomass residues in Romania, by sector. Source: Scarlat (2011) [15]

Comparison of data on waste biomass potential is challenging because it is necessary to survey the various sectors of bioeconomy with a rather low amount of initial data available in official statistics. The challenge is to compare the multiple sectors of bioeconomy while capturing their diversity. The petrochemical and agro-food industries in Romania can play an important role in creating a new industry based on the use of biomass as a raw material and its transformation into value-added products, according to the latest country report by the Bio-Based Industries Consortium [1].

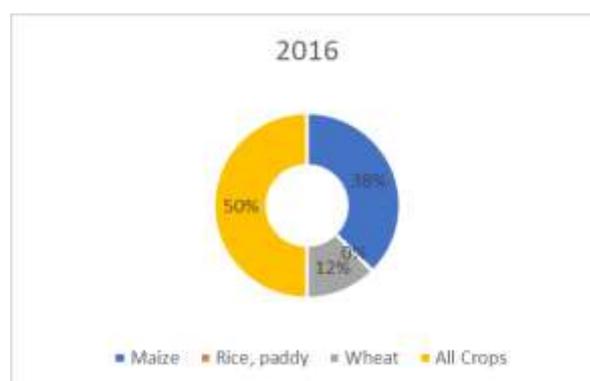


Figure 3. The biomass burned (dry matter) in Romania, 2016 Source: Faostat data [2]

The value of biomass burned in Romania, in 2016 came mostly from maize crops 2,578.5 thousand tonnes, and from wheat 854.1 thousand tonnes (Figure 3).

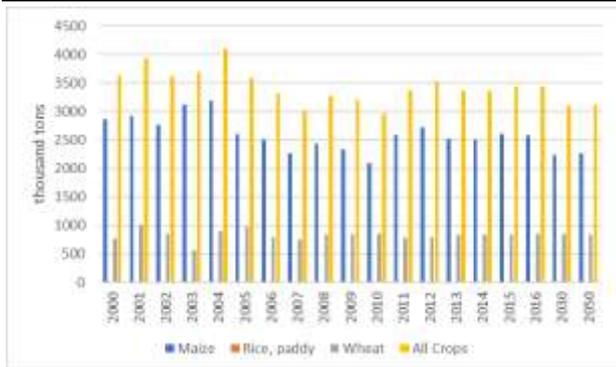


Figure 4. The biomass burned (dry matter) in Romania from 2000 to 2016, 2030, 2050

Source: Faostat [2]

The percentage of renewable energy from the total energy consumed for Romania reached a level of approximately 25% in 2016, higher than the target for 2020, established at 24% (Figure 5).

The highest share was reported in Iceland, namely 72.6%, and the lowest in Luxembourg 5.4%.

In 2017, according to European Environment Agency (EEA) data, 11 member states (Bulgaria, Croatia, Czechia, Denmark, Estonia, Finland, Hungary, Italy, Lithuania, Romania and Sweden) had already achieved their binding renewable energy share targets for 2020, as set under the Renewable Energy Directive [7].

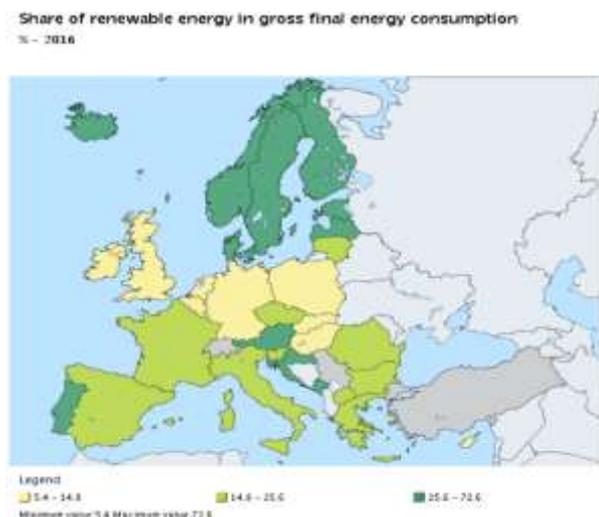


Figure 5. Share of renewable energy in gross final energy consumption

Source: European environmental agency; Eurostat t2020\_31, [7]

It was reported in the literature that 1.4 billion people lack access to electricity, while 85% of

them are living in rural areas. For the future, it is expected that the number of rural communities relying on the traditional use of biomass to rise from 2.7 billion in 2016 to 2.8 billion in 2030 [12].

The structure of the biomass sources across Europe has changed a lot during the last decade (Figure 6), nowadays making room for wind power, solar power and renewable wastes (Figure 7).

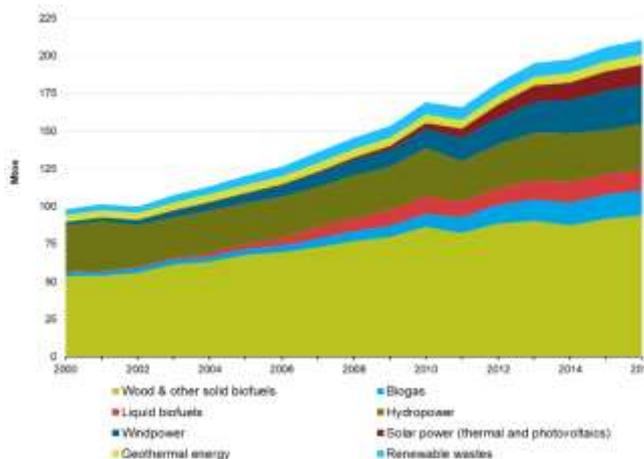


Figure 6. The structure of the raw material source for renewable energy in Europe.

Source: Eurostat [7]

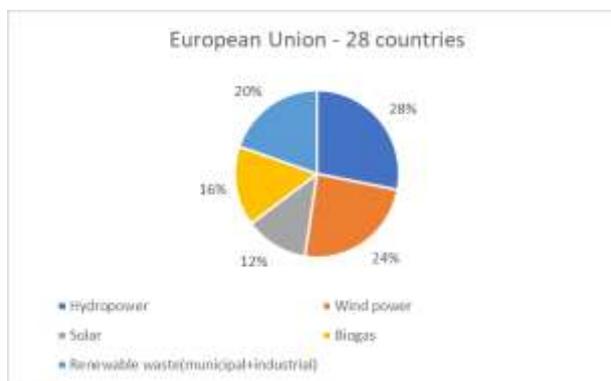


Figure 7. The share of renewable energy in Europe by source, 2016

Source: Eurostat [7].

It was reported that biomass (including the biodegradable fraction of waste) is by far the most important renewable energy source in the EU: it accounts for 63.3% of total renewable energy production. That is why the agricultural and forestry sectors are particularly important in this context. For example, in 2010, 48.5% of renewable energy produced in the EU came from forest biomass, while agricultural biomass

accounted for 10.6% of this total (Figure 6) [6].

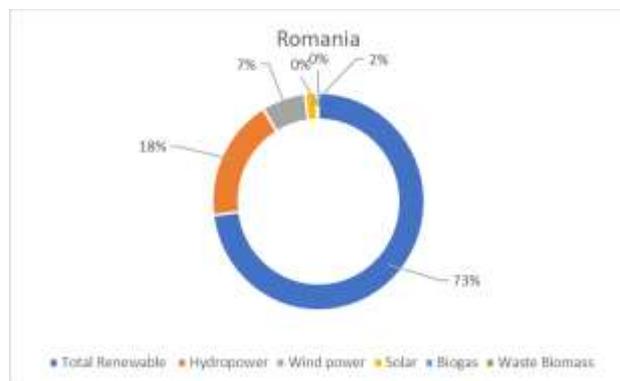


Figure 8. The percentage of renewable energy in Romania, sorted by source of provenience, 2016  
 Source: [8]

The percentage of biomass energy production of USA represented nearly a 50 % share in the total renewable energy in 2017, as shown in figure 9.

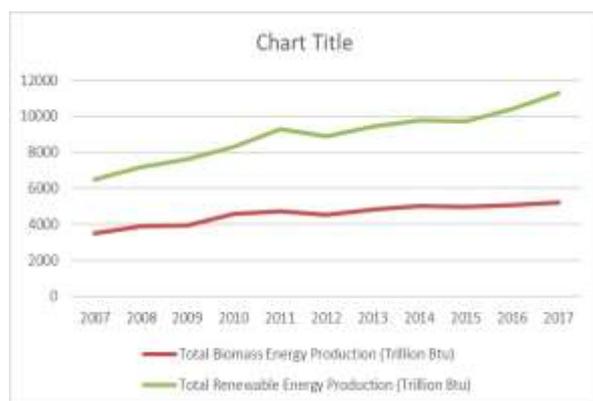


Figure 9. Production of Renewable Energy vs total Production of Energy - USA

Source: Data withdrawn from <https://www.eia.gov/>

Currently, biomass is used far-reaching as primary resource for the production of wood-based materials, pulp and paper production, biomass-derived fibres, and as biofuel feedstock (from oil crops, starch and sugar crops) [16]. However, the targeted transition to a bio-based economy will bring up questions and answers regarding the sustainability [3] of biomass as raw material for several industries, and the economic efficiency of its use [3, 10, 16]

Having as a target the sustainable development, the concept of biomass being

reinsert into the market system represent the fundamentals of a bio-economy.

## CONCLUSIONS

The transition of national economies towards the bioeconomy is seen as a pathway to reaching increased sustainability. However, the controversies within science, public and policy makers and public discussion panels on the conflict food vs fuel suggest are complex and need to be observed.

Biomass is the fourth largest energy source after coal, oil and natural gas, making it the largest and most important renewable energy option at present and can be used to produce different forms of energy. Therefore, biomass is the most important renewable energy source, which will play an important role in global and European energy markets. The role of using biomass energy resources is important as European development and energy independence strategies aim for 20% renewable sources by 2020.

Agriculture sector is a significant contributor to the biomass supply globally, and a great share of all biomass supply comes from agriculture sector in the form of energy crops, by products and waste materials.

## REFERENCES

- [1]Biobased Industries consortium, Mapping The Potential Of Romania For The Bio-Based Industry, <https://biconsortium.eu/library/bic-documents>, Accessed on January 10, 2019.
- [2]European Comission (EC), Review of the 2012 European Bioeconomy Strategy. Luxemburg, 2017.
- [3]Brumă, I.S., Bohateret, V.M., 2016, Plausible Evolutions of the Commercial Agricultural Holdings in Romania, Agricultural Economics and Rural Development, New Series, Year XIII, no. 2, 2016, Bucharest, 169-183.
- [4]European Comission (EC) A new bioeconomy strategy for a sustainable Europe, Brussels, 2018.
- [5]European Commission, Joint Research Centre, Institute for Prospective Technological Studies, Spain, 1-4.
- [6]European court of auditors, Renewable energy for sustainable rural development. Special report 5/2018, ISSN 1977-5806 doi:10.2865/31896.
- [7]European Environment Agency, <https://www.eea.europa.eu/>, Accessed on January 10, 2019.

[8]Eurostat Energy Data Base, <https://ec.europa.eu/eurostat/>, Accessed on January 10, 2019.

[9]International Energy Agency, IEA, [www.iea.org](http://www.iea.org), Accessed on January 10, 2019.

[10]Kluts, I., Wicke, B., Leemans, R, Faaij, A. 2017, Sustainability constraints in determining European bioenergy potential: a review of existing studies and steps forward. *Renew Sustain Energy Rev*; Vol. 69:719–34.

[11]Ladanai, S., Vinterbäck, J., 2009, Global Potential of Sustainable Biomass for Energy.

[12]Owusu, P. A., Asumadu-Sarkodie, S., Dubey, S., 2016, A review of renewable energy sources, sustainability issues and climate change mitigation, *Cogent Engineering*, 3:1, <https://www.cogentoa.com/article/10.1080/23311916.2016.1167990>, Accessed on January 10, 2019.

[13]Pfau, S.F., Hagens, J.E., Dankbaar, B., Smits, A.J.M., 2014, Visions of Sustainability in Bioeconomy Research. *Sustainability*, Vol. 6:1222-1249.

[14]Ronzon, T., Santini, F., M'Barek, R., 2015, The Bioeconomy in the European Union in numbers. Facts and figures on biomass, turnover and employment.

[15]Scarlat, N., Blujdea, V., Dallemand, J.F., 2011, Assessment of the availability of agricultural and forest residues for bioenergy production in Romania, *Biomass and Bioenergy*, Vol. 35: 1995-2005

[16]Scarlat, N., Dallemand, J.F., Monforti-Ferrario, F., Nita V., 2015, The role of biomass and bioenergy in a future bioeconomy: Policies and facts, *Environmental Development*, Vol.15:3–34.

[17]Sillanpää, M., Ncibi, C., 2017, Biomass: The Sustainable Core of Bioeconomy. In: *A Sustainable Bioeconomy*. Springer, Springer international publishing AG 2017:55-78.

[18]Strategia-Energetica-a-Romaniei-2016-2030 (Romania's Energy Startegy 2016-2020).

[19]Ten Bos, R., van Dam, J.E.G., 2013, Sustainability, polysaccharide science, and bio-economy. *Carbohydr. Polym.*, Vol. 93: 3–8

[20]World Bioenergy Association, 2018, Global Bioenergy statistics, 1-43.

## STORAGE METHODS INFLUENCE SOME PHYSICAL AND GRAVIMETRIC PROPERTIES OF *JATROPHA* (*Jatropha curcas*) SEEDS

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### Abstract

Common storage methods and their effects on some engineering properties of *Jatropha* seeds were studied. Engineering properties of seeds are important in their handling, storage, processing and equipment design. Samples were collected from the *Jatropha* plantation in the Teaching and Research Farm of the University of Ibadan, Nigeria, populated with *Jatropha* accessions of age uniformity. Using standard methods, gravimetric properties (like true and bulk densities, porosity) and physical properties (like length, width, thickness, sphericity, surface area) of the seeds were determined for three months of storage at one month interval for crib, refrigerator and room storage methods. Data were analysed using GENSTAT Discovery (Edition 4). Means were separated using Least Significant Difference (LSD) at 5% probability level. The storage methods had no statistical significant effect on the physical properties while gravimetric properties were significantly affected. In the crib method, bulk density decreased (416 - 398 kg/cm<sup>3</sup>) and true density increased (709 - 820 kg/m<sup>3</sup>) while refrigerator showed increases in bulk (416 to- 432 kg/m<sup>3</sup>) and true (709 - 788 kg/m<sup>3</sup>) densities. For room method, true and bulk densities increased from 709 to 764 kg/m<sup>3</sup> and 416 to 441 kg/m<sup>3</sup> respectively. Porosity increased in the crib (41.3 – 51.4%), refrigerator (41.3 – 42.2%) and room (41.3 – 41.7%) methods. Therefore drying will be most efficient in crib method because of more pore spaces in the seed bulk. Baseline data of the physical and gravimetric properties of *Jatropha curcas* seeds required for machine and equipment design was generated.

**Key words:** *Jatropha*, physical property, seed storage, crib, porosity

### INTRODUCTION

*Jatropha curcas*, commonly called ‘physic nut’, is a deciduous, multipurpose shrub belonging to the family Euphorbiaceae. *Jatropha curcas* L. is the commonest specie found in Nigeria [9] and known as “cinidazugu” and “lapa lapa” in Hausa and Yoruba languages respectively [5]. It is normally a small evergreen, nearly glabrous or soft-wooded shrub of three to four meters in height but can attain a height of eight to ten meters under favorable conditions. The fruit is a capsule of 2.5 to 5.0 cm in diameter; seed is ovoid-oblong and becomes dull brownish black when matured after two to four months of flowering. Five year old plantation of *Jatropha curcas* (J. Curcas) yields 12 tons of seeds per hectare in a year [11], while 0.8-1.0 kg of seeds/meter of live fence can be obtained if it is planted for hedge [10]. J. Curcas seed, leaf and bark have medicinal values. The sap from the leaves can be used

on bee or wasp sting. J. Curcas has been used in traditional medicine to cure various infections such as scabies and dermatitis. Researchers had isolated and characterized numerous biologically active compounds from all parts of the plant. J. Curcas plant also has environmental benefits such as a potential enrichment of the soil. Its oil cake is rich in Nitrogen (6%), phosphate (2.75%) and potassium (0.94%) which can be used as organic manure [1]. The oil can also be used to replace synthetic fertilizer by undertaking plantations of *J. curcas* in waste lands [1]. It is also recognized as the most potential plant for biodiesel production, since the seed contains high oil content (30-38%) and can be grown under different land-use situations [6]. It is propagated by seeds or cuttings and bears fruits within two to three years. Also, it can be commercially exploited in four to five years and lasts for about 50 years [7]. The huge plantation has already started and going on across Nigeria. Meeting such large-scale

planting targets and raw materials for biodiesel and pharmaceutical production will require a very substantial quantity of seed supply annually, hence the need for effective storage. However, the engineering properties of seeds generally play an important role in the proper handling, storage and processing of the seeds including the design and construction of required machines and equipment. Bulk density, true density and porosity can be useful in sizing grain hoppers and storage facilities. Grain bed with low porosity will have greater resistance to water vapor escape during the drying process, which may lead to higher power to drive the aeration fans. Sphericity of seeds determine how easily the seeds will roll on material surfaces and the shape of apertures on screening equipment while arithmetic and geometric mean diameters help in determining the aperture size. According to [4], a number of important changes in the structure of agricultural materials take place in the course of hydration and they are mainly associated with increased water content. Therefore seeds, when exposed to atmospheric conditions may experience seed moisture changes. This work therefore investigated the likely changes in the physical and gravimetric properties of *Jatropha* seeds under different storage methods.

## MATERIALS AND METHODS

### Collection and preparation of sample

Samples were collected from the *Jatropha* plantation in the Teaching and Research Farm of the University of Ibadan, Oyo State, Nigeria. The *Jatropha* plantation is populated with *Jatropha* plants of different accessions with uniformity in age. Matured pods were both picked from the floor (fallen pods) and also plucked from the trees by hand. The pods are in clusters and brown in color indicating its maturity.

### Shelling of pods and cleaning of seeds

The pods were split open by hand. There was minimum of one seed and maximum of three seeds per pod. The seeds were collected in a polythene bag and cleaned to remove dirt and remains of broken pods that might have been mistakenly packed together with the seed. The

seeds were later distributed into three sample lots.

**Storage of seeds:** The 3 storage methods employed in this project include: a) Refrigerator, b) Crib and c) Room methods. The seeds were stored in these three ways for three months and data were taken at one month interval.

### Determination of physical properties

**Measurement of seed axial dimension:** The true axial dimensions of each of 30 randomly selected seeds from each sample lot were measured [22, 15, 20, 4]. The axial dimensions were: length, width and thickness. A Vernier caliper with 0.05 mm accuracy was used for taking the measurements.

**Principal dimensions:** The principal dimensions are the Arithmetic mean diameter ( $D_a$ ) and Geometric mean diameter ( $D_g$ ) dimensions which were calculated according to equations 1 and 2 respectively from the values of the three axial dimensions of each seed.

$$D_a = (L + W + T)/3 \quad (1)$$

$$D_g = (LWT)^{1/3} \quad (2)$$

where L = length; W = width; T = thickness in mm [14].

**Surface area:** The surface area for *Jatropha* seeds was determined by using the analogy of a sphere of the same geometric mean diameter using equation 3

$$S = \pi D_g^2 \quad (3)$$

where S = surface area,  $D_g$  = geometric mean diameter. [17, 19, 2, 12].

### Determination of Gravimetric Properties

**Individual seed mass:** The mass of individual seed was determined by weighing ten seeds and dividing the total mass of the seeds by ten. To cross reference with the above method, the mass of individual seed was also determined by weighing individual seed. This was replicated 5 times.

**True density:** Seed volume was determined using the liquid displacement method discovered by [14]. The volume of individual seed was determined by pouring 10 g of seeds into 20 ml of toluene ( $C_7H_8$ ) in a measuring

cylinder. The difference between the initial and final level of toluene in the measuring cylinder represented the volume displaced by the seeds which was divided by the number of seeds making up the 10 g to determine the volume of one seed. This was replicated five times. Toluene was used in place of water, because it is absorbed by seeds to a less extent. Also, its surface tension is low and its dissolution power is low [13].

**Thousand Grain mass:** The mass of a thousand grains was determined by counting randomly selected hundred seeds and weighing them on an electronic balance. The result was multiplied by 10 to obtain the mass for 1,000 seeds. The experiment was replicated five times and the means determined for each sample. [20].

**Bulk density:** The bulk density is the ratio of the mass of a sample of a seed to total volume [18]. Bulk density for all the samples were determined by filling an empty 320 ml beaker with *Jatropha* seeds and weighed [14]. The weight of the seeds was obtained by displacing the weight of the beaker on an electronic balance while weighing the seed - filled beaker on the balance. To achieve uniformity in bulk density, the beaker was tapped 10 times for the seeds to consolidate [14]. The beaker was filled with seeds dropped from a 15 cm height and a sharp - edged flat was used to remove excess seeds to level the surface at the top of the graduated beaker [15]. Bulk density was calculated using equation 4, given below:

$$\rho_b = m/v \quad (4)$$

where m = mass of seeds; v = volume of beaker occupied by the seed bulk. This was replicated 5 times [14]

**Porosity:** Porosity is the ratio of free space between grains to total of bulk grains, determined by

$$P = [(\rho_t - \rho_b) / \rho_t] \times 100 \quad (5)$$

where P = porosity,  $\rho_t$  = true density,  $\rho_b$  = bulk density. [8]. This was calculated for each replicate of samples using their respective values of bulk and true densities.

#### Statistical analysis

Data collected were subjected to analysis of variance using GENSTAT Discovery (edition 4). Means were separated using Least Significant Difference (LSD) at 5% level of probability.

## RESULTS AND DISCUSSIONS

### Physical properties

Analyses of the physical properties of *Jatropha* seeds for the three storage methods are shown in Tables 1, 2 and 3. Changes in all the physical properties for the methods were not statistically significant ( $P < 0.05$ ) except for significant decrease and increase in seed thickness for crib and room methods respectively within three months of storage.

Table 1. Physical properties of *Jatropha* seeds at different months in a crib

Month	Length (cm)	width (cm)	thickness (cm)	Arithmetic dimension (cm)	Geometric dimension (cm)	Surface Area (cm <sup>2</sup> )	Sphericity
0	1.789	1.099	0.873	1.254	1.196	4.509	0.671
1	1.783	1.092	0.850	1.242	1.183	4.404	0.664
2	1.738	1.101	0.831	1.224	1.167	4.288	0.672
3	1.787	1.105	0.857	1.249	1.191	4.461	0.668
LSD	NS	NS	0.029*	NS	NS	NS	NS

\*Significant at  $p=0.05$

Source: Laboratory work (2018)

The changes in seed thickness may be ascribed to changes in seed moisture caused by changing atmospheric conditions depending also on the seed internal structure or internal cell arrangement. This caused a

permanent change in the axial dimensions of the seeds because of the seeds' exposure to the atmosphere.

The refrigerator method had no significant effect on the physical properties of *Jatropha*

seeds therefore the seeds can be stored for three months in the refrigerator without significant change in the seeds' physical properties.

This may be attributed to the 'controlled

atmospheric conditions' in the refrigerator. It is one of the values for calculating arithmetic and geometric mean diameters which are used in determining aperture size in the design of screens or separators for seeds.

Table 2. Some physical properties of Jatropha seeds at different months in a refrigerator

Month	Length (cm)	width (cm)	thickness (cm)	Arithmetic dimension (cm)	Geometric dimension (cm)	Surface Area (cm <sup>2</sup> )	Sphericity
0	1.789	1.099	0.873	1.254	1.196	4.509	0.671
1	1.812	1.105	0.856	1.257	1.196	4.500	0.661
2	1.829	1.119	0.879	1.276	1.216	4.647	0.665
3	1.811	1.112	0.852	1.258	1.196	4.504	0.661
LSD	NS	NS	NS	NS	NS	NS	NS

\*Significant at  $p=0.05$

Source: Laboratory work (2018)

Table 3. Some physical properties of Jatropha seeds at different months stored at room temperature

Month	Length (mm)	width (mm)	thickness (mm)	Arithmetic dimension (mm)	Geometric dimension (mm)	Surface area (mm <sup>2</sup> )	Sphericity
0	1.789	1.099	0.873	1.254	1.196	4.509	0.671
1	1.811	1.128	0.852	1.264	1.203	4.552	0.665
2	1.767	1.109	0.835	1.237	1.178	4.368	0.668
3	1.820	1.114	0.874	1.269	1.209	4.602	0.665
LSD	NS	NS	0.027*	NS	NS	NS	NS

\*Significant at  $p=0.05$

Source: Laboratory work (2018)

The graph (Fig. 1) shows the non-linear trend in the effect of Crib and Room storage methods on the seed thickness of Jatropha. The equations generated can be used to predict the value of seed thickness at any time of storage.

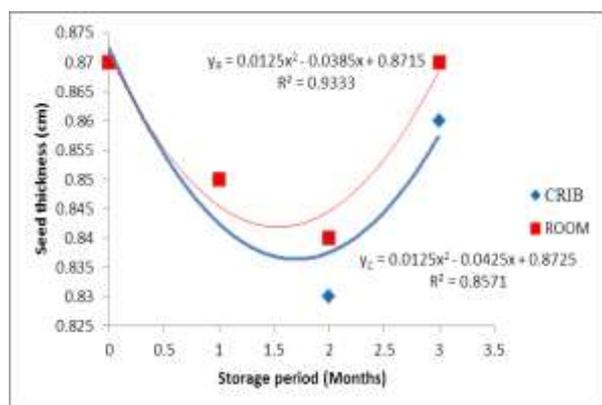


Fig. 1. Graph showing effect of Crib and Room storage methods on seed thickness.

Source: Laboratory work, 2018.

$$Y_{Crib} = 0.0125x^2 - 0.0425x + 0.8725$$

$$R^2 = 0.8571$$

$$Y_{Room} = 0.0125x^2 - 0.0385x + 0.8715$$

$$R^2 = 0.9333$$

### Gravimetric properties

Tables 4, 5 and 6 show the significant effects of storage methods on porosity, bulk and true densities of Jatropha seeds. In the crib method, true density increased while bulk density decreased significantly ( $P<0.05$ ) in three months. Both properties also significantly increased in room and refrigerator storage methods. Decrease in either bulk or true density implies that the rate of increase in mass of the seed bulk is lower than the corresponding volumetric expansion rate of the seed bulk [16]. And increase in either bulk or true density implies that the rate of increase in the mass of the seed bulk is higher than that of the volume it occupies. Increase or decrease in bulk and true densities is due to structural properties of the seed [13]. Similar decreasing trend in bulk density was reported by [21] for pea seed, [3] for some legume seeds, and [16] for Karanja kernel. The knowledge of bulk and true densities of Jatropha seeds is important in the design of and the choice of material for its storage and packaging equipment. Fig. 3 and 4 show the

polynomial and linear trends in the storage effects on true and bulk densities of *Jatropha* seeds. The equations generated can be used to determine the value of the densities and porosity at any point of storage (Fig. 2, 3 and 4). Porosity increased linearly in crib (41.33 – 54.41%), and increased (41.33 – 42.17%) in both room and refrigerator methods significantly ( $P < 0.05$ ) in a second order polynomial trend (Fig. 2). Highest value of porosity was recorded in crib method while room and refrigerator methods had similar values. This implies that influence of changing atmospheric conditions was more severe in crib method where *Jatropha* seeds were fully exposed to the atmosphere, limited in room method and controlled in refrigerator method. Porosity depends on bulk and true

densities, hence the variation in porosity [13]. It describes the ratio of pore spaces in a grain bulk to the space occupied by the whole grain mass. This means that increase and decrease in porosity result in high and low magnitude of pore spaces respectively in a grain mass. Porosity is an essential characteristic used in determining the rate of aeration, cooling, drying, heating and the design of heat exchangers and packaging equipment. High porosity encourages faster rate of drying or cooling because of free air flow within the seed bulk which also discourages spoilage during storage. Irrespective of the storage method or period of storage, other gravimetric properties of *Jatropha* seeds did not have a significant difference.

Table 4. Some gravimetric properties of *Jatropha* seeds at different months in a crib

Month	Individual seed weight(g)	10 seeds weight (g)	1000 unit mass (g)	True density (kg/m <sup>3</sup> )	Bulk density (kg/m <sup>3</sup> )	Porosity (%)
0	0.802	6.99	657.2	709	416	41.33
1	0.650	7.04	668.4	814	415	48.97
2	0.760	7.06	678.2	788	409	48.07
3	0.704	6.86	662.5	820	398	51.41
LSD	NS	NS	NS	0.027*	0.008*	2.020*

\*Significant at  $p=0.05$

Source: Laboratory work (2018)

Table 5. Some gravimetric properties of *Jatropha* seeds at different months stored in a refrigerator

Month	Individual seed weight(g)	10 seeds weight (g)	1000 unit mass (g)	True density (kg/m <sup>3</sup> )	Bulk density (kg/m <sup>3</sup> )	Porosity (%)
0	0.802	7.00	657.2	709	416	41.33
1	0.720	6.57	647.7	714	439	38.59
2	0.656	6.60	639.7	769	444	41.65
3	0.682	6.74	642.5	788	432	42.17
LSD	NS	NS	NS	0.021*	0.008*	1.418*

\*Significant at  $p=0.05$

Source: Laboratory work (2018)

Table 6. Some gravimetric properties of *Jatropha* seeds at different months stored in a room

Month	Individual seed weight (g)	10 seeds weight(g)	1000 unit mass (g)	True density (kg/m <sup>3</sup> )	Bulk density (kg/m <sup>3</sup> )	porosity (%)
0	0.802	7.00	657.2	709	416	41.33
1	0.638	6.60	678.7	769	438	43.02
2	0.720	6.98	671.8	769	449	41.65
3	0.808	6.98	664.8	764	441	42.17
LSD	NS	NS	NS	0.018*	0.009*	1.832*

\*Significant at  $p=0.05$

Source: Laboratory work (2018)

After three months of storing *Jatropha*, the physical appearance of the seeds stored in the refrigerator and room temperature maintained their physical appearance over the period of storage (Plates 2 and 3). This is probably because of the controlled and limited atmospheric conditions in the refrigerator and room methods respectively. Appearance of seeds stored in crib changed after three months of storage and attacked by insects (Plate 1).



Photo 1. *Jatropha curcas* seeds stored in crib after three months  
 Source: Laboratory work 2018.

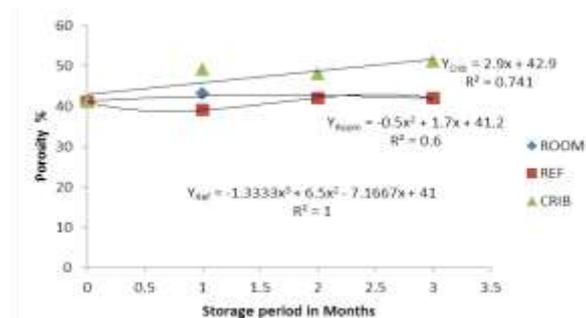


Fig. 2 Graph showing the effects of the storage methods on the porosity of *Jatropha* seeds.  
 Source: Laboratory work 2018.



Photo 2. *Jatropha curcas* seeds stored in room temperature after three months  
 Source: Laboratory work 2018.

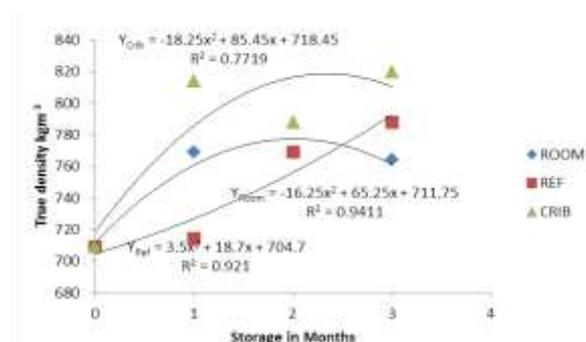


Fig. 3 Graph showing the effects of the storage methods on the True density of *Jatropha* seeds.  
 Source: Laboratory work 2018.



Photo 3. *Jatropha curcas* seeds stored in refrigerator after three months  
 Source: Laboratory work 2018.

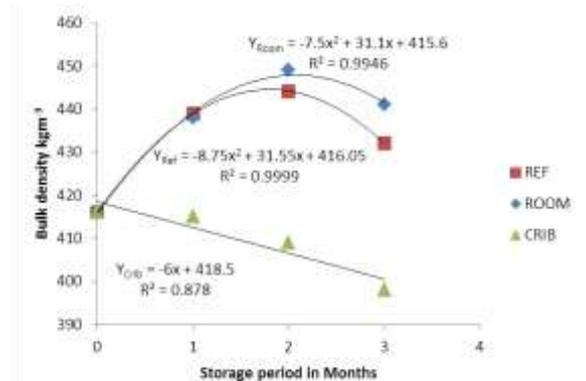


Fig. 4 Graph showing effects of storage methods on the Bulk density of *Jatropha* seeds.  
 Source: Laboratory work 2018.

## CONCLUSIONS

The following conclusions were drawn from the study:

- Changes in the physical properties of *J. Curcas* seeds like seed dimensions, sphericity and surface area due to storage methods studied were not statistically significant.
- J. Curcas* seeds showed statistical significant differences in their gravimetric properties when subjected to different storage methods.
- Equations were generated to predict the behavior of *J. Curcas* seeds under the different storage methods.

-Some of the data necessary for the design of equipment for handling, storing and packaging of *Jatropha* seeds were developed.

## REFERENCES

- [1]Agbogidi, O.M., Mariere, A.E., Oluwo, A., 2013, Metal concentration in plant tissues of *Jatropha curcas* L grown in crude oil contaminated soil. *Journal of Bioinnovation*, 23:137-145.
- [2]Altuntas, E., Ozgoz, E., Taser, F., 2005, Some physical properties of Fenugreek (*Trigonella foenum-graceum* L.) seeds. *Journal of Food Engineering*. 71: 37-43.
- [3]Altuntas, E., Demirtola, H., 2007, Effect of moisture content on physical properties of some grain legume seeds. *New Zealand Journal of Crop and Horticultural Science*. 35 (4):423-433.
- [4]Andrejko, D., Kaminska, A., 2005, Selected properties of yellow lupine seeds formed by hydration. *Electronic Journal of Polish Agricultural Universities*, 8(4): 82-88.
- [5]Blench, R., Dendo, M., 2007, Hausa names for Plants and Trees. 2nd Edition, 8 Guest Road, Cambridge, United Kingdom.
- [6]Forson, F.K., Oduro, E.K., Donkoh, E.H., 2004, Technical note performance of *Jatropha curcas* oil blends in a diesel. *Renewable Energy* 29: 1135-1145.
- [7]Gubitz, G.M., Mittelbach, M., Trabi, M., 1999, Exploitation of the tropical oil seed plant. *Jatropha curcas* L. *Biores. Technol.*, 67: 73-82.
- [8]Heidarbeigi, K., Ahmadi, H., Kheiralipour, K., Tabatabaefar, A., 2008, Some physical and mechanical properties of Iranian wild pistachio (*Pistachio mutica* L.). *American-Eurasian Journal of Agricultural & Environmental Science* 3(4):521-525.
- [9]Heller, J., 1996, Physic nut, *Jatropha curcas* L. promoting the conservation and use of herbs. 2nd Edition, Boca Raton, CRC Press.
- [10]Henning, R.K., 1996, The *Jatropha* project in Mali. Rothkreuz II, D-88138, Weissensberg, Germany.
- [11]Jones, N., Miller, J. N., 1992, *Jatropha curcas*: A multipurpose species for problematic sites, Washington DC: The World Bank, pp. 7-8.
- [12]Kiani Deh Kiani, M, Minaei, S., Maghsoudi, H., Ghasemi Varnamkhasti, M., 2008, Moisture dependent physical properties of red bean. *International Agrophysics* 22: 231-237.
- [13]Milani, E., Seyed, M., Razavi, A., Koocheki, A., Nikzadeh, V., Vahedi, N., MoeinFard, M., Gholamhossein Pour, A., 2007, Moisture dependent physical properties of cucurbit seeds. *International Agrophysics*. 21: 157-168
- [14]Mohsenin, N.N., 1986, Physical properties of plant and animal materials. 2nd Edition (revised). Gordon and Breach Science Publishers, New York, U.S.A.
- [15]Nalbandi, H., Ghassemzadeh, H.R., Seiedlou, S., 2010, Seed moisture dependent physical properties of *Turgenia latifolia*: criteria for sorting. *Journal of Agricultural Technology*: 6(1):1-10.
- [16]Pradhan, R.C., Naik, S.N., Bhatnagar, N., Swain, S.K., 2008, Moisture-dependent physical properties of Karanja (*Pongamia pinnata*) kernel. *Industrial Crops and Products*, 28(2): 155-161.
- [17]Sacilik, K., Ozturk, R., Keskin, R., 2003, Some physical properties of hemp seed. *Biosystems Engineering* 86(2): 191-198.
- [18]Shafiee, S., Motlagh, A., Minaee, S., Haidarbigi, K., 2009, Moisture dependent physical properties of dragon's head seeds (*Lallemantia iberica*). *Agricultural Engineering International: the CIGR Ejournal*. 11: 1-10.
- [19]Tunde-Akintude, T.Y. and Akintude, B.O., 2004, Some physical properties of sesame seed. *Biosystems Engineering*, 88: 127-129.
- [20]Tunde-Akintunde, T.Y., Akintunde, B.O., 2007, Effect of moisture content and variety on selected properties of Beniseed. *Agricultural Engineering International: the CIGR Ejournal*. 9:1-14
- [21]Yalcin, I.C., Ozarsalan, C., Akhas, T., 2007, The physical properties of pea (*Pisum sativum*) seed. *Journal of Food Engineering*, 79:731-735.
- [22]Zewdu, A., Solomon, W., 2008, Moisture-dependent physical properties of Grass pea (*Lathyrus sativus* L.) seeds. *Agricultural Engineering International:the CIGR Ejournal*. 10: 1-14.



## RESULTS OF THE DECENTRALIZATION REFORM IN UKRAINE: LAND USE

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### Abstract

*The article deals with the issues of decentralization of power reform in Ukraine as the transfer of authority from the state authorities to local governments, in particular the territorial communities. The focus is on the implementation of the decentralization of land use decision-making on through the prism of sustainable development. It is noted that world trends of political decentralization for implementation of sustainable development projects demonstrate the efficiency of rural development. Based on the transfer of power to local communities, this approach provides more realistic governance decisions with a high probability of sustainable development. An analysis of legislation on the implementation of extension of powers of territorial communities in Ukraine, which involves the establishment of capable territorial communities are done. The capacity of communities is manifested in the formation of the source of local budget revenues and prerequisites for the well-being of territorial communities and, in general, rural areas. Land and other natural resources that can be transferred to community property are considered in the study as the main source of revenues of local communities in Ukraine. The intermediate results of the process of decentralization of power in Ukraine in terms of land use are indicated, as well as a number of issues that need to be resolved in the next stage, are identified.*

**Key words:** decentralization, sustainable development, rural development, capable territorial communities, communal ownership, land use

### INTRODUCTION

In Ukraine, one of the main problems of the long and uncompleted process of economic reforms, including the land reform, started in 1991, consisting in the restructuring of the centralized and planned national economy to a more de jure and de facto decentralized, focused on competitive market environment, according to the concept of sustainable development, we consider the gap of an effective mechanism to ensure and encourage the balanced use of natural resources. First of all land use by territorial communities in order to achieve parity of environmental, economic and social aspects of social welfare and rural development.

According to the Constitution of Ukraine (1996), the land is exclusively national

property and at the same time may be owned by state, cooperative, public enterprises, organizations, institutions or individual citizens [3]. The Land Code of Ukraine (2001) regulates that land in Ukraine may be in private, communal and state property [15]. The communal property is: a) all lands within the settlements, except for land plots of private and state ownership; b) land plots where buildings, structures, and other objects of communal property are located, regardless of their location. The material and financial basis of local self-government is, in particular, the revenues of local budgets, other funds, land, and natural resources owned by territorial communities [3].

Ukraine also ratified the European Charter of Local Self-Government (1997). The above show that in Ukraine theoretically has been

established the legal basis of local self-government. In practice, self-government took place only at the regional (oblast) level. The main reason for this situation is the financial insolvency of the territorial communities, due to which their local government bodies were not able to perform their administrative functions inherent in them [6]. Due to this discrepancy, the Government of Ukraine has been implemented decentralization of power reform since 2014. According to the objectives of this reform, powers, resources and responsibilities from the central government are transferred to the territorial communities as primary independent entities in the administrative-territorial organization of Ukraine. Territorial communities can be voluntarily united in order to ensure economic efficiency, obtaining state support for development. The legal basis for the formation of united territorial communities is a Perspective Plan. The Perspective Plan contains a list of capable territorial communities, the names of the territorial communities that are part of them, information on the boundaries of the capable territorial communities, and their potential administrative centres.

The policy of extension of powers of territorial communities in Ukraine is also considered as a part of initiatives to support the development of rural areas. Most problematic aspect that arises in this case is the institutional – it is a duplication of competences of the authorities within one unit of governance, which also results in the negative consequences of inefficient management of the natural resource potential of rural areas and the country as a whole.

The extension of powers of local authorities is also intended to contribute to the more successful achievement of the Regional and National Sustainable Development Goals, as local needs will be focused.

The reduction of direct state (centralised) governance in the field of the use of natural resources and the transition to wider use of market-based regulatory and management methods will enable citizens to exercise their rights in accordance with the UNECE Convention on Access to Information, Public

Participation in Decision-making and Access to Justice in Environmental Matters (Aarhus Convention).

## MATERIALS AND METHODS

Since the 1980s the search for consensus and the optimal balance of centralization and decentralization of state power in civil society have been intensifying to improving the partnership between decision-making centres at different governance levels - national, regional and local. If the process of centralizing governance occurs at a certain stage of society's development in response to the need for national unity, then decentralization is conditioned by the need for a variety of forms of governance and concentration of power. Decentralization by its very nature [12] is the transfer of part of the powers of the central government or regional authorities to local institutions. Decentralization is also seen [2] [12] as a means of determining the participation of citizens in the governance of public property. The local level ceases to be the point of implementation of the development policy identified by external actors of governance, the local community determines its own direction of development, and also ensures its implementation.

There are three main trends in governance associated with the transition to decentralization of power at the stages of social development in the twentieth century [12]:

- development of a deconcentration of power between national, regional and local governance levels as a limited form of decentralization;
- delineation of state and economic liberalization, which contribute to a new wave of decentralization through a devolution;
- activation of various forms of participation and partnership of local self-government in the adoption of decisions.

In the agrarian sector and, at the same time for the development of rural areas, the central governance method has been a long time centralised state regulation with limited delegation of functions related to finance,

marketing and technical support to semi-public authorities. The method did not justify itself due to poor managerial influence on the technical and economic parameters of projects. Such centralized regulation cannot properly take into account the needs of local communities and local agricultural producers, and therefore does not solve local development problems in their long-term strategic plans.

Standard decentralization model does not exist [1]. Decentralization processes and procedures differ from each other and depend on the main goals, tasks, as well as on the organizational structure and implementation mechanisms. Accordingly, various forms of decentralization are possible in the system of governance of natural resources, in particular land: political, administrative, fiscal and market.

The model of decentralization must be adapted to specific conditions, because each territory has its own features, but the main problem, the solution of which people have to work in the field and take appropriate action. Therefore, the process of decentralization of power in Ukraine must take into account both the positive and negative experience of other countries.

The global trends of political decentralization for implementation of sustainable development projects demonstrate the effectiveness of rural development based on small projects on the initiative of the rural population and varying degrees of responsibility [13].

This approach provides more realistic managerial decisions with high probability of sustainable development.

The data source is statistical form 2-zem the State Service of Ukraine for Geodesy, Cartography and Cadastre.

## RESULTS AND DISCUSSIONS

The Verkhovna Rada of Ukraine (Ukrainian Parliament) during 2014-2015 adopted a number of laws that directly or indirectly implement decentralization of power reform in Ukraine. The organizational and legal framework for cooperation of territorial

communities is established in the Law of Ukraine "On Cooperation of Territorial Communities" (2014) [7]. The partnership of voluntary united territorial communities of villages, settlements, cities, as well as the procedure for their state support, is regulated by the Law of Ukraine "On Voluntary Unification of Territorial Communities" (2015) [5].

The Cabinet of Ministers of Ukraine approved Prescriptions "On Approval of the Concept of Local Self-Governance and Territorial Power Reforming in Ukraine" (2014) [6], "On Approval of the Action Plan for Implementation of the Concept of Reforming Local Self-Government and Territorial Organization of Power in Ukraine" (2014) [10], and Resolutions "On Approval of the State Strategy of Regional Development for the period until 2020" (2014) [8], "On Approval of the Methodology of Establishment of Capable Territorial Communities" (2015) [9].

All principles and mechanisms of development and partnership of territorial communities, defined in the aforementioned normative acts, are embodied in the Perspective Plans for the establishment of capable territorial communities. The Prospective Plan covers the whole territory of the region (oblast), it is being developed and approved to ensure that there are no incapable communities in the region that do not have their own resources for their development and resolve issues of local importance.

Local government reform and decentralization in Ukraine are also foreseen by the Strategy for Sustainable Development of Ukraine until 2020 (2015) [11]. This Strategy declares the necessity decomposition of governance model, providing financial opportunities for the development of local communities, building an effective new territorial system in accordance with the European Charter of Local Self-Government based on local interests. The purposes of the extension of powers of local authorities in Ukraine are the establishment of capable united territorial communities and stimulating their self-development on the basis of transferring them to the disposal of local natural resources and



At the end of December 2018, the first stage of the process of extension of powers of territorial communities in Ukraine (2014-2018) was completed. In general, during the first stage, 876 territorial communities were formed in Ukraine. In 2018 650 united territorial communities received in communal ownership more than 1.5 million hectares of agricultural land. The plan for the transfer of state agricultural land to the communal property of the united territorial communities of the Transcarpathian, Ivano-Frankivsk, Kirovograd, and Cherkasy regions (oblasts) is fully implemented on October 1, 2018. In other regions (oblasts), this process is still ongoing [14]. The transfer of state agricultural land to the communal property of the united territorial communities will continue in 2019 for 185 communities that united in 2018. In addition, the State Budget of Ukraine provides funds for inventory of land that has not yet been transferred to united territorial communities. The Government of Ukraine announced the beginning of a new stage of the extension of powers of territorial communities (2019-2020), which envisages the completion of the establishment of capable communities, the change of the territorial structure, and a clear separation of governance and management functions of different levels of power without duplication. The objectives of the decentralization of power reform are to establish 1,600-1,800 capable territorial communities [14]. At the same time, mechanisms of citizen participation in decision-making concerning the environment and the use of natural resources are important for sustainable development of capable territorial communities. However, they also need to implement.

## CONCLUSIONS

The results of our study indicate that the decentralization of power reform in Ukraine is not political; it is primarily a fiscal phenomenon, despite the manifestation of some of the features of the first one. In Ukraine, legislative and organisational requirements for the reform of the local self-government system, the unification of

territorial communities, and the establishment of capable territorial communities on the basis of the Perspective Plan are created. The basis of the development of a capable territorial community is the natural resource potential of its territory. Therefore, plots of agricultural land of state ownership have already been transferred and will be transferred to the communal property of the united territorial communities.

The extension of powers of local authorities in Ukraine has not yet been completed, and its second stage has begun. It is necessary to apply the strategic planning procedures at the state, regional and local levels, which will ensure the coercive and regulated use, reproduction and protection of land resources, taking into account the interests of local communities and the state on the basis of sustainable development.

## REFERENCES

- [1] Decentralization and Rural Property Taxation, 2004, FAO land tenure studies 7. : <http://www.fao.org/docrep/007/y5444e/y5444e00.htm>, Accessed 11.01.2019.
- [2] Khvesyuk, M. A., Bystriakov, I. K., Klynovyi D. V., 2018, Pryrodni resursy u finansovo-ekonomichnomu zabezpechenni rozvytku obiednanoi terytorialnoi hromady (rekomentatsii dlia mistsevykh lideriv ta kerivnykh OTH), [Natural Resources in the Financial and Economic Provision of the Development of a United Territorial Community (Recommendations for Local Leaders and Heads of UTC)], Public Institution "Institute of Environmental Economics and Sustainable Development of the National Academy of Sciences of Ukraine", Kyiv. (in Ukrainian).
- [3] Konstytutsiia Ukrainy, 1996, [Constitution of Ukraine]. <https://zakon.rada.gov.ua/laws/show/254%D0%BA/96-%D0%B2%D1%80>. (in Ukrainian), Accessed on 11.01.2019.
- [4] Martyniuk, M., 2018, Peredacha zemel iz derzhavnoi vlasnosti u komunalnu vlasnist, [Transfer of land from state property to communal property], prezentatsiia Pershoho zastupnyka Ministra aharnoi polityky ta prodovolstva Ukrainy, <http://decentralization.gov.ua/uploads/library/file/159/zemel-iz-derzhavnoi-vlasnosti-u-komunalnuvlasnist.pdf>. (in Ukrainian), Accessed on 11.01.2019.
- [5] Pro dobrovilne obiednannia terytorialnykh hromad, 2015, [On Voluntary Unification of Territorial Communities]. <https://zakon.rada.gov.ua/laws/show/157-19>. (in Ukrainian), Accessed on 11.01.2019.

- [6]Pro skhvalennia Kontseptsii reformuvannia mistsevoho samovriaduvannia ta terytorialnoi orhanizatsii vlady v Ukraini, 2014, [On Approval of the Concept of Local Self-Governance and Territorial Power Reforming in Ukraine]. <https://zakon.rada.gov.ua/laws/show/333-2014-%D1%80>. (in Ukrainian), Accessed on 11.01.2019.
- [7]Pro spivrobotnytstvo mizh terytorialnymy hromadamy, 2014, [On Cooperation of Territorial Communities]. <https://zakon.rada.gov.ua/laws/show/1508-18>. (in Ukrainian), Accessed on 11.01.2019.
- [8]Pro zatverdzhennia Derzhavnoi stratehii rehionalnoho rozvytku na period do 2020 roku, 2014, [On Approval of the State Strategy of Regional Development for the period until 2020]. <https://zakon.rada.gov.ua/laws/show/385-2014-%D0%BF>. (in Ukrainian), Accessed on 11.01.2019.
- [9]Pro zatverdzhennia Metodyky formuvannia spromozhnykh terytorialnykh hromad, 2015, [On Approval of the Methodology of Establishment of Capable Territorial Communities]. <https://zakon.rada.gov.ua/laws/show/214-2015-%D0%BF>. (in Ukrainian), Accessed on 11.01.2019.
- [10]Pro zatverdzhennia planu zakhodiv shchodo realizatsii Kontseptsii reformuvannia mistsevoho samovriaduvannia ta terytorialnoi orhanizatsii vlady v Ukraini, 2014, [On Approval of the Action Plan for Implementation of the Concept of Reforming Local Self-Government and Territorial Organization of Power in Ukraine], <https://zakon.rada.gov.ua/laws/show/591-2014-%D1%80>. (in Ukrainian), Accessed on 11.01.2019.
- [11]Stratehiia staloho rozvytku "Ukraina – 2020", 2015, [The Strategy for Sustainable Development of Ukraine until 2020]. Prezentatsiia Pershoho zastupnyka Ministra ahrarynoi polityky ta prodovolstva Ukrainy. <https://zakon.rada.gov.ua/laws/show/5/2015>. (in Ukrainian), Accessed on 11.01.2019.
- [12]The Online Sourcebook on Decentralization and Local Development. A History of Decentralization. [http://www.ciesin.org/decentralization/English/General/history\\_fao](http://www.ciesin.org/decentralization/English/General/history_fao), Accessed 11.01.2019.
- [13]Udovychenko, V., Melnychuk, A., Gnatiuk, O., Ostapenko, P., 2017, Decentralization reform in Ukraine: assessment of the chosen transformation model, *European Spatial Research and Policy*, 24(1): 23-40.
- [14]Uriad zavershyv zaplanovanu na 2018 rik peredachu derzhavnykh silhospzemel u komunalnu vlasnist obiednanykh terytorialnykh hromad, 2018, [The government has completed the planned transfer of state agricultural land to the communal property of the united territorial communities for 2018], <http://land.gov.ua/uriad-zavershyv-zaplanovanu-na-2018-rik-peredachu-derzhavnykh-silhospzemel-u-komunalnu-vlasnist-obiednanykh-terytorialnykh-hromad/>. (in Ukrainian), Accessed on 11.01.2019.
- [15]Zemelnyi kodeks Ukrainy, 2001, [Land Code of Ukraine], <https://zakon.rada.gov.ua/laws/show/2768-14/print/>. (in Ukrainian), Accessed on 11.01.2019.

## SOCIO-ECONOMIC DEVELOPMENTS AT COUNTY LEVEL. CASE STUDY: ILFOV COUNTY, ROMANIA

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### Abstract

*The present study approaches the problem of the socioeconomic developments at county level over a ten-year interval starting with the year when Romania acceded to the European Union, and tries to highlight the main structural changes within areas such as demography, economic activities and social infrastructure within Ilfov County, which is one of the most dynamic territorial units of Romania as it capitalises its excellent position and is a polarising centre for workforce as well as for economic activities. The analysis uses statistical data from official sources, both national and European, which have been processed with classical statistical methods. The results suggest a strong dynamics of the main parameters that are relevant to demography and to economic activities, as well as a steady development of the social infrastructure.*

**Key words:** demography, social infrastructure, economic activity

### INTRODUCTION

The socio-economic evaluation of territorial units at various levels of aggregation (national, regional, countywide) is an approach that stays abreast of time, at academic level as well as at government level, supported by the necessity of identifying the trends and changes occurring in each territorial unit, the effectiveness of the funding programs and strategies, and, moreover, of framing development strategies adjusted to each territorial unit [5]. The socioeconomic analysis is a basic tool in drafting customised development strategies and an important step towards identifying distinctive features that define the development potential of each territorial unit [1].

### MATERIALS AND METHODS

The present study analyses of official statistical data on demography, workforce, economic activities and social infrastructure. The source of the data is the Tempo Online database of the Romanian National Institute of Statistics [10] and the Eurostat database,

respectively [3]. The data was processed using classical statistical methods.

### RESULTS AND DISCUSSIONS

Ilfov County lies in the south-east of Romania and has an area of 1,583 km<sup>2</sup>, being Romania's smallest county and part of the Buharest-Ilfov development region, one which stands out through a high economic and social diversity [8]. To the east it borders the counties of Călărași and Ialomița, Giurgiu County to the south, Dâmbovița County to the west and Prahova County to the north [2] (Fig. 1).



Fig.1. The map of Ilfov County  
Source: [www.observatordeilfov.ro/harta-politica-a-ilfovului](http://www.observatordeilfov.ro/harta-politica-a-ilfovului)

The demographic profile of Ilfov County is marked by its position, as it practically surrounds the Municipality of Bucharest.

During the last decade there has been an increase in population of more than 40% (Table 1).

Table 1. The demographic evolution in the interval 2007-2017 (number of inhabitants)

Year	2007	2009	2011	2013	2015	2017
Total	294,233	312,089	334,412	358,151	383,512	415,594
Male	143,060	151,688	162,569	174,222	186,548	201,765
Female	151,173	160,401	171,843	183,929	196,964	213,829

Source: Tempo-Online, NIS, 2018.

Concerning the gender structure, the population volume has an advance of approximately 3 percentage points in favour of the female population, which is found along the whole interval analysed. The age structure was marked by a strong increasing

trend of more than 44% in the young population, 0-19 years old, and of more than 45% in the older population between 20 and 64 years old. At the same time, the older population, aged 65 or more, has had a weaker increase, of around 20% (Table 2).

Table 2. The population age groups evolution 2007-2017 (%)

Year/Group	2007	2009	2011	2013	2015	2017
0-19	20.9	20.0	20.0	20.4	20.8	21.4
20-64	64.2	65.7	66.5	66.7	66.3	65.9
65 and more	14.9	14.3	13.5	12.9	12.9	12.7

Source: processing data from Tempo-Online, INS.

The demographic process in this county describes an aging population, with more than 12.7% made up of persons aged 65 years or more. However, this age group also had a decreasing trend during the interval 2007-

2017, from 14.9% to 12.7%, very close to the threshold of 12% considered to be the beginning of an aging process. This can lead, in the future, to multiple effects on society.[9]

Table 3. The demographic dependency ratio\*, 2007-2017

Year	2007	2009	2011	2013	2015	2017
Demographic dependency ratio	55.8	52.2	50.4	49.8	50.8	51.7

\*0-19+ 65 and over/20-64x100

Source: own calculations using Tempo-Online data

Ilfov County experienced a process of demographic rejuvenation/regeneration, with a dependency ratio diminished from 55.8% in 2007 to 51.7% in 2017 (Table 3). The Pearl index ranges between 20.9% (2007) and 21.4% (2017), marking the contribution of the young population to the process of demographic recovery. The volume of each age group increased during the analysed interval, out of which the most substantial was the population aged between 20 and 64 years. A similar evolution can be found for the active civilian population, which had an ascending trend during the interval analysed (Fig.2).

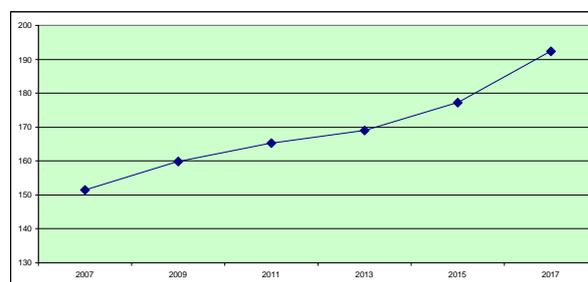


Fig. 2. Active civilian population, 2007-2017

Source: processing data from Tempo-Online, INS

After a short interval marked by variations (2008-2012), the active population had a new increasing trend and reached the value of 192.3 persons in 2017, which is roughly 27% higher than at the beginning of the interval. This value is very close to that of the

employed population, which was 191.1 thousand persons in 2017 (Fig. 3).

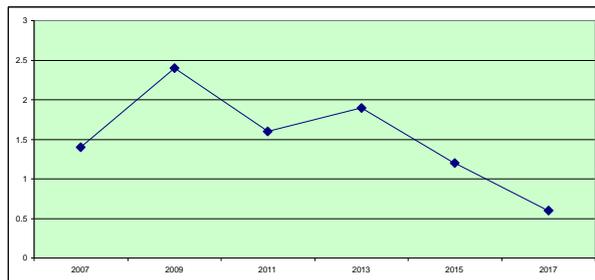


Fig. 3. Unemployment rate, %, 2007-2017

Source: processing data from Tempo-Online, INS

Given this evolution of the employed population it is not surprising at all to find out that the unemployment rate in Ilfov County had, on the whole, a descending trend between 2007 and 2017.

However, this process included variations, with two intervals when this population was higher than in the previous years (2009-2011 and 2012-2013), but the descending trend resumed in 2014 reaching the value of 0.6% at the end of the analysed interval, which is the lowest value during of the interval.

As expected, the positive evolution of the parametres describing population and workforce during 2007-2013 also marked the economic activity of Ilfov County. One of the parameters that are most useful in estimating the overall performance of a geographic area is the Gross Product (GP) both total and per capita. This is a primary measure of the economic performance (at various levels of territorial aggregation) and represents the total value of the final goods and services output during a year. GP per capita is an important measure of the standard of living. In order to make comparisons at national level, the GP per capita is calculated depending on the inhabitants' place of residence, a fact required by the national legislation (The Pearl index is computed as a ratio between the population aged 19 or less and the total population).

The Gross Product of Ilfov County had an overall increasing trend during the interval 2007-2015, from 3,089 billion euros (in current prices) in 2007 to 4.296 billion euros in 2015, which means an increase of around 39% (Fig. 4). The path was, however, not a linear one along the whole interval but

marked by successive short spans of increase and of decrease, especially between 2008 and 2010, at a time which, in addition, was the start of the global economic and financial crisis that also had a strong impact on the Romanian economy. Towards the end of the interval, the local economy of the county recovered its initial momentum, with a Gross Product reaching 4.3 billion euros, the highest peak of the analysed interval.

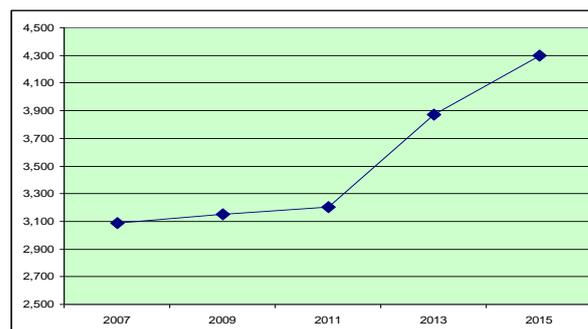


Fig. 4. GP, millions of euro, current prices, Ilfov County, 2007-2017

Source: own processing after Eurostat

Regarding the GP per capita in Ilfov County during the analysed interval, its evolution was similar to that of the nominal value GP, although at a slower growth rate, against a background of a substantially growing population during the same time interval (Fig. 5).

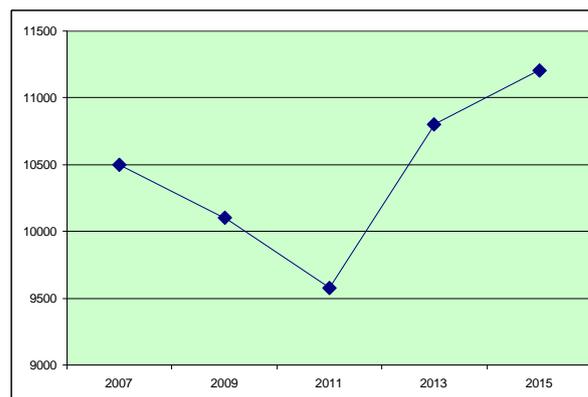


Fig. 5. GP/inhabitant, euros, current prices, Ilfov County, 2007-2017

Source: own processing after Eurostat and Tempo-Online, INS.

This evolution of the GP/capita should, however, be approached in relation to the national results too. From this perspective, the values recorded in Ilfov County were

considerably higher than the national average. In 2015, for instance, GP/capita was 11,202, euros in Ilfov, compared to the national average of 7,202 euro — i.e. 55.5% higher.

However, if one looks back towards the early part of the analysed interval one will find differences that are even bigger, such as in 2008, when the GP per capita in Ilfov County was more than 95% higher than the national average, and in 2012, when it was more than 90% higher than the national average. At this point in time, together with the Bucharest Municipality, the GP/capita was well above national level [7]. The late part of the interval is, however, marked by a smaller gap between these values and a faster growth of the Gross National Product, which was still under the value of the Gross Product of Ilfov County.

The demographic and economic growth of Ilfov County between 2007 and 2017 was supported, among other things, by the development of the social and urbanistic infrastructure, including the habitation infrastructure, as well as the educational and health infrastructure (Fig. 6).

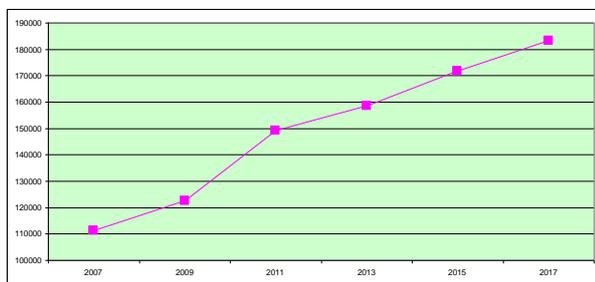


Fig. 6. Dwellings existing at the end of the year, 2007-2017

Source: own processing after Tempo-Online, INS.

Ilfov County has become a polarising area both for internal migration, from the historical regions to the Capital, as well as for many inhabitants of Bucharest in search of better habitation, far from the crowded city, which has led to a fast development in the real estate sector. In fact, the construction sector is one of the main employers of labour force in this region.[6] The habitation infrastructure of the county developed at a very quick pace between 2007 and 2017, at the same time with a higher demand for new dwellings. This process led to an improvement in the quality of housing concerning the ratio habitable area

per inhabitant, which, between 2007 and 2017 grew from 20,0 m<sup>2</sup> to 29 m<sup>2</sup>, a growth of around 45%. This rapid development in the real estate sector led also to several problems at technical and urbanistic level many housing complexes were built either outside the area covered by drinking water supply networks, as well as of sewage networks, or they were not yet connected to them because of the bureaucratic procedure and the lack of the financial resources needed by the local authorities. Moreover, the access roads leading to some of the newly-built residential areas had not been transferred to the public domain while the owners/developers were made responsible for doing it. This process led to serious problems regarding the road access, as long as many of these roads are not modernised and are not easily accessible, especially in inclement weather. The public road network of Ilfov County lagged also behind the rapid developments of the interval 2007-2017. Its total length decreased from 810 km in 2007 to 784 km in 2017 (Fig. 7). But even more worrying is the lack of financing for the road network maintenance programme, especially towards the end of the analysed interval.

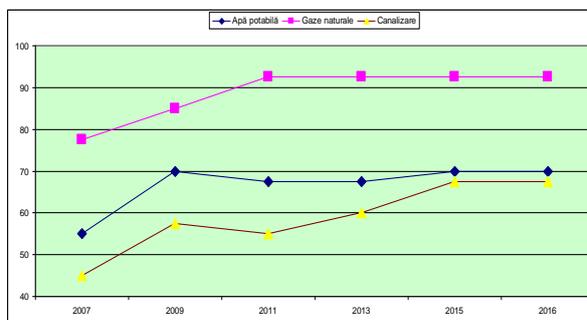


Fig. 7. The share of the localities connected to utilities networks, % of the total number of localities, 2007-2016

Source: own processing after Tempo-Online, INS.

The share of the modernised roads in the total number of roads was nearly 60% in 2007 and grew subsequently up to 86.3% in 2016. The lack of financial resources became obvious after this year, as this share went down fast to 49.1% at the end of 2017. This highlights an important opportunity of turning to EU funds for the development of infrastructure as a

way of supporting the accessibility and mobility across the region.[4]

Concerning the public networks of supplying drinking water, natural gas and sewage, one may remark an increase of the share of the connected localities, during the interval 2007-2017. However, the investment programmes need to be accelerated, especially for the networks of drinking water and sewage. The expansion programmes came to an obvious standstill in 2015. The demographic expansion of 2007-2017 lead to a development in the educational infrastructure of Ilfov County, particularly that of the young pre-school population. Kindergartens had the most dynamic evolution, from 23 units in 2007 to 53 units in 2017. This process of adjusting the structure of the school units took into account the growth of the pre-school population during the analysed interval, with more than 48%. The educational infrastructure expanded at the secondary school level too, both in secondary schools and in trade schools, where there were 14 units in 2007 and 18 units in 2017. This was enabled by the process of reforming the educational system, which lead to re-organising several school units, either by aggregating or by a status change, which also occurred within the primary and middle education units, whose number diminished from 67 in 2007 to 63 in 2017.

In the area of higher education, no changes occurred in the school units, and there still is only one higher education unit in Ilfov County. Besides the educational infrastructure, the sanitary infrastructure is another highly important part in evaluating the quality of life and indicates the population's accessibility to medical services. During the analysed interval, the sanitary infrastructure of Ilfov County has developed, especially concerning the units that offer specialised medical services. Their number rose constantly along the interval, from 104 units in 2007 to 276 units in 2017. In addition to them, a strong development occurred in the case of dental surgeries (from 88 to 191), family doctor's surgeries, pharmacies, analysis laboratories and other medical units.

Moreover, the number of hospitals has remarkably increased (from 7 in 2007 to 9 in 2017). The only medical units which were redimensioned during the analysed interval were the pharmaceutical stores and the general practitioners' surgeries.

## CONCLUSIONS

During the interval 2007-2017, Ilfov County was marked by a strong process of socioeconomic development, besides the expansion at demographic level and of economic activities. Its polarising nature in relation to the population looking for new a new workplace and for better housing conditions, is obvious and caused important structural evolutions.

The rapid development if the real estate sector and of the economic activities brought about the development of the technical-urbanistic and social infrastructure, but also generated several problems at these levels, especially in the road infrastructure.

This accelerated rate of development outran the possibilities that local institutions have in expanding/ modernising the utility networks, which slowed down development and aggravated the current problems of the infrastructure.

Although the private sector undertook the initiative of simultaneously developing the social infrastructure, especially the education and health areas, this is not a long-term solution.

Local budgets must be adjusted to the new coordinates of the economic and social activities and secure the funds required by the programmes of expanding/modernising the technical-urbanistic infrastructure, in order to support both the inhabitants' quality of life and the attractiveness of developing economic activities in a durable and sustainable way.

## REFERENCES

- [1] Consiliul Județean Ilfov, Strategia de dezvoltare a județului Ilfov 2020, Partea I: Planificare strategică, (Ilfov County Council, The development strategy of the Ilfov County 2020, Part I; Strategic Planning), [http://www.cjilfov.ro/upload2/strategia\\_orizont/august2](http://www.cjilfov.ro/upload2/strategia_orizont/august2)

014/Partea\_I\_Planificare\_strategica\_21.02.14.pdf,

Accessed 09.11.2018

[2]Consiliul Județean Ilfov, Strategia de dezvoltare a județului Ilfov 2020, Partea II: Analiza diagnostic, Ilfov County Council, The development strategy of the Ilfov County 2020. Part II: Diagnostic analysis), [http://www.cjilfov.ro/upload2/strategia\\_orizont/august2014/Partea\\_a\\_II-a\\_Analiza\\_Diagnostic\\_21.02.14.pdf](http://www.cjilfov.ro/upload2/strategia_orizont/august2014/Partea_a_II-a_Analiza_Diagnostic_21.02.14.pdf), Accessed 09.11.2018.

[3]Eurostat Data base, [www.https://ec.europa.eu/eurostat/data/database](http://ec.europa.eu/eurostat/data/database), Accessed on 08.11.2018

[4]Ionescu, C., Curpan, S., 2013, Infrastructure investments: Need for a higher territorial cohesion in Bucharest-Ilfov region. Acta Universitatis Danubius, Vol. 9, no.4, 74-81.

[5]MDRAP, Raport privind starea teritoriului 2017, (Report on the territory status 2017), <http://www.mdrap.ro/userfiles/Raport%20privind%20starea%20teritoriului%202017.pdf>, Accessed on 09.11.2018

[6]Patronatul Investitorilor autohtoni Piarom, 2015, Studiu privind analiza forței de muncă la nivelul regiunilor de dezvoltare ale României aferent anului 2015, (Piarom Autochthonous Investors Patronate, 2015, A study on the analysis of labor force in Romania's development regions in the year 2015), [https://www.piarom.ro/wp-content/uploads/2016/11/Studiu\\_forta\\_de\\_munca-2016.10.03-TIPAR.pdf](https://www.piarom.ro/wp-content/uploads/2016/11/Studiu_forta_de_munca-2016.10.03-TIPAR.pdf), Accessed on 11.11.2018

[7]Popescu, D.C., 2013, Study regarding socio-economical dimension of Bucharest-Ilfov development region. Scientific Papers, Series I, Vol.XV (1), Agroprint Publishing House, Timișoara

[8]Rusu, M., Florian, V., Tudor M., coord. 2011, Inegalități economico-sociale în spațiul rural. Analiză în profil regional. (Economic-social disparities in the rural space. An analysis in the regional profile), Terra Nostra Publishing House, Iași.

[9]Stoicescu, A., Alecu, I.N., Tudor, V., 2013. Demographic Analysis of Bucharest-Ilfov Region. Procedia Economics and Finance 6: 392-398, Elsevier

[10]Tempo-Online, INS, [www.insse.ro](http://www.insse.ro), Accessed on 08.11.2018.

## FORMATION OF NATIONAL CERTIFICATION SYSTEM OF ORGANIC AGRICULTURAL

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### Abstract

*It is proved that for the full functioning of certification institutions at the national level, it is necessary to legally fix a mixed (public-private) system for organizing certification of organic production. This, on the one hand, requires strict control over the activities of private certification bodies, but on the other, it will allow to avoid state monopolism and bureaucracy. A structural-functional organic certification scheme in Ukraine has been proposed, which includes three main levels: global, state, and enterprise level, and is also based on a combined certification system, in which state and private certification bodies operate under equal conditions with the involvement of control from the state accreditation body. The proposed scheme, first of all, is intended to make certification of organic enterprises more accessible (cheaper compared to foreign), which in turn will help stimulate the development of organic agriculture in Ukraine. The development of national accreditation and labeling systems and their registration at the international level will allow organic products to be positioned as a high-quality organic goods, create demand for such products by organizing educational activities and conducting a large-scale information campaign (for example, social advertising). In addition, this system will contribute to the promotion of an international partnership in the field of environmental certification and labeling, which will provide an opportunity to increase the export potential of organic products.*

**Key words:** public-private system, certification, organic agricultural, control, level.

### INTRODUCTION

The current dilemma of the further development of agricultural production and the preservation of the natural environment as the basis for the life of future generations has identified the search for alternative development options for the industry. Thus, over the past decades, leading foreign scientists and agrarian practitioners, in order to solve environmental problems and improve the quality of food, are gradually switching to organic farming methods, turning this industry into a strategically important and significant sector of the economy [14].

Now the noticeable development of the organic sector of agricultural production takes place in the USA, Canada, the European Union countries, Australia, China, and Japan. According to a report published by the

International Federation of the movement for organic agriculture, agricultural producers in more than 130 countries around the world, along with the traditional system of farming, are mastering the methods of organic production [8].

Ukraine is also no exception, but is at the initial stage of development, that is, the first organic agricultural organizations certified by foreign and domestic companies appear.

As international practice confirms, for the effective functioning of organic markets and the development of organic agriculture, the guarantee system, which includes certain standards, as well as inspection and certification institutions, plays an extremely important role. This system ensures compliance with the organic standards of the entire process of agricultural production and processing of agricultural raw materials to the

level of the final product, including its packaging and labeling.

## MATERIALS AND METHODS

The informational basis of the study consists of domestic and international laws and regulations in the field of organic agriculture, materials and reports of the International Federation of Organic Agricultural Movement (IFOAM).

The methodological basis of the study is the assumption mutual determinism of economic processes, is implemented in the synthesis of analytical achievements of various areas of economic research. On this basis, applied methods and approaches of classical economic theory, institutional theory, theory values and consumer behavior regarding the certification of organic production as a factor in improving the competitiveness of agriculture, in particular a systematic approach, a method of analysis and synthesis, an abstract-logical, computationally-constructive and experimental.

## RESULTS AND DISCUSSIONS

Certification is one of the main and most capacious components of the organic guarantee system. After all, the consumer requires high-quality and safe food, and it is organic standards that establish the requirements for the production of such food, and inspection and certification ensure compliance with relevant standards.

From the Latin language, the word "certification" is translated as "done correctly". The roots of its occurrence go back to the times of ancient Greece, despite the fact that, at first glance, it seems that certification has appeared only recently. As a systemic phenomenon, certification appeared much later in Germany, where in 1920 the German Institute of Standards approved the mark of compliance with its DIN standards [1]. Today, the modern world is very difficult to imagine without certification, since certification is the process of confirming the compliance of services and goods with quality and safety requirements.

The absence in Ukraine of a corresponding legal framework and national certification system for organic production is a barrier in the development of the domestic market for organic products. This significantly limits the realization of the legal rights of consumers and manufacturers of such products. Since August 2018, the Law of Ukraine "On the basic principles and requirements for organic production, handling and labeling of organic products" came into force in Ukraine. "The law defines the basic principles and requirements for organic production, circulation and labeling of organic products, the basis for the legal regulation of organic production, the circulation of organic products and the functioning of the market for organic, the legal framework for the activities of the central executive bodies, the subjects of the organic products market and the direction of state policy in these areas".

Specialists from the organic sector express the hope that with the adoption of the law, the state will see a revitalization and strengthening of the development of the organic sector, and, equally important, the existence of such a phenomenon as "pseudo-organic" will become impossible.

Organic products imported from other countries and produced in accordance with their legislation, which is confirmed by the relevant certificate and the inscriptions "organic", "biodynamic", "biological", "ecological", with the words "bio", etc., should translated into Ukrainian language denoted by the inscription "organic product".

However, it should be noted that as long as Ukraine has not developed the relevant by-laws, domestic producers undergo the procedure of organic certification of their production according to the standards of other countries, which are mentioned above.

In the absence of national standards, compliance with the provisions of Council Regulation (EC) No 834/2007 regarding organic production and labeling of organic products is common in Ukraine (Fig. 1), where provision 31 says: "...in order to ensure that the production of organic products is in compliance with EU regulations on organic production, the activities that are

carried out by operators at all stages of the production, preparation and sale of organic products should be checked within the control system that is established and operates in accordance with the rules” [6].

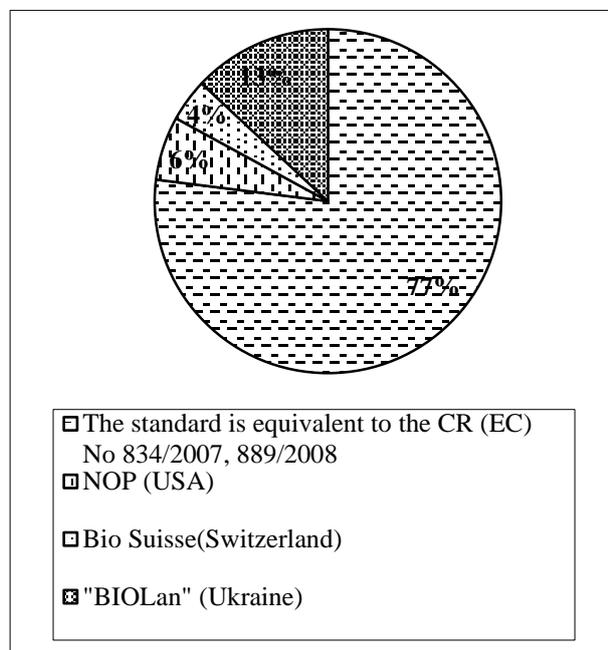


Fig. 1. Structure of market operators organic agricultural products by type of certificates  
Source: Calculated by the author based on the data of Ministry of Agrarian Policy and Food of Ukraine, Control body.

Council Regulation (EC) No 834/2007 [6] and Commission Regulation (EC) No 889/2008 “Detailed Organic Production, Labeling and Control Rules for Implementing Council Regulation (EC) No 834/2007 on Organic Production and Organic Product Labeling regulatory framework in EU organic production” [5]. They determine the methods of production, inspection and certification of organic farms, processing plants, importers and traders, as well as the system of supervision at the European level. EU member states can decide themselves which type of control system to implement, since there are three basic models in the European Union (although different models are used in different parts of the world, especially where farmers have small plots of land and work in cooperatives or associations).

The main specificity of certification of organic production is strict and continuous monitoring of all stages of organic production

from field to table. That is, not the final product is certified, but the whole process of organic production. In world practice, the warranty system of control has been widely used, which consists of two components, namely [12]:

1) inspection – on-site scheduled inspection of an agricultural enterprise for compliance of its activities with the requirements of organic production standards;

2) certification process – assessment and verification of inspection documents, fulfillment of the requirements of the previous year and adoption of a certification decision.

The certification system promotes consumer confidence in organic production and organic products. It provides organic agro-production with a specific definition and makes it easier for organic products to enter the market [10, p. 31]. Not only state bodies, but also private ones have the right to carry out certification. For example: in Europe, there are three types of control systems (Fig. 2).

According to the first model of the control system, the state accredits and supervises private control bodies. This is the most common control system in organic farming. This type of control is implemented in the following countries: Austria, Belgium, Bulgaria, Cyprus, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Portugal, Romania, Slovenia, Sweden and the United Kingdom of Great Britain and Northern Ireland. In this system, the authorized body (the relevant ministry within the government - as a rule, the Ministry of Agriculture) delegates the task of controlling one or more controlling authorities (primarily private) that it authorizes and oversees [13].

According to the second model of the controlling system, the state acts as a certification body. An authorized body (government) delegates its controlling functions to one or more controlling authorities (primarily government agencies). This approach is used in Denmark, Estonia, Finland, Lithuania and the Netherlands [13].

According to the third (last) model of the control system, inspections and certification are carried out by private controlling authorities. The state accredits the official

supervisory authority for scheduled (announced) and selective (unannounced) inspections of direct operators (producers, processors, traders). They can also carry out financial inspections aimed at providing

subsidies for organic farming (inspections at the request of the agency, paying subsidies). This approach works in countries such as the Czech Republic, Luxemburg, Malta, Poland, Slovakia and Spain [3].

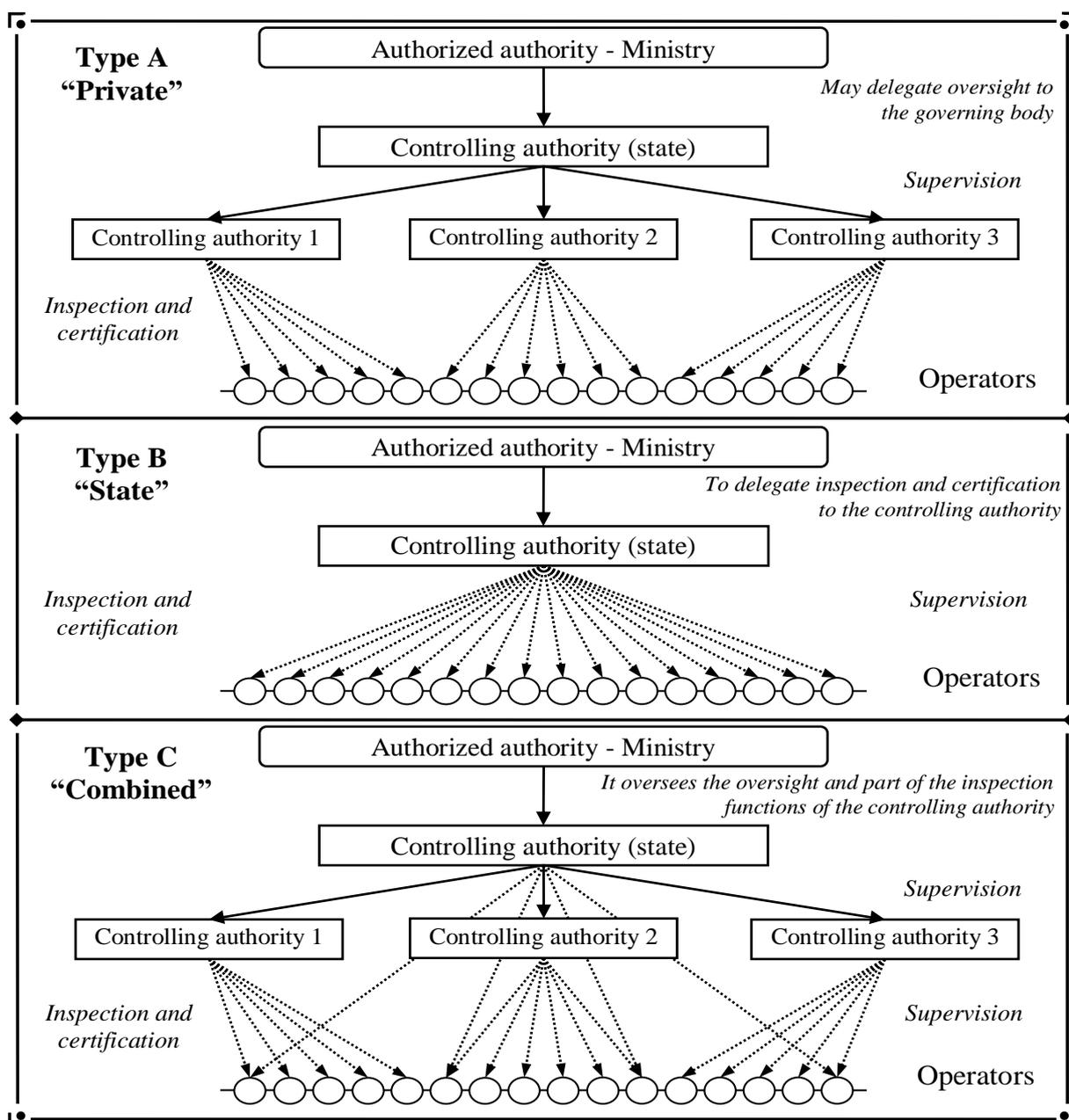


Fig. 2. Types of control systems of organic agricultural in EU countries  
 Source: author's elaboration.

Thus, in the first and second systems, private controlling bodies are part of the official control system in accordance with Council Regulation (EC) No 882/2004. They should have the same experience and qualifications as the state supervisory bodies involved in the official inspection.

All private regulatory authorities must be accredited in accordance with EU general requirements for bodies operating in product or service certification systems (European Standard EN 45011 / ISO 65). The linkage of the controlling system of organic agriculture with the requirements of official inspections is

part of the current European legislation on the organic sector. In general, regulatory authorities should be impartial in carrying out inspections and approved by the authorized supervisory authorities of EU member states. The controlling bodies of the organic sector also work in third countries that do not have their own organic legislation (or in countries where such legislation is not harmonized with the relevant legislation of the European Union) when manufacturers want to export their products to EU countries. This method works so far in Ukraine for exporters or those who plan to export their products to EU member states (or to other countries) [9; 11; 15].

The status of “organic” receives products that have passed the appropriate certification procedure and received confirmation from an accredited body, only in this case, these products can be exported. Certification organizations are subject to accreditation by the International Federation of the Organic Agriculture Movement (IFOAM) in compliance with a number of regulations, namely: the general objectives and requirements of organic standards (COROS) of the IFOAM standard for an organic production and processing system; approved accreditation requirements for certification bodies controlling organic production and processing processes. The accreditation process is provided by the International Organic Accreditation Service (IOAS) on the principles of non-engagement but not on a commercial basis [16, p. 22-28].

In the domestic market for certification services, there are thirteen accredited competent certification bodies that certify in different areas and standards, in accordance with the requirements of the countries whose products are planned to be supplied to the market.

Due to the fact that Ukraine does not have state standards for certification of organic agricultural production, domestic producers of organic products certify products according to foreign or private standards (Table 1). Ukraine has already developed private standards for organic agricultural production and the labeling of agricultural products and

foodstuffs “BIOLan” and LLC “Organic Standard”, which is included in the list of regulatory bodies recognized by the European Commission, and is the first Ukrainian certification body to certify organic production Ukraine according to EU standards [3].

Table 1. Standards governing the certification procedure organic production in Ukraine

Name	Characteristic
EU Organic	Recognized in EU countries and are obligatory for entering these markets. Agreed with Council Regulation (EC) No 834/2007 and Comision Regulation (EC) No 889/2008.
NOP (National Organic Program)	Developed by the US Department of Agriculture, which is responsible for monitoring compliance with these requirements for importers and exporters of relevant products.
JAS	Requirements are developed by the Japanese Ministry of Agriculture, Forestry and Fisheries (MAFF), which regulate the rules for domestic and foreign producers wishing to enter organic markets in Japan.
Bio Suisse	The requirements are designed to qualify for the labeling of products with the BIO SUISSE Knospe logo, which is necessary for the sale of organic products in Switzerland.
Naturland	Trade standards, which are used in Germany for the examination procedure and obtaining a quality certificate that meets the requirements developed by the Association of Organic Agriculture Naturland.
Demeter	Necessary for realization on the territory of Germany when marking products with a prefix “bio”. Compliance monitoring is carried out at the Demeter Enterprise Association with the participation of EU bio-control.
KRAV	Standards are developed on the basis of basic IFOAM standards and modified according to Swedish conditions by KRAV. The modernization consists of a wider scope of certification, which includes restaurants, catering establishments, fishing, etc.
BIOLan	Oriented to use within Ukraine by producers and processors of organic products. Developed by domestic and foreign spialists in the framework of the Ukrainian-Swiss project to promote and ensure the development of the market of organic products in Ukraine. The basis is Council of Europe Regulation No. 2092/91 and the standards of the Association of Swiss Organizations of Organic Producers.

Source: formed by the authors on the basis of data [2; 7; 11; 17].

"The Codex Alimentarius, or Food Codex, has become a global reference point for consumers, producers and processors of food products, national food control authorities and

international food trade. The Codex Alimentarius System provides all countries with a unique opportunity to participate, together with the entire international community, in the development and harmonization of food standards and in ensuring their implementation on a global scale. It also allows them to play a role in the development of rules and regulations governing hygienic methods of food processing and recommendations regarding compliance with these standards. This brochure was first published in 1999 in order to foster a broader understanding of the constantly evolving food code and the activities carried out by the Codex Alimentarius Commission, the body responsible for compiling a compendium of standards, technical norms and rules, guidelines and recommendations that together form Codex Alimentarius" [4].

The development of domestic certification bodies is a promising step towards the development of organic agriculture, because when applying the requirements to the production process in accordance with the Codex Alimentarius, an appropriate organization should function in the state to ensure control over compliance with these requirements during the certification procedure. If it is impossible to ensure an adequate level of compliance with certification authorities or their absence, importers can use the services of foreign organizations with appropriate accreditation.

The need to form a domestic system of certification institutions is now due to the high cost of services provided by representative offices of foreign certification bodies, with no state support for Ukrainian agricultural producers, leading to an increase in their costs and a reduction in export opportunities. For the full functioning of certification institutes in Ukraine, we consider it important to legislatively consolidate a mixed (public-private) certification organization system. On the one hand, this will require strict control over the activities of private certification bodies, but on the other hand, it will allow to avoid state monopolism and bureaucracy.

Significant importance is also in providing the

necessary conditions that would create a system of Ukrainian private (non-state) certification bodies that can compete with foreign companies that operate in Ukraine. The main characteristic of a non-state certification body should be its authority and level of recognition in the international community. After all, the possibility of its equivalence to national standards in other countries depends on this [9].

Ukraine has already begun the formation of a national certification system. A working group consisting of specialists from the Swiss-Ukrainian project "EcoFinLan" and the Association "BIOLan of Ukraine" developed the standards "BIOLan". They are based on the Basic Standards of the International Federation of Organic Agriculture (IFOAM) Council Decree (EEC) No. 834/2007, as well as Standards BIO SUISSE (Association of Swiss Organizations of Organic Producers). However, for the formation of a certification system for organic products, it is necessary to create a special body that would issue licenses for the certification of organic producers to both state and non-state structures. We believe that such a body, of course, should be public, because the responsibility that will lie is indisputable.

Revealing the essence of the activity of the accrediting body, we will additionally note the need to ensure equal access to it by both state and private certification institutions. After all, the creation of advantages for one of the parties and additional obstacles for the other will deny the existence of one of the main principles of market relations – freedom of competition and diversity of ownership.

Proceeding from this, for governmental structures there is a task to create a special state body, whose competence would be to accredit certification institutions, control their activities, create national standards for the recognition of organic products, coordinate the activities of public organizations and, conduct a unified state information policy in this area. For the efficient operation of the organic market in Ukraine, we offer the following structural and functional organic certification scheme in Ukraine (Fig. 3).

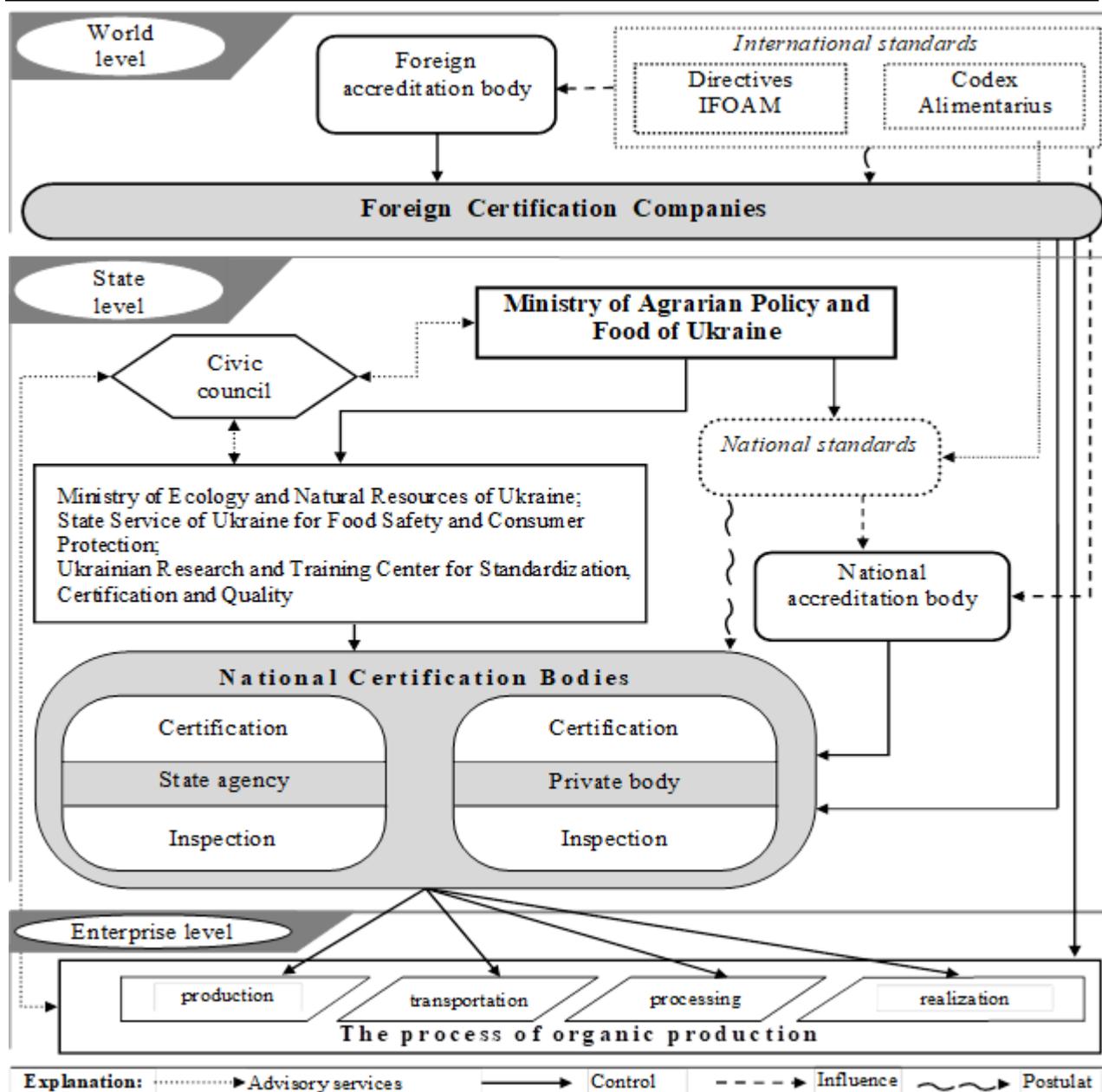


Fig. 3. Structural and functional scheme certification of organic agriculture in Ukraine  
 Source: author's elaboration

We believe that this scheme is primarily intended to make certification of organic enterprises more affordable (cheaper than foreign) and to stimulate the development of organic agriculture in Ukraine. In the formation and further development of the scope for the provision of certification services to producers of agricultural organic products, it is important to pay attention to the mechanism for ensuring the protection of domestic producers through the use of economic and legal instruments at the national level.

In this case, it is necessary to focus on the regulatory methods of protecting the own manufacturer, such may be the establishment of additional certification procedures, examinations (the domestic market), as well as the signing and ratification of international treaties, and the harmonization of international legislation concerning Ukrainian manufacturers.

## CONCLUSIONS

In general, given the pace of industry

development and the increased demand for organic products, it is necessary to establish a national certification system to increase the level of confidence in organic products and ensure a high level of competition in the market. However, the formation of a national certification system is impossible without taking into account international experience in this field, taking into account the possibility of exporting Ukrainian organic products.

Development of the national accreditation and marking systems and their registration at the international level will allow to position organic products in front of the consumer, to create on it by organizing educational activities and conducting a large-scale information campaign (for example, social advertising), to promote international partnership in the field of environmental certification and marking, and this, in turn, will contribute to increasing the export potential of organic products.

## REFERENCES

- [1]Badgley, C.; Moghtader, J.; Quintero, E.; Zakern, E.; Chappell, M.; Avilés-Vazquez, K., Samulon, A., Perfecto, I., 2006, Organic Agriculture and the Global Food Supply. In: Renewable Agriculture and Food Systems, 22 (2):86-108.
- [2]Baier, A., Ahramijian, L., 2016 Organic Certification of Farms and Businesses Producing Agricultural Products. Washington: ATTRA, p. 1–8.
- [3]Chudovska, V.A., Shkuratov, O.I., Kyporenko, V.V., 2016, Ekoloho-ekonomichnyj mekhanizm rozvytku orhanichnoho sil's'koho hospodarstva: teoriia i praktyka [Ecological-economic mechanism for the development of organic agriculture: theory and practice]. Kyiv: DIA, p. 25–87.
- [4]Codex Alimentarius, 1999, Guidelines for the Production, Processing, Labelling and Marketing of Organically Produced Foods (GL-32). Rome: Secretariat of the Joint FAO, p. 5-40.
- [5]Comision Regulation (EC) No 889/2008 of 5 September 2008 laying down detailed rules for the implementation of Council Regulation (EC) No 834/2007 on organic production and labelling of organic products with regard to organic production, labelling and control (Official Journal of the European Union, L 250 of 18.09.2008).
- [6]Council Regulation (EC) No 834/2007 of 28 June 2007 on organic production and labelling of organic products and repealing Regulation (EEC) No. 2092/91. (Official Journal of the European Union, L 189 of 20.07.2007).
- [7]Dangour, A.D. et al., 2009, Nutritional quality of organic foods: a systematic review. The American Journal of Clinical Nutrition 92(1):203-210.
- [8]Hranovska, V.H., 2017, Mekhanizmy stymuliuвання rozvytku pidpriemstv orhanichnoho sektoru: adaptatsiia svitovoho dosvidu [Mechanisms for stimulating the development of enterprises in the organic sector: adaptation of world experience]. Economy and society, 9:384-390.
- [9]Jeločnik M., Ion R., Jovanović M., Popescu C., 2015, Has organic farming potential for development? Comparative Study in Romania and Serbia. Procedia Economics and Finance, 22:268-276.
- [10]Kyporenko V.V., 2014, Formuvannja systemy sertyfikaciji orhaničnoho sil's'koho hospodarstva v Ukraïni [Formation of the system of certification of organic agriculture in Ukraine] AgroSvit, 24: 28-34.
- [11]National Organic Program (2016), U.S Department of Agriculture, <http://www.ams.usda.gov/> (12.09.2017– access date).
- [12]O'Doherty Jensen K., Denver S., Zanoli R., 2011, Actual and potential development of consumer demand on the organic food market in Europe. NJAS – Wageningen Journal of Life Sciences 58(3-4): 79-84.
- [13]Schmid, O., 2007, Development of Standards for Organic Farming. In: Lockeretz, William (Ed.) Organic Farming. An International History. CAB International, Wallingford, UK, chapter 8, p. 152-174.
- [14]Shkuratov, O., Hreshchuk, H., Lobanova, O., 2018, Forecast scenarios of development of the internal consumer market of organic products in Ukraine. Scientific Papers: Series Management, Economic Engineering in Agriculture and Rural Development, 18 (4):303-310.
- [15]Skrodzka, V., 2017, Organic agricultural products in Europe and USA, Management, 21(2): 151-164.
- [16]Willer, H., Lernoud, J., 2018, The World of Organic Agriculture. Statistics and Emerging trends 2018. FiBL&IFOAM Organic International. Bonn: Medienhaus Plump, p. 11–332.
- [17]Zinovchuk, N.V., Chudovska, V.A., 2013 Suchasni chynnyky rozvytku orhanichnoho sil's'koho hospodarstva v Ukraïni [Modern factors in the development of organic agriculture in Ukraine]. Visnyk Zhytomyr's'koho natsional'noho ahroekolohichnoho universytetu, 1-2(37):299-306.

## STUDY REGARDING THE OPTIMAL DIMENSION OF THE S.C. AGROZOOOTEHNICAL FARM S.A. WITH THE HELP OF STATISTICAL-MATHEMATICAL METHODS

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### *Abstract*

*An important problem, on which production and economic results depend for a long time, is the size of agricultural exploitations. The use of statistical methods, among which the one known as the "statistical method of studying the mass experience" or simply the "method of grouping", is the most widespread [10] in order to determine the optimum size of agricultural exploitations is based on the concept of statistical correlation, that can be attributed to the links between potential indicators (factorial or independent variables) and results and economic efficiency indicators (resultant or dependent variables) of an agricultural holding. The calculations show that the managers of the exploitations from the forth interval have made greater efforts to match the highest level of turnover and profit. How many? As far as the optimal number is concerned, it should be taken into account that the cost of production is more important to producers, as the sales price is formed under the impulse of the demand-supply ratio. In conclusion, the present study sets the optimal range related to the area of 3,801ha – 4,400ha and the optimal breeding females: 686 heads.*

*Key words:* agricultural exploitation, optimal dimension, production

### INTRODUCTION

Lately, determining the optimal size of the agricultural exploitation and its subdivisions has been a major concern for both economic research and agricultural organization, as well as for agricultural practice.

In this context, the problems related to the microeconomic optimum have outlined themselves methodologically, by several methods and procedures. [4]

For example: The monographic method, also referred to as "the monographic study of the experience of the leading households", "the study of the experience of the leading households" or "the generalization of the experience of the leading households" consists in studying the typical production units for the profile and the respective area, with the best results in production. [7]

The company's main activity is the production, trade and industrialization of agrotechnological products.

The company operates in average 4,000 ha arable land per year, out of which 3,000 ha are

irrigated, and is also engaged in raising dairy cattle ranging around 1,450 heads of cattle, of which 800 heads are breeding females.

The land that the company exploits is the property of the company, an area of 1,140 ha, and the difference is leased arable land that is owned by natural persons adjacent to the company.

The company produces on the arable land area cereals and technical plants as well as feeds necessary for the livestock sector. In livestock production, the company manufactures cow's milk and fattens cattle.

The initial social capital of 167,000 lei and 167 shares with a face value of 1,000 lei each during the activity underwent a series of increases in total value of 6,390,623 lei and decreases of 1,543,223 lei. At the moment of research, the social capital of the company being 5,015,000 lei.

The activity is organized in production farms and specialized service sectors of the production farms. Thus, the company has the following subunits: - 3 farms with vegetal profile; - 1 dairy cattle breeding farm; - the

servicing sector with repair profile of agricultural machinery and execution of services specific for agriculture towards the farms of the company; - the supply, distribution, transport sector, which aims at providing the necessary material for the production process, distribution of the products obtained by the farms and managing the means of transport necessary for the above activities; - the accounting department and a number of 219 employees, out of which 184 permanent employees.

## MATERIALS AND METHODS

**The method of parallel interdependent series** consists in the appreciation of the link between two or more ordered features in the form of parallel strings. [2]

In order to determine the optimal dimension of agricultural exploitations (variable  $x_i$ ), the correlation with the  $y_{ij}$  values will be made, which represent the results and efficiency indicators.

Applying the method implies the existence of a data bank on: a certain number of agricultural exploitations, the surface for each exploitation, the levels of the results indicators and the efficiency that characterizes their activity. [3]

The method starts by grouping the units according to size ranges, for which it is recommended to use H.D. Sturges' relationship [6]:

$$h = \frac{x_{\max} - x_{\min}}{K}$$

where:

$x_{\max}$ ,  $x_{\min}$  – the maximum, respectively the minimum surface, of the units taken under study;

$K = 1 + 3.322 \log n$  – represents the number according to groups in which the „n” agricultural units split.

In order to carry out the grouping of exploitations it is necessary to meet the following requirements in advance:

- the exploitations should have the same specialization and have the same production conditions;

- each group should include a certain number of agricultural exploitations so that the results are significant;

- the grouping interval should ensure differences in the level of outcome and efficiency indicators. [1]

Having the group units (K), the partial averages of each economic efficiency and results indicator will be calculated according to the formula:

$$\bar{y}_i = \frac{\sum_{i=1}^{n_j} i_j}{n_j}$$

$\bar{y}_i$  – represents the average of the indicator for class  $j$ ;

$j = 1, 2, 3, \dots, K$

$y_{ij}$  – the levels of the indicators according to the  $n_j$  units from group  $j$ ;

$n_j$  – the number of units from each group;

$n$  – the total number of units;

$$n = \sum_{i=1}^{n_j} n_j$$

The optimal size range will be the one that corresponds to the maximum level of partial averages for the direct and/or minimum for the indirect efficiency and results indicators.

[5]

The study of the dimension at S.C Agrozootechnical Farm S.A. was conducted based on the information obtained through own research, from the practical activity of several exploitations.

## RESULTS AND DISCUSSIONS

Following the information processing, the resulting data are as follows:

$$n = 15$$

$$x_{\max} = 5,000$$

$$x_{\min} = 2,000$$

So:

$$h = \frac{5,000 - 2,000}{1 - 3.322 \log 15} = 600 \text{ ha}$$

Table 1. Results and efficiency indicators of agricultural exploitations of different sizes

Nr.	Dimension interval (ha) $x_i$	Nr. of units	Results and economic efficiency indicators				
			Turnover (thousand lei)	Expenses related to the turnover (thousand lei)	Labor productivity (thousand lei/pers)	Expenses per 1,000 lei turnover	Profit
1	2,000-2,600	2	15,642	14,164	252,600	905.5	1,478
2	2,601-3,200	4	29,850	25,819	304,525	864.9	4,031
3	3,201-3,800	4	37,000	32,500	379,779	878.3	4,500
4	<b>3,801-4,400</b>	3	42,875	36,536.5	415,000	852.1	6,338.5
5	4,401-5,000	2	32,000	28,880	325,900	902.5	3,120
Total		15					

Source: own calculation.

As can be seen, interval nr. 4 is optimal because we have maximum levels for direct indicators (turnover, labor productivity, profit) and minimum levels for indirect indicators (expenses per 1,000 lei turnover). However, in the interval nr. 4, the expenses related to the turnover represent a maximum level (the method has limitations in application), which shows that the managers of the exploitations in this interval have made greater efforts corresponding to the highest level of turnover and profit.

**The regression method** - studying the dimension and setting its optimum level can be done by resorting to the regression method that is based on the use of the production function.

The production function expresses the functional relationship between a dependent variable (production and economic indicators) and an independent variable (surface or livestock) in the form: [8]

$$y = f(x)$$

In order to study the size using the regression function, you need to go through the following steps:

- the graphical representation of empirical data in order to find out the types of function that characterize the phenomenon (the link between the two variables); [9]
- determining, using the smallest squares method, the coefficients of the production function;
- finding the maximum or minimum point of the function by calculating its derivative I and the value of the independent variable;
- determining the value of the dependent variable by introducing the value of the

independent variable in the concrete form of the function.

The study aims to determine the dairy breeding females at S.C. Agrozootechnical Farm S.A. through the afore mentioned method, using information retrieved from farms having the same activity.

The production function is a statistical method, when it is applied, we proceed as in the previous case when establishing the group interval:

$$h = \frac{950 - 200}{1 - 3.322 \log 15} = 150 \text{ heads}$$

Table 2. Indicators of the different agricultural exploitations studied

Nr.	Heads dimension interval $x_i$	Nr. of units	Average production (Q) (l/head $y_1$ )	Cost/liter milk (lei/l) $y_2$	Cost/liter milk (RON/l) $y_2$
1	200-350	4	3,800	4,100	0.41
2	351-500	5	4,500	3,900	0.39
3	501-650	3	5,200	3,300	0.33
4	651-800	1	4,900	3,500	0.35
5	801-950	2	4,100	3,600	0.36
Total		15			

Source: own calculation.

*Analysis of the correlation between livestock and average production on fed cow*

$$y = a + bx + cx^2$$

$$na + b \sum x + c \sum x^2 = \sum y$$

$$a \sum x + b \sum x^2 + c \sum x^3 = \sum xy$$

$$a \sum x^2 + b \sum x^3 + c \sum x^4 = \sum x^2 y$$

$$n = 5$$

Table 3: Correlation between livestock and average production on fed cow

	x	y	x <sup>2</sup>	x <sup>3</sup>	x <sup>4</sup>	xy	x <sup>2</sup> y
	275	3,800	75,625	20,796,875	5,719,140,625	1,045,000	287,375,000
	425	4,500	180,625	76,765,625	32,625,390,625	1,912,500	812,812,500
	575	5,200	330,625	190,109,375	109,312,890,625	2,990,000	1,719,250,000
	725	4,900	525,625	181,078,125	276,281,640,625	3,552,500	2,575,562,500
	875	4,100	765,625	669,921,875	586,181,640,625	3,587,500	3,139,062,500
Σ	2,875	22,500	1,878,125	1,338,671,875	1,010,120,703,125	13,087,500	8,534,062,500

Source: own calculation.

$$5a + 2,875 b + 1,78,125 c = 22,500$$

$$2,875 a + 1,878,125 b + 1,338,671,875 c =$$

$$= 13,132,500$$

$$1,878,125 a + 1,338, 671,875 b +$$

$$+ 1,010,120,703,125 = 8,592,562,500$$

$$y = 998.73 + 13.787 x - 0.012 x^2$$

$$y' = 0 \Rightarrow 13.787 - 0.024 x = 0$$

x = 574 optimum heads of animals which determine the highest level of animal production.

$$y = 998,73 + 13,787 \cdot 574 - 0,012 \cdot 574^2$$

$$y_{MT} = 4,959 \text{ l/animal head}$$

*Analysis of the correlation between livestock and the production cost per liter of milk.*

Table 4: The correlation between livestock and the cost of production per liter of milk

	X	y (lei/l)	y (RON/l)	x <sup>2</sup>	x <sup>3</sup>	x <sup>4</sup>	xy	x <sup>2</sup> y
	275	4,100	0.41	75,625	20,796,875	5,719,140,625	1,127,500	310,062,500
	425	3,900	0.39	180,625	76,765,625	32,625,390,625	1,657,500	704,437,500
	575	3,300	0.33	330,625	190,109,375	109,312,890,625	1,897,500	1,091,062,500
	725	3,500	0.35	525,625	181,078,125	276,281,640,625	2,537,500	1,839,687,500
	875	3,600	0.36	765,625	669,921,875	586,181,640,625	3,150,000	2,756,250,000
Σ	2,875	18,400	1.84	1,878,125	1,338,671,875	1,010,120,703,125	10,370,000	6,701,500,000

Source: own calculation.

$$5a + 2,875 b + 1,878,125 c = 18,400$$

$$2,875 a + 1,878,125 b + 1,338,671,875 c =$$

$$10,370,000$$

$$1,878,125 a + 1,338,671,875 b + 1,010,120$$

$$703,125 c = 6,701,500,000$$

$$y = 5,486.11 - 6.044 x + 0.0044x^2$$

$$y' = 0 \Rightarrow -6,44 + 0.0088x = 0$$

$$x = 686 \text{ heads}$$

$$y = 5,486.11 - 6.044 \cdot 686 + 0.0044 \cdot 686^2$$

$$y = 3,410.55 \text{ lei/ liter}$$

$$y = 0.34 \text{ RON/ liter}$$

The problem of choosing the optimal solution appears: how many? To this end, it is to be considered that the production cost is more important to producers, as the sales price is formed under the impulse of the demand-supply ratio.

## CONCLUSIONS

S.C. Agrozootechnical Farm S.A. is in the optimal range regarding surface (3,801-4,400

because it exploits a surface of 4,000 ha.

From an economic point of view, we can say that the optimal female breeding stock is 686 heads, but from an ecological point of view we could say that the optimal female breeding stock is 574 heads because the production is maximum, and the ecological pressure will be lower due to a smaller flock.

## REFERENCES

- [1] Dobre, I., 2003, Organizarea și strategia dezvoltării unităților agricole, (Organization and strategy of the development of agricultural holdings), ASE Publishing House, București, pp.123
- [2] Grădinescu, M., 1994, Instrumente de analiză economico-financiară a întreprinderii agricole (Tools of economic and financial analysis of agricultural holding), A.I. Cuza University Press House, Iași, pp.289
- [3] Hartia, S., Samochiș, B. 1964, Unele aspecte privind metodologia de calcul a dimensiunii optime a fermelor de vaci, în vol. „Probleme de economie agrară”, Vol. I, (Some aspects regarding the calculus methodology of

optimum size of dairy farms, In Vol." Problems of Agrarian economy", Vol.1), pp140

[4]Năstase, M., 1999, Dimensiunea optimă a exploatațiilor agricole (Optimum size of agricultural holdings), Chrater B Publishing House, București, pp.79

[5]Novikov, G.I., 1965, Metodka resciota optimalnîh razmerov melocinîh ferm (Method of farm size optimization), Ekonomika s-h, 8.

[6]Oancea, M., 1999, Tratat de management în unitățile agricole (Treatise of agricultural holdings management), Ceres Publishing House), București, pp.105

[7]Olteanu, I., Mihai, L., 1980, Dimensiunea întreprinderii într-o succintă retrospectivă istorică, Viața economică, (Enterprise dimension in a brief historical retrospect, Economica Life), No.4.

[8]Panayoton, Th., 1988, Economics, Environment and Development; Development Discussion Paper Nr.259, Cambridge, Harvard, Institute for International Development.

[9]Pearce, D.W., Turner, K., 1999, The Development of Environmental Indicators; Report UK Department of the Environment, April, 1999.

[10]Samochiș, B., 1974, Dimensiunea optimă a fermelor de vaci (Optimal dimension of dairy farms), Ceres Publishing House), București, pp.97



## STUDY REGARDING THE ORGANIZATION OF HUMAN RESOURCES AT S.C. AGROZOOOTEHNICAL FARM S.A.

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### **Abstract**

*The present study is intended for the management of the analysed company, which is concerned with the increase of the efficiency of the activity. Labor productivity has increased from one year to another. The efficiency in using human resources is the way of observing some correlations between the main objectives and the results obtained from their realization. The study of certain correlations, at the level of the selected society, shows that biggest increase in turnover was obtained through labor productivity, therefore by intensive and not extensive means.*

**Key words:** labor, contract, production, staff

### **INTRODUCTION**

The company's main activity is the production, trade and industrialization of agrotechnological products.

The company operates in average 4,000 ha arable land per year, out of which 3,000 ha are irrigated, and is also engaged in raising dairy cattle ranging around 1,450 heads of cattle, of which 800 heads are breeding females.

The land that the company exploits is the property of the company, an area of 1,140 ha, and the difference is leased arable land that is owned by natural persons adjacent to the company.

The company produces on the arable land area cereals and technical plants as well as feeds necessary for the livestock sector. In livestock production, the company manufactures cow's milk and fattens cattle.

The initial social capital of 167,000 lei and 167 shares with a face value of 1,000 lei each during the activity underwent a series of increases in total value of 6,390,623 lei and decreases of 1,543,223 lei. At the moment of research, the social capital of the company being 5,015,000 lei.

The activity is organized in production farms and specialized service sectors of the production farms. Thus, the company has the following subunits: - 3 farms with vegetal

profile; - 1 dairy cattle breeding farm; - the servicing sector with repair profile of agricultural machinery and execution of services specific for agriculture towards the farms of the company; - the supply, distribution, transport sector, which aims at providing the necessary material for the production process, distribution of the products obtained by the farms and managing the means of transport necessary for the above activities; - the accounting department and a number of 219 employees, out of which 184 permanent employees.

In order to achieve its activity objective, S.C. Agrozootehnical Farm S.A. uses qualified and unqualified labor, according to the specific activity requirements.

The labor force used consists of employees with an individual labor contract of indefinite duration and seasonal employees with a fixed-term labor contract.

Labor resources are made up of communes and surrounding villages located between 3-20 km, but also labor recruited from Moldavia for seasonal work.

Given the specificity of the company, in order to ensure the labor force in the livestock sector, the company recruited the labor force also from Moldavia, but with labor contracts of indefinite duration, ensuring accommodation for the employees and their

families in the housing blocks owned by the company.

## MATERIALS AND METHODS

The efficiency of using human resources is highlighted by the manner of respecting some correlations between the main objectives and the results obtained from their realization. [2] The first correlation of efficiency is the following:

$$I_{ca} \geq I_{Fs} \geq I_{Ns}, \text{ where:}$$

$I_{ca}$  – turnover index;

$I_{Fs}$  – salary fund index;

$I_{Ns}$  – number of employees' index.

The second correlation of efficiency:

$$I_w \geq I_s, \text{ where:}$$

$I_w$  – labor productivity index;

$I_s$  – average salary index.

## RESULTS AND DISCUSSIONS

The company uses a large workforce in both livestock and vegetable sector due to the limited possibilities of the company towards mechanization.

Regarding the dynamics and structure of the staff employed by the company, there are significant reductions in mechanizers and animal caretakers, caused by the replacement of small power tractors with other high-power tractors, which have a 4-5 times higher productivity and higher economic yields.

Tabel 1. The workforce structure over the last three years

STAFF CATEGORY	Year 2016	Year 2017	Year 2018
TOTAL STAFF, from which:	279	245	219
Permanent employees, from which:	261	210	184
- workers, from which:	215	184	158
mechanizers	52	52	40
Caretakers	87	83	75
Drivers	16	16	14
- other staff	34	33	29
TESA staff, from which:	26	26	26
agronomic engineers	5	5	5
Veterinarians	5	5	5
Economists	2	2	2
- other staff	14	14	14
Seasonal workers	35	35	35

Source: own calculation.

Given the specificity of agriculture, employees work in the vegetable sector during spring, summer and autumn, all day long, including Saturdays, Sundays, according to the needs and the weather.

In animal husbandry, the schedule of employees is also tailored to the specific, in the sense that they work in the first part of the day from 5 to 9, and in the afternoon between 14:30-19:00 and by rotation on Saturdays and Sundays. [1]

Considering the fact that the studied company operates in the agri-food field, where the pedoclimatic conditions have a great influence on labor productivity, it is necessary to follow its level in dynamics over a longer period of time.

Tabel 2. Labor Productivity and Efficiency Correlations

INDICATOR	UM	Year 2016	Year 2017	Year 2018	2017/2016 %	2018/2017 %
Turnover	thousand lei	30,171	41,335	71,386	137.0	172.7
Average number of staff	Pers.	276	245	219	88.8	89.4
Salary fund	thousand lei	7,190.9	9,785.8	13,897	136.1	142
Annual average salary	thousand lei	33,046	39,942	63,456	120.9	158.8
Labor productivity	thousand lei/pers	109.3	168.7	325.9	154.3	193.2

Source: own calculation.

The data in the table above reflects the permanent concern of the company's management to increase work efficiency. Through a better organization of work and staff dimensioning, the management of the company has succeeded in carrying out an efficient activity.

Thus, labor productivity has increased from one year to another. This situation is on the one hand, the consequence of the decrease of the staff number that marks a decrease of 10.6% in the third year and, on the other hand, the increase of the turnover by over 70% in 2018 compared to 2017.

The first correlation of efficiency of the utilization of the human resources is the following:

$$I_{ca} \geq I_{Fs} \geq I_{Ns}$$

The obtained results was:

$$172.7\% \geq 142.0\% \geq 89.4\%.$$

The second correlation of efficiency was:

$$I_w \geq I_s$$

and the obtained results was:

$$193.2\% \geq 158.8\%.$$

## CONCLUSIONS

Two aspects are required to be highlighted through these correlations: first of all, the ascending dynamics of the volume and efficiency indicators that allow correlation; second of all, the spectacular leaps of these indicators [3] in 2018 compared to 2017:

$$I_w = 193.2\% \text{ and } I_{Ca} = 172.7\%.$$

Such a situation shows that most of the increase in turnover was obtained on the basis of labor productivity [4], therefore through intensive and not extensive means.

In the field of human resources for the organization of S.C. Agrozootechnical Farm S.A. on a sustainable basis, it is recommended:

- to provide qualified staff in perspective of the complex development of the activity; [10]
- to train employees on the application of sustainable technologies (based on efficiency and environmental protection); [9]
- to provide a marketing department in order to orientate and adapt production to market needs; [7]
- to increase labor productivity by introducing modern mechanization;
- to train employees regarding compliance with the veterinary, phytosanitary and quality standards of agricultural products;
- to ensure work motivation by setting salary incentives;
- to encourage the subordinate's initiative;
- that management should be based on a vision of individual motivation and responsibility; [6]
- to facilitate the workers' labor by ensuring adequate technical endowment;

- to create and maintain a favorable relational environment in order to achieve the objectives; [8]

- to constantly pursue the improvement and increase of the employees' qualification;

- to improve the management of the company, which also should keep in mind the accounting of ecological resources. [5]

## REFERENCES

- [1] Alecu, I., Merce, E., Pană, D., Sâmbotin, L., Ciurea, I., Bold, I., Dobrescu, N., 1997, Management in agricultura, Ceres Publishing House, București, pp.210.
- [2] Cojocaru, C., 1997, Analiza economico-financiară a exploatațiilor agricole și silvice (Economic and Financial Analysis of agricultural and forestry holdings), Economica Publishing House, București, pp.174.
- [3] Crecană, C., 2000, Rentabilitatea întreprinderilor mici și mijlocii, (Profitability of small and medium size enterprises), Economica Publishing House, București, pp.87.
- [4] Gheorghiu, A., 1997, Diagnosticul global al firmei, Rev. Tribuna Economică (Global firm diagnosis, Economic Tribune), no.49/1997.
- [5] Mărgulescu, D., Niculescu, M., Robu, V., 1994, Economic and financial diagnosis), Romcart Press House, București.
- [6] Marian, M., Merce E., Merce, E., 1994, Introducere în managementul exploatației agricole, (Introduction in the management of agricultural holdind), Intel Credo, Press House, Deva, pp.301.
- [7] Nicolescu, O., Verboncu, I., 1995, Management, Economica Press House, București, pp.205.
- [8] Oancea, M., 1999, Treatise of management in agricultural holdings, Ceres Publishing House, București, pp.110.
- [9] Otiman, P., 1999, Economie rurală, (Rural economy), Agroprint Press House, Timișoara, pp.329.
- [10] Voicu, R., Dobre, I., 2003, Organizarea și strategia dezvoltării unităților agricole (Organization and strategy of agricultural holdings development), ASE Press House, București, pp.156.



## CHANGES AND TRENDS OF PEACHES AND NECTARINES MARKET IN ROMANIA

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### Abstract

*This paper analyses the main indicators reflecting the evolution of the peach and nectarine production and marketing sector in Romania for the period 2012-2017. The most important indicators which are analyzed refers are production of peach and nectarine at the national level, but also macroregional and regional, the average level of price for each of them, the value of import and export. From an economic point of view, peach plantations are a particular importance, occupying the third place, after apple and plum. In Romania, the peach occupied significant areas, but after 1990, they have diminished massively. Peach plantations in Romania is more popular compared to nectarine. The data used in the paper was taken from the National Institute of Statistics and specialized international sites. The results of this analysis have been highlighted in relevant tables and graphs.*

**Key words:** peaches, nectarines, production, annual consumption, export, Romania

### INTRODUCTION

Worldwide, peach is ranked second in the list of fruit trees that have fallow fruits. First, the top of these species is apple [15].

Researches in the field have shown that the peach is originates from China, and a number of remarks have been found about it. The peach belongs to the Rosales Order, the Rosaceae family [5].

At present, peach plantation is found on all continents, especially between 50 degrees north latitude and 35-49 degrees south latitude [15].

Peaches and nectarines are fruits that are crafted through a series of significant bioactive principles, helping to strengthen the immune system. For example, 100 grams of fresh peach contains the following elements required for human body: 86.5 grams of water; 10.4 grams of carbohydrates; 0.9 grams of albumin; 0.9 grams of food fiber; 0.7 grams of free organic acids; 20 milligrams of calcium; 363 milligrams of potassium; 34 milligrams of phosphorus; 16 milligrams of magnesium; 50 milligrams provitamin A; 4.1

milligrams of iron, 10 milligrams of vitamin C; 0.70 milligrams of vitamin PP [3].

According to statistical data, in 2017, were cultivated 1,528,026 hectares with peaches and nectarines and a production of 24,665,205 tons were recorded worldwide. The distribution of continental production was as follows: Asia 69.4%; Europe 18.4%; America 7.6%; Africa 4.2%; Oceania 0.3%. The world's top peach and nectarine producers are made up of: China; Spain; Italy; Greece; America; Turkey; Iran; Egypt; Chile; Korea [7].



Photo 1. Springold  
Source: [6]

The peaches and nectarines are for consumption in fresh and processed form. Likewise, as in the world, in Romania there are find three groups of peach varieties: *Peaches varieties for fresh consumption*: Springold; Cardinal; Jerseyland, etc [6].

*Varieties of peach for industrialization*: Babygold 6; Fortuna; Vivian, etc [15, 16].



Photo 2. Babygold 6

Source [4]

*Nectarines varieties*: Fantasia; Nectared 4; Romamer, etc [15, 16].



Photo3. Fantasia

Source [14]

## MATERIALS AND METHODS

In the research on the market of peaches and nectarines, specialized materials from the National Institute of Statistics of Romania, as well as materials from specialized sites were consulted and analyzed. The analysis is based on the specific indicators of the peach and nectarine production and marketing sector. In this case, a number of indicators have been

analyzed, such as: the number of peaches and nectarines both at national level and at macroregional level; production of peaches and nectarines at national level and by macroregions; average production for peaches as well as for nectarines at national and macroregional level; the average price for peaches in Romania; average annual per capita consumption of peaches and nectarines in Romania; imports and exports of peaches and nectarines related to Romania. Between 2012 and 2017, indicators specific to the peach and nectarine production and marketing sector were mainly analyzed in dynamics.

## RESULTS AND DISCUSSIONS

The number of peaches and nectarines found in fruit orchards presents an element of interest in the situation where a particular emphasis is placed on the production and marketing of fruit [2].

In Romania, find a variety of peach and nectarine varieties both domestic and foreign.



Photo 4. Peach blossoms.

Source: [9]



Photo 5. Nectarine blooming.

Source: [13]

The dynamics of the number of peaches and nectarines in Romania for the period 2012-2017 is presented in Table 1. The data on the number of peaches and nectarines have been presented both at national level and on macroregions. Regarding the number of peaches, it can be noticed that, during the analysis period, it registered a decreasing trend at national level. In 2017, the number of peaches per piece decreased by 20.42% compared to 2012. In 2017, the lowest number of peaches per fruit (1,075,956) was registered at the national level. At the macroregional level, the number of peaches per year has varied from year to year. In 2017, the number of peaches per head has decreased compared to 2012 in all macro-regions. The largest number of peaches per year was recorded in the year 2013 (511,464) in

macroregion 2. At the opposite end, the smallest number of peaches per fruit was recorded in 2016 (111,196) in macroregion 3. The number of fruit nectarines in Romania in the period 2012-2017 recorded oscillations from one year to the next. In 2017, the number of nectarines decreased by 11.08% on the national level compared to 2012. Regarding the evolution of the number of nectarines at the macroregional level in 2017, compared to 2012, the following situation was registered: in macroregion 1, the number of nectarines on wheat increased 9.90%; in macroregion 2, there was a decrease in the number of nectarines by 63.55%; in macroregion 3 there was a substantial increase in the number of peaches by 104.41%; in macroregion 4 there was a 14.36% decrease in the number of peaches per fruit.

Table 1. Dynamics of the number of peaches and nectarines at national and macro-regions, period 2012-2017 (number)

Specification	2012	2013	2014	2015	2016	2017	2017/2012 (%)
<b>PEACHEAS</b>							
Romania	1,351,970	1,278,842	1,148,844	1,134,639	1,092,259	1,075,956	79.58
Macroregion 1	355,395	350,500	357,544	341,885	362,316	344,566	96.95
Macroregion 2	491,171	511,464	373,716	378,773	355,482	345,121	70.26
Macroregion 3	128,406	112,608	121,524	113,500	111,196	127,344	99.17
Macroregion 4	376,998	304,270	296,060	300,481	263,265	258,925	68.68
<b>NECTARINIES</b>							
Romania	51,698	48,495	52,356	29,720	37,962	45,972	88.92
Macroregion 1	14,580	15,261	16,081	11,434	12,058	16,024	109.90
Macroregion 2	15,720	7,297	18,285	5,166	10,568	5,731	36.45
Macroregion 3	4,960	15,339	6,986	7,018	9,612	10,139	204.41
Macroregion 4	16,438	10,598	11,004	6,102	5,724	14,078	85.64

Source: Own calculation based on National Institute of Statistics, Tempo- Online Database, 2019 [11]

The total production of peaches and nectarines obtained in Romania is mainly destined for domestic consumption. Of the production, only a small part is allocated for export. The dynamics of global peach and nectarine production, both nationally and macro-regional in the period 2012-2017, is presented in Table 2.

The production of peaches and nectarines in Romania has recorded variations from year to year. In Romania, the most significant peach production was achieved in 2014 (23,764 tonnes) and the smallest production was 16,838 tonnes (2012).

In 2017, peach production increased by 10.14% compared to 2012, but declined 21.94% compared to 2014, when peach production in the analyzed period was recorded. At the level of the macroregions, the data presented show that: the highest production of peaches was registered in 2014 (10,720 tons), in macroregion 1; the smallest peach production was achieved in 2015 (1,606 tonnes) in macroregion 3. In macroregion 2, in 2017, peach production decreased by 4.77% compared to 2012.



Photo 6. Peaches in plantation

Source: [17]

In macroregion 4, in 2017, peach production increased by 11.56% compared to 2012. The production of nectarine produced in Romania is well below the production of peaches. In the analyzed period, nectarine production has changed from one year to the next, both at the national level and within macroregions. At the

national level, the most significant production of nectarines was recorded in 2014 (949 tonnes). In 2017, the production of nectarines increased by 34.57% compared to 2012. At the level of the macro-regions, the following were recorded: the highest production of nectarines was 481 tons, in 2014 macroregion 1; the smallest production of nectarines was 55 tons, the macroregion 2; in macroregion 3, in 2017, there was the highest percentage increase of nectarine production (+153.44%) compared to 2012; in macroregion 4, in 2017, nectarine production declined by 15.9% compared to 2012. In Romania, a significant peach production is found in Constanta; Dolj Bihar; Timis. There are areas where plantation of peaches is not present in Romania because there are areas where the climate is cold and is not suitable for these fruits [15].

Table 2. Dynamics of peach and nectarine production at national and macro-regional level, period 2012-2017 (tonnes)

Specification	2012	2013	2014	2015	2016	2017	2017/2012 (%)
<b>PEACHES RODUCTION</b>							
Romania	16,838	18,427	23,764	21,325	22,869	18,546	110.14
Macroregion 1	6,052	6,946	10,720	9,656	10,113	7,163	117.91
Macroregion 2	5,418	5,728	5,540	5,508	5,183	5,160	95.23
Macroregion 3	1,650	1,654	2,011	1,606	2,072	2,075	125.75
Macroregion 4	3,718	4,099	5,493	4,555	5,501	4,148	111.56
<b>NECTARINES PRODUCTION</b>							
Romania	590	703	949	494	778	794	134.57
Macroregion 1	175	227	481	257	288	266	152.00
Macroregion 2	162	98	144	55	251	217	133.95
Macroregion 3	58	178	109	73	146	147	253.44
Macroregion 4	195	200	215	109	93	164	84.10

Source: Own calculation based on National Institute of Statistics, Tempo- Online Database, 2019 [11]

The dynamics of average peach and nectarine production on the tree at national and macro-regional level in 2012-2017 is presented in table no. 3. In terms of the average production of peaches and nectarines on the tree, there are different developments from one year to the next. At national level, an average yield of 21 kg (2014 and 2016) for peaches has been recorded. The smallest average yield for peaches was 12 kg / tree (2012).

In Romania, average peach tree production in 2017 increased by 41.66%. At the macroregional level, in 2017, the increase in

average production on the peach tree is observed compared to 2012. The most significant average peach tree production was 30 kg (2014) in the macroregion 1. At the opposite pole, the the smallest average tree yield was 10 kg (2014) in macroregion 4.

Regarding the average production on the nectarine tree at national level in 2017, there was an increase of 54.54% compared to 2012. The average production on the nectarine tree in Romania varied between 11-20 kg. The largest average production on the nectarine tree was 38 kg (2017), recorded in

macroregion 2. In this macroregion, the highest increase of the average production on the nectarine tree was recorded, by 280% in 2017 compared to the year 2012. In macroregion 1 and in macroregion 3 there

were registered increases in average per capita production in 2017 compared to 2012. At the level of macroregion 4 the average production on the nectarine tree remained constant in 2017 compared to 2012 (12 kg / tree).

Table 3. Average production of peaches and nectarines on the national and macro-regional period 2012-2017 (kg / tree)

Specification	2012	2013	2014	2015	2016	2017	2017/2012 (%)
<b>AVERAGE PRODUCTION OF PEACHES</b>							
Romania	12	14	21	19	21	17	141.66
Macroregion 1	17	20	30	28	28	21	123.52
Macroregion 2	11	11	15	15	15	15	136.36
Macroregion 3	13	15	17	14	19	16	123.07
Macroregion 4	10	13	19	15	21	16	160.00
<b>AVERAGE PRODUCTION OF NECTARINES</b>							
Romania	11	14	18	17	20	17	154.54
Macroregion 1	12	15	30	22	24	17	141.66
Macroregion 2	10	13	8	11	24	38	380.00
Macroregion 3	12	12	16	10	15	14	116.66
Macroregion 4	12	19	20	18	16	12	100.00

Source: Own calculation based on National Institute of Statistics, Tempo- Online Database, 2019 [11].

The evolution of the average price for peaches in Romania is presented in Fig.1. During the period, the average price for peaches has evolved differently. From the presented data it is noted that in 2012, the highest price for peaches was recorded, namely 4.2 lei / kg. In 2013, the price for peaches registered a slight decrease reaching 4.13 lei / kg. In the period 2014-2015, the price for peaches was 3.73 lei /kg, registering a decrease of 11.2% compared to 2012. In 2016, the price continued its descending trend, reaching 3.39 lei / kg. In 2016, it is easy to see that the lowest price of the analyzed period was registered. The price for peaches in 2016 decreased by 19.3% compared to 2012. This year saw the highest price drop for peaches compared to 2012. Year 2017, there is a slight increase compared to 2016, the price reaching to 3.57 lei / kg. In 2017, the price for peaches was 5.3% compared to 2016, but declined by 19.3% compared to 2012.

The annual average consumption per capita of peaches and nectarines in Romania ranged from 3.1 to 6.6 kg. This consumption varied from year to year (see Fig.2.). From the data presented, it can be very well observed that, starting with 2014, the average annual

consumption of peaches and nectarines has been rising.

This is due to a number of factors such as the substantial content in vitamins and minerals necessary for the good functioning of the human body; increasing information on the role of fruit consumption by the population; easy access to peaches and nectarines over a longer period of time because sufficient quantities are imported; changing the pattern of consumption for some of the population; and so on.

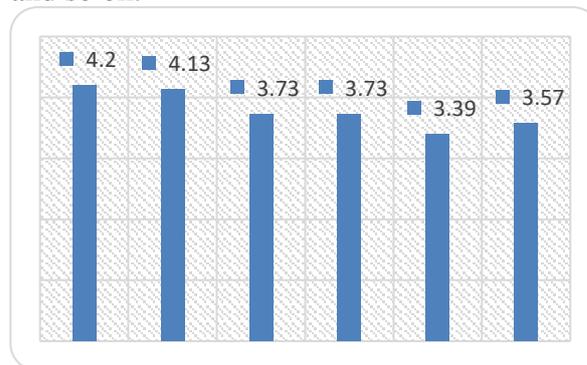


Fig. 1. Peach average price, period 2012-2017

Source:

Own design based on NIS Tempo-online database 2019 [11]

In 2017, the average annual consumption of peaches and nectarines increased by 94.1% compared to 2012. This increase in

consumption of peaches and nectarines in 2017 is partly related to the factors mentioned above and on the other hand because price is with 19.0% lower than in 2012. According to the data provided by the National Institute of Statistics, in 2016, human consumption of peaches and nectarines in Romania was 122 thousand tons, and the degree of self-supply was 19.7% [10].

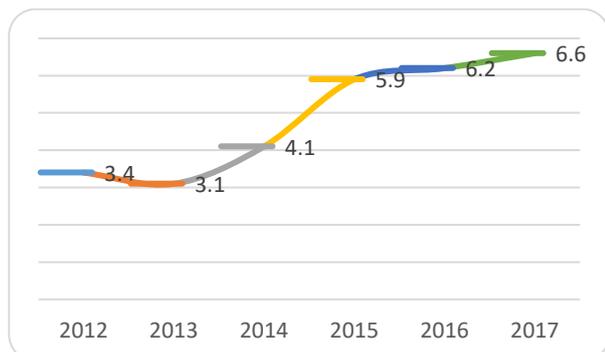


Fig. 2. Dynamics of the annual average consumption per inhabitant of peaches and nectarines in Romania, 2012-2017 (kg / inhabitant)

Source: Own design based on NIS Tempo-online database 2019 [11]



Photo 7. Peaches for consumption  
Source: [1]



Photo 8. Nectarines for consumption  
Source: [12]

In the period 2012-2016 Romania imported peaches and nectarines from different countries of the world. The imported quantity of peaches and nectarines varied. The smallest imports were registered in 2013 (26,218 tonnes) and the largest imports were registered in 2015 (45,417 tonnes) (see Fig.3.).

In 2015, quantitative imports of peaches and nectarines increased by 19.4% compared to 2012. In 2016, a slight decrease in the quantity of peaches and nectarines was observed compared to 2015, reaching 45,403 tonnes. Although imports of peaches and nectarines are declining in 2016, compared to 2015, imports remain high compared to 2013. These imports increased in 2016 by 73.1% compared to 2013.

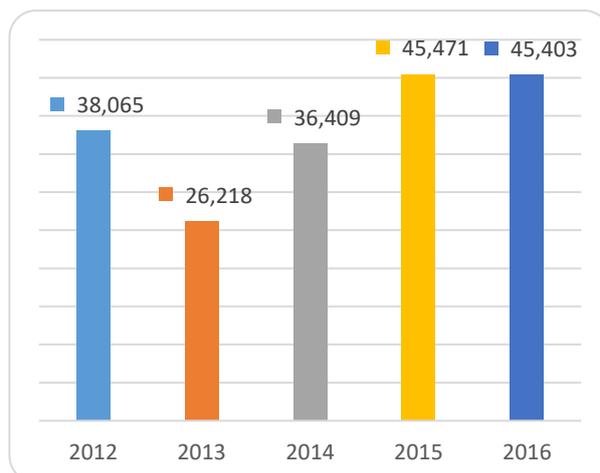


Fig. 3. Dynamics of Romania's quantitative imports of peaches and nectarines in 2012-2016 (tonnes)

Source: [8]

The value of imports for peaches and nectarines has fluctuated. The lowest import value was recorded in 2013 (\$ 18,934 thousand) (see Fig.4.). This low import value is closely correlated with the amount of peaches and nectarines that was imported in 2013. In 2016, the highest import value was recorded, of 31.223 thousand dollars. It can be seen that in 2016 the value of imports for peaches and nectarines increased by 60.2% compared to 2012 and by 64.9% compared to 2013.

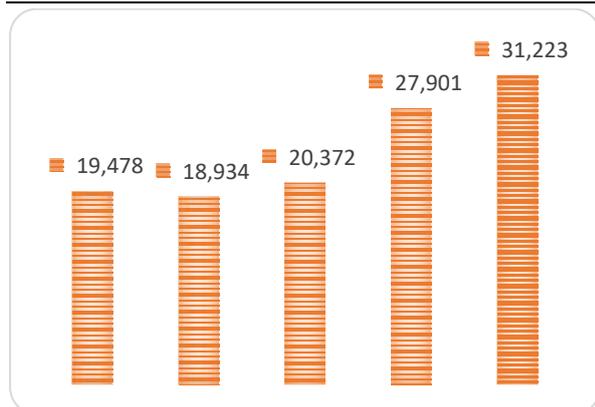


Fig.4. Import value for peaches and nectarines in Romania, 2012-2016 (thousands of dollars)

Source: [8]

As regards Romania's quantitative exports of peaches and nectarines from the data provided by FAOSTAT, their massive decline during the analyzed period is noticeable. The highest quantities of peach and nectarine exports were made in 2012 (2,046 tonnes) (see Fig.5.). Also, the lowest exports were only 10 tonnes (2015). From the data regarding the imports and exports of Romanian peaches and nectarines for the period 2012-2016, it is noticed that the imports are ahead of the exports. This has a negative impact on the results obtained both at farm level and at macroeconomic one.



Fig.5. Dynamics of quantitative exports for peaches and nectarines in 2012-2016 (tonnes)

Source: [8]

According to the central data by FAOSTAT, the value of exports for peaches and nectarines in the period 2012-2016 shows that it has been substantially reduced since 2014. The highest export value was registered in 2012 (\$ 1,420 thousand, and the smallest was \$ 11 thousand (2015) ( see Fig.6.). The value of exports of peaches and nectarines recorded

by Romania is directly related to the quantity of peaches and nectarines exported during the analyzed period.

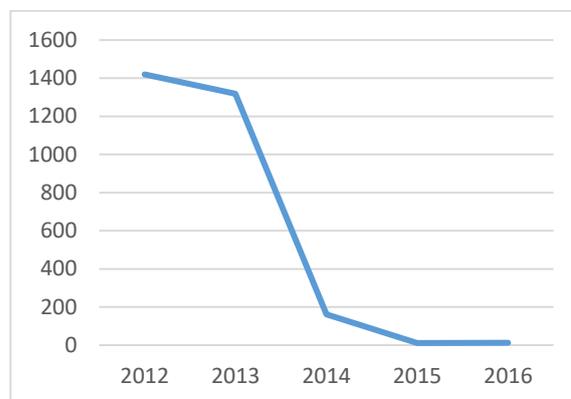


Fig. 6. Export value for peaches and nectarines, Source: [8]

Regarding the value of the imports and exports for peaches and nectarines, during the period 2012-2016, it results that there was an obvious deficit of Romania in the international trade in this fruit category.

## CONCLUSIONS

This paper studied the changes and trends related to the production and marketing of peaches and nectarines in Romania. The statistical data that led to the analysis carried out in the paper were consulted by the National Institute of Statistics, as well as by various specialized international materials. The research was conducted for the period 2012-2017 and a number of indicators were analysed. The indicators studied were production, average price, imported and exported quantities, consumption availability, consumption per capita, value of imports and exports. It was found that most of the peaches and nectarines obtained in Romania are destined for domestic consumption and only a small the quantity is for export. Peaches production was varied annually, the most significant being recorded in 2014 (23,764 tonnes) and the lowest was achieved in 2012 (16,838 tonnes). Also, in 2017, peach production increased by 10.14% compared to 2012, but declined by 21.94% compared to 2014. The production of nectarines was varied, with the highest production being

achieved in the year 2014 (949 tonnes). In 2017, nectarine production increased by 34.57% over the reference year 2012. The annual average consumption per capita of peaches and nectarines in Romania ranged from 3.1 to 6.6 kg. This consumption varied from year to year. From the data presented, it can be very well observed that, starting with 2014, the average annual consumption of peaches and nectarines has been rising. This was due to a number of factors such as the substantial content in vitamins and minerals, easy access to peaches and nectarines over a longer period of time because sufficient quantities are imported; changing the pattern of consumption for some of the population. As regards Romania's quantitative exports of peaches and nectarines, a decline during the analyzed period was noticeable. The highest quantities of peaches and nectarines exports were made in 2012 (2,046 tonnes). Also, the lowest exports were only 10 tonnes (2015). From the data regarding the imports and exports of Romanian peaches and nectarines for the period 2012-2016, it is noticed that the imports are ahead of the exports. This has a negative impact on the results obtained both at farm level and at macroeconomic one. In economic terms, the export of peaches and nectarines increased and the import decreased this means a deficit in the international trade in this fruit category.

## REFERENCES

[1] Andreevici, I., 2018, Producers of peaches near bankruptcy although production was a record this year, *Bună Dimineața Iași Newspaper* (Producătorii de piersici aproape de faliment deși producția a fost una record anul acesta, 9 august 2018, *Ziarul Bună Dimineața Iași*), <https://www.bunadimineataiasi.ro/producerii-de-piersici-aproape-de-faliment>, Accessed on January 18, 2019.

[2] Bălan, A., Soare, E., Cofas, E., Niculae, I., 2012, Study on the fruit sector in Romania, *Lucrări Științifice, Seria I, Management Agricol, Vol. XIV (2), Timișoara*, pp: 133-140.

[3] Brădățeanu, V., Radu, E., 2016, Peaches - the fruits of longevity (Piersicile – fructele longevității, 06/08/2016), <http://www.rador.ro/2016/08/06/piersicile-fructele-longevitatii/>, Accessed on January 25, 2019.

[4] CSABA nursery (Pepiniera CSABA),

<http://www.pepinieracsaba.ro/magazin/piersici-babygold-6/76/detalii>, Accessed on January 25, 2019.

[5] Cociu, V., Botu, I., Șerboiu, L., 1999, Progress in improving horticultural plants in Romania, Volume 1, Horticulture, Ceres Publishing House, Bucharest, pp: 113-115 (Progrese in ameliorarea plantelor horticole din Romania, 1999, Volumul 1, Horticultura, Editura Ceres, Bucuresti, pp: 114-115).

[6] Dumitru, D. M., 2015, The best peach varieties. The varieties that give the most tasty fruit, *Adevarul.ro* (Cele mai bune soiuri de piersici. Soiurile care dau cele mai gustoase fructe, 24 aprilie 2015, *Adevarul.ro*) [https://adevarul.ro/life-style/stil-de-viata/cele-mai-bune-soiuri-piersici-soiurile-dau-cele-mai-gustoase-fructe-1\\_553a1c52cfbe376e35820a35/index.html](https://adevarul.ro/life-style/stil-de-viata/cele-mai-bune-soiuri-piersici-soiurile-dau-cele-mai-gustoase-fructe-1_553a1c52cfbe376e35820a35/index.html), Accessed on January 10, 2019.

[7] Faostat, Crops, <http://www.fao.org/faostat/en/#data/QC/visualize>, Accessed on January 15, 2019.

[8] Faostat, Crops and livestock products, <http://www.fao.org/faostat/en/#data/TP>, Accessed on January 18, 2019.

[9] Maintenance of the orchard. *Paradis Verde* (Intretinerea livezii. *Paradis Verde*) [https://www.google.com/search?q=livada+cu+piersici+infioriti+imagini&client=firefox-b&tbm=isch&source=iu&ictx=1&fir=0voE4elCkfyvpM%253A%252Cihjqpx92V6IpaM%252C\\_&usg=AI4\\_kQr126pjXBBvbGrtO7uvEmOFKDe8w&sa=X&ved=2ahUKEwjD-dnNyIbgAhWGiywKHRLedHQ9QEwAXoECAIQBg#imgrc=2zvvgOxLxgEf8M](https://www.google.com/search?q=livada+cu+piersici+infioriti+imagini&client=firefox-b&tbm=isch&source=iu&ictx=1&fir=0voE4elCkfyvpM%253A%252Cihjqpx92V6IpaM%252C_&usg=AI4_kQr126pjXBBvbGrtO7uvEmOFKDe8w&sa=X&ved=2ahUKEwjD-dnNyIbgAhWGiywKHRLedHQ9QEwAXoECAIQBg#imgrc=2zvvgOxLxgEf8M), Accessed on January 20, 2019.

[10] National Institute of Statistics, Availability of population consumption in 2016, 2017 (Disponibilitatile de consum ale populației in anul 2016, 2017), [http://www.insse.ro/old/sites/default/files/field/publicatii/disponibilitatile\\_de\\_consum\\_ale\\_populatiei\\_anul\\_2016.pdf](http://www.insse.ro/old/sites/default/files/field/publicatii/disponibilitatile_de_consum_ale_populatiei_anul_2016.pdf), Accessed on January 20, 2019.

[11] National Institute of Statistics, Tempo- Online Database, 2019 <http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table>, Accessed on January 25, 2019.

[12] Nectarines (Nectarine), <https://legumefructetm.ro/produs/nectarine/>, Accessed on January 25, 2019.

[13] Nectarine dwarf. *Album-Flower garden 2015*, (Nectarin pitic. *Album- Gradina cu flori*, 18 aprilie 2015), [https://www.sunphoto.ro/Floria/a-Gradina\\_cu\\_flori\\_2015/102798409](https://www.sunphoto.ro/Floria/a-Gradina_cu_flori_2015/102798409), Accessed on January 20, 2019.

[14] Nectarine Fantasia variety, EMMA nursery (Nectarin soiul Fantasia), <http://pepinieraemma.ro/nectarin-fantasia>, [https://www.google.com/search?q=NECTARIN+FANTASIA+IMAGINI&client=firefox-b&tbm=isch&source=iu&ictx=1&fir=i1i-DTBepi2iJM%253A%252CRFTX6rjbszqY\\_M%252C\\_&usg=AI4\\_-kS3f7D2hxNZ6JQq6-5P9mfkXoy8OQ&sa=X&ved=2ahUKEwiytaolpTgAh](https://www.google.com/search?q=NECTARIN+FANTASIA+IMAGINI&client=firefox-b&tbm=isch&source=iu&ictx=1&fir=i1i-DTBepi2iJM%253A%252CRFTX6rjbszqY_M%252C_&usg=AI4_-kS3f7D2hxNZ6JQq6-5P9mfkXoy8OQ&sa=X&ved=2ahUKEwiytaolpTgAh)

UKy6QKHYxOD6MQ9QEwAnoECAYQCA#imgsrc=i  
1i-DTBepi2iJM, Accessed on January 12, 2019.

[15]Peach culture, 2008 (Cultura piersicului, 12  
Septembrie 2008)

[https://www.gazetadeagricultura.info/pomicultura/598-  
pomi-fructiferi/1954-cultura-piersicului.html](https://www.gazetadeagricultura.info/pomicultura/598-pomi-fructiferi/1954-cultura-piersicului.html), Accessed  
on January 20, 2019.

[16]Pomohaci, N., Nămoleşanu, I., 1999, Horticultural  
crop technology, Ceres Publishing House, Bucharest,  
pp: 174-175 (Tehnologia culturilor horticole, Editura  
Ceres, Bucuresti, pp:174-175).

[17]Pop, P.A., 2016, Tree fruits and berries. New  
varieties in Roman nurseries, World of the Village  
(Pomi și arbuștii fructiferi. Soiuri noi în pepinierele  
Roman, 01 Martie 2016, Lumea Satului),  
[https://www.lumeasatului.ro/articole-revista/2748-  
pomi-si-arbustii-fructiferi-soiuri-noi-in-pepiniereler-  
roman.html](https://www.lumeasatului.ro/articole-revista/2748-pomi-si-arbustii-fructiferi-soiuri-noi-in-pepiniereleroman.html), Accessed on January 18, 2019.



## MARKET ANALYSIS OF PEARS IN ROMANIA

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### Abstract

*In the present paper there are highlighted several aspects referring to the activity of producing and marketing of pears in Romania during the period 2012-2017. In order to carry out a study that reflects the finalization of pears at national level, various specific indicators were analysed, such as: the total number of bearing pear trees in Romania; total pear production obtained internally; average pears production per tree at national level; the average price for table pears on the domestic market; imports and exports of pears both in terms of quantity and value. In Romania, nowadays, table pears are among the fruits appreciated by consumers, with an average annual consumption per capita of over 4.5 kg. In order to insure the amount of pears needed for domestic consumption, Romania imports significant annual quantities of pears. In this context, farmers in Romania can also focus on setting up pear plantations because they are less vulnerable to disease and are cost-effective even on less extensive surfaces. The National Institute of Statistics and specialized international sites were the main providers of statistical data that led to the realization of this study.*

**Key words:** pears; total production of pears, average pear production per tree, annual average consumption of pears per capita, Romania

### INTRODUCTION

Worldwide, the pear tree is grown on smaller surfaces compared to the apple tree, because it has a higher yield which maintains in time. In 2017, 1,385,629 ha of pears were grown on the globe. Pears are the first fruits grown and are part of the *Rosaceae* family. At present, over 5,000 varieties of pears are known, which are classified into two representative categories: European pears and Asian pears [8].

In Romania apples, pears, peaches, plums and grapes belong to the fruits that are the most appreciated and consumed by consumers [1, 5, 13].

Nowadays there is a particular emphasis on the consumption of fruits and vegetables worldwide. Specialists in the field recommend that one person should consume more than 400 grams of fruits and vegetables a day [10]. Pears are, on the one hand, those fruits that can be eaten fresh, and on the other hand they represent important raw material for the food industry. Pears are especially valuable for

human consumption because they contain a series of vitamins and minerals that help to strengthen the immune system. In Romania are grown a series of pear varieties such as: Triumf; Trivale; Aromata de Bistrita; Napoca; Williams; Abatele Fetel; Untoasa de Geoagiu etc [11].

Pears, as well as other fruits, are perishable and therefore it is necessary to use specific distribution channels to avoid their loss of quality [9].

In order to create profitable pear plantations, fruit growers must take into account some key aspects such as:

-Placement of plantations on land with south, south-east or south-west exposure, since pear trees have high light requirements;

-In areas where pear trees are grown, winter temperatures should not exceed -26 degrees Celsius;

-Pear trees need fertile soils with high humidity and depth [11].

Nowadays, in Romania, those who want to create profitable pear plantations are advised by specialists in the field to focus on

cultivating the following varieties: Nopaca; Untoasa de Geoagiu; Cure or Popești; Doina; Aromata de Bistrita [2].

## MATERIALS AND METHODS

This study highlights the main elements specific to the activity of producing and marketing pears in Romania. The main indicators that have been analyzed in the paper are: the total number of pears at national level; domestic pear production; average pear production per tree; the average price for pears in Romania; quantitative and value imports and exports. The statistical data concerning pears were taken from the National Institute of Statistics and also from other profile sites. In order to overcome the activity of producing and capitalization of pears in Romania, a number of specialized materials were investigated. The research of the main indicators in this study was polarized on the interval 2012-2017. The results of research on the production and capitalization of pears at national level were illustrated graphically.

## RESULTS AND DISCUSSIONS

The number of bearing pear trees in Romania for the interval 2012-2017 presented modifications from one year to year (Fig.1). The most representative number of bearing pear trees at national level was recorded in 2013 (3,484,785 pear trees) and the lowest number was identified in 2017 (3,153,616 pear trees). In 2017, we witnessed a reduction in the number of bearing pear trees by 8.6% compared to the base year (2012). In 2017, the number of bearing pear trees in Romania occupied for 4.18% of the number of fruit-bearing fruit trees.

At the national level, pear production in the period 2012-2017 has seen annual variations (Fig.2).

The pear production obtained in Romania is mainly destined for the domestic market. From the production of pears obtained in Romania in 2016 (52,751 tonnes), only 7.0 tonnes were exported.

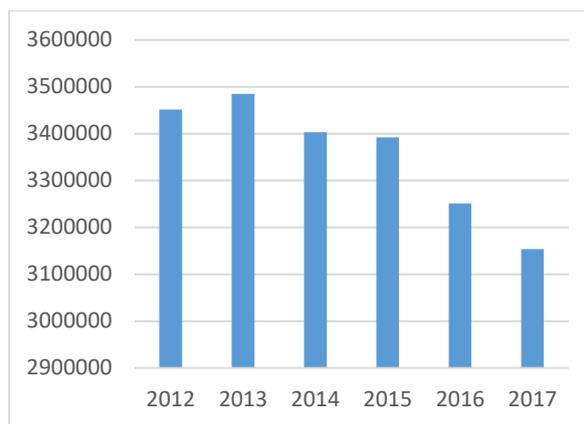


Fig. 1. Evolution of the number of bearing pear trees in Romania in the period 2012-2017 (number)

Source: Own design based on NIS Tempo-online database 2019 [6]

The data show that the largest production was achieved in 2013 (66,849 tonnes) and the smallest production was 45,595 tonnes (2015). In 2017, total pear production in Romania decreased by 9.95% compared to 2012. This decrease in production is mainly due to the reduction of the number of bearing pear trees internally. In Romania, in the year 2017, the production of pear produced occupied for 4.61% of the fruit production realised internally. In the year 2017, the production of pears accounted for 4.61% of the domestically fruit production. In 2017, a pear production of 24,168,309 tonnes was achieved worldwide. In this context, Romania, in 2017, obtained 0.20% of the world's pear production. This aspect shows that Romania is not an important player in the international pear transactions. The worldwide pear production in 2017 was distributed as follows: Asia (76.3%); Europe (11.6%); Americas (8.4%); Africa (3.2%) and Oceania (0.5%) [3].

The largest production, in 2017, was obtained by China, 16,410,000 tonnes. Romania has achieved only 0.29% of the pear production achieved by the world leader. China, the leading pear grower in the world made a farm gate price in 2015 of 498 USD/tonne compared to Romania, which made a price of 1,130.9 USD/tonne [3]. At the European Union level, there are a number of countries where the farm gate price per tonne of pear is

much lower than the one made by the Romanian producers.

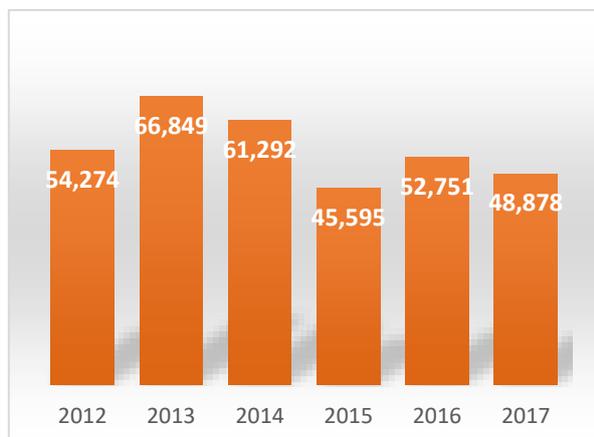


Fig. 2. Evolution of total pear production in Romania in the period 2012-2017 (tonnes)

Source: Own design based on NIS Tempo-online database 2019 [6]

At national level, the average pear production per tree varied in the interval 2012-2017 (Fig.3). The most representative average pear production per tree was 19 kg (2013) and the smallest was 13 kg (2015). In Romania, in 2017, the average pear production per tree reduced by 6.25% compared to 2012. The average pear production per tree achieved in Romania in 2017 was by 7.14% higher compared to the average obtained by species of fruit trees at national level.

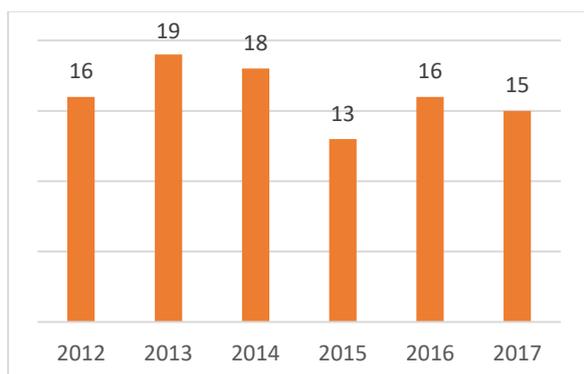


Fig.3. Evolution of average pear production per tree in Romania in 2012-2017 (kg/tree)

Source: Own design based on NIS Tempo-online database 2019 [6]

Annual average consumption of pears per capita varied between 4.4 kg and 4.7 kg between 2015 and 2016 [7].

Annual average consumption of pears per capita increased by 6.81% compared to 2015.

In 2015, in Romania, the annual average consumption per inhabitant accounted for 5.01% of the average annual consumption of fruits and fruit products, and in the year 2016 it accounted for 4.89%.

In Romania, between 2012 and 2017 there were average consumption prices different from one year to another for table pears (Fig. 4). The biggest average price for table pears was 5.21 lei / kg (2017). In Romania, in 2017, the average price for table pears increased by 24.34% compared to 2012. At the opposite end, the lowest average price for table pears was recorded in 2013 (4.18 lei / kg). From the data presented, it is observed that, during the analyzed period, the average prices for table pears did not show very high variations. This highlights, first of all, that pears represent, in essence, one of the most known types of fruit, and like these, that they keep a high price during the season and also every year [2].

The high average prices for table pears can be a motivation for farmers who want to set up their pear plantations.

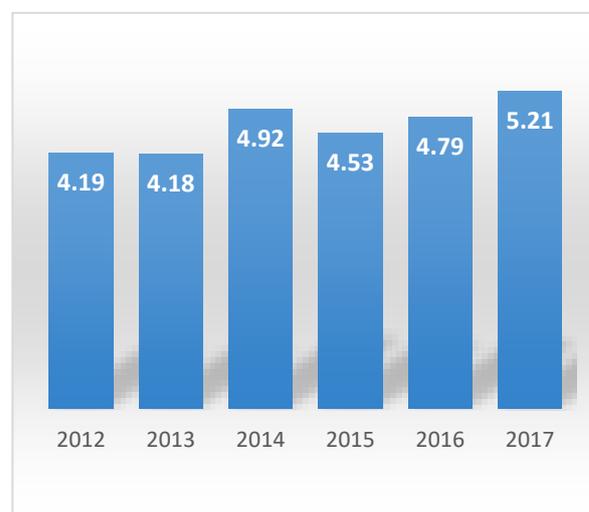


Fig.4. Dynamics of average prices for table pears in Romania, in the period 2012-2017 (lei/kg)

Source: Own design based on NIS Tempo-online database 2019 [6]

From the data on the quantitative imports of Romanian pears, between 2012 and 2016, there are changes from year to year (see Fig. 5). Quantitative imports of pears from Romania are clearly superior to the quantitative exports of pears in the period under review. In 2013, the smallest quantity

of pear imports of 6,532 tonnes was achieved. The largest quantities of pears were imported in 2016 (24,004 tonnes). In 2016, Romania's quantitative imports of pears rose by 161.88% compared to 2012. In 2016, Romania's quantitative imports of pears accounted for 45.5% of the domestic production. By the year 2016, Romania imported significant quantities of fresh apples, pears and quinces from: Poland; Italy; Germany; Netherlands; Hungary; Greece; Macedonia; Belgium and Serbia [12].

This situation reflects the fact that in Romania the pears are in the attention of consumers throughout the whole year. Significant amounts of pears are imported, especially during winter-spring, when no production is obtained in our country.

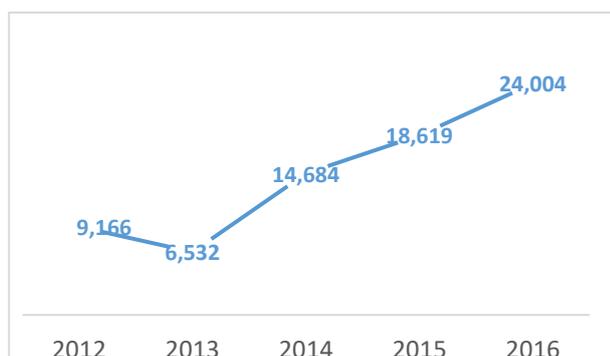


Fig.5. Evolution of the quantitative imports of Romanian pears in 2012-2016 (tonnes)  
 Source: [3, 4]

In the period 2012-2016, in Romania, the value of pear imports was on an ascending trend (see Fig. 6). In 2012, the lowest import value was registered, \$ 6,218 thousand, and the highest import value was \$ 19,619 thousand (2016). From the statistics presented, it can be noticed that, in 2016, the value of pear imports have grown by 215.51% compared to 2012.

In Romania, the quantitative exports of pears in the interval 2012-2016 oscillated from one year to the next (Fig.7). The most significant quantities of pear exports were made in 2012 (802 tonnes), while the lowest were registered in 2016 (7 tonnes).

From the data presented, it is observed that, in 2016, the quantitative exports have been massively reduced.

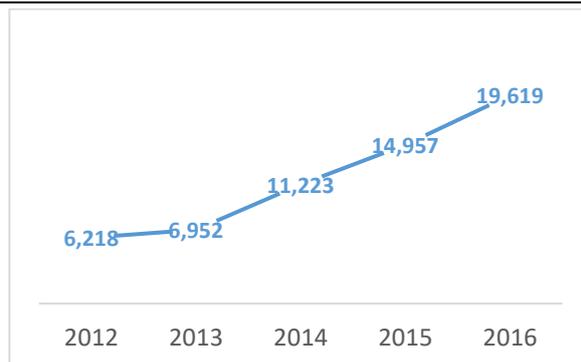


Fig.6. Evolution of the value imports of Romanian pears in 2012-2016 (thousand dollars)  
 Source: [3, 4]

The decrease in the quantity of pear exports is due to several factors, such as: reduction of domestic production in the context of unfavorable weather conditions; production of inferior quality pears not corresponding to export requirements; high production costs, etc.

In 2012, Romania exported only 1.47% of the domestic pear production, and in 2016 it exported only 0.01% of the production. In 2016, the main markets for Romanian exports of apples, pears and quinces were: Hungary, Germany and Bulgaria [12].

According to the statistically valid data for 2016, the top five pear exporters worldwide were: China (452,435 tonnes); Belgium (327,570 tonnes); Netherlands (315,902 tonnes); Argentina (310,011 tonnes) and South Africa (250,254 tonnes) [3].

In 2016, Romania exported 0.001% of the amount of pear exported by China.

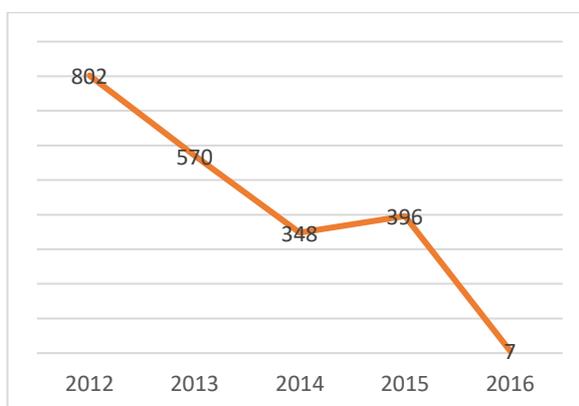


Fig.7. Dynamics of the quantitative exports of Romanian pears in the interval 2012-2016 (tonnes)  
 Source: [3, 4]

According to statistical data during the interval 2012-2016, the value of the Romanian pear exports was framed on a clear downward trend (Fig. 8). The value of exports is closely correlated with the quantitative exports of pears. The lowest export value for the pear category was \$ 9 thousand (2016), and the highest export value was registered in 2012 (\$ 619 thousand).

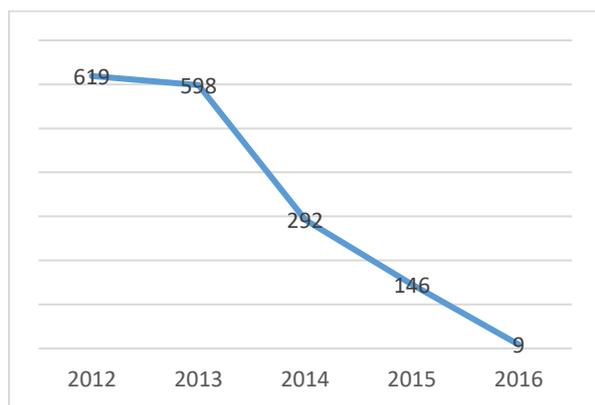


Fig. 8. Evolution of the value exports of Romanian pears in 2012-2016 (thousand dollars)

Source: [3, 4]

## CONCLUSIONS

The activity of producing and marketing of pears in Romania during 2012-2017 is characterized by the followings:

-Decrease of the number of bearing pear trees, by 8.6% in 2017 compared to 2012;

-The total production of pears obtained varied from year to year. In 2015, a minimum production was recorded, namely 45,595 tonnes. At the opposite end, in 2013, there was a maximum production of 66,849 tonnes;

-In 2013, we recorded the highest average pear production per tree of 19 kg. This high average production led to the achievement of the largest total production for the analyzed period;

-In 2016, annual average consumption per capita was 6.81% higher compared to 2015;

-Pears are appreciated and demanded by the population on the domestic market. This fact is also reflected by the average price that exceeded the 4 lei/kg threshold in the period 2012-2016. In 2017, the average price for pears exceeded a new threshold of 5 lei/kg;

-Romania's imports of pears are clearly higher than exports, which in the analyzed period led to a deficit in the international trade for this type of fruits. In fact, the deficit has spread to the whole range of fruits and vegetables imported or exported by Romania, within the period under review.

In conclusion, in Romania, the plantations can be established, on the one hand, to ensure a decent income for the growers and, on the other hand, to provide the consumers on the internal market with high quality fruits at affordable prices.

## REFERENCES

[1]Bălan, A., Soare, E., Cofas, E., Niculae, I., 2012, Study on the fruit sector in Romania, *Lucrări Științifice, Seria I, Management Agricol, Vol..XIV (2), Timișoara*, pp: 133-140.

[2]Dobre, R., 2015, Five pear tree varieties recommended by romanian researchers for setting up a profitable plantation, *Agrointeligenta (Cinci soiuri de păr recomandate de cercetătorii români pentru înființarea unei plantații profitabile, Agrointeligenta, 12 septembrie 2015)*

<https://agrointel.ro/39282/cinci-soiuri-de-par-recomandate-de-cercetatorii-romani-pentru-infiintarea-unei-plantatii-profitabile/>, Accessed on January 25, 2019.

[3]Faostat, Crops, <http://www.fao.org/faostat/en/#data/QC/visualize>, Accessed on January 15, 2019.

[4]Faostat, Crops and livestock products, <http://www.fao.org/faostat/en/#data/TP>, Accessed on January 18, 2019.

[5]Ion, R. A., 2015, Fruits And Vegetables Market In Romania: Better Understand Consumers' Preferences, *Agricultural Economics and Rural Development - Realities and perspectives for Romania 20-21 November, 2015, Bucharest, Romania*, pp: 426-433.

[6]National Institute of Statistics, Tempo- Online Database, 2019 <http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table>, Accessed on January 25, 2019.

[7]National Institute of Statistics, Availability of population consumption in 2016, 2017 (Disponibilitatile de consum ale populatiei in anul 2016, 2017), [http://www.insse.ro/old/sites/default/files/field/publicatii/disponibilitatile\\_de\\_consum\\_ale\\_populatiei\\_anul\\_2016.pdf](http://www.insse.ro/old/sites/default/files/field/publicatii/disponibilitatile_de_consum_ale_populatiei_anul_2016.pdf), Accessed on January 20, 2019.

[8]Pear, the miracle fruit recommended in diabetes. See other benefits (Pere, fructe-minune recomandate în diabet. Vezi și alte beneficii) <https://www.csid.ro/diet-sport/dieta-si-nutritie/pere-fructe-minune-recomandate-in-diabet-vezi-si-alte->

beneficii-11249859, Accessed on January 25, 2019.

[9]Peț, E., Străin, L.M., Peț, I., 2014, Aspects of the Romanian fruit market, *Lucrări Științifice, Seria I, VOL.XVI (2)*, pp.97-100.

[10]Pirvutoiu, I., Popescu, A., Trends in Romania's fruit market, 2013, *Annals of the University of Craiova - Agriculture, Montanology, Cadastre Series, Vol. XLIII 2013*, pp:164-169 (*Analele Universității din Craiova, seria Agricultură – Montanologie – Cadastru, Vol. XLIII 2013*, pp:164-169)

<http://anale.agro-craiova.ro/index.php/aamc/article/view/86/82>, Accessed on January 28, 2019.

[11]Pomohaci, N., Nămoșeanu, I., 1999, Horticultural crop technology, Ceres Publishing House, Bucharest, pp: 174-175 (*Tehnologia culturilor horticole, Editura Ceres, Bucuresti, pp: 174-175*).

[12]Trade Map, International Trade Statistics  
[https://www.trademap.org/tradestat/Country\\_SelProductCountry\\_TS.aspx?nvpm=1%7c642%7c%7c%7c%7c0808%7c%7c%7c4%7c1%7c1%7c1%7c2%7c1%7c2%7c2%7c1](https://www.trademap.org/tradestat/Country_SelProductCountry_TS.aspx?nvpm=1%7c642%7c%7c%7c%7c0808%7c%7c%7c4%7c1%7c1%7c1%7c2%7c1%7c2%7c2%7c1), Accessed on January 12, 2019

[13]Turek Rahoveanu, A., Turek, M., Zahiu, L., Ion, R. A., Zaharia, C., Dachin, A., Istudor, N., Manole, V., Dobre, I., Ignat, R., 2008, Analysis on the fruits-vegetables sector in Romania, *Cartea Universitară Publishing House, Bucharest*, pp: 342 (*Analiza filierei sectorului legume-fructe în România, Editura Cartea Universitară, București, pp: 342*).

## THE CURRENT STATE OF AND PROSPECTS FOR THE DEVELOPMENT OF GRAIN PRODUCTION IN SIBERIAN FEDERAL DISTRICT

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### Abstract

*Siberian Federal District (SFD) is located in the center of the Russian Federation, occupying 30% of its territory. Its population is 19,326 thousand people, which constitutes 13.2% of Russia's total population. The district consists of 12 constituent entities, which, to one degree or another, are engaged in agricultural production. Grain crops are grown in each of the SFD regions, with the way being currently led by Altai Krai, Krasnoyarsk Krai, Omsk Oblast, Kemerovo Oblast, and Novosibirsk Oblast, which account for 90% of the district's gross grain output. Most of the district's land under cultivation is sown to wheat (67%). However, due to unstable and low prices for wheat, agriproducers are forced to consider dropping some of the traditional crops and shifting, in accordance with the changing needs of the market, to other – sought-after and more competitive – grain crops. Another major issue in grain production within the district is the relatively low quality of grain, which diminishes its competitiveness in the market, with nearly 60% of all grain being represented by low-protein feeding grain. It may, therefore, be advantageous for Siberian agriculturists to grow grain for livestock farming, and this may require enhancing the actual structure of the land under cultivation and focusing on growing grain crops with the protein component greater than in the 4th class soft wheat. The paper shares some of the findings from an assessment of the region's agro-climatic potential for the period through to 2025.*

**Key words:** grain farming, Siberian Federal District, indicators of production, agro-climatic potential

### INTRODUCTION

The nation's ability to ensure its food security depends, above all, on the level of development of its grain production sector and its potential for meeting for sure the population's need for wholesome food. Its ability to provide itself with food and guard itself from all manner of natural disasters and emergencies of both an internal and external nature will largely depend on its ability to generate guaranteed volumes of grain [4, 5]. As a result of a series of negative phenomena that plagued Russia's agriculture during the early 1990s, domestic grain producers were faced with a number of issues, some of which are touched upon in this paper. Siberia's land sown to grain has quite a diverse structure, with the major focus being on growing traditional crops, like wheat, rye, barley, oats,

corn, buckwheat, and peas. In recent years, the district's agriculturists have been increasingly interested in crops that are not in wide use in Siberia, like triticale, chickpeas, lentil, and soybeans. This may be due to a major portion of the district's crop production being oriented toward livestock farming, with a focus on growing high-protein grain crops.

### MATERIALS AND METHODS

The purpose of this study is to develop a set of various indicators of the development of grain production both for the current and future periods. These indicators must serve as guideposts that will be applied in respect of production activity both by state-run and by privately-owned organizations.

The study's theoretical and methodological basis is grounded in scholarly works focused

on the issue under review and publications from research-to-practice conferences.

Depending on their objectives pursued, the authors employ the following methods of research: monographic, abstract/logical, economic/statistical, computational/constructive, and expert assessment.

The study's information basis is relevant methodological and reference materials from the Russian Federal State Statistics Service, statutes and policy papers from public authorities, and reports on the financial/economic status of producers within SFD's agro-industrial complex.

The study's subject is today's economic relationships within SFD's grain complex. Its object is factors and principles influencing grain production in the district.

## RESULTS AND DISCUSSIONS

The paper provides a brief characterization of Siberian Federal District (SFD). It analyzes the current state of the district's grain production through the lens of its regions. The study is focused on the time period of 1970–2015. The authors identify a set of factors influencing the development of grain production in the region, as well as a set of trends in its development across a set of key production indicators.

The authors identified some of the key reasons behind declines in the planting of grain crops in the district. They suggest boosting the quality of grain in the region through providing support for regional seed development and breeding work, approaching grain production, harvesting, and processing as a single process with a common flow scheme, and employing monitoring of the quality of grain as a tool for regulating the domestic grain market and developing grain exports.

The paper determines the district's agro-climatic potential through the lens of its regions for the period through to 2025. The authors suggest attaining target indicators

through the implementation of the following activities: restoring neglected cultivation areas, building new melioration systems for irrigating grain crops, reviving regional seed development stations, employing cutting-edge technology and machinery, employing mineral fertilizers and integrated protection for plants, and implementing the differentiated deployment of grain crops.

### Characteristics of SFD

SFD covers an area of 5,145 thousand square kilometers (30% of Russia's territory). As of early 2017, its population is 19,326 thousand people (13.2%). By area, SFD is Russia's second largest federal district (after Far Eastern Federal District), and by population it is the nation's third largest district (after Central Federal District and Volga Federal District) [16]. Table 1 lists SFD's 2016 rankings among the constituent entities of the Russian Federation based on agricultural production.

In 2016, the district produced 12% of Russia's total Gross Regional Product. The region ranked 4th nationally in grain production, accounting for 16% of Russia's total grain crop output. SFD consists of 12 constituent entities.

These regions are contributing to the district's grain production sector differently. The largest relative share of the area sown to grain is held by Altai Krai, Krasnoyarsk Krai, Omsk Oblast, Novosibirsk Oblast, and Kemerovo Oblast. These five regions account for 90% of all of the district's land under grain crops and nearly 93% of its gross grain output [17].

Based on soil/climatic conditions, SFD is divided into eight major zones. Each zone is characterized by a distinct system of arable farming and livestock farming of its own. The district's sum of positive temperatures (above 10°C) increases north to south from 1,350° to 2,450°C, while, conversely, its annual precipitation decreases from 550 mm to 200 mm. Depending on the region, the district's accumulated precipitation varies from 700–650 to 300–350 mm [7].

Table 1. Rankings of the regions within SFD Based on agricultural production in 2016

Regions within SFD	Gross grain output	Gross potato output	Gross vegetable output	Production of livestock and poultry for slaughter	Milk production	Egg production
SFD's rank among the constituent entities of the Russian Federation	4	3	5	3	3	3
Altai Republic	11	11	11	10	11	11
Republic of Buryatia	10	9	9	9	8	9
Tuva Republic	12	12	12	12	12	12
Republic of Khakassia	8	10	8	11	9	8
Altai Krai	1	2	3	1	1	3
Zabaykalsky Krai	9	8	10	8	7	10
Krasnoyarsk Krai	3	1	4	4	2	6
Irkutsk Oblast	6	5	6	5	5	4
Kemerovo Oblast	5	4	2	6	6	2
Novosibirsk Oblast	4	6	6	3	4	1
Omsk Oblast	2	3	1	2	3	5
Tomsk Oblast	7	7	7	7	10	7

Source: Altaikraistat, 2017 [3]

### SFD's land under cultivation

The district's agricultural lands are located in areas where the sum of positive temperatures (above 10°C) ranges from 1,400°C to 1,950°C. This makes it possible for SFD regions to grow both regular (wheat, rye, peas, oats, and barley) and heat-loving grain crops (grain maize, buckwheat, sunflower, and millet) [8].

Today, the district's grain crop producers depend less on such a key factor as the natural/climatic factor.

The use of new machinery and intensive technology and the conduct of meaningful plant-breeding work are helping minimize the impact of the natural factor, but this is being offset by declines in the use of mineral fertilizers and chemical crop protection products, spikes in the cost of combustibles and lubricants, as well as declines in the use of irrigation systems for grain crops [14].

Another indicator that has an effect on the district's gross grain output is the size of land under cultivation (Table 2).

The largest areas sown with grain and grain legume crops were registered in 2015 in Altai

Krai (36.7%), Omsk Oblast (21.7%), and Novosibirsk Oblast (15.4%).

The lowest indicators – less than 1% – were posted by the Altai Republic and the Tuva Republic.

Declines in the planting of grain crops are due to not only a plethora of technical/technological and economic reasons, but oftentimes are caused by a lack of funding for cultural control activities [18].

### Dynamics of grain crop yield

The region's grain crop yield is not sufficiently high. Evidence from practice indicates that most of today's agricultural organizations have yet to exploit the potential of Siberia's cropland to the fullest. In the period of 1990–2015, the lowest crop yield across the district's regions – 5.8 dt/ha – was registered in 1995 in the Tuva Republic and in 2005 in the Republic of Khakassia, while the highest one – 22.0 dt/ha – was posted by Krasnoyarsk Krai in 2015 (Table 3).

In the 25-year period, the district's average crop yield varied between 11.4 and 15.0 dt/ha.

Table 2. Land under cultivation, including land sown with grain crops across the regions within SFD ( in holdings of all categories), Thousand ha

Regions within SFD	All land under cultivation			Land sown to grain crops		
	2005	2010	2015	2005	2010	2015
SFD	15,258.6	14,555.4	15,026.7	10,224.0	9,484.6	9,883.3
Altai Republic	103.4	103.3	108.3	16.5	9.2	6.5
Republic of Buryatia	221.8	192.8	154.0	120.2	107.0	85.5
Tuva Republic	38.4	27.8	27.2	26.0	18.1	6.1
Republic of Khakassia	199.5	222.8	240.4	97.3	90.9	92.7
Altai Krai	5,191.3	5,149.3	5,394.3	3,609.2	3,393.6	3,632.1
Krasnoyarsk Krai	1,608.0	1,461.1	1,538.1	999.9	977.5	1,043.4
Zabaykalsky Krai	278.8	217.2	208.2	213.2	152.1	139.7
Irkutsk Oblast	715.4	639.0	675.3	426.3	358.0	410.5
Kemerovo Oblast	1,065.3	1,037.1	971.7	697.5	683.7	605.8
Novosibirsk Oblast	2,536.6	2,326.2	2,339.9	1,703.0	1,560.7	1,517.6
Omsk Oblast	2,911.8	2,797.5	3,029.4	2,069.7	1,893.5	2,146.0
Tomsk Oblast	388.4	381.3	339.9	245.1	240.4	197.6

Source: Russian Federal State Statistics Service, 2016 [16]

Table 3. Dynamics of grain crop yield ( in weight after processing) in SFD (in holdings of all categories), DT/ha

Regions within SFD	1990	1995	2000	2005	2010	2015
SFD	11.6	12.3	15.0	11.9	14.5	14.4
Altai Republic	10.9	7.8	13.8	13.1	13.1	10.9
Republic of Buryatia	14.9	9.4	12.3	8.8	12.7	7.7
Tuva Republic	8.5	5.8	9.1	6.2	9.9	8.2
Republic of Khakassia	10.2	9.8	7.9	5.8	14.6	13.0
Altai Krai	8.7	9.6	13.8	8.8	12.8	11.0
Zabaykalsky Krai	12.1	8.1	10.8	14.5	13.4	11.1
Krasnoyarsk Krai	16.5	16.1	18.6	16.2	21.3	22.0
Irkutsk Oblast	11.2	13.8	14.3	15.3	15.6	16.4
Kemerovo Oblast	15.3	15.0	14.6	15.0	17.3	17.1
Novosibirsk Oblast	12.1	14.2	17.0	10.9	15.1	14.5
Omsk Oblast	11.2	13.3	15.3	13.9	12.1	15.5
Tomsk Oblast	12.1	15.1	14.2	14.0	15.1	15.3

Source: Russian Federal State Statistics Service, 2016 [16]

### Dynamics of gross grain output and its structure in SFD

SFD is located in a risky arable farming zone. The area's natural/climatic conditions are having a significant effect on key production indicators of grain production in the district. The largest volumes of gross grain output (in

weight after processing) were recorded during the period of 1971–1975 (the most successful for agriproducers) – 18,639 thousand tons of grain, while the smallest volumes were posted between 1996 and 2000 – 11,024 thousand tons (Table 4).

Table 4. Dynamics of gross grain output (in weight after processing) in SFD (in holdings of all categories), Thousand tons

Regions within SFD	1971–1975	1976–1980	1981–1985	1986–1990	1991–1995	1996–2000	2001–2005	2006–2010	2011–2015
SFD	18,639	17,077	16,074	17,568	14,040	11,024	13,296	14,522	13,149
Altai Republic	35.7	36.3	29.2	47.7	24.0	12.0	17.5	13.9	8.1
Republic of Buryatia	480.5	278.0	427.5	501.4	317.0	240.4	105.0	85.0	87.7
Tuva Republic	130.2	105.7	105.9	135.6	89.4	23.7	19.2	12.4	12.2
Republic of Khakassia	377.4	257.5	348.0	377.1	243.4	145.5	96.1	94.1	144.1
Altai Krai	5,865.3	5,043.9	4,257.0	5,051.5	3,506.0	2,918	3,836	4,389	3,719.5
Krasnoyarsk Krai	2,490.8	2,194.2	2,513.2	2,431.7	2,325.0	1,762	1,826	1,979	2,164.5
Zabaykalsky Krai	941.4	824.4	861.6	1,113.3	625.1	263.9	220.2	194.6	153.7
Irkutsk Oblast	1,192.4	1,067.5	1,175.7	1,207.2	985.8	694.2	563.3	757.8	681.3
Kemerovo Oblast	1,146.3	1,034.5	1,008.0	1,203.4	931.3	738.1	968.4	1,357	908.3
Novosibirsk Oblast	2,753.0	2,539.4	2,327.4	2,504.0	2,255.0	1,982	2,370	2,475	1,993
Omsk Oblast	2,810.9	3,284.7	2,626.8	2,564.3	2,352.0	1,930	2,904	2,899	2,990.1
Tomsk Oblast	414.7	411.2	393.3	431.3	386.6	315.5	338.5	357.5	276.2

Sources: State Statistics Committee of the Russian Federation, 2003 [21] and Russian Federal State Statistics Service, 2016 [16]

The largest amount of grain is currently produced in Altai Krai, Krasnoyarsk Krai, Novosibirsk Oblast, and Omsk Oblast. The smallest amount of grain is produced in the Altai Republic and the Tuva Republic, which are characterized by natural/climatic conditions that are unsuitable for growing grain crops and where local holdings are gradually reducing the area sown to grain crops and shifting to other types of agricultural production [21, 12, 15]. It may help to not only focus on boosting gross grain output but reconsider the actual crops that are

grown. It may be worth focusing on growing high-protein grain legume crops in the district. Decreases in the district's land under grain cultivation are directly associated with decreases in cattle stock, as nearly 60% of produced grain is used for feeding purposes [6, 10, 11].

#### The district's agro-climatic potential and key indicators of its development

The authors have computed a set of indicators of grain production across SFD, based on the area's special characteristics.

Table 5. Indicators of the agro-climatic potential and crop yield of grain crops across the regions within SFD

	Agro-climatic potential of grain crops, thousand tons		Indicator of crop yield, dt/ha	
	2015	2025	2015	2025
SFD	13,803.6	22,704.0	14.4	22.9
Altai Republic	7.0	11.0	10.9	17.0
Republic of Buryatia	21.4	136.8	7.7	16.0
Tuva Republic	3.2	7.3	8.2	12.0
Republic of Khakassia	115.6	194.7	13.0	20.0
Altai Krai	3,940.4	8,172.2	11.0	21.0
Krasnoyarsk Krai	2,253.9	2,931.9	22.0	27.0
Zabaykalsky Krai	62.8	238.9	11.1	17.1
Irkutsk Oblast	551.7	985.2	16.4	24.0
Kemerovo Oblast	1,034.1	1,665.9	17.1	27.5
Novosibirsk Oblast	2,196.5	3,551.2	14.5	23.4
Omsk Oblast	3,316.7	4,334.9	15.5	20.2
Tomsk Oblast	300.3	474.2	15.3	24.0

Source: Russian Federal State Statistics Service, 2016 [16].

Agro-climatic potential across SFD's natural regions varies between 9 and 45 dt/ha. Table 5 lists indicators of grain crop yield and the lands' agro-climatic potential for the period through to 2025.

Based on the authors' estimates, grain production in the district is projected to increase to 22,704.0 thousand tons, with SFD's average crop yield expected to rise to 22.9 dt/ha [2].

### **Focus areas for the development of grain farming in the region**

One of the most promising areas for boosting the region's gross grain output is seed farming. It is impossible to overestimate the role of seed farming in enhancing and boosting grain farming in the district as a whole or any individual region within it in particular. Even when there are delays or a total lack of compensation on seed variety upgrades, investment in this activity is known to pay off within a year's time. Seed farming is gradually recovering in the region. If just 10 years ago the sector was running mainly based on enthusiasm, right now things have improved substantially, with domestic released varieties with improved characteristics increasingly entering the market [9, 20]. These include the following varieties of wheat: Siberian 17, Omsk 38, Novosibirsk 31, Novosibirsk 44, Bagan 95, and Ob 2; oats: Sig, Orion, Irtysh 22, and Rovesnik; barley: Omsk naked, Sibirsky Avangard, Biom, and Tanay.

Under Resolution of the Government of the Russian Federation No. 1432, in force since 2013, agriculturists can get 15–20% off when purchasing machinery manufactured domestically, which has helped drive the demand for domestic machinery up significantly in recent years. In addition, in 2016 the Russian government signed into law 'The Strategy for the Development of Russia's Agricultural Machinery Industry for the Period through to 2030', which means there will be state support for enterprises operating within the sector [19].

SFD possesses unique genetic reserves of grain crops which are among the world's greatest, which makes it possible for holdings in just about any of its regions to produce

grain of the highest quality. Having said that, the current volumes of production of the first-class and second-class grain are not too large. For the most part, the fourth- and fifth-class wheat is grown. There are various causes behind declines in the planting of strong varieties of grain crops, including the technological, economic, and organizational factors. To enhance the quality of grain, the government may need to provide support for regional seed development and breeding work across the district, approach grain production, harvesting, and processing as a single process with a common flow scheme, and employ monitoring of the quality of grain as a tool for regulating the domestic grain market and developing grain exports [13].

To attain target indicators, the following key activities may need to be carried out:

- (i) Restoring neglected cultivation areas to plant grain crops on them and making changes to the structure of land under grain by reference to the region's agro-climatic potential;
- (ii) Renewing and continuing work related to building new melioration systems for irrigating grain crops;
- (iii) Reviving regional seed development stations and encouraging the use of superior-generation released seeds of Russian design;
- (iv) Employing cutting edge technology and machinery by reference to the region's natural/climatic characteristics;
- (v) Employing integrated protection for plants by reference to the latest solutions designed to boost the effect of applying mineral fertilizers and agrichemicals.
- (vi) Implementing the differentiated deployment of grain crops by reference to the region's specialization and natural potential, which will have a direct effect on the quality of grain.
- (vii) Employing the latest technology for harvesting, drying, and storing grain to enable preserving the quality of grain (gluten and protein).

Right now, of added relevance is the issue of grain exports. In modern economics, the export of grain is testimony to stability within the nation, which is able to provide with food not only its own population but also make

steady shipments to the external market. During the period between the late 19th and early 20th centuries, Russia was a key supplier of grain in the world market, while in the late 20th century it was importing grain. During the early 2000s, the nation's grain policy underwent radical changes, as a result of which as early as in 2005 the nation's grain exports exceeded 10 million tons, and in 2014 Russia ranked among the world's top grain exporters. In 2017, after achieving a record grain harvest of 137.2 million tons, the Russian Federation became the world's top grain exporter. With wheat currently being a staple of the nation's grain exports, Russia also exports barley, corn, soybeans, and rye. In 2017, barley exports increased 2 times, and corn exports rose 12 times [1]. The amount of grain shipped from SFD is not too large at the moment – around 3%. It is mostly supplied to the country's northern regions. To further develop its export potential, the region will need to not just boost its grain output but improve on its key performance indicators, as well as focus on advanced grain processing.

## CONCLUSIONS

SFD is Russia's second largest federal district by area and third by population. It is Russia's fourth largest grain producer, contributing to 16% of the nation's total grain production.

The largest grain planting acreages are in Altai Krai, Omsk Oblast, and Novosibirsk Oblast. The least amount of acreage – about 1% – is supplied by the Tuva Republic and the Altai Republic.

In the 25-year period of 1990–2015, the average crop yield across the district ranged between 11.4 and 15.0 dt/ha. In the above period, the greatest grain crop yield was recorded in Krasnoyarsk Krai – 22 dt/ha, and the lowest one in the Tuva Republic and the Republic of Khakassia – 5.8 dt/ha. SFD's average gross grain output ranged between 11,024 and 18,639 thousand tons. The greatest amount of grain is currently produced in Altai Krai, Krasnoyarsk Krai, Novosibirsk Oblast, and Omsk Oblast.

One of the potential areas for boosting the region's gross grain output is seed farming,

with a focus on shifting to domestic released varieties with improved characteristics.

Due to natural/climatic factors, a portion of grain farming in the Siberian region is focused on feeding grain, which is used for livestock breeding.

Therefore, it may help to not just focus on boosting the region's crop yield and gross grain output but reconsider the actual crops that are grown. It may be worth growing sought-after crops and high-protein grain legume crops.

If new technology is used, the regions' agro-climatic potential could help increase its crop yield to 22.9 dt/ha and its gross grain output to 22,704.0 thousand tons by the year 2025.

## REFERENCES

- [1]AB-Centre, (n.d.), Strany-eksportery pshenitsy, strany-importery pshenitsy [Wheat exporter nations and wheat importer nations], <http://ab-centre.ru/page/strany-eksportery-pshenitsy-strany-importery-pshenitsy>, Accessed 15.12.2017.
- [2]Aleshchenko, V. V., Chupin, R. I., Aleshchenko, O. A., 2017, Ekonomicheskaya effektivnost' ispol'zovaniya v Zapadnoi Sibiri sortov pshenitsy Omskogo GAU s kompleksnoi ustoichivost'yu k bolezniam i zasukhe [The economic effectiveness of using in Western Siberia wheat varieties from Omsk State Agrarian University with integrated resistance to diseases and drought], Vestnik NGAU, 1: 214–225.
- [3]Altakraistat, 2017, Agro-industrial complex of the Siberian Federal District, 2012–2016. Barnaul.
- [4]Altukhov, A. I., 2005, Sovremennye problemy razvitiya zernovogo khozyaistva i puti ikh resheniya, FGUP VO Minsel'khoza Rossii [Current issues in the development of grain farming and ways to resolve them], Moscow .
- [5]Altukhov, A. I., Nechaev, V. I., 2016, Ekonomicheskie problemy innovatsionnogo razvitiya zernoproduktovogo podkompleksa Rossii [Economic issues in the innovation-driven development of Russia's grain subcomplex]. APK: Ekonomika, Upravlenie, 3: 92–93.
- [6]Chernova, S. G., Sibirtseva, A. S., 2018, Sovremennye problemy kachestva zerna i izdelii iz nego [Current issues associated with the quality of grain and products made from it] in Proceedings of The Integrated Development of Rural Areas and the Use of Innovative Technology within the Agro-Industrial Complex: 3rd International Onsite and Offsite Research-and-Methodological and Research-to-Practice Conference, Novosibirsk, January 16, 2018, 207–211, Siberian Research Institute of Agricultural Economics, Siberian Federal Scientific Center for

Agrobiotechnology of the Russian Academy of Sciences, Novosibirsk.

[7]Donchenko, A. S., Kalichkin, V. K., Denisov, A. S. (Eds.), 2016, Mezhregional'naya skhema razmeshcheniya i spetsializatsii sel'skokhozyaistvennogo proizvodstva sub"ektov Rossiiskoi Federatsii Sibirskogo federal'nogo okruga: Rekomendatsii [The interregional scheme for the deployment and specialization of agricultural production in RF constituent entities within Siberian Federal District: Recommendations], FGBU SO AN, Novosibirsk

[8]Goncharov, P. L., Donchenko, A. S., Shelepov, V. G., 2004, Agrarnaya nauka Sibiri [Siberia's agrarian science] (2nd ed.), IPTs Yupiter, Novosibirsk

[9]Khrabskov, E. N., Zagovalova, E. M., 2015, Sovremennaya praktika analiza riskov vyrashchivaniya ozimnykh zernovykh kul'tur, [Today's practice of analyzing risks inherent in growing winter cereals]. APK: Ekonomika, Upravlenie, 3: 67–70.

[10]Kovaleva, I. V., 2017, Prioritetnye napravleniya realizatsii gosudarstvennykh i vedomstvennykh tselevykh programm razvitiya sel'skogo khozyaistva Altaiskogo kraia [Priority areas for implementing state and local special-purpose programs for the development of agriculture in Altai Krai], Vestnik Altaiskogo GAU, 5: 182–186.

[11]Mezhina, M. V., Mezhin, S. S., 2015, Razvitie agrarnogo sektora APK Altaiskogo kraia [The development of the agrarian sector of the agro-industrial complex of Altai Krai], Vestnik Altaiskogo GAU, 7: 176–181.

[12]Novosibirsk Oblast Territorial Body of the Russian Federal State Statistics Service, 2017, Sibirskii federal'nyi okrug-2016: Statisticheskii sbornik. [Siberian Federal District-2016: A statistical digest], [http://novosibstat.gks.ru/wps/wcm/connect/rosstat\\_ts/novosibstat/ru/news/](http://novosibstat.gks.ru/wps/wcm/connect/rosstat_ts/novosibstat/ru/news/), Accessed 21.12.2017.

[13]Stadnik, A. T., Chernov, S. V., Grigor'ev, N. V., 2018, Sovershenstvovanie zernovoi politiki i mery po ee resheniyu (Enhancing grain policy and measures to resolve it), in Proceedings of The Integrated Development of Rural Areas and the Use of Innovative Technology within the Agro-Industrial Complex: 3rd International Onsite and Offsite Research-and-Methodological and Research-to-Practice Conference, Novosibirsk, January 16, 2018, 181–184, Siberian Research Institute of Agricultural Economics, Siberian Federal Scientific Center for Agrobiotechnology of the Russian Academy of Sciences, Novosibirsk.

[14]Rasporyazhenie Pravitel'stva Rossiiskoi Federatsii ot 7 iyulya 2017 goda N 1455-r "Ob utverzhenii Strategii razvitiya sel'skokhozyaistvennogo mashinostroeniya Rossii na period do 2030 goda". [Ordinance of the Government of the Russian Federation No. 1455-r 'On Signing into Law the Strategy for the Development of Russia's Agricultural Machinery Industry for the Period through to 2030' of July 7, 2017], <http://docs.cntd.ru/document/436748452>, Accessed 20.12.2017.

[15]Russian Federal State Statistics Service, (n.d.), Katalog publikatsii [Publications catalogue], [http://www.gks.ru/wps/wcm/connect/rosstat\\_main/rosstat/ru/statistics/publications/catalog/](http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/ru/statistics/publications/catalog/), Accessed 18.12.2017.

[16]Russian Federal State Statistics Service, 2016, Regiony Rossii: Sotsial'no-ekonomicheskie pokazateli Statisticheskii sbornik. [Russia's regions: Social/economic indicators (2016): A statistical digest], [www.gks.ru/free\\_doc/doc\\_2016/region/reg-pok16.pdf](http://www.gks.ru/free_doc/doc_2016/region/reg-pok16.pdf), Accessed 21.12.2017.

[17]Sel'skoe khozyaistvo v Novosibirskoi oblasti: Sbornik. Period 2010-2016 gg (po katalogu 8.12), [Agriculture in Novosibirsk Oblast: A digest. The period 2010–2016 (Catalogue 8.12)]. (2017), KMB Novosibirskstata, Novosibirsk

[18]Sharavina, E. V., Stadnik, A. T., Denisov, D. A., 2017, Neobkhodimost' nauchno obosnovannoi sistemy vedeniya sel'skokhozyaistvennogo proizvodstva v usloviyakh politiki importozameshcheniya, [The need for a scientifically substantiated system of running agricultural production in a climate of a policy of import substitution]. Vestnik Novosibirskogo GAU, 1: 246–255.

[19]Stadnik, A. T., Chernova, S. G., Denisov, D. A., Chernov, S. V., 2015, Regulirovanie ekonomicheskikh vzaimootnoshchenii v kooperativnykh formirovaniyakh, Ekonomika Sel'skokhozyaistvennykh i Pererabatyvayushchikh Predpriyatii, [Regulating economic relationships in cooperative institutions], 9: 19–22.

[20]Stadnik, A. T., Samokhvalova, A. A., Denisov, D. A., 2015, Sovershenstvovanie mekhanizma upravleniya zemel'nymi resursami Novosibirskoi oblasti [Enhancing the mechanism underlying the management of land resources in Novosibirsk Oblast], Vestnik Novosibirskogo GAU, 4: 230–237.

[21]State Statistics Committee of the Russian Federation, 2003, Rossiiskii statisticheskii ezhegodnik-2003: Statisticheskii sbornik, [Russian statistics yearbook-2003: A statistical digest], [http://www.gks.ru/wps/wcm/connect/rosstat\\_main/rosstat/ru/statistics/publications/catalog/doc\\_1135087342078](http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/ru/statistics/publications/catalog/doc_1135087342078), Accessed 10.12.2017.

## METHODOLOGICAL FOUNDATIONS OF THE ORGANIZATION AND PROTECTION OF LANDS IN THE CONTEXT OF THE BALANCED NATURE USE

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### *Abstract*

*One should determine that the necessary prerequisite for the balanced land use in the agricultural sector is the application of instruments for the organization and protection of agricultural lands, which include a list of land management documentation and land protection measures. The methodological foundations of the combination of land management and lands protection measures into a single system of instruments, which will be aimed at ensuring the balanced nature use, are justified. The state of the development of land management projects and the financing of works on the protection and rational use of land is analyzed. The system of application of instruments for the organization and protection of lands is revealed. The essence of the system of the application of instruments is a comprehensive approach to the organization and protection of the territory that will ensure a balanced use of both land and natural resources.*

*Key words:* land management, organization and protection of lands, balanced nature use, agricultural lands

### INTRODUCTION

Under modern conditions, economic methods on agricultural lands provide for constant concern of the scientific community, state authorities, landowners and land users. Permanent load of agricultural producers to land resources requires decisive steps from legislative and executive authorities [12]. If the agricultural lands market is created, then the rational and efficient land resources use is one of the crucial tasks of ensuring the balanced nature use.

The necessary prerequisite for the balanced land use in the agricultural sector is the application of instruments for the organization and protection of agricultural lands [10], which include a list of land management documentation and land protection measures. Land management documents ensure an effective organization and establish norms and rules for the lands use by economic entities, the state and society from the national level to the level of a separate land plot.

Despite the relevance of the use of instruments for the organization and

protection of agricultural lands, the number of the accomplished land management projects and land protection measures is not sufficient to reproduce and restore the qualitative indicators of land resources.

Its reasons are the imperfect funding mechanism and the lack of a clear legally regulated system.

Both land organization and protection instruments are necessary to apply in accordance with this system.

Therefore, today it is of vital importance to find ways to improve the system of application of instruments for the land organization and protection.

Unfortunately, such scholars as O. Atamaniuk [1], V. Budziak [2], D. Dobriak [3], A. Martyn [8], M. Stupen [11, 13], A. Tretiak [14], A. Shvorak [9] did not provide the practice of ensuring the balanced land use when the effective land protection system has not been formed yet.

Under the prevailing conditions, it is expedient to improve the system of the comprehensive application of instruments for

the organization and protection of agricultural lands.

## MATERIALS AND METHODS

In the course of conducting research, a monographic method was used in the study of scientific publications on the issues of sustainable use of agricultural lands. The systematic method is used to study the patterns, tendencies, and features of the balanced nature use. Information on the directions of implementation of the system of land protection measures is studied on the basis of economic analysis [7]. Making theoretical generalizations and the formation of conclusions, and the improvement of instruments for the protection and use of land are accomplished using the abstract and logical method. An algorithm was developed in the research. According to it, documentation on the land organization and lands protection measures will be combined into a single system of instruments for the organization and protection of agricultural lands, which will be aimed at ensuring the balanced nature use.

## RESULTS AND DISCUSSIONS

In Ukraine since the beginning of conducting the land reform, it is impossible to speak about the existing balanced agricultural land use despite the great land and resource potential. A significant list of ecological and economic, organizational problems relating to agricultural lands is the evidence to it. These problems are the following ones [1]:

- the tendency to deteriorate soils quality as a result of anthropogenic factors;
- the intensity of erosion processes;
- a high level of soil contamination;
- unfavorable changes in the hydrological regime, processes of desertification and waterlogging;
- environmental pollution with an excessive amount of mineral fertilizers and pesticides;
- extensive methods of development of agricultural commodity producers;
- low level of land use productivity;

-a high share of agricultural lands in the composition of the productive forces of the state;

- the lack of a coherent environmental policy in the country, etc.

According to the basic principles of sustainable development, one must develop the balanced agricultural lands use, ensuring the proper living standards of the local population, environmental safety, and agricultural production, but these tasks cannot be realized without solving the above-mentioned problems. One should focus on the organization and protection of agricultural lands among the directions of solving environmental, economic and organizational problems of agricultural land use. However, a clear list of measures for agricultural lands protection is not specified in the legislation [6].

Ensuring the balanced land use is possible only with the help of instruments that allow taking into account the features of the relative territorial unit. Therefore, the main instrument of the providing for the balanced use and protection of lands should be land management as a set of social and economic and environmental measures aimed at regulating land relations and rational organization of the territory of administrative and territorial entities, economic entities carried out under the influence of social and industrial relations and the development of productive forces [5].

Taking into consideration the experience of Ukraine, mainly not very successful creating of the land relations system, and current tendencies, there is a necessity for a rethinking of the relationship to the land management. Today, most civilized countries are strengthening the state influence on the land system and actively interfere with private property in order to realize public interests, first of all in the ecological and social and economic spheres, methods of state land management [14].

One should implement the effective process of organization and protection of land ownership and land use in a complex manner, in accordance with existing land management schemes and technically economic studies on

land use and protection, preliminary assessment of available ecological, economic, organizational land use problems. Therefore, it is expedient to use instruments for the organization and protection of agricultural lands in the performance of various types of works and measures that can be combined depending on the ecological state of lands, economic opportunities, the organizational

and legal form of economic entities and other factors [1]. Analyzing the state of the development of land management projects concerning the setting of boundaries of localities in Lviv region (Table 1), we observe that they are not properly implemented primarily in the territories of Horodok, Skole and Turka districts.

Table 1. The state of the development of land management projects concerning the setting of boundaries of localities in Lviv region for 2016

Administrative district	Area, ha						Boundaries of localities are set and changed according to land management projects
	Cities of district significance		Settlements		Villages		
	all, ha	out of them according to land management projects on the setting and changing boundaries	all, ha	out of them according to land management projects on the setting and changing boundaries	all, ha	out of them according to land management projects on the setting and changing boundaries	
Brody	898.4		355.1		16,202.3	1,541.8	1,541.8
Busk	1,066	1,066	822.6		15,690.7		1,066
Horodok	623.6		389		14,423.9		-
Drohobych			1,224		20,790	1,074	1,074
Zhydachiv	2,175.9	831.9	1,356		18,182		831.9
Zhovkva	2,267		449		20,194	831.5	831.5
Zolochiv	1,629	1,172.3	368.1		21,739.2		1,172.3
Kamianka-Buzka	678.8		700.6		10,587	1,865.2	1,865.2
Mykolaiiv	553.1	553.1	256		9,395.7		553.1
Mostyska	2,503.5	2,503.5			17,512.8	63.4	2,566.9
Peremyshliany	855.4	390.4			17,221		390.4
Pustomyty	1,176.6	1,176.6	636		25,176.3	1,589.7	2,766.3
Radekhiv	838.8	838.8	767.8		14,075		838.8
Sambir	367	838.8	532		17,579.5	552.7	1,391.5
Skole	437		950		10,712		-
Sokal	2,572.5	1,247.5	444.4		22,768.4		1,247.5
Staryi Sambir	1,785.5	1,442.5	631.4		29,564.7		1,442.5
Stryi			349.3		11,539.8	332.3	332.3
Turka	258.5		330		27,166.2		-
Yavoriv	2,184.4	2,184.4	1,056.7	210.8	18,399.4	1,016.7	3,411.9
All	24,632	15,808.8	13,970	210.8	358,919.9	8,867.3	23,345.9

Source: Own calculation on the basis of data [7]

In Fig. 1 the system of application of instruments on lands organization and protection was reproduced. Land management projects that provide ecological and economic justification for crop rotation and lands ordering are the only comprehensive instrument for the use and protection of land for agricultural lands, since these projects are developed for the organizing agricultural production, the regulation of agricultural lands within land tenure and land use for the effective management of agricultural production, rational use and protection of lands, the creation of a favorable ecological environment and the improvement of natural landscapes [4].

The availability of one land management project is not sufficient for the existing needs of agricultural lands use since it does not include separate measures on land protection. Whereas comprehensive instruments for the use and protection of agricultural lands mainly include measures on land management, it is necessary to improve the methodological foundations of drafting land management projects and to expand their types. First of all, there is a demand to improve the documentation on internal economic land management of the territories of modern agricultural producers.

The essence of the system of the application of instruments on the organization and

protection of lands is that land use cannot be considered as a separate array, since each land plot is one of the links of a certain agro-

landscape and, accordingly, planning of its use is possible taking into account the features and conditions of its location.

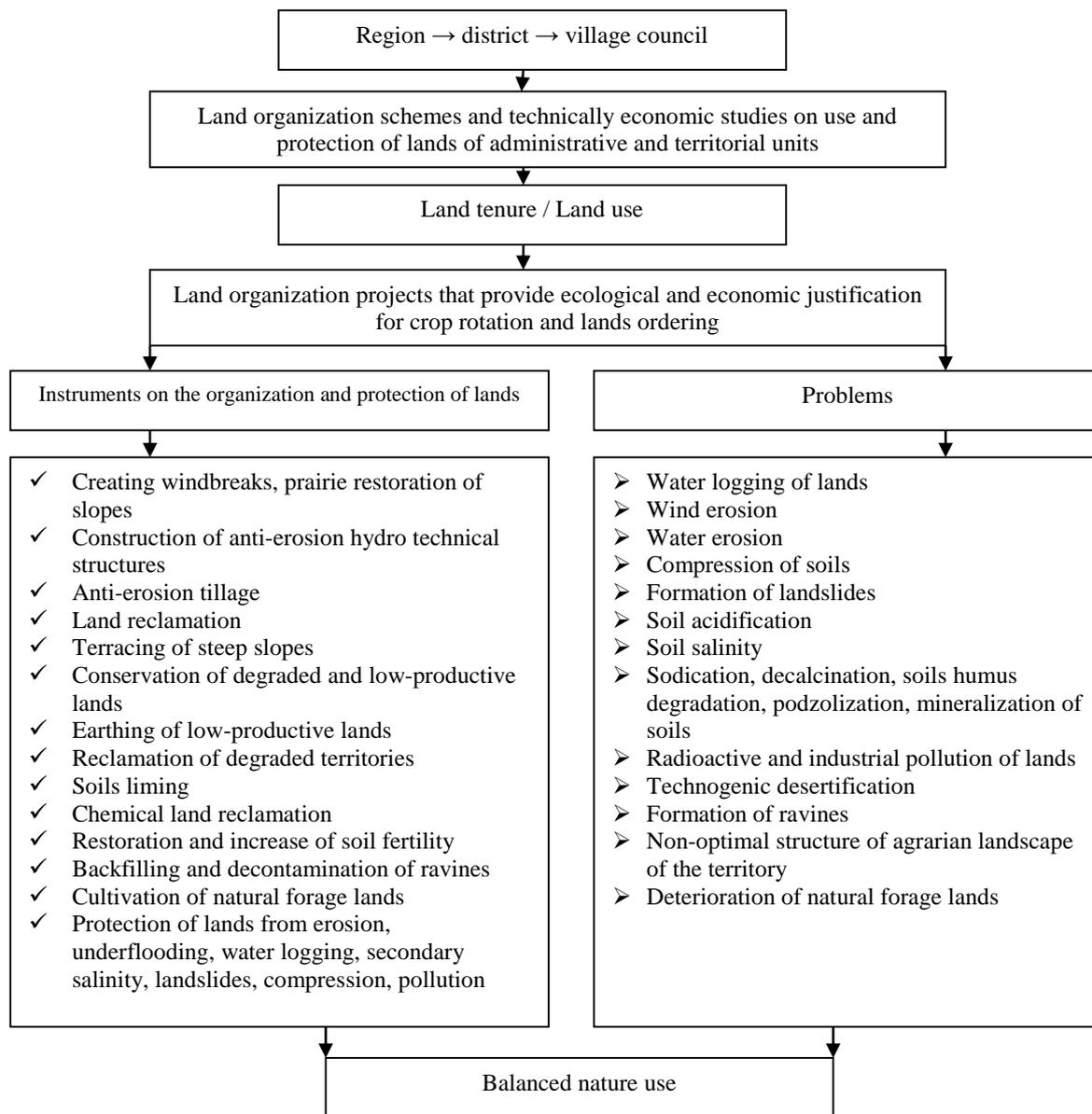


Fig. 1. The scheme of application of instruments on lands organization and protection  
 Source: it is done by the author

Only a comprehensive approach to the organization and protection of the territory will ensure a balanced use of both land and natural resources.

The real instrument for solving the above-mentioned problems is the financing of land protection in Lviv region (Table 2), which increased by 7% in 2016 in comparison to 2014.

Today, the system of stimulation of scientifically grounded use of agricultural lands is quite imperfect. Therefore, the next scientific task in the direction of development of the balanced land use by instruments on the organization and protection of lands is the search of a mechanism of their financial support.

Table 2. The state of funding of works on the protection and rational use of lands in Lviv region

Types of works	2014		2015		2016	
	area, thousand ha	cost, thousand UAH	area, thousand ha	cost, thousand UAH	area, thousand ha	cost, thousand UAH
Development of land management projects on delimitation of state and communal property	116.52	7,072.85	423.76	20,393.25	547.5	23,905
Establishment of boundaries of districts	554.2	2,541.2	554.2	2,541.2	554.2	2,541.2
Development of land management projects on the setting and changing boundaries of localities	422	16,592.4	423	16,718	433	17,094.5
Inventory of state lands	77.7	194,127.9	77.7	194,127.9	77.7	194,127.9
Conservation of degraded, low-productive and technogenically polluted lands	10	65.6	10	65.6	10.2	65.6
The scheme of land management and technical and economic justification of land use and protection	532.6	636	532.6	636	532.7	636
Land management project that provides ecological and economic justification for crop rotation	90	1,260	90	1,260	90	1,260
Conducting works on normative monetary valuation of settlements	39.13	2,800.1	36.56	2,647.1	33.72	2,500.2
<i>All, UAH</i>	<i>225,096.1</i>		<i>238,389.1</i>		<i>242,130.4</i>	

Source: Own calculation on the basis of data [7]

## CONCLUSIONS

All in all, one cannot apply successful instruments for the organization and protection of agricultural lands autonomously, without taking into consideration the conditions of the region. It is significant to study the features of land use in detail when applying these instruments. This task can be fulfilled using schemes of land management of the village (settlement) council or district. Due to the documentation of land management, one can identify the features of the location of land use and attach the key parameters of its use to it, choose the necessary set of instruments, their application is needed to eliminate or prevent the emergence of environmental problems. The information, which is included in land management projects, in combination with land protection measures, will provide a scientifically based choice of instruments for the organization and protection of agricultural lands in accordance with the existing conditions of land use and the functioning of economic entities in agriculture. So, such an approach can be considered one of the major principles of balanced nature use.

## REFERENCES

[1]Atamaniuk, O., 2016, Ecological and Economic Instruments of the Organization and Protection of

Agricultural Lands: Thesis of the Candidate of Economic Sciences, Kyiv, 215 p.

[2]Budziak, O., Budziak, V., 2017, Problems of Management of Ecologically-safe Land Use. Journal "Agrosvit", Kyiv, 5: 3-9.

[3]Dobriak, D., 2012, Problems of Modern Land management. Land Management Herald, Kyiv, 1: 30-34.

[4]Kotykova, O., 2015, Classification of Land management Documentation of Agricultural Lands. Innovative Economics, Kyiv, 2: 121-126.

[5]Law of Ukraine № 858-IV from May 22, 2003, On Land management. URL: <https://zakon.rada.gov.ua/laws/show/858-15/card2>, Accessed on 14.01.2019.

[6]Law of Ukraine № 962-IV from June 19, 2003, On Land Protection. URL: <https://zakon.rada.gov.ua/laws/show/962-15/card4>, Accessed on 14.01.2019.

[7]Lviv City Council, 2019, The Development Program of Land Relations in Lviv Region for 2011-2015. URL: [https://loda.gov.ua/agr\\_prohramy](https://loda.gov.ua/agr_prohramy). Accessed on 15.01.2019.

[8]Martyn, A., Shevchenko, O., 2014, Problems of Agricultural Lands Protection under Land Reform Completion. Land management, Cadastre and Monitoring of Lands, Kyiv, 1-2: 48-56.

[9]Shvorak, A., 2013, Regional Features of Agricultural Lands Consolidation. Land Organization and Cadastre, Kyiv, 3: 9-16.

[10]Stupen, R., Ryzhok, Z., 2018, Methodological approaches on the effective land resources use in the regions of Ukraine. Scientific Papers. Series "Management, Economic Engineering in Agriculture and Rural Development", Vol. 18(4): 353-359.

[11]Stupen, R., Stupen, O., 2018, Formation of energy resources potential of rural territories. Engineering for Rural Development: the 17<sup>th</sup> International Scientific Conference, Latvia, 1639-1643.

[12]Stupen, R., Stupen, M., Stupen, O., 2018, Prospects of the land – rental relations development in agriculture of Ukraine. Scientific Papers. Series “Management, Economic Engineering in Agriculture and Rural Development”, Vol. 18(3), 441-448.

[13]Stupen, N., Stupen, M., Stupen, O., 2018, Electronic agricultural maps formation on the basis of GIS and earth remote sensing. Scientific Papers. Series “Management, Economic Engineering in Agriculture and Rural Development”, Vol. 18(4): 347-353.

[14]Tretiak, A., Dorosh, O., Tretiak, N., 2011, New Paradigm of Land management in Land Policy of Ukraine. Land Management Herald, Kyiiv, 1: 10-16.

## METHODOLOGICAL FUNDAMENTALS OF THE ASSESSMENT OF THE RECREATIONAL TERRITORIES RESOURCE POTENTIAL

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### *Abstract*

*The methodological approach to the comprehensive assessment of the recreational territories resource potential which implies an integral index use that takes into account the system of indicators according to the following components: nature and resource, historical and cultural, social and economic and ecological ones, has been made on the basis of the analytical generalizations and identified problems in the recreational resources study. Applying the proposed methodological approach according to type and component principle will enable to identify regions with similar natural properties, social and economic state, infrastructure support with the purpose of effective spatial planning of the recreational sphere development, as well as to determine the strategic directions of the recreational territories resource potential implementation. On the basis of the developed methodical approach, an assessment of the level of the recreational territories resource potential in Ukraine has been done. According to the calculations of the integral index, conducted in the regions of Ukraine, they have been grouped as to the following levels of the recreational territories resource potential: high, medium, low and very low. It is established that the Autonomous Republic of Crimea (final assessment 0.78) has the optimal conditions for the implementation of resource potential and the development of recreational territories among the regions of Ukraine. The potential is lower in Lviv (index – 0.61), Odesa (0.54) and Transcarpathian (0.51) regions. At the same time, most regions of Ukraine have a low level of the recreational territories resource potential compared to the best analogs in the country.*

*Key words:* recreational territories, resource potential, integral index use, spatial planning

### INTRODUCTION

To begin with, the recreational territory has been formed by a recreational offer based on the high density of attractors, special characteristics (nature, scenery, and landscape), developed tourist infrastructure, social and economic potential, favorable environmental conditions, etc. The territory undergoes a priority or perspective transformations under the limited financial capacity of the region, depending on the level of development of the listed factors.

Recreational territories development modeling means the implementation of such an algorithm of research: inventory of recreational resources and capacity of the territory (at this stage it is supposed to find out the quantity, mutual location, the specificity of attractor objects that have already been used or the potential ones); spatial grouping of attractor objects aimed at detecting the nodes of the tourist and

recreational network and its boundaries within the territory; the selection of certain recreational territories (at this stage, it is supposed to indicate the priority of the development for each of them as to the recreation, the justification of specialization, the pointing out of the most promising directions of its development). Moreover, at this stage, the conclusion is made about the level of the possibility (impossibility) of the development of the territory as a recreational one together with objectively existing manifestations of nature use at that time. As a result, one can also sum up about the full or partial reorientation of nature use in the territory.

The balanced development of recreational territories is indissolubly related to the use of recreational resources and recreational potential of these territories in general. Based on the assessment and classification of recreational resources, recreational zoning of the territory is carried out according to certain

characteristics, which is the most crucial instrument for the territorial planning of the recreation development and it should be taken into account in the schemes of territorial planning.

## MATERIALS AND METHODS

Today, there are plenty of methodological approaches to the assessment of recreational resources and the potential of recreational territories (recreational potential). The ecosystem (environment), the system of recreation within the defined territory as a whole, its components and their constituents can be assessed. Mainly, the recreational potential of a certain territory can be assessed using natural indicators, based on the definition of its capacity, occupied area, as well as cost assessment. The assessment of the recreational potential of the territory carried out by the use of such natural indicators allows solving the problem of organizational measures of planning and location of recreational establishments, as well as the relevant spheres, determining the degree and correlation of their development. In addition, this assessment has a clear application [3].

In our opinion, the tasks of the resource approach to exploring the potential of recreational territories are the following ones: studying the quantitative and qualitative composition of the recreational territory resources, assessing the availability of recreational potential according to the relevant resources, determining the level of the relevance of the spatial configurations of the diversity of natural resources potential and the existing recreational functionally directed zoning of the territory, assessing the intensity level of natural resources use and its social and ecological and economic efficiency, identifying directions of the actuality of existing recreational resources during the exaltation of these territories.

Other scientists (for example, S. Boholiubov, M. Iliina, V. Kyfiak) suggest the resource potential of the territories to be assessed on the following positions [2; 5; 8]: numerical resources assessment based on their attractiveness, survey time, ecological load, as well as number of tourists per unit of resource; qualitative assessment of resources, which will allow to realize the optimization of the available potential of recreational territories; research of resources, which have not been used yet, considering the

social and economic stability of specific recreational territories.

The authors of the provided methodology suggest the formation of a cadastre of recreational territory resources, based on their economic or environmental assessment. According to their vision, one should make this assessment on the basis of the specialists' considerations on this issue (that is, using mark assessment), as well as taking into account the tourists' views, and ultimately identifying the strengths and weaknesses when implementing the potential of recreational territories. Thus, the foundation for assessing the potential of the territories is a cadastre of recreational resources, which may be incorporated into the concept or the target program for the development of recreational services of the territory.

S. Shabalina, V. Rubtsov, and E. Baibakov consider that the complex recreational potential assessment contains an algorithm for this assessment, including the individual components. Methodological approaches, proposed by the authors, provide for the division of the territory into operational and territorial units for each of the selected indicators. Then their totality is ranked in accordance with the properties that characterize this indicator. Then the interrelation of these indicators is established by the factors of influence on the use of the territory resource potential [12]. Methodological foundations of the recreational territories resource potential assessment for the recent years have been enriched by the approach, proposed by the professor of Kyiv National University named after Taras Shevchenko O. Beidyk [1], who carried out an integrated assessment of the recreational resources of Ukraine and formed a resource and recreational rating of the regions of Ukraine on this basis.

Yu. Shabardina [13, p. 55], having studied the recreational potential, proposes to make its diagnosis through the prism of two components: an assessment of recreational activity, in particular, via activity indicators to meet the recreational needs for health and recreation, services of historical and cultural objects, and tourism services; recreational potential assessment through indicators of historical and cultural heritage, natural and recreational, infrastructure, innovation and investment resources, and the state of the environment.

In addition, D. Stechenko and I. Bezuhlyi offer recreational potential assessment to be carried out in two stages. At the first stage, one should single out the recreational potential of the territory as a

whole and define its territorial boundaries. Only those components of the environment and cultural and historical objects, which are used or can be used for recreational purposes, are provided in such a research. At the second stage, one analyzes the component structure of the recreational potential of the territory, particularly, natural and cultural and historical recreational resources from the point of view of the development of various types of recreation and their role in the structure of the economy of the region [14].

O. Samko recommends to assess the recreational potential using the integral method, assessing certain components, in particular, infrastructure, intellectual, cultural and historical, information ones [11]. It is worth agreeing with the possibility of using the integral method for assessing the recreational territories resource potential, but the source data, used by the author, need further justification.

In Yu. Khudenkyi's view, an integrated assessment of the tourist and recreational potential of the territory is a normative and comparative method of assessing marks of the potential of the territory [7]. The assessment has been done on the basis of normatively-established, publicly available, reliable indicators. It reduces the influence of the subjective researcher's representations while trying to take into account all the diversity of components of the potential, which only complicates the assessment and increases the risk of mistakes at a certain stage [4]. Therefore, suggest using a minimum set of the most representative indicators. It gives an opportunity, with less time consuming, to assess the potential of one territory relative to another one, which allows you to determine the share of each territory, both in a separate component and in their totality in the region.

All in all, one can conclude that all of the above-mentioned methods are distinct, usually associated with the transfer of potential elements based on the selected profile of research (natural, economic, social and cultural, etc.). Thus, despite the scientists' significant contribution and their achievements in the field of methodology of assessment approaches to the research of the recreational territories resource potential, their application is accompanied by a weak elaboration of a plenty of theoretical and methodological problems, in particular the selection of the subject and object of assessment at the territorial level, the criteria and assessment indicators in terms of potential components, completeness of information provision in assessing indicators,

bringing assessment indicators to a single measurement system, methods of the defining the importance of a component in the structure of the integral indicator.

## RESULTS AND DISCUSSIONS

Generally, the major requirements for the assessment conducting of the characteristics of territories for recreational zoning include: the necessity to build an integral indicator of the assessment of recreational territories in order to identify and rank the most attractive recreational territories; the integration of statistical and expert approaches in the course of rating assessment; combining quantitative and qualitative marks; the consolidation method use of assessment (ranking) of attractive recreational territories for ensuring its simplicity and appropriateness for managers, etc.

The main reason for recreational territories resource potential assessment lies in the fact of the possibility to identify and assess reserves, the economic efficiency of cost on the reproduction of its constituent elements. The setting of research purposes of recreational territories resource potential assessment provides for the delimitation of the observation object and development of indicators system that characterizes it. Based on the obtained data regularities of the processes of the recreational potential use are revealed and relationships between the studied indicators, qualitative analysis of which is the basis for the development and efficient managerial solutions, are identified [10; 15].

At the same time, the expediency of the analysis methods application implies the selection of a number of certain requirements that allow assessing the level of recreational potential of territories systematically and, on this basis, applying the instruments of their effective influence on the effectiveness of the recreational sphere. One should evaluate the structural elements that are part of recreational territories resource potential in order to assess and analyze it. This representation can be obtained by establishing the best interrelation of dynamic characteristics of indicators. In the standard result, the indicators should be

higher in comparison to the original indicators as to the major system elements. Thus, the dynamic system of indicators becomes the most valuable normative condition for the movement of the distinguished characteristics that govern the final results.

To assess the effectiveness of the recreational territories resource potential by constructing a dynamic norm, it is indispensable:

- (i) to determine a set of indicators that characterize the resource potential of the territory;
- (ii) to identify the most informative indicators in this set;
- (iii) to develop a method for assessing the real result compared to the standard.

On the basis for the methodology for constructing a dynamic standard one can apply a method of rank assessment of the effectiveness of certain parameters, which allows adjusting the diverse indicators of the recreational potential of the territory. Mathematical tools of rank statistics are based

on a comparative analysis of two sets of numbers, one of which is ordered (normative), and the other one is unordered (actual).

The comprehensive assessment of the recreational territories resource potential involves identifying the natural, social and economic, historical and cultural and ecological resources that exist in a certain territory. The complex character is manifested in the component structure of the recreational potential, since each group of resources has been divided into components of lower orders, and those ones can be also divided. However, taking into consideration the specific property of the information and analytical support of the recreational sphere, a list of indicators that reveal the criteria, can not be discovered due to the lack of relevant data. In accordance with it, the relation of the component affiliation of the recreational territories resource potential can be derived from the indicators, provided in Table. 1.

Table 1. Components of recreational territories resource potential

Components	Indicators of the 1 <sup>st</sup> order	Indicators of the 2 <sup>nd</sup> order
Natural and Resource	Index of Natural and Resource Potential	–
Historical and Cultural	Index of Historical and Cultural Potential	Number of monuments of cultural heritage of national importance
		Number of monuments of history, archeology, urban planning and architecture, monumental art
		The share of the most significant monuments from their total number
		Number of notable historical events
Social and Economic	Index of Social and Economic Potential	Regional Human Development Index
		An average number of staff members in collective means of accommodation
		Revenue from services, provided by specialized means of accommodation
		Number of collective means of accommodation
Ecological	Index of Ecological Potential	Emissions of pollutants into atmospheric air
		Dump of contaminated water into natural surface water objects

Source: it is done by the author.

The model of the assessment of the attractiveness of the territories for recreational nature use, based on the methodological approach to the assessment of the recreational territories resource potential, is presented in Fig. 1. The vital element of the methodological approach is the integral index of the level of the recreational territories resource potential.

Integral Index of the level of the Recreational Territories Resource Potential (Irrp) includes aggregate indicators of the major components of this potential, namely, nature and resource, historical and cultural, social and economic and

ecological. It is calculated according to the following formula:

$$Irrp = \sqrt[4]{Inrp \cdot Ihkp \cdot Isep \cdot Iep}, \quad (1)$$

where Irrp – Integral Index of the level of the Recreational Territories Resource Potential;

Inrp – aggregate index of natural and resource potential;

Ihkp – aggregate index of historical and cultural potential;

Isep – aggregate index of social and economic potential;

Iep – aggregate index of ecological potential.

An indicator assessing the nature and resource potential of recreational territories is a

principal one when constructing an integral index and in its turn includes a large set of components that characterize the main groups of natural and recreational resources that can become the objective for visiting by tourists. Its value is defined as the sum of all components. The central criteria for the determination of the nature and resource component may be a diversity of elements (basic ones from the point of tourism and recreation development) of the nature and resource potential of the territory and the possibility of the influence of these elements on the perspectives for the tourism and

recreation development. Indicators that are of vital importance for the development of the recreational sector (the existence of the seaside; the network of internal reservoirs; the location of forests, parks, gardens; the characteristics of landscapes; balneological resources that can provide development of certain types of tourism) in order to calculate the coefficient of nature and resource potential among the total set of its elements in a certain territory. The more elements include a particular territory, the higher is its nature and resource diversity.

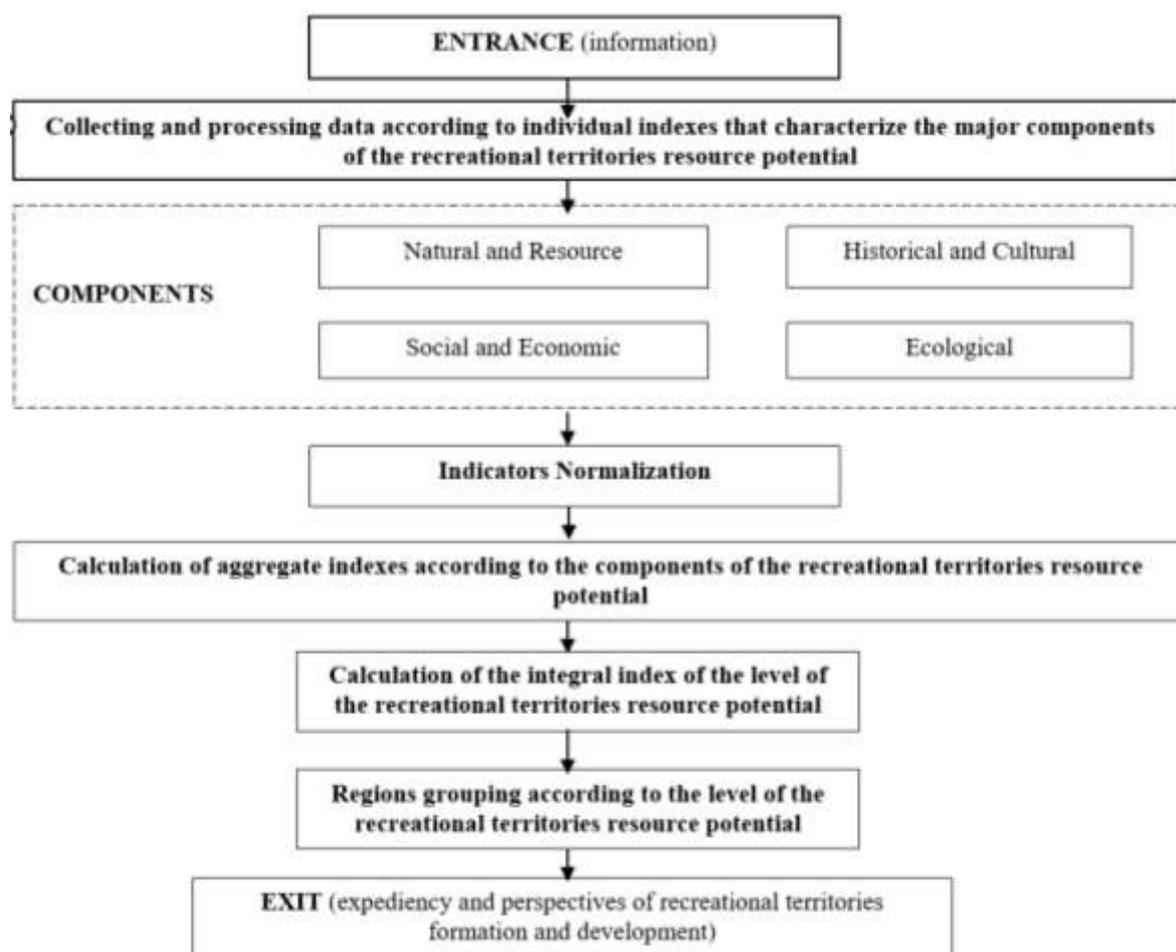


Fig. 1. The model of the assessment of the attractiveness of the territories for recreational nature use. Source: it is done by the author.

Undoubtedly, methods for the assessment of the nature and resource potential of recreational territories in the future should be further developed (improved) by profound studies of this problem. Thus, instead of the given coefficient of the possible influence of elements of nature and resource potential on

the development of the recreational territory, one can use another one – an indicator of qualitative assessment – tourist and recreational suitability of the fundamental elements of nature and resource potential. In the forest sector, for example, this indicator depends on the following environmental

indicators: forest type; composition of the tree state; permeability; fire danger; contamination; resistance to anthropogenic loads [7]. Each of the indicators is determined according to a 5-mark scale.

The qualitative assessment of crucial natural objects is generally carried out using the important factors that are calculated by the expert method considering the level of significance of natural objects at each of the levels – international, national, regional, local (municipal).

It is worth highlighting the methodology of the component and integral economic assessment of nature and resource potential of the territory, proposed by V. Rudenko. According to his methodology, component assessment implies «an economic assessment of the use of the potential of certain types of natural resources as a characteristic of their public consumption value, which was conducted annually on the basis of a single criterion – the saving of social labor and a generalizing indicator – the value of gross output, expressed in national or (if there is not a such one) regional cadastre prices, calculated by the method of ranking of reduced costs. Gross output characterizes the aggregate productivity of all natural resources of the territory» [9, p. 86-87]. Therefore, propose an analysis of nature and resource potential of recreational territories of Ukraine to consider as a level of natural and recreational potential, proposed by V. Rudenko. It will allow us to take into account the potential possibilities of recreational territories to meet the needs of tourists and to determine the prospects for the recreational nature use development.

Other component groups of the recreational territories resource potential are provided to calculate as to indicators of the 2<sup>nd</sup> order (see Table 1). The aggregate index of a separate component group  $I_k$  ( $I_{nrp}$ ,  $I_{hkp}$ ,  $I_{sep}$ ,  $I_{ep}$ ) is calculated as the average normalized values of the above-mentioned indicators:

$$I_k = \frac{\sum_{j=1}^n x_{ij}}{n} \quad (2)$$

where  $x_{ij}$  – normalized value of  $j$  indicator for  $i$  region;

$n$  – quantity of indicators, applied at the calculation.

In most cases, the formation of the normalized indicator is based on the requirement of representing all the signs as stimulants. The sign  $x_i$  is called a stimulator, if it is characterized by the growth simultaneously with higher quality (that is, the higher value of the sign corresponds to the highest quality of the object). If the quality grows, the sign  $x_i$  decreases, then such a sign should be considered as a de-stimulator. In this case, one can maintain a positive relation with the quality that is the object of the study. Considering the above mentioned, the value of the integral indicator also does not depend on the measurement unit of the signs.

It is necessary to carry out the standardization (unification of the scales) according to which the primary measurements have been made in order to the fulfillment of these conditions [6]. This process involves transforming the scale (changing the point of counting or scale) so that the area of possible measurement values remains within the interval  $(0; n)$ , where the number  $n$  is chosen by the researcher, depending on his/her profound considerations. In this case, the null value, that is transformed, should correspond to the lowest level of quality according to this property, and the value  $n$  is the highest respectively. The normalized indicator is always constructed so that its value is within the range from 0 to 1. It creates opportunities for meaningful interpretation of the value of such an indicator and facilitates the process of its comparison with different objects. To do this, the value  $n$  should be chosen as equal to 1 in the process of unifying the scale. If the sign is a stimulant, then the normalized values are calculated by the formula:

$$x_{ij} = \frac{x_{ij} - x_j^{\min}}{x_j^{\max} - x_j^{\min}} \quad (3)$$

where  $x_{ij}$  – actual value of  $j$  indicator for  $i$  region;

$x_j^{\min}$  – minimal value of  $j$  indicator;

$x_j^{\max}$  – maximum value of  $j$  indicator.

If the sign is a de-stimulator, then the normalized values are calculated by the formula:

$$x_{ij} = \frac{x_j^{\max} - x_{ij}}{x_j^{\max} - x_j^{\min}} \quad (4)$$

The disadvantage of such an approach is the fact that the calculated integral index has no longer relevance to the major indicators, which greatly complicates the formation of objective conclusions. However, the mentioned approach allows solving the tasks of ranking objects, comparing them, studying their structure, etc., which fully meets the requirements for the aggregate and the integral indicator.

To determine the coefficient of historical and cultural potential from the whole set of elements of historical and cultural diversity of the territory, the most significant ones for the development of certain recreation types on the territory can be selected: monuments of architecture and urban development; archeological monuments; monuments of art; museums; monuments of history; the names of the great citizens whose activity was connected with a specific territory, etc. Monuments of the cultural heritage of national importance, as well as monuments of history, archeology, urban planning and architecture, monumental art, are the most important (in terms of tourism and recreation development) of significant objects of history and culture.

An essential resource component of recreational territories and the development of recreational potential are largely determined by the level of infrastructure development (including transportation), collective and specialized catering establishments, revenues from location, staff, etc. Skilled workers (managers), who can serve tourists with high quality, are crucial in the process of providing tourist services. It is significant to assess both the actual staff potential and its use according to the required level for the assessment of the staff potential of the territories. The staff potential of recreational territory should be assessed in the following directions: assessment, which involves calculation of the existing number of staff potential; assessment, associated with the use of human resources; an assessment, suggesting that the existing staff potential corresponds to its required level

in accordance with the strategic goals of the development of recreational territories.

Unfavorable anthropogenic processes, amplified under the influence of the production factor, complicate the ecological situation; provoke environmental risks and threats, which, for instance, can cause the reduced duration of the holiday season or recreational flow. To the greatest extent, a number of environmental indicators characterize the negative impact of destabilizing factors on the successful formation of recreational nature use. These indicators include the level of man-made pollution; the level of harmful substances emissions into the atmosphere; dump of pollutants into natural surface water; accumulation of industrial toxic waste, etc.

On the basis of the calculating results of the integral index of the level of recreational territories resource potential, one can assess the object (region, district, area, recreational activity subject) according to the proposed classification (Table 2).

Table 2. Classification of the level of the recreational territories resource potential

The level of the resource potential	Integral index value (or separate indicator)
High	0.76–1.00
Medium	0.51–0.75
Low	0.26–0.50
Very low	0.01–0.25

Source: it is done by the author.

As a result, a number of ranked recreational areas are built up, and then a decision is made on the number of priority territories that are being planned to be selected for the purposes of granting them the status of a recreational zone with the regime of the largest economic and investment promotion. The basis of the project for the creation and development of zones is the idea of increasing the flow of tourists due to the providing annual access to tourist centers, infrastructure development, and the formation of a modern tourist complex.

That is why one can use the significant recreational potential of the territory and involve it in international logistics. At the same time, the centers of such zones should

be the points of localization of tourist and recreational clusters, which are characterized by a range of properties: a high level of concentration of interconnected objects, tourist displays, which allows creating a considerable value added due to combining them in diverse thematic and complex tours; a relatively high level of concentration of labor resources with an appropriate level of specialization and qualification; developed tourist, engineering, transport, social, energy infrastructure; the existence of branched

cooperative ties among enterprises of the tourist complex, which are in the internal competitive environment.

Based on the proposed methodical approach, calculations of aggregate indexes of the main components and the integral index of the level of the recreational territories resource potential have been done, which made it possible to rank the regions of Ukraine depending on the values of these indicators (Table 3).

Table 3. Calculation results of the integral index of the level of the recreational territories resource potential, 2017

Region	Aggregate index of natural and resource potential	Aggregate index of historical and cultural potential	Aggregate index of social and economic potential	Aggregate index of ecological potential	The integral index of the level of the recreational territories resource potential
Autonomous Republic of Crimea	1.00	0.48	0.88	0.88	0.78
Vinnitsia	0.11	0.28	0.32	0.95	0.31
Volyn	0.09	0.37	0.15	0.99	0.27
Dnipropetrovsk	0.26	0.16	0.27	0.36	0.25
Donetsk	0.35	0.18	0.15	0.03	0.13
Zhytomyr	0.09	0.19	0.05	0.98	0.17
Transcarpathian	0.61	0.22	0.52	0.99	0.51
Zaporizhzhia	0.20	0.12	0.46	0.57	0.28
Ivano-Frankivsk	0.22	0.30	0.38	0.92	0.39
Kyiv	0.09	0.69	0.35	0.68	0.35
Kirovohrad	0.41	0.06	0.04	0.98	0.18
Luhansk	0.22	0.12	0.05	0.91	0.19
Lviv	0.30	0.73	0.71	0.90	0.61
Mykolaiv	0.09	0.15	0.26	0.84	0.23
Odesa	0.39	0.37	0.65	0.92	0.54
Poltava	0.11	0.22	0.30	0.85	0.28
Rivne	0.07	0.21	0.07	0.99	0.35
Sumy	0.11	0.15	0.09	0.71	0.18
Ternopil	0.07	0.21	0.15	0.98	0.22
Kharkiv	0.37	0.30	0.29	0.73	0.39
Kherson	0.13	0.14	0.26	0.90	0.26
Khmelnytsk	0.09	0.32	0.07	0.98	0.21
Cherkasy	0.13	0.22	0.10	0.95	0.23
Chernivtsi	0.11	0.18	0.26	0.99	0.27
Chernihiv	0.20	0.35	0.04	0.97	0.23

Source: it is done by the author.

Table 4. Ranking of the regions of Ukraine as to the level of the recreational territories resource potential

The level of the resource potential	Region
High (higher than 0.76)	Autonomous Republic of Crimea
Medium (0.51–0.75)	Lviv, Odesa, Transcarpathian
Low (0.26–0.50)	Kharkiv, Ivano-Frankivsk, Kyiv, Rivne, Vinnitsia, Zaporizhzhia, Poltava, Chernivtsi, Volyn, Kherson
Very low (lower than 0.25)	Dnipropetrovsk, Mykolaiv, Cherkasy, Chernihiv, Ternopil, Khmelnytsk, Luhansk, Sumy, Kirovohrad, Zhytomyr, Donetsk

Source: it is done by the author.

results of calculations of their integral index, conducted in the context of regions of Ukraine, they have been grouped (Table 4).

The analysis of Table 4 shows that Autonomous Republic of Crimea (final assessment 0.78) has the optimal conditions for the implementation of resource potential and the development of recreational territories according to the aggregate of the considered components. The potential is lower in Lviv (index – 0.61), Odesa (0.54) and Transcarpathian (0.51) regions. Instead, most regions of Ukraine have a low level of the

Taking into account the proposed of the classification of the levels of the recreational territories resource potential and based on the

recreational territories resource potential compared to the best analogs in the country.

## CONCLUSIONS

All in all, a profound approach to the assessment of the attractiveness of territories for recreational nature use, based on a comprehensive assessment of the recreational territories resource potential, in contrast to existing ones, implies the integral index use that takes into account the system of indicators according to the following components: nature and resource, historical and cultural, social and economic and ecological. The qualitative analysis of indicators of the recreational territories resource potential is the basis for development and adoption of efficient managerial decisions. The aggregate index of a separate component group is calculated as the average of normalized values of the indicators included in these indexes.

To conclude with, the normalization process involves the transformation of the scale (changing the point of counting or scale) in such a way that the scope of possible measurement values remains within the range from 0 to 1. It creates opportunities for meaningful interpretation of the value of such an indicator and facilitates the process of its comparison with different objects. This approach allows performing tasks of ranking objects, to compare them, to study their structure, which fully meets the requirements for aggregate and integral indexes.

## REFERENCES

- [1]Beidyk, O., 2001, Recreational and Tourist Resources of Ukraine: Methodology and Methods of Analysis, Terminology, Zoning: monograph, Kyiiv, 2001. 395 p.
- [2]Boholiubova, S., 2010, Ecological and Economic Assessment of Recreational Resources, International Journal of Experimental Education, 3: 27–28.
- [3]Cherchyk, L., Kolenda, N., 2008, Strategic Potential of the Recreational System of the Region: Theory, Methodology, Assessment: monograph; Lutsk, 224 p.
- [4]Didyk, Ya., Syniakevych, I., 1992, The Planning of Forest Recreational Resources Use, Forestry, Forest, Paper and Wood Processing Industry, 23: 104–106.
- [5]Iliina, M., 2013, An Integral Assessment of Tourist and Recreational Sphere of Territories of Diverse Types, Economics. Management. Innovations, 2. URL:[http://nbuv.gov.ua/UJRN/eui\\_2013\\_2\\_31](http://nbuv.gov.ua/UJRN/eui_2013_2_31).
- [6]Hryhoruk, P., Tkachenko, I., 2012, Methods of Constructing Integral Indicator, Journal “Business Inform”, 4: 34–38.
- [7]Khudenykh, Yu., 2006, Approaches to Territory Tourist Potential Assessment on the Example of the Regions of Perm Territory, Geography and Tourism: Collection of Scientific Papers. Perm, Issue 2: 217–230.
- [8]Kyfiak, V., 2010, The Strategy of Territorial Recreational Systems Development: Theory, Methodology, Practice: monograph; Kyiiv, 427 p.
- [9]Rudenko, V., 2010, Geography of Nature and Resource Potential of Ukraine. In 3 parts, Chernivtsi, 552 p.
- [10]Russell, R. V., Riddick, C. C., 2014, Research in Recreation, Parks, Sport & Tourism, Sagamore Publishing, 314 p.
- [11]Samko, O., 2010, Region Tourist Potential Assessment and the Level of its Use, Economic Sciences. Series «Regional Economy». Collection of Scientific Papers, Lutsk, Issue 7(27), Part 4: 129–134.
- [12]Shabalina, S., Rubtsov, V., Baibakov, Ye., 2015, Territorial Aspects of Tourism Development in the Republic of Tatarstan, Kazan, 160 p.
- [13]Shabardina, Yu., 2011, The Recreational Potential as a Component of Productive Forces of the Regional Economic Space: Thesis of Candidate of Economic Sciences, Chernihiv, 20 p.
- [14]Stechenko, D., Bezuhlyi, I., 2009, Theoretical Aspects of the Research of Natural and Recreational Potential, Scientific Herald of Chernihiv State Institute of Economics and Management, 2(3): 65–76.
- [15]Wennergren, B., Nielsen, D., 1970, Probability estimates of recreation demands, Journal of Leisure Research, Vol. 2. No. 2: 155–167.



## STATIC AND DYNAMIC ANALYSIS OF PRODUCTIVITY OF BEARING FRUIT VINEYARDS – A BASIC FACTOR FOR THE ECONOMIC GROWTH OF THE VINE AND WINE SECTOR OF THE REPUBLIC OF MOLDOVA

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### Abstract

*The paper presents a static and dynamic analysis of bearing fruit vineyard areas and productivity at 1 ha in the Republic of Moldova. The linear trend of the productivity development of the bearing fruit vineyard plantations during 2010-2016 and the prognosis of the level for 2022 have been determined and analysed.*

**Key words:** *vine and wine sector, economic growth, vineyard, forecasting, productivity, linear trend*

### INTRODUCTION

The vine and wine sector of the Republic of Moldova is of strategic importance for the national economy given that, first of all, viticulture has a high level of capitalization of the slope agricultural land, being the base of raw materials for winemaking and the food industry. Secondly, the attractive and tasteful appearance of the grapes, also gives them the value of the energy-appreciated food, vitaminized, mineralized to which dietary and therapeutic qualities can be added.

At the same time, the annual vine and wine sector contributes to the annual increase of revenues in the country by about 205 mil. EUR from the export of its production, ensures breakdowns in the state budget through excises, VAT and income tax of more than 400 mil. MDL annually, provides profit of 5-85 thousand MDL for 1 ha of bearing fruit vineyard, ensures permanent job places, etc.

The wine-growing heritage in the Republic of Moldova (in all categories of households) as at 01.01.2017 accounted for 135.3 thousand ha.

The purpose of this study is to analyze statically and dynamically the vineyard plantations and the global grape production, which represents the raw material for

industrial processing that ensures the high quality of the wines and the economic growth of the vine and wine sector.

### MATERIALS AND METHODS

In the research, the authors have used the materials of the legislative framework in the field of wine sector development, data from the National Bureau of Statistics of the Republic of Moldova and the specialized literature.

In the scientific research process, the following research methods have been applied: method of comparison, table method and graphical presentation of the studied phenomena, average and relative size method, mathematical method of analytical levelling and determination of trend of change of phenomena in dynamics.

### RESULTS AND DISCUSSIONS

The Republic of Moldova is one of the main vine-growing countries. Viticulture has a well established place in the national economy.

The morphological characteristics and agri-biological traits of the vine allow it to occupy and efficiently utilize light sandy-clay or clay-sandy soils, because the quality of grapes is higher.

On 01.01.2017, the country's viticulture heritage in all categories of households constituted 5.4% of the total amount of the agrarian land area (Table 1).

Table 1. Distribution of agricultural land and vine plantations on forms of ownership, on 01.01.2017 in the Republic of Moldova

Indicator	All forms of ownership - total		Of which:			
	Thous. ha	Share, %	Public		Private	
			Thous. ha	Share, %	Thous. ha	Share, %
Surface of the agricultural land - total	2,499.8	100	646.5	25.8	1,853.3	74.2
Vine plantations - total	135.3	100	8.0	6.0	127.3	94.0

Source: Data calculated by authors based on the Annual Statistical Yearbook of the Republic of Moldova 2017, p. 290.

Out of the total area of vine plantations, 127.3 thousand ha or 94% are managed by private sector households and only 6% by the public sector.

The analysis of the 2010-2016 dynamics of the share of bearing fruit vineyard plantations in the total amount of vineyards shows a slight increase from 91.6% to 95.4%, i.e. by 3.8 pp (Figure 1).

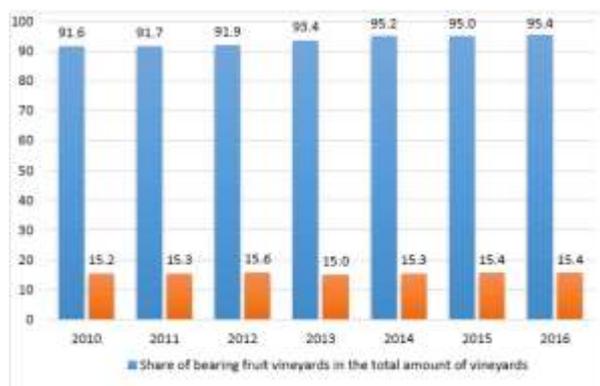


Figure 1. The share of bearing fruit vineyards in the total amount of vineyards in all categories of households in the Republic of Moldova

Source: Own calculation based on the data from Statistical Office, Rep. of Moldova.

However, the share variation of table grapes vineyards in the amount of bearing fruit vineyards is even more modest. It represented 15.2% in 2010 and 15.4% in 2016. The varieties for wine are about 80%. The share of the main varieties of wine such as: Aligote,

Isabella, Sauvignon, Cabernet-Sauvignon, Merlot, Pinot Noir in the structure of the bearing fruit vineyard plantations is about 6.5-15.0% each.

The regulation and organization of the production activity in the vine and wine sector in the Republic of Moldova is conducted in accordance with the State Policy elaborated and promoted by the Ministry of Agriculture, Regional Development and Environment, as well as the legislative framework (Law of the Vine, 2006; Government Decision, 2009; Operational Procedure, 2015) [9, 10].

The objectives planned for the period 2000-2006 were achieved, except of the grubbing up of vineyards. Analysis of the biological status of plantations reveals that 26.1% of the vine had to be grubbed down by 2010 and 57.3% - by 2020.

Results of the researches carried out (Table 2) show that on all types of vine plantations, since 2010, the areas have decreased or diminished in average by 0.5-1.2%.

In 2016, 4.6 thousand hectares of vine plantations with a low agro-technical and phytosanitary status were grubbed up, and the absence of a large number of young vines caused colossal losses. For the next 4 years (2016-2020) it may be possible to plant about 20 thousand ha if new investment projects from abroad are attracted. The planting material should be multiplied with varieties and rootstocks included in the catalogue of plant varieties of the Republic of Moldova and should not be attacked by diseases and pests that may diminish the productive potential of the vine [Rusu D., 2017 and 2018] [11, 12].

The aspects of the technological scheme for the production of the vine planting material in the Republic of Moldova have been elaborated in various laws and regulations [Moldovan Standards 207:2010; Moldovan standards-206/2010] [7, 8], which obliges the producers to respect the particularities of the planting material according to the standards and the technical norms in force, so that the process of producing the grafted vineyards will be high, will have a normal growth in the formation of the horns, which directly influences productivity at 1ha.

Table 2. Analysis of the dynamics of the vineyard plantations in the Republic of Moldova for the period 2010-2016

Indicator	Annual							Average growth / decrease rate
	2010	2011	2012	2013	2014	2015	2016	
All categories of households. Vine plantations - total, thous. ha	144.9	139.9	140.7	136.7	140.4	135.4	135.3	X
Growth (decrease) rate in chain, %.	100	96.5	100.5	97.2	102.7	96.4	100	98.8
Of which bearing fruit vineyards, thous. ha	132.8	128.4	129.4	127.7	133.7	128.8	129.1	X
Growth (decrease) rate in chain, %.	100	96.6	100.8	98.7	104.7	96.3	100.2	99.5
Of which vineyards, table grapes, thous. ha	20.2	19.7	20.2	19.2	20.5	19.9	19.9	X
Growth (decrease) rate in chain, %.	100	97.5	101.5	95.0	106.8	97.0	100	99.8

Source: Data calculated by authors based on the Annual Statistical Yearbook of the Republic of Moldova 2017, p. 302.

Analyzing the results obtained in dynamics (Table 3), we conclude that the productivity of bearing fruit vineyard plantations in all types of households on average annually, increased by 5% over the last 7 years. In peasant farms and households of the

population with smaller areas due to lack of monetary funds, producers do not have the possibility to grub up the vine that does not correspond according to their biological state and therefore, there is attested a slower growth rate of productivity.

Table 3. Analysis of the dynamics of the productivity of bearing fruit vineyard plantations by categories of households in the Republic of Moldova

Indicator	Annual							Average growth rate
	2010	2011	2012	2013	2014	2015	2016	
Productivity of the bearing fruit vineyards, q/ha	All types of households							X
	34.9	45.5	38.6	47.3	43.7	45.6	46.9	
Growth (decrease) rate in chain, %.	100	130.4	122.5	92.4	104.3	102.3	102.8	105.0
Productivity of the bearing fruit vineyards, q/ha	Agricultural enterprises							X
	23.7	46.0	41.9	64.6	53.5	54.9	65.3	
Growth (decrease) rate in chain, %.	100	194.0	91.1	154.2	82.8	101.8	118.9	118.4
Productivity of the bearing fruit vineyards, q/ha	Peasant farms							X
	26.7	33.4	29.0	32.8	33.8	40.4	32.1	
Growth (decrease) rate in chain, %.	100	125.1	86.8	113.1	103.0	119.5	79.5	103.1
Productivity of the bearing fruit vineyards, q/ha	Households of the population							X
	56.0	63.5	51.0	58.1	51.0	47.4	56.3	
Growth (decrease) rate in chain, %.	100	113.4	80.3	113.9	87.8	93.0	118.8	100.0

Source: Data calculated by authors based on the Annual Statistical Yearbook of the Republic of Moldova 2017, p. 304.

In the agricultural enterprises from the Southern and Central Industrial Region of the Republic of Moldova where the planting of vineyards is carried out in accordance with the agro-technical guidelines approved by the Ministry of Agriculture, Regional Development and Environment and on the basis of the projects developed by the licensed design offices specialized in the field of perennial plant design, the yield per ha of bearing fruit vineyard increased from 23.7 q / ha to 63.5 q / ha in 2016.

The analysis of the researches on the distribution of vine plantations at the regional level, in the average of the years 2014-2016, shows that their share in the South region accounts for 47.7%, TAU Gagauzia - 23.5%, the Centre region -23.3% and Chisinau municipality - 4.3%. Nowadays, in the enterprises from these regions, viticulture has

experienced a modest recovery, as the productivity of bearing fruit vineyards has increased by 18.4% in the dynamic average of 2010-2016 and in 2016 the global harvest amounted to 515.7 thousand tons. These achievements allow for the global grape production as a raw material for industrial processing to ensure the high quality of the wines.

Further, analyzing the productivity dynamics per 1 ha for the period 2010-2016, (Table 4) it was established that it has a tendency to change in the form of the linear function:

$$\bar{y}_t = a_0 + a_1 t$$

where:  $a_0$  și  $a_1$  - function parameters,  
 $t$  - time mark.

This is confirmed by both the minimum deviation and the coefficient of variation.

Table 4. Determination of the tendency in changing the productivity of bearing fruit vineyard plantations in the Republic of Moldova and the forecast for 2022, q / ha.

Types of households	Equation of linear trend $\bar{N}_t = a_0 + a_1 t$	Average indicator level in 2010-2016	Forecasted level for 2022	Deviation of the level of 2022 compared to the average 2010-2016 (+ ;-) q / ha
All types of households	$\bar{N}_t = 43.2 + 1.47t$	43.2	56.4	+13.2
Agricultural enterprises	$\bar{N}_t = 50.0 + 5.51t$	50.0	99.5	+49.5
Peasant farms	$\bar{N}_t = 32 + 1.25t$	32.0	43.2	+11.3
Households of the population	$\bar{N}_t = 54.7 - 1.12t$	54.7	44.62	-10.08

Source: Calculated by authors based on Table 3 data.

Thus, the pattern of linear function adjustment most closely corresponds to the objective trend of productivity growth at 1 hectare in all households. The exponential function and the parabolic function of the second degree proved to be more distant from the real evolution of the indicator during the studied period.

Parameter of the Linear Function  $a_1$  indicates that in the 2010-2016 period, the yield per hectare of bearing fruit vineyard plantations tends to change on an annual average in the following way:

- in all categories of households - increase by 1.47 q / ha;
- in all agricultural enterprises - 5.51 q/ha increase;

- in all peasant farms - increase by 1.25 q / ha;
- in households of population - decrease by 1.12 q / ha.

On the basis of the linear trend model, the prognosis of the productivity dynamics per 1 ha by 2022 was performed. The extrapolation method reflects the forecasting calculations, which show that if trends of change in the directions and sizes obtained by calculation will persist in the future, then the yield of grapes per hectare of bearing fruit vineyard by 2022 will be as follows:

- in all categories of households - 56.4 q/ha, with an increase of 13.2 q/ha;
- in agricultural enterprises - 99.5 q/ha, with an increase of 49.5 q / ha;

-in peasant farms - 43.3 q/ha, with an increase of 11.3 q / ha;

-in households of population - 44.62 q/ha, with a decrease of 10.08 q / ha.

It should be noted that in agricultural enterprises with large agricultural land areas, from 50 ha to 5-7 thousand hectares, the increase in productivity per hectare, on average annual, was the highest - 5.51 q / ha, and the forecast for 2022 is an increase of about 2 times of the productivity per 1 ha. We believe that this level can be reached and even higher if effort is made to achieve a remarkable correlation between the vine variety, soil, technologies and climatic conditions in which the harvest is formed. In addition, support from the state, rigorous observance of the Government's decisions, regulations, agrarian policy of the Republic of Moldova and of the common agrarian policy, development strategies, etc., in the field of the development and growth of the wine sector are required.

Particular attention should be paid to the establishment of new plantations in strict compliance with agro-hedging and climatic factors and to take into consideration the experience gained by producers in the field of wine-making.

In order to obtain the most qualitative and demanded wines on the internal and external markets, it is necessary to increase the areas planted with native varieties (Feteasca Alba, Feteasca Regala, Fetească Neagra, Rara Neagra, Pinot gris, Pinot Noir, Pinot Blanc, Sauvignon (white) as well as Syrah, Sangeoveze and the classic traditional (red) ones. The quality wines obtained from the new intra-specific varieties cultivated successfully on different wine-growing areas of the Republic of Moldova with a productivity of 100-150 q / ha, from varieties such as Viorica, Bianca, Legenda, Riton ,Solearis etc.present a significant interest [Gaina Boris, 2017; Cuharschi M, 2018; Cuharschi M., Ceban V., 2017] [2, 3, 4].

The results obtained from the researches carried out at the Scientific-Practical Institute of Horticulture and Food Technologies (SPIHFT), the "Plopi" branch, Cantemir District, KVINT (from Doibani, Donduseni)

and "Mold-Nord" L.L.C. shown that the Viorica variety is highly productive (the amount of grapes reaches up to 160 q / ha, with a sugar coefficient of 172 g/dm<sup>3</sup> and acidity up to 9 g/dm<sup>3</sup> and more) [Cuharschi M.et.a. 2018] [2].

Together with the liberalization of the EU wine market for Moldovan products, the export of high-quality table grapes, wines and spirits based on the protected geographical indications and protected designations of origin (PDO) system will be increased in accordance with the requirements of European regulations [Council Regulation/2009, Regulation (EC), 2009; Government Decision, 2015] [1, 5, 6]. At present, the share of wine products with a typical wine-growing area is still low.

## CONCLUSIONS

The research pointed out that of 135.3 thousand ha of vine plantations, 94% are managed by private sector households and only 6% by the public sector.

In the 2010-2016 dynamics, the wine-growing area in the country diminished by 1.2% on average annually, and for the years 2017-2020, it is possible to plant about 20 thousand ha, if the own monetary sources of producers will increase and new investment projects will be attracted from abroad.

When producing vine planting material, the standards and technical regulations in force must be followed.

Dynamic research over the last 7 years has shown that productivity per 1 ha on average has increased in all households by 5% and in agricultural enterprises by 18.4%. It has been established that the change in productivity at 1 hectare has a linear function, which has an increase of 1.47 q / ha in all types of households and in agricultural enterprises by 5.51 q / ha in the yearly average. The forecast shows that if the growth trend in the calculated quantities is maintained in the future, the productivity per hectare will increase to 56.4 q / ha by 2020 and 99.5 q / ha respectively.

The economic growth of the wine sector is possible if effort is made in relation to a remarkable correlation between the basic factors such as: vine variety, soil, technologies and climatic conditions in which the productivity of the bearing fruit young plantation is formed, as well as the grape quality, then it will influence most vineyard plantations with native varieties (Feteasca Alba, Feteasca Neagra, Sauvignon (white) etc.), new intra-specific varieties with productivity of 100-150 q / ha, Viorica, Legenda, Riton etc., and most of the high quality wines and spirits with the name (PGI) and (PDO) in order to meet the requirements of the European partners.

## REFERENCES

- [1] Council Regulation (EC) No. 491/2009 of May 25, 2009 amending Regulation (EC) No. 1234/2007 on establishing a common organization of agricultural markets and on specific provisions for certain agricultural products (Single CMO Regulation)
- [2] Cuharschi, M. *et al.*, 2018, The peculiarities of cultivation and the evaluation of Viorica's variety analogy potential for the production of organic wines with geographical indication and designation of origin (GI and DOP). Scientific journal "Pomiculture, viticulture and winemaking" no.5 [77].
- [3] Cuharschi, M., Ceban, V., 2017, Some aspects of the development of contemporary viticulture based on the introduction of varieties for wine with group stability. Scientific journal "Pomiculture, viticulture and winemaking", no.4 [70].
- [4] Gaina, B., 2017, The viticultural sector of the Republic of Moldova: Prospective tasks, Scientific journal "Pomiculture, viticulture and winemaking", No.2 [68].
- [5] Government Decision No. 418 of 09.07.2009 regarding the approval of the Technical Regulation "Production, Certification, Control and Realization of Material for Reproduction of Grapes and Grape Landing Material" (Official Gazette, 2009, no.112-114);
- [6] Hotărârea Guvernului nr. 356 din 11.06.2015 cu privire la aprobarea Reglementării tehnice "Organizarea pieței vitivinicole". Monitorul Oficial nr. 104-108 din 18.06.2015 (Government Decision No. 356 of 11 June 2015 regarding the approval of the Technical Regulations "Organization of the wine market". Official Monitory No.104-108 of 18 June 2015).
- [7] Moldovan Standards (SM) -207:2010; "Vineyard planting material. Technical conditions", which establish quality requirements for vineyard planting material. INSM. Chisinau, 2010;
- [8] Moldovan standards (MS) -206:2010; "Vine reproduction material. Technical conditions", which establish quality requirements for reproduction material. INSM. Chisinau, 2011.
- [9] Law on the vine and wine no. 57 of 10.03.2006 (Official Gazette, 2006, no. 75-78, art. 314).
- [10] Operational procedure PO-02/02. Certification of viticultural planting material from 28.10.2015.
- [11] Rusu, D., Bratco, D., 2018, Production of viticultural reproduction material in Prut–Dniester space. Scientific journal "Pomiculture, viticulture and winemaking", no.4 [76], 2018, pp. 26-34.
- [12] Rusu, D., Bratco, D., 2017, Production of viticultural planting material in Prut–Dniester space. Scientific journal "Pomiculture, viticulture and winemaking", no.4 [76].
- [13] Regulamentul (CE) nr. 607/2009 al Comisiei din 14 iunie 2009 de stabilire a unor norme de aplicare a Regulamentului (CE) nr. 479/2008 din 29 aprilie 2008 al Consiliului în ceea ce privește denumirile de origine protejate și indicațiile geografice protejate, mențiunile tradiționale garantate și prezentarea anumitor produse vitivinicole. ( Commission Regulation No 607/2009 of 14 July 2009 laying down certain detailed rules for the implementation of Council Regulation (EC) No 479/2008 as regards protected designations of origin and geographical indications, traditional terms, labelling and presentation of certain wine sector products)

## MANAGEMENT OF THE ORGANIZATION'S FINANCES IN CONDITIONS OF UNCERTAINTY

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### **Abstract**

*The market economy of management introduces significant changes in the understanding of the role and responsibility of state institutions and economic entities in the development of socio-economic processes and their effectiveness. Despite the huge role of state institutions, the real sector of the economy is the main contributor to state budget revenues. Its quality depends on the financial condition of economic entities, which, in turn, depends on the quality of financial management, the improvement of which in the conditions of external uncertainty is extremely important.*

**Key words:** market economy, delegation of authority, economic autonomy, financial management, budgeting, cost centers, responsibility centers, material incentive fund, business entities, payment calendar

### **INTRODUCTION**

The market economy is fundamentally changing the approaches to managing the economic activities of organizations. Their essence lies in the fact that there have been made fundamental changes in the delegation of authority to manage economic processes and the responsibility for their results.

Regardless of the form of the economic system, such tasks as ensuring: the economic development of the state; economic employment of the population; price stability; decent standard of living of the population; defenses remain behind the state. Their decision is provided by the state through the use of appropriate economic instruments. In turn, economic entities are given significant powers in the conduct of business. The business independently decides: what to produce, how much, to whom to realize it only without violating the current legislation. Business is also fully responsible for the results of economic activity, which increases the requirement for the quality management of business processes. [1] This is especially important and difficult in the conditions of market environment. That business will be successful that at the initial stage will be able

to make the right choice of the strategic area of management and build an effective management system [2].

### **MATERIALS AND METHODS**

The material used to carry out the study was: research, analysis and interpretation of information from the literature. We used such research methods as: analysis, comparison, deduction, monographic method.

### **RESULTS AND DISCUSSIONS**

In the conditions of economic independence of economic entities, an important point is the participation of the whole team in the management system. This should not be understood as the absolute participation of all members of the staff in management by voting when making decisions. It all depends primarily on the type of the enterprise. So, in the participation in management is accepted only by the shareholders owning ordinary shares, [2] in a cooperative - shares. [3] At the same time, employees also work in the organization, participate in the implementation of decisions made through operational activities. So, this category of

workers should be motivated to improve the effectiveness of the organization as a whole, in achieving its ultimate goal - making a profit. Their motivated participation in the increase of production efficiency can be achieved by improving the intra-economic calculation. [9] Currently, this is being implemented as a budgeting system, the expediency of which, from the point of view of scientific management in conditions of independence and responsibility, the economic entities in the decisions making and their results, is undeniable. Only in this case, the entire management system will function as a whole; otherwise it will not be a system, but a simple set of links not interconnected by the ultimate goal.

Organization and implementation of budgeting should be preceded by a certain organizational work. First of all, the organizational structure should be clearly defined — the cost centers (CFSs) and the responsibility centers (RCs) are defined; the basic production assets and working capital should be fixed for them; a regulatory framework should be developed for the use of all types of production resources; a regulation on internal relations between structural units and provision for additional material incentives should be developed. [10] A prerequisite for budgeting is the organization of the accounting of the results of the work of the divisions and the actual costs of production according to the established list of items.

In the practice of operational asset management, the functional and process approach to budgeting is best known. [8] The functional approach is consistent with the traditional accounting system, is easy to use; does not require significant IT resources. However, management may have difficulty with rapidly changing conditions. Its application is suitable for organizations with a simple structure. In complex organizations, in which a culture of process management is formed, it is advisable to use a process approach in budgeting. During its application the adaptation to the changing environment is facilitated; the motivation of employees in

achievement of the end results business of processes increases.

An important point in the application of the budgeting system is the sequence of working with it. As a rule, the implementation of the budgeting system goes through the following stages:

1. Development of the draft budget,
2. Bringing the draft budget of the CFS,
3. Alignment of control results,
4. Approval and notification of the budget of the CFS,
5. Budget execution control,
6. Budget Performance Report,
7. Evaluation of CFS' activity.

The cost centers develop the draft budget, on the basis of the control figures of the company's business plan for this period, the results of operating activities for the previous budget period (quarter), and also taking into account the changes that have occurred, have not been taken into account in the control indicators of the business plan. The draft budget is submitted to the CFS for review, after which it is returned to the budget commission. In the presence of the similar moments there is their coordination. The agreed budget is approved by the head of the organization and communicated to the CFS for execution.

In the process of budget execution, the conditions initially adopted as the basis for its calculation may change. In this case, their justification is made and, if necessary, the budget commission makes the necessary changes to the originally approved version. This procedure for the execution of the budget requires a well-established work of the budget commission. This is especially important in the conditions of significant volatility of external factors affecting the business. At the same time, it is not always advisable and impossible to summon a budget commission for any reason. For the operational solution of arising deviations from the control tasks of the budget, it may be sufficient for the Chairman of the budget commissions, the conclusions of the relevant specialists on the merits of the arisen problem. This method of decision-making does not violate the rhythmic work of production units.

The quality of work on the rationing of the consumption of material, energy, labor resources is of great importance. It is important that the norms were calculated by an analytically calculated method, which allows to identify the ways of saving at all the stages of design and production, as well as to develop organizational and technical measures aimed at saving of all types of resources.

In a number of industries, in particular in agriculture, the rate of consumption of certain types of raw materials, material and energy resources; the duration of the production cycle depends on many factors, the impact of which is difficult to take into account by the usual method. In such situations, it is advisable to apply the methods of mathematical statistics, in particular the method of correlation (6). Methods of calculation of coefficients of correlation are stated in textbooks statistically and special works on the theory of correlation. With its help, it is possible to determine the quantitative relationship between the various factors affecting the value of the norm.

When using this method, it is first necessary to determine the composition of the factors affecting the magnitude of the norm. For example, in agriculture it is the average monthly amount of precipitation; soil moisture reserve; temperature conditions of the norm, norms of fuels and lubricants, etc. Then from the total number of factors are allocated the main factors that will be used in establishing the norm. The main factors should be considered as those for which the full and partial correlation coefficients approach unity. This means that a change in these factors significantly affects the value of the standard.

To obtain reliable data, the application of this method must be preceded by a thorough economic analysis of the nature of the allocated factors, their comparability, uniformity of measurement, etc. Then, for each object under study, the actual costs of normalized production resources are established and the influence of each factor on the cost value is determined in quantitative terms.

The organization of the activities of internal divisions in the budgeting system is one of the components of the financial management of the organization as a whole. At the same time, it is extremely important to understand that the production structural units are only the executors of the tasks brought to them, and are not at all responsible for providing them with the necessary resources for this. These functions belong to the centers of responsibility – logistical, financial, staffing, etc. The dominant share in the functioning of the production process, as such, belongs to financial support. This problem is solved through financial planning – perspective, current and operational. For the budgeting system of operating activities of production units, it is important to organize operational financial management, the main task of which is to ensure the financial support of production needs in all types of material and labor resources. To this end, especially in conditions of complete economic independence, it is necessary for enterprises to develop a payment calendar, cash plan and calculation of the need for a short-term loan. [5]

The payment calendar is formed for a quarter with breakdown on months and smaller periods. It should be linked to the budgets of responsibility centers and cost centers, stock status, receivables. A properly compiled payment calendar allows you to identify financial errors, possible financial problems and to identify specific measures to ensure financial sustainability. In the process of developing the payment calendar, the following problems are solved:

- interim reconciliation of income and expenditure of funds;
- the formation of the information base of inflows and outflows of funds;
- daily recording of changes in the information database;
- analysis of non-payment and organization of specific measures to overcome them;
- calculation of short-term loan requirements and prompt purchase of borrowed funds;
- calculation of temporarily available funds of the enterprise;

The initial data for the development of the payment calendar are budgets of all levels; regulatory deadlines for payments on financial obligations; the contract; schedule of wages payment, etc.

Thus, full interconnection of operational budgets of all levels into a single financial system of the enterprise, their security and operational management of problems arising during the implementation will be ensured.

The most important principle of financial management with the help of the budgeting method is economic incentives for the achieved success. [4] Even the most modern system of intra-corporate management is worth nothing if it is not complemented by an effective system of financial incentives. From this it follows that the effectiveness of the budgeting system will not be ensured if it does not provide the material incentives of the collective for the results achieved. The sources of additional material incentives can be the Fund of material incentives and savings, as a result of reducing the cost of production (work). This material interest should be structured in such a way that a direct link between the contribution of this unit to the overall results of the enterprise and its share in the total amount of this income, savings was a direct link. The size of the share in this case is determined by the contribution of each financial INSTITUTION in improving the efficiency of the entire enterprise. The material incentive fund is self-supporting, therefore its distribution and use must comply with the principles of self-financing. In other words, its distribution should be such that it economically stimulates individual and collective interest in improving production efficiency. The material incentive fund should also be distributed based on the real contribution of each CFS to the overall results of the enterprise. Additional material encouragement should be provided for the implementation and over-fulfillment of key estimated indicators of the budget irrespective of their performance for other CFS and in the enterprise in general. Only in this case there will be a real desire to improve the efficiency and financial stability of the business.

In order to ensure that the CFS of the material incentive fund can be accrued in accordance with the performance indicators, it is advisable to develop fund-forming indicators. For this purpose, one or two fund-forming indicators can be established for each CFS from among those approved in the budget.

For CFS with a complete production cycle and producing finished products, such fund-forming indicators as the implementation of the plan for profit and profitability, the growth in sales of products are most preferable. The most appropriate indicators of cost reduction are suitable for the rest.

Let us consider the example of an appropriate indicator use—reducing the cost of production. To do this, it is necessary to calculate the conditional prices for manufactured products by the CFS. The author recommends to calculate conditional prices on the basis of the cost of production for each CFS and the level of its profitability for the enterprise. Initial data for establishment of conditional prices thus are the cost price of the product of CFS, the operating wholesale price of the enterprise for the product and the level of profitability of the product calculated at the cost price of CFS. The calculation of conditional prices for CFS is presented in Table 1. The current wholesale price of the enterprise to the product is 120 cu.; the cost for CFS: No. 1 – 13 cu.; No. 2 – 60 cu.; No. 3 – 27cu.

Table 1. Calculation of the conditional prices of a product for CFS in proportional to cost of production

CFS	Prime cost of CFS, cu.	Conditional price of CFS, cu.	Profitability, %
№1	13	$(13*120)/100=15.6$	20.0
№2	60	$(60*120)/100=72.0$	20.0
№3	27	$(27*120)/100=32.4$	20.0
Total enterprise	100	$15.6+72.0+32.4=120$	20.0

Source: Own calculation.

As it can be seen from the calculation, the sum of the conditional prices for the product according to the CFS is equal to the wholesale price of the enterprise. As for the profitability, it will be the same only at the time of the approval of the budget assignment, and in the process of its implementation it may vary depending on the performance of each CFS. The advantage of this method of calculating

conditional prices for CFS is that it allows you to analyze the dynamics of profitability of products for CFS and take into account their contribution in the distribution of the fund of material incentives.

The calculated conditional prices for the product according to CFS allow using the corresponding fund-forming indicators for calculating the fund of material incentives. Let us consider the use of fund-forming indicator – reducing the cost of production, as the main source of increase in profits of the enterprise.

Table 2. Budget prices for CFS in the quarter

Product name	Quantity, pieces	Price CFS, cu.	Planned cost, cu.	Output, ths.cu.		The planned fund of material incentives, thousand cu
				Price CFS	At planned cost	
A	2,000	30	25	60.0	50.0	-
B	5,000	40	35	200.0	175.0	-
				260.0	225.0	20.0

Source: Own calculation

The planned cost of manufactured products is 225.0 thousand units, and the planned costs per unit of commodity products of CFS is 225.0 thousand cu.: 260.0 thousand cu. = 86.5 cu. The planned fund of material incentives has been established by the Central Stock Exchange in the amount of 20.0 cu.

Table 3. The actual data on CFS for the quarter

Product name	Quantity, pieces	The actual unit	Output, thousand cu			The cost of CFS on 1 cu	
			Price CFS	At planned cost	At actual cost	According to recalculated plan	Actual
A	2300	26	69.0	57.5	59.8		
B	5500	34	220.0	192.5	187.0		
Total	-	-	289.0	250.0	246.8	86.5	85.4

Source: Own calculation

As it follows from the above data, the actual output at the approved cost-accounting index of the cost of production is 250.0 thousand cu, and the actual cost of production is 246.8 thousand cu, or the savings are 246.8-250.0 = -3.2 thousand cu.

The savings achieved by the CFS should be aimed at additional material incentives for the team and at capitalization in a ratio that takes into account the interests of the staff and the owner as well. If we accept that 50% of the savings will be sent to the fund of material incentives, then in general for the quarter in the Central Federal Reserve Fund it will amount to 21.6 thousand cu (20.0 thousand cu + 1.6 thousand cu)

It is necessary to strive to ensure that the use of one or another method of calculation should ensure the relatively high interest of the whole team in improving production efficiency, as the basis of its competitiveness in a market economy.

Thus, the development and application of a scientifically and economically sound financial management system for business entities will be an effective factor in ensuring their financial sustainability.

## CONCLUSIONS

The size of the fund for material encouragement for CFS can be established differently. [7] The method for determining it in proportion to the planned amount of the wage fund for each CFS is widely known. The method of distributing the material incentive fund is also used, taking into account the importance of the CFS in the formation of the main performance indicators and the real contribution to the overall results of the enterprise.

It is necessary to strive to ensure that the use of one or another method of calculation should ensure the relatively high interest of the whole team in improving production efficiency, as the basis of its competitiveness in a market economy.

Thus, the development and application of a scientifically and economically sound financial management system for business entities will be an effective factor in ensuring their financial sustainability.

## REFERENCES

- [1] Civil code of PMR. Edition on 03.01.2012, pp. 117-135.
- [2] Law PMR of 10.01.2004 №384-3-III "On joint-stock companies". Edition on 13.07.2011, pp. 22-31.
- [3] Law PMR of 10.07.2002 №153-3-III "On limited liability companies". Edition on 12.06.2007.
- [4] Blank, I. A., 1998, Profit management. – NIKA-Center "Elga", pp. 253-261.
- [5] Kolchin, N. V., 1998, Enterprise Finance – UNITY. Moscow "Finance", pp. 251-260.
- [6] Ryauzov, N. N., 1984, General theory of statistics. – Moscow. Finance and statistics, pp. 299-302.
- [7] Samknulo, G.M., 1970, In-Plant self-financing of woodworking enterprises. – Moscow. Publishing house "Forest industry", pp. 19-28.
- [8] Seleznev, N. N., Ionova, A. F., 2007, Financial analysis. Financial management. – UNITI. Moscow, pp. 35-58.
- [9] Trach, D. M., Trach, M. I., 2005, Corporate planning is the most important unit of economic calculation. Problems of economy of Transnistria and ways of their decision. Collection of the II International scientific-practical conference. - Tiraspol: Publishing of Transnistrian University, pp. 78-82.
- [10] Trach, D. M., Trach, M. I., Paustovsky, D. Y., 2008, Managing business-based budgeting. Socio-philosophical and economic aspects of the development of modern society. Materials of the international scientific-practical conference April 14, 2008, - Part I. – Saratov: "Scientific book", pp. 139-143.

## STUDIES ON THE CURRENT LEVEL OF INVESTMENTS FUNDED BY THE NATIONAL RURAL DEVELOPMENT PROGRAM FOR MEAT PROCESSING IN THE DEVELOPMENT CENTER REGION

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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 4.2. - "Support for investment in the processing / marketing and / or development of agricultural products", falls within measure 4 - Investments in physical assets. It is necessary to concentrate support for investments in modern production spaces and technologies, the development of new products, the application of innovative practices and technologies in the meat industry. The main purpose of this paper is an analysis of the investments with European funds regarding the development of meat processing in the Region of the Development Center of Romania in the period 2015-2017. In this paper, we propose to follow the influence of support under sub-measure 4.2 on the dynamics of investments in meat processing, at the level of the Centre Region, which have an eligible value of 14,837,922 euros, and the public value is 6,482,196 euros, in relation to nationally funded projects with an eligible value of 70,435,100 euros and a public value of 32,501,225 euros and a number of 30 projects.*

**Key words:** *eligible value, processing, meat, public funds, financing, livestock unit, project, measure*

### **introduction**

At the moment, the consumer must be provided with food safety by observing the quality and hygiene standards of the products and eliminating from the market counterfeits and products for which harmful additives may be used so that their health is not affected. This helps to increase consumer confidence in the quality of food consumed. [14]

In recent years, interest in meat authenticity has increased. Many consumers are concerned about the meat they eat and accurate labelling is important to inform consumer choice. [9] The vulnerability of food supply chains to

fraud/adulteration is growing as a result of globalisation, which is expanding the scope and scale of the incidence of food fraud/adulteration. [6]

Animal production, as an economic branch destined to provide mainly organic animal raw material for the preparation and production of human food, but also for other fields: the textile industry, the leather industry, etc., is subject to the conditions imposed by the two requirements of the contemporary society: food security and food safety [14].

There are increasing concerns of society towards the consumption of animal products

which have been produced and transformed in a sustainable manner. This trend influences consumer purchasing decision making, particularly in developed countries. [7] The use of EU subsidies within the Common Agricultural Policy community has had a positive impact on accelerating output growth in the meat industry. [8]

In Romania, the agricultural product processing sector needs investment to create new processing capacities, upgraded equipments and technologies, technology flows to meet new Community standards and improve productivity. Also, in order to absorb part of the surplus labor force from semi-subsistence farming and to capitalize on the growth potential of the agri-food sector, it is necessary to create jobs in this sector. These needs highlight the fact that the Romanian food industry still has significant gaps in the added value of agricultural products in relation to the production capacity of indigenous agricultural products. [10]

Investments for food needs of the country's population must be made after a well-defined analysis, so the state must support the production of meat and meat products through efficient methods to help the producer. [13]

The European Union (EU) is the world's third largest producer of beef. This contributes to the economy, rural development, social life, culture and gastronomy of Europe. The diversity of breeds, animal types (cows, bulls, steers, heifers) and farming systems (intensive, extensive on permanent or temporary pastures, mixed, breeders, feeders, etc) is a strength, and a weakness as the industry is often fragmented and poorly connected. [3] Romania is a net exporter of bovine meat, but the highest share in the export structure belongs to bovine live weight (84.4%). [11]

Romania is an net exporting country of sheep meat, as long as it has a surplus, and the domestic consumption is low. Romania has a high potential for producing more meat for the internal market and export. [12] The potential for meat production of Romanian Tsigai sheep breed depends on the fattening technologies applied. Improving the carcass and meat quality can be achieved by crossing

of Tsigai breed, as maternal genotype, with specialized sires for meat production. [4]

Developing an appropriate, focused strategy for the allocation of EU funds is only the first, though perhaps the most important step in implementing the EU cohesion policy. The successful implementation of EU co-funded projects is contingent not only upon the effectiveness of these countries' administrative systems, but also on the activity of the potential beneficiaries. [1] Using cohesion policy funds gave an opportunity to fulfil UE demands. One of the sectors which needed that support was agriculture and rural areas. [5]

Sub-measure 4.2 "Support for investment in the processing / marketing of agricultural products" is in line with Regulation (EU) 1305/2013, Art.17, Measure 4 - Investing in physical assets - and contributing to the two areas of intervention as follows: (1) individual and / or collective investments leading to the development and upgrading of agricultural processing and marketing capacities, compliance with European standards, including modern technologies, new innovations and ideas, as well as facilities for increasing the efficiency and productivity of businesses and the added value of agricultural products, investment in storage and packaging facilities, quality management systems, environment-friendly systems, labelling, promotion and marketing within food chains; investments to modernize and expand collection and conditioning systems, combined with marketing and product quality enhancement; (2) investments that will contribute to the creation of new local agricultural processing units and the promotion of integrated food chains, actions that will have the direct effect of creating jobs, thus contributing to the promotion of employment. [2]

## MATERIALS AND METHODS

In this paper, a statistical study was carried out to highlight the investments made under Sub-measure 4.2 of NRDP for the study period 2015-2017, regarding the projects financed for the development of the meat

processing units in the counties of Alba, Brasov, Covasna, Sibiu, Mures, Harghita which make up the Center Development Center (Transylvania). Also, the number of consultancy firms has been consulted on the speciality site. The situation of the financed projects was carried out by consulting the selection reports published by the contracting authority on the site www.afir.info.

The livestock (bovine, swine, sheep, poultry) were converted into livestock unit by multiplying the number of animals by the conversion factor specific to each species.

The value of the conversion factor by species is the following one: Bovine 1.00, Swine 0.30, Sheeo 0.15, Poultry 0.03.

Several correlations and polynomial functions have been made to see if there is a link between the terms (eligible value, livestock unit, number of consulting firms) by using the formulas below:

- the equation for the correlation coefficient:

$$r = \frac{\sum(x_i - \bar{X})(y_i - \bar{Y})}{\sqrt{(\sum(x_i - \bar{X})^2)(\sum(y_i - \bar{Y})^2)}}$$

where:

$\bar{X}$  and  $\bar{Y}$  - are the averages for samples, AVERAGE (matrix1) and AVERAGE (matrix2).

-polynomial function:

Polynomial - the n order polynomial model:

$$y = a_0 + a_1x^1 + a_2x^2 + \dots + a_nx^n.$$

## RESULTS AND DISCUSSIONS

In the period 2015-2017, in the Center Region, through sub-measure 4.2, there financed 6 projects, representing 20% of the total number of projects financed at national level so far (30 projects), which represents a relatively good score for this region. Of the 6 projects, 1 was financed in Covasna County in 2016, 1 in Harghita county in 2017, and 4 in Mures County, of which 1 financed in 2016 and 3 financed in 2017, and in the counties of Alba, Brasov and Sibiu there was no project funded by the NRDP 2014-2020 in the development of meat processing units (Table 1).

The total value of selected projects in the Center Region is EUR 14,837,922, representing the eligible value and the public value being of EUR 6,482,196.

At the national level, the total value of the selected projects is EUR 70,435,100 representing the eligible value and the public value being 32,501,225 euros, for the projects financed between 2015-2017 in the development of meat processing capacities.

It can be noticed that the counties, which attracted European funds or the development of storage capacities, are: Covasna, Harghita and Mures. Surprisingly, in Alba, Harghita and Sibiu counties, there is no project financed by European funds in the development of meat processing capacities, although they have a high potential in meat production (Table 2).

Table 1. Numerical situation of selected projects in Region 7 - Center Region

Year	County						Total	Total national
	Alba	Brasov	Covasna	Harghita	Mures	Sibiu		
2015	0	0	0	0	0	0	0	4
2016	0	0	1	0	1	0	2	8
2017	0	0	0	1	3	0	4	18
Total	0	0	1	1	4	0	6	30

Source: Own calculation.

Table 2. Total value status of selected projects in Region 7 - Central Region (Transylvania)

Year	Value	Alba		Brasov		Covasna		Harghita		Mures		Sibiu	Total V. e.	Total V.p.	Total national V.e.	Total national V.p.
2015	E	0	0	0	0	0	0	0	0	0	0	0	0		2,185,556	
	P	0	0	0	0	0	0	0	0	0	0	0	0	0		1,092,778
2016	E	0	0	0	4,999,175	0	0	340,686	0	0	0	0	5,339,861		27,066,427	
	P	0	0	0	2,499,587	0	0	170,343	0	0	0	0	2,669,930		12,439,399	
2017	E	0	0	0	0	2,250,773	0	7,247,288	0	0	0	0	9,498,061		41,183,117	
	P	0	0	0	0	900,309	0	2,911,957	0	0	0	0	3,812,266		18,969,048	
Total	E	0	0	0	4,999,175	2,250,773	0	7,587,974	0	0	0	0	14,837,922		70,435,100	
	P	0	0	0	2,499,587	900,309	0	3,082,300	0	0	0	0	6,482,196		32,501,225	

E – eligible value; P – public value.

Source: Own calculation.

The highest eligible value is in Mures county, amounting to 7,587,974 euros, and the public value is 3,882,300 euros, followed by Covasna with the eligible value of 4,999,175

euros and the public value 2,499,587 euros, and the last place is the Harghita County with the value publishes EUR 2,250,773 and the eligible value EUR 900,309 (Table 2).

Table 3. Livestock bovine, swine, sheep, poultry in 2015\* and livestock unit

Animal category	Alba		Brasov		Covasna		Harghita		Mures		Sibiu	
	Livestock head*	Livestock unit	Livestock head*	Livestock unit	Livestock head*	Livestock unit	Livestock head*	Livestock unit*	Livestock head*	Livestock unit*	Livestock head*	Livestock unit
Bovine	63,451	63,451	59,801	59,801	37,687	37,687	70,932	70,932	70,032	70,032	37,676	37,676
Swine	105,945	31,783.5	106,139	31,841.7	45,028	13,508.4	33,659	10,097.7	120,234	36,070.2	68,517	20,555.1
Sheep	307,596	46,139.4	372,430	55,864.5	213,601	32,040.15	191,603	28,740.45	457,936	68,690.4	574,770	86,215.5
Poultry	2,657,497	79,724.9	2,459,588	73,787.64	792,243	23,767.29	758,586	22,757.58	1,663,950	49,918.5	508,360	15,250.8
Total Livestock unit	-	221,098.8	-	221,294.84	-	107,002.84	-	132,527.73	-	224,711.1	-	159,697.4

Source: \* <http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table> (21.12.2018)

Table 4. Livestock unit, projects number, eligible value, number of consulting firms

County	Livestock unit	Projects number	Eligible value [€]	Number of consulting firms *
Alba	221,098.8	0	0	193
Brasov	221,294.84	0	0	550
Covasna	107,002.84	1	4,999,175	82
Harghita	132,527.73	1	2,250,773	155
Mures	224,711.1	4	7,587,974	329
Sibiu	159,697.4	0	0	354
Total	1,066,332.7	6	14,837,922	

Source: \* <https://www.topfirme.com/judet/sibiu/caen/7022/>

In order to give us an idea of the raw materials situation in the region, considering that they influence the situation of the processing investments, in Table 3, there are presented the livestock unit values calculated based on the conversion ratios. The livestock values are the following: Alba - 221,098.8, Brasov - 221,294.84, Covasna - 107,002.84, Harghita - 132,527.73, Mures - 224,711.1, and Sibiu - 159,697.4.

Several correlations have been made as follows: between eligible value and projects number, between eligible value and livestock unit, between livestock unit and investment, between the number of consulting firms and investment, to see if there is a link between the raw material in the counties of this area and the investments made in the counties of this area, but also if there is a link between the consultancy firms and the investments made (Table 5).

Table 5. Correlations value

Correlation	r	R <sup>2</sup> Polynomial function grade 2	R <sup>2</sup> Polynomial function grade 3	R <sup>2</sup> Polynomial function grade 4	R <sup>2</sup> Polynomial function grade 5
Eligible value – Projects number	0.92	0.92	1	-	-
Eligible value – Livestock unit	- 0.11	0.78	0.81	-	-
The number of consulting firms– Investments	- 0.31	0.11	0.31	0.52	1

Source: Own calculations.

There is a close link between the eligible value and the number of projects submitted, this being shown by the values of  $r = 0.92$  and  $R^2$ . The values of  $R^2$  were as follows: 0.92 - Grade 2 polynomial function and 1 - Grade 3 polynomial function. (Table 5 and Figure 1). There is no correlation between the eligible value and the livestock unit production, as it results from the value of  $r = -0.11$ , these two

variables correlate starting with polynomial grade 2 and polynomial grade 3 (0.78 and 0.81 respectively) as follows Table 5 and Figure 2. This correlation shows that the investments were made randomly and did not take into account the raw material in the respective counties.

In the case of the correlation between the number of consulting firms and the

investments made in the development of processing capacities, this can be confirmed starting with the 5th degree ( $R^2 = 1$ ) polynomial function, as shown in Table 5 and Figure 3.

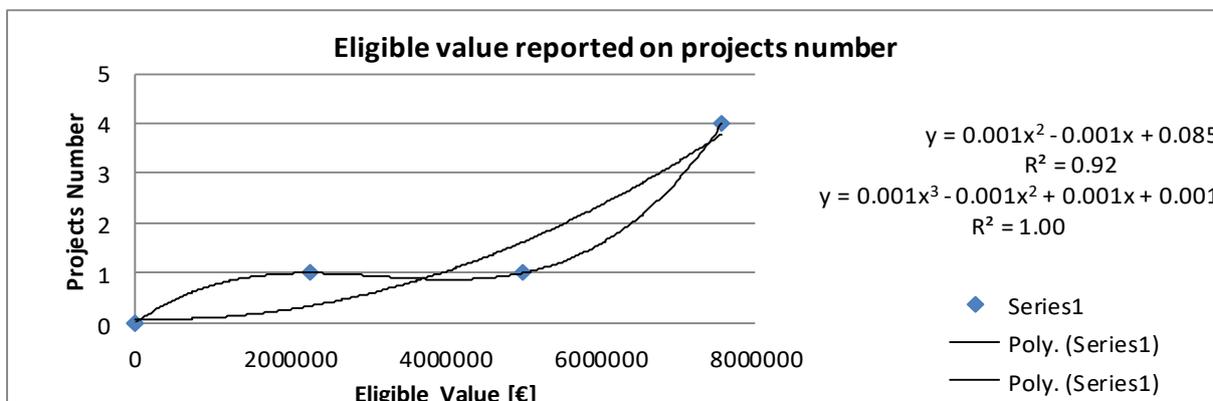


Fig. 1. Correlation between eligible value and projects number  
 Source: Own design.

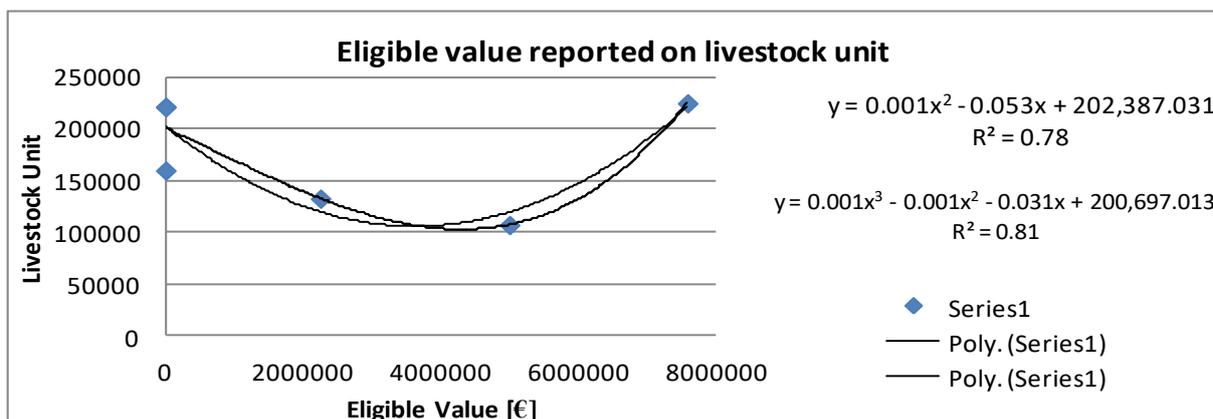


Fig. 2. Correlation between eligible value and livestock unit  
 Source: Own design.

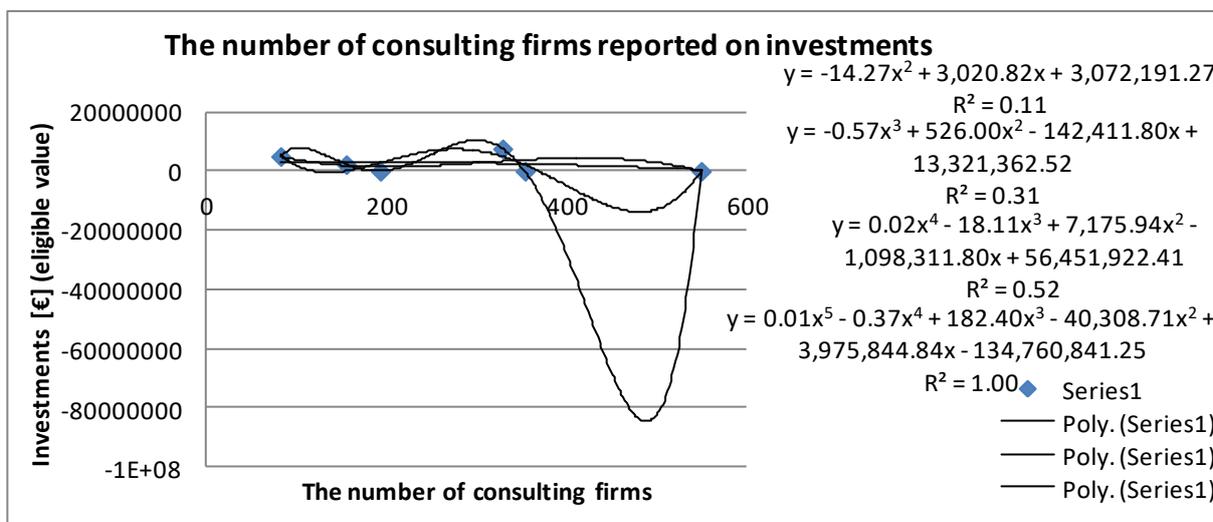


Fig. 3. Correlation between the number of consulting firms and investment  
 Source: Own design.

Neither consultancy firms in the counties in this area have influenced investments in the development of meat processing capacities between 2015-2017 through the 2014-2020 NRDP.

## CONCLUSIONS

At the level of the Center Region, under sub-measure 4.2 "Support for investments in the processing / marketing and / or development of agricultural products", in the period 2015-2017, 6 projects were financed in the development of meat processing units, representing 20% of projects funded at national level so far (30 projects).

Projects selected in the Center region have an eligible value of EUR 14,837,922 and public value is EUR 6,482,196, while at national level, the total value of the selected projects is EUR 70,435,100, representing the eligible value and the public value being EUR 32,501,225, projects funded between 2015-2017, through NRDP 2014-2020, in the development of meat processing capacities.

It is concluded that there is no correlation between the investments made in the development of the meat processing capacities and the livestock unit being shown by the correlation coefficient  $r = -0.11$ , and that the investments in this field were made randomly without taking into account the raw material.

## REFERENCES

- [1] Dumitrescu, A., Tache, I., 2011, The Absorption of Ue Funds in the Current Context of the Cohesion Policy, *Bulletin of the Transilvania University of Brasov. Series V: Economic Sciences* 4 (2): 215–220.
- [2] Ghidul Solicitantului Sub-Masura 4.2 2018 [Applicant's Guide to Sub-Measure 4.2 2018], page: 4. Agency for Rural Investment Financing. <https://www.afir.info>, Accessed on 20.01.2019.
- [3] Hocquette, J.F., Marie-Pierre Ellies-Oury, Lherm, M., Pineau, C., Claus, D., Farmer, L., 2018, Current Situation and Future Prospects for Beef Production in Europe — A Review, *Asian-Australasian Journal of Animal Sciences*, 31 (7): 1017–1035.
- [4] Ilisiu, E., Radu, V., Galatan, A., Vicovan, G.P., Ilisiu, C.V., Padeanu, I., 2018, The Potential for Meat Production of the Romanian Tsigai Sheep Breed, *Scientific Papers: Animal Science & Biotechnologies /*

*Lucrari Stiintifice: Zootehnie Si Biotehnologii* 51 (1): 161–165.

[5] Kłós, L., 2017, Zmiana Wizerunku Polskiej Wsi W Kontekście Polityki Spójności, (Change of the Image of Polish Countryside in the Context of Cohesion Policy), no. 465: 71–78.

[6] Kowalska, A., 2018, Unfair Information Practices Related to Meat and Meat Products in Poland, Conference 'Economic Sciences for Agribusiness and Rural Economy', pp. 37-44.

[7] Montossi, F., Font-i-Furnols, M., Campo, M., San Julian, R., Brito, G., Sañudo, C., 2013, "Sustainable Sheep Production and Consumer Preference Trends: Compatibilities, Contradictions, and Unresolved Dilemmas", *Meat Science* 95, pp. 772-779.

[8] Mroczek, R., Tereszczuk M., 2015, Impact of Integration with the European Union on the Polish Meat Industry, *Roczniki Naukowe Stowarzyszenia Ekonomistów Rolnictwa i Agrobiznesu* 17 (5), pp. 172-178.

[9] Nicolai, B., 2010, Authentication of Meat and Meat Products, *Meat Science*, pp. 577-587.

[10] PNDR-2014-2020-Approved-Version-30-June-2017, page: 157, <http://www.madr.ro/docs/dezvoltare-rurala/PNDR-2014-2020-versiunea-aprobata-30-iunie-2017.pdf>, Accessed on 20.01.2019.

[11] Popescu Agatha, 2016, Considerations on Beef Production, Consumption and Trade Balance in Romania (2007-2015), *Scientific Papers-Series Management Economic Engineering in Agriculture and Rural Development* 16 (4): 267–277.

[12] Popescu Agatha, 2017, Analysis of Sheep and Goats Livestock and Milk and Meat Production in Romania, 2007-2016, *Scientific Papers: Management, Economic Engineering in Agriculture & Rural Development* 17 (4): 267–279.

[13] Shebanina, O., Golubeva, O., Burkovska, A., Radzevicius, G., 2018, The Investment in the Meat Sector in the Context of Food Security in Ukraine, *Management Theory and Studies for Rural Business and Infrastructure Development* 40 (3): 393–402.

[14] Vladu, M., 2008, Processing of Animal Production, Beladi Publishing House, page:11.

## SUSTAINABLE USE OF MEDICINAL AND AROMATIC PLANTS FROM THE FOREST ECOSYSTEMS LOCATED IN DOGROGEA (SOUTH-EASTERN ROMANIA)

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### Abstract

*The tradition of using medicinal and aromatic plants in Romania dates back to the year 1862. The purpose of the present paper is to identify the main medicinal and aromatic plants, as well as estimating the quantities that can be harvested from Dobrogea in 2018 from the forest fund managed by RNP - Romsilva, the National Forest Management Institute. As such, 21 medicinal plants were identified in the two forest districts (DS) from Constanța and Tulcea Counties. A quantity of 22 t of medicinal plants from 10 species was estimated for harvesting in DS Constanța, while in DS Tulcea the number reached 588 tones from 21 species. The largest quantities that can be harvested in DS Constanța are represented by locust (*Robinia pseudoacacia*) – 5 tones and elderberry (*Sambucus nigra*) – 5 tones, while for DS Tulcea they are represented by silver linden (*Tilia tomentosa*) – 180 tones, elderberry (*Sambucus nigra*) – 60t and nettle (*Urtica dioica*) – 50 tones. All the other species can be gathered in quantities ranging from 1 ton to 40 tones. Taking into account the natural conditions, Dobrogea region is characterised by a high potential of medicinal plants. The possibility that these natural resources are maintained and even developing future abundant populations is conditioned by the appliance of appropriate management measures that abide to the present laws, the species sustainability principle as well as the protection of endangered species.*

**Key words:** aromatic plants, Dobrogea, medicinal plants, non-wood forest products

### INTRODUCTION

Medicinal plants are among the most used non-wood forest products since ancient times. In most of the countries worldwide, regardless of their medicinal traditions, the plants provided the main ingredients for medicines. However, the term “medicinal plants” can generate some controversies. As such, there are plants that are mainly used as food source but they are also considered to have additional health benefits. Furthermore, some aromatic plants (condiments or “herbs” - aromatic plants) are also known for their medicinal properties. Based on their characteristics, an insignificant difference is made between the plants used as food and the ones used as medicine, especially in areas such as Africa or India, in comparison with the Occident. Thereby, medicinal plants are grouped in the largest “medicinal and aromatic plants” (MAP) category which covers not only the plants used from a medicinal point of view (as they are known generally), but also plants that

are used for similar or overlapping purposes such as nourishment, condiments or cosmetic products [25].

Worldwide, the total number of plants used in medicine is ranging between 35,000 and 70,000 [25]; [9], while the percentage of people who rely on medicinal plants for satisfying their primary medical needs is of approximately 70-80%. [21]; [9]. For example, China uses 11,000-11,250 plant species in medicine [10]; [34]; [22], while India uses 7,500 [26], Mexico 2,237 [31] and North America 2,572 [20], respectively.

In Occidental medicine plants were used as ingredients for remedies or they had an important role in discovering new ones. Some remedies are extracted directly from plants, while others are obtained by manufacturing chemical substances from plants and others are synthesized from inorganic materials, even though they were also based on the research of active compounds identified in plants [16]; [15].

The tradition of using medicinal plants in Romania, was observed in the first century A.D. So that in 1862, was published the first Medicinal Book, describing 217 medicinal plants [14].

Medicinal and aromatic plants represent an important income source for the poor population from villages, especially through the form of harvested plants.

However, harvesting and trading medicinal and aromatic plants on a large scale can lead to the extinction of certain species. As such, the possibility that some species can become extinct at a local, regional or national level must not be sub estimated. This can lead to severe consequences for the economy, livelihood, as well as causing genetic conservation problems [9].

The most collected herb from Prahova County is wild garlic (*Allium ursinum* L.) [7], while in the case of Timiș County is common St John's-worth (*Hypericum perforatum* L.) [8].

The purpose of this paper was to identify the medicinal and aromatic plants from Dobrogea as well as to estimate the quantities that can be collected in 2018 from the forest fund managed by the National Forest Administration-ROMSILVA.

## MATERIALS AND METHODS

Dobrogea has the shape of an irregular quadrilateral encompassing two counties: Constanța and Tulcea (Fig. 1). Dobrogea is confined by important European geographical coordinates. As such, the lower inferior Danube course bounds the area in the West and North side, while the Black Sea does the same in the East part. Overall, Dobrogea is a vast erosion plateau with landscape differentiations from one unit to the other [11]. The area accounts 10,400 km<sup>2</sup>, namely 4.3% from our country's territory. The climate is continental with tendencies of accentuated excessivity.

The largest part of Dobrogea is characterised by silvo-steppe and steppe vegetation, with grayish oak, pubescent oak and Tatarian maple. The forest encompasses Măcin Mountains, Tulcea Hills, Babadag and Casimcei Plateaus, as well as South-West

Dobrogea with its sub Mediterranean, Mediterranean-balcanic, oriental, tauric-caucasian and medium-European elements [24]. The North is predominantly composed of holm, linden and hornbeam [5], composing a mesophile balcanic level; in the center (Casimcea), linden and grayish oak (accompanied by hornbeam and ash) form dense forests in a second xerotherm (Mediterranean) level; the elements of the two levels mentioned above can be found in the south (in Oltinei Plateau), with a preponderance of the mesophile ones - ash and hornbeam.

The forest soils characteristic for this area are chernozem and phaeozem [29], soils rich in humus [3] and nutritive elements [27]. The most common animals are wild boar, buck, jackal, European hare, duck and wild goose [4].



Fig. 1. Research area (/www.google.com/)

Identifying and estimating the quantities of medicinal and aromatic plants that can be collected from Dobrogea in 2018 [32] was based on the data recorded in the last years by the specialists from "Marin Drăcea" National Institute for Research and Development in Forestry (INCDS). These records concerned medicinal plants (information from specialty works: research themes, scientific papers etc.) and took into account the actual surface of the forest fund managed by RNP - Romsilva National Forest Administration.

Were taken into account also some ecologic factors that influence the forest ecosystems productivity. They included altitude, annual average precipitations and soil type. Another

factor taken into consideration was the principle of the sustainable harvesting, so that the limit of 75% imposed by the fundamental Romanian environment protection law was respected.

Very important for estimating the productivity of resources is meteorological prognosis for the current year. The quantities of medicinal herbs can significantly vary from one year to another, according to the precipitation quantities present during the blooming season.

## RESULTS AND DISCUSSIONS

Medicinal and aromatic plants, with their potential for satisfying living needs, offering health alternatives and a series of ecological products for household, pharmaceutical or cosmetic usages can be found in significant quantities in Dobrogea, under the form of shrubs, trees or grasses. Twenty one species of medicinal and aromatic plants that can be harvested were identified on the surface of the two forestry directorates (*ro.* Direcție Silvică) from Constanța and Tulcea Counties.

A quantity of 22 tones of medicinal and aromatic plants from 10 species was estimated as harvestable in Constanța Forestry Directorate, followed by a quantity of 588 tones from 21 species in Tulcea Forestry Directorate (Fig. 1 and Fig. 2).

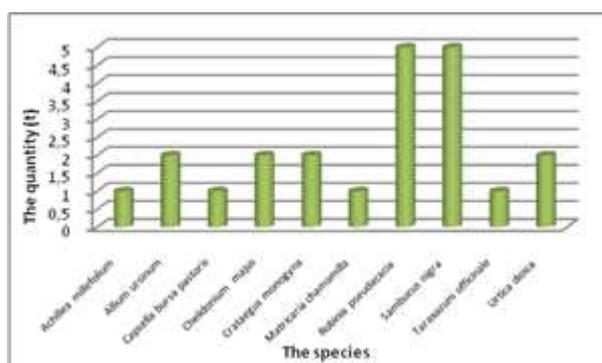


Fig.2. The quantity of medicinal and aromatic plants that can be harvested from DS Constanța  
Source: Original

It was recently reported, the largest quantities of medicinal plants can be harvested from three of the 41 national forestry directorates, namely Bihor (16%), Tulcea (10%) and Vaslui (7%) [32]. As such, Tulcea Forestry

Directorate is an important center at a national level, from where important quantities of medicinal and aromatic plants can be harvested.

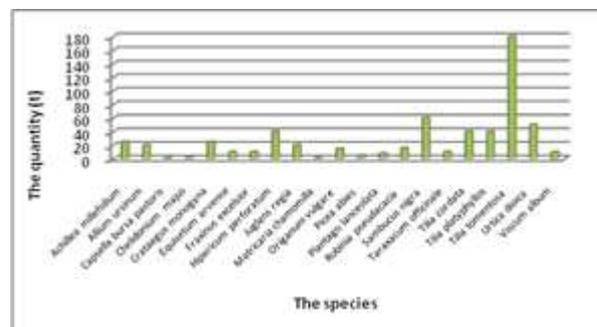


Fig.3. The quantity of medicinal and aromatic plants that can be harvested from DS Tulcea  
Source: Original

In Constanța Forestry Directorate, the largest harvested quantities are those of black locust (*Robinia pseudoacacia*) – 5 t and elderberry (*Sambucus nigra*) – 5 t.

**Black locust** (*Robinia pseudoacacia* L., Family Fabaceae), is a rather pretentious species in regard with the climate and soil, but due to its peculiar vitality, it can grow in the most varied conditions, especially in plain areas, on light, sandy soils that are fixed by its strong root system [6]. It is commonly planted on roadsides from South Oltenia, Muntenia and South Moldova [28].

It usually blooms between May and June. The flowers (*Flores Acaciae*) are harvested, registering a drying yield of 6-8:1.

Due to the low content of robinia and acaciina - a flavonoidic glicozid and a volative oil, the flowers are recommended as gastric antacid and are indicated in some medicinal teas for calming cough [1].

**Black elderberry** (*Sambucus nigra* L., Family Caprifoliaceae) can be found in Europe, Asia and North Africa. In our country, the species is commonly found in fields, hills and inferior mountain areas [28].

The plant prefers warm areas with fertile soils, rich in humus, mellow and ravens [13] [29]. Black elderberry is one of the most recognized medicinal herb in Bihor County [30].

It develops in semi shadow and it can be found in the stands from hill and field forest.

The flowers are harvested during May-June and the fruits (*Fructus Sambuci*) during September-October.

The fruits are recommended as sudorific, in bronchitis, and urinary infections and fruits can be used in treating constipation. Elderberry has also an external usage for treating abscess, furuncle, eyesore, conjunctivitis etc [1].

The flower drying yield is 5- 6:1.

In Tulcea Forestry Directorate, the harvest estimate is high for quantities of silver linden (*Tilia tomentosa*) – 180t, elderberry (*Sambucus nigra*) – 60t and nettle (*Urtica dioica*) – 50t. All the other species can be harvested in quantities gathered between 1t-40t.

**Silver linden** (*Tilia tomentosa* Moench., Family Tiliaceae) is the most widespread species, being very resistant to frosts. It can be found in hill areas or pure linden stands, rarely in field or mountain forests[28].

The plant blooms between June-July, and only the flowers (*Flores Tiliae*) are harvested. Harvesting these flowers is a very hard process due to the tree's height and the harvesting height. The drying yield is of 3,5-4:1.

Due to mucilages, linden flowers decrease respiratory inflammations. The plant is also very good as a sedative in nervous conditions, insomnia and as expectorant in bronchitis [1].

**Nettle** (*Urtica dioica* L., Family Urticaceae) is spread out in the entire country, from the field area to the alpine one, preferring soils rich in nitrogen (forest clearings, near stables, on water shores, etc.) [29].

It blooms during June-October. Only the leaves (*Folium Urticae*) are harvested, or all the aerial part of the plant (*Herba Urticae*).

Nettle juice can be used as antidote for the sting caused by nettle leaves, while a fresh leaf infusion can cure burns. The root has a benefic effect for enlarged prostate. A homeopathic remedy from leaves is used in treating rheumatic gout, hives and chickenpox, while on the exterior it can be applied for treating bumps [2]. A rational harvesting can prevent its extinction from the spontaneous flora.

### **The sustainable use of medicinal and aromatic plants**

In order to maintain the structure and stability of biocoenosis, the protected species will be controlled in order to prevent their harvesting and to ensure the species' perpetuity.

All the other species will be collected by respecting the following rules:

- it is forbidden: to collect plants that belong to small populations; to tear or destroy the subterranean parts (roots, rhizomes, etc.) of the plants used only for their superior parts; to break or cut stem or branches while collecting fruits, flowers or leaves or any other form of impairing plants and their habitat; to collect near roads with heavy traffic or waste deposits [13];

- the collected species must be very well identified so that confusions with similar species will be avoided, avoiding such species that can have a negative health effect or to avoid the harvest of rare or endangered species;

- one exemplar from the collected species must be kept in the Herbarium;

- species will be collected from the habitats where their populations are the most numerous;

- only mature exemplar will be collected, and only the parts with the highest content of active substances for which the plant is used [23]; [13].

The plant's parts will be collected during the year, when the content of active substances is the highest, as follows [33]:

- subterranean parts: autumn (September-October);

- bark: spring (March-April) and very rarely autumn;

- herbaceous plants: at the beginning of the plant's blooming;

- leaves: at the beginning of the plant's blooming;

- flowers: when the buds open;

- dried fruits: immediately before maturing;

- succulent fruits: when they are matured;

- seeds: when they are completely matured.

The management measures for medicinal and aromatic plants must take into account the future reserve, as well as methods for conserving species.

According to [12], a good method for maintaining future reserves and for conserving medicinal and aromatic plants is their cultivation, as it will satisfy the request for extending the market for these raw material. However, cultivating medicinal plants presents some inconveniency, such as [18]:

- most plants are hard to cultivate;
- cultivating a plant can often last many years;
- many plant species are required only in small quantities;
- the quality of plants harvested from wild areas is superior;
- the costs for the plants collected from the wild flora are lower than from the cultivated ones [17].

The socio-economic aspect implied by collecting of medicinal plants from the wild flora as an additional income or sometime the only means of subsistence for the poor population from certain countries, comes as a fact that sustains this type of harvesting against cultivation. However, in the case of medicinal and aromatic plants that are high in demand or for those threatened by supra-population or loss of habitat, cultivation remains the only method for stopping the diminishing of plant populations and for ensuring the survival on a long term of certain species [19].

## CONCLUSIONS

Taking into account natural conditions, Dobrogea presents a high potential of harvesting medicinal plants. There is a possibility that these natural resources can be kept and even to develop abundant populations in the future if we consider the application of management measures that respect current legislation, the species and population sustainability principle and the protection of endangered species. As such, future generations can enjoy the benefits offered by medicinal and aromatic plants from this area, while people from poor cities can still be involved in their harvesting and can considerably improve their living conditions and income.

## REFERENCES

- [1]Bojor, O., 2003, Ghidul plantelor medicinale și aromatice de la A la Z (The medicinal and aromatic herbs Guide from A to Z). Ed. Fiat Lux. Bucharest.
- [2]Chevallier, A., 1996, The Encyclopedia of Medicinal Plants: A Practical Reference Guide to over 550 Key Herbs and Their Medicinal Uses. Hardcover.
- [3]Dincă, L.C., Dincă, M., Vasile, D., Spârchez, G., Holonec, L., 2015, Calculating organic carbon stock from forest soils, *Notulae Botanicae Horti Agrobotanici Cluj-Napoca* 43 (2): 568-575.
- [4]Dincă, L., Enescu, C.M., Timiș-Gânsac, V., 2018, Game species from Tulcea county and their management. *Scientific papers series Management, Economic Engineering in Agriculture and Rural Development* 18(3): 101-106.
- [5]Doniță, N., Chiriță, C., Stănescu, V., 1990, Tipuri de ecosisteme forestiere din România (Types of forest ecosystems from Romania). Ministry of Waters, Forests and the Environment, National Institute for Research and Development in Forestry, Bucharest, 390 P.
- [6]Enescu, C.M., Dănescu, A., 2013, Black locust (*Robinia pseudoacacia* L.) – an invasive neophyte in the conventional land reclamation flora in Romania. *Bulletin of the Transilvania University of Brașov, Series II: Forestry.Wood Industry. Agricultural Food Engineering* 55(2): 23-30.
- [7]Enescu, C.M., Dincă, L., Crișan, V., 2018, The most important non-wood forest products from Prahova County, *Revista Pădurilor* 1:45-51.
- [8]Enescu, C.M., Dincă, L., Cântar, I., 2018. Which are the most common non-wood forest products in Timis County?, *Research Journal of Agricultural Science* 50(1): 51-56.
- [9]Hamilton, A.C., 2004, Medicinal plants, conservation and livelihoods. *Biodiversity and Conservation* 13: 1477–1517.
- [10]He, S.A., Gu, Y., 1997, The challenge for the 21st Century for Chinese botanic gardens. In: Touchell D.H. and Dixon K.W. (eds), *Conservation into the 21st Century. Proceedings of the 4th International Botanic Gardens Conservation Congress (Perth, 1995)*. Kings Park and Botanic Garden, Perth, Australia, pp. 21–27.
- [11]Ielenicz, M., 1999, Dealurile și podișurile României (The hills and plains of Romania). Ed. "Romania of Tomorrow" Foundation, Bucharest.
- [12]IUCN, WHO, WWF, 1993, Guidelines on the conservation of medicinal plants. IUCN, WHO and WWF, Gland, Switzerland.
- [13]Kostadinović, L., Ružičić, L., Dozet, G., Cvijanović, G., 2013, Sustainable agricultural production of medicinal herbs, *Agriculture & Forestry* 59(3) 193-205.
- [14]Kupke, J., Schwierz, A., Niefind, B., 2000, *Arznei- und Gewürzpflanzen in Osteuropa. Anbau, Verarbeitung und Handel in 18 ausgewählten MOE-Ländern.- Materialien zur Marktentwicklung*, 34; 95

- pp. Zentrale Markt- und Preisberichtsstelle GmbH (ZMP), Bonn.
- [15] Laird, S.A., Pierce, A.R., Schmitt, S.F., 2003, Sustainable raw materials in the botanical industry: constraints and opportunities. Paper given at the 3rd World Congress on Medicinal and Aromatic Plants for Human Welfare, 3–7 February 2003, Chiang Mai, Thailand.
- [16] Lama, Y.C., Ghimire, S.K., Aumeeruddy-Thomas, Y., 2001, Medicinal Plants of Dolpo: Amchis' Knowledge and Conservation. WWF-Nepal Program, Kathmandu, Nepal.
- [17] Lange, D., 1997, Trade figures for botanical drugs world-wide, *Medicinal Plant Conservation* 3: 16-17.
- [18] Lange, D., 1998, Europe's medicinal and aromatic plants: their use, trade and conservation. TRAFFIC International, Cambridge.
- [19] Lange D., 2004, Medicinal and Aromatic Plants: Trade, Production, and Management of Botanical Resources. *Acta Hort.* 629, ISHS 2004. Publication supported by Can. Int. Dev. Agency (CIDA).
- [20] Moerman, D.E., 1998, Native North American food and medicinal plants: epistemological considerations. In: Prendergast H.D.V., Etkin N.L., Harris D.R. and Houghton P.J. (eds) *Plants for Food and Medicine. Proceedings from a Joint Conference of the Society for Economic Botany and the International Society for Ethnopharmacology*, London, 1–6 July 1996. Royal Botanic Gardens, Kew, UK, pp. 69–74.
- [21] Pei, S., 2001, Ethnobotanical approaches of traditional medicine studies: some experiences from Asia, *Pharmaceutical Botany* 39: 74–79.
- [22] Pei, S., 2002, A brief review of ethnobotany and its curriculum development in China. In: Shinwari Z.K., Hamilton A. and Khan A.A. (eds) *Proceedings of a Workshop on Curriculum Development in Applied Ethnobotany*, Nathiagali, 2–4 May 2002. WWF-Pakistan, Lahore, Pakistan.
- [23] Pešić, V., Janković, P., 2006, Sustainable agricultural production from the standpoint of biodiversity. *Facta Universitatis, Series: Working and living Environmental Protection* 3(1): 83-89.
- [24] Popovici, I., Grigore, M., Velcea, I., 1984, *Podișul Dobrogei și Delta Dunării (The Dobrogei Plateau and the Danube Delta)*, Ed. Scientific and Encyclopedic., Bucharest.
- [25] Schippmann, U., Leaman, D.J., Cunningham A.B., 2002, Impact of Cultivation and Gathering of Medicinal Plants on Biodiversity: Global Trends and Issues. Inter-Department Working Group on Biology Diversity for Food and Agriculture, FAO, Rome, Italy.
- [26] Shiva, V., 1996, Protecting our Biological and Intellectual Heritage in the Age of Biopiracy. The Research Foundation for Science, Technology and Natural Resources Policy, New Delhi, India.
- [27] Spârchez, G., Târziu, D.R., Dincă, L., 2011, *Pedologie (Pedology)*, Editura Lux Libris, Brașov, 293 pag.
- [28] Stănescu, V., Șofletea, N., Popescu, O., 1997, *Flora forestieră lemnoasă a României (Romania's woody flora)*. Ed Ceres. Bucharest, pp. 446.
- [29] Târziu, D.R., Spârchez, G., Dincă, L., 2002, *Solurile României (The soils of Romania)*, Ed. For Life, Brașov, 98 pag.
- [30] Timiș-Gânsac, V., Enescu, C.M., Dincă, L., Oneț, A., 2018. The management of non-wood forest products in Bihor county, *Natural Resources and Sustainable Development* 8(1): 27-34.
- [31] Toledo, V.M., 1995, New paradigms for a new ethnobotany: reflections on the case of Mexico. In: Schultes R.E. and von Reis S. (eds) *Ethnobotany: Evolution of a Discipline*. Chapman & Hall, London, pp. 75–88.
- [32] Vasile, D., Dincă, L., Voiculescu, I., 2015, Recoltarea plantelor medicinale din flora spontană a fondului forestier administrat de RNP Romsilva (The collection of medicinal plants from the spontaneous flora of the forest fund managed by RNP Romsilva). *Journal of Forestry and Cinegetics* 37: 88-94.
- [33] Walter, S., 2002, Certification and benefit-sharing mechanisms in the field of non-wood forest products - an overview. *Medicinal Plant Conservation* 8: 3-9.
- [34] Xiao, P.-G., Yong, P., 1998, Ethnopharmacology and research on medicinal plants in China. In: Prendergast H.D.V., Etkin N.L., Harris D.R. and Houghton P.J. (eds) *Plants for Food and Medicine. Proceedings from a Joint Conference of the Society for Economic Botany and the International Society for Ethnopharmacology*, London, 1–6 July 1996. Royal Botanic Gardens, Kew, UK, pp. 31–39.

## THE MOST IMPORTANT FOREST FRUITS FROM NEAMŢ COUNTY AND THEIR HARVESTING MANAGEMENT

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### Abstract

*From an economic and social point of view, the interest for the non-wood forest resources has increased during the last couple of years. Due to its varied landscape, Romania has as its disposal, besides wood as the main forest resource, a large diversity of non-wood resources. As such, the most important non-wood forest products are forest fruits, edible mushrooms, game and medicinal plants. The present study intends to emphasize the most representative forest fruits from Neamţ County and to describe their harvesting process management. In order to establish this, an analytical hierarchic process based on certain criteria was created with the help of specialists from the domain. As such, it has been observed that cherries, blueberries and raspberry from Neamţ County have a high market potential, while the harvesting process is a complex one, either manually or mechanically.*

**Key words:** harvesting, forest fruits, sea buckthorn, Neamţ County

### INTRODUCTION

Over time, the diversity and abundance of forest resources had played a decisive role for the survival, development and revenues of humanity [1].

Non-wood forest products (NWFPs) are the oldest trading objects from the world and play an important role in the worldwide economy. In present times, they represent a main nourishment source for the rural population. According to recent reports, worldwide, there are more than 150 NWFPs that have an important international trading role, such as honey, mushrooms, resins, essential oils or different parts of several plant species used for pharmaceutical products [29]. In the last decades, the marketing of the forest fruits recorded a continuous growth, especially to the fact that more and more people are valuing their high vitamin content and their therapeutically properties [12], [20]. For example, in Romania, approximately 4,000 tonnes of forest fruits are harvested every year, the highest quantities being recorded in the case of dog-rose (*Rosa canina* L.), raspberry (*Rubus idaeus* L.), blueberry (*Vaccinium myrtillus* L.), sea buckthorn

(*Hippophaë rhamnoides* L.) and blackberry (*Rubus hirtus* W. et K.) [23].

Currently, the interest shown for NWFPs products has increased also as a consequence of the attention given by the general public to the environmental issues, including the forest ecosystems [3].

The aim of this research was to highlight the most important forest fruits from Neamţ County and to describe their harvesting management.

### MATERIALS AND METHODS

Neamţ County is situated in the Central-East part of Romania (Fig. 1) and it has a total area of 589,614 hectares [26]. The forest fund occupies a surface of 211,042 hectares, most of them being managed by Neamţ Forestry Directorate, through its thirteen forest districts [27]. In the last decade, as a consequence of the application of the restitution laws and due to the changes that occurred in the forestry normative framework, two private-owned forest districts were founded in Neamţ County, namely Asociația Ocolul Silvic Privat Bicazul Ardelean and Ocolul Silvic Bisericesc Neamţ.



Fig. 1. Location of Neamț County  
 Source: <https://en.wikipedia.org>

An analytical hierarchic process (AHP) was used in order to determine the most important forest fruits. This process, which was developed by Thomas L. Saaty, is based on a number of criteria [18]. The following 19 criteria were taken into account: 1) harvesting period, 2) portfolio of derived products, 3) harvested quantity by one worker in 8 hours, 4) harvesting cost, 5) recognition knowledge, 6) harvesting knowledge, 7) tools needed for harvesting, 8) complexity of harvesting process, 9) distribution range, 10) market potential, 11) the price of raw product, 12) the price of the derived product, 13) transport from the harvesting point to the storage centre, 14) perishability, 15) “celebrity” of the product on the market, 16) market demand, 17) biotic threats, 18) abiotic threats and 19) the development of the harvesting process. Expert Choice Desktop (v. 11.5.1683) was used as the main software for analyses.

This methodology was also used for other similar studies realized in the following counties: Ialomița [6], Maramureș [7], Prahova [8], Timiș [9] and Bihor [22].

## RESULTS AND DISCUSSIONS

The forest fruits that were selected for AHP were: dog-rose (*Rosa canina* L.), raspberry (*Rubus idaeus* L.), blackberry (*Rubus hirtus* W. et K.), bilberry (*Vaccinium* sp.), blackthorn (*Prunus spinosa* L.), cherry (*Prunus avium* L.), cornel tree (*Cornus mas* L.) and sea buckthorn (*Hippophaë rhamnoides* L.). The AHP classification was

realized based on the opinion of experts and is given in Table 1.

Table 1. AHP alternative ranking

Criterion	Berries							
	<i>Rosa canina</i>	<i>Rubus idaeus</i>	<i>Rubus hirtus</i>	<i>Vaccinium</i> sp.	<i>Prunus spinosa</i>	<i>Prunus avium</i>	<i>Cornus mas</i>	<i>Hippophaë rhamnoides</i>
1	8	3	4	2	7	1	5	6
2	3	7	6	5	2	4	1	8
3	4	7	6	2	3	8	5	1
4	2	4	3	5	7	1	6	8
5	5	2	4	3	7	1	8	6
6	4	2	3	5	6	1	7	8
7	3	1	2	7	6	4	5	8
8	4	1	2	6	7	3	5	8
9	4	6	5	2	3	8	1	7
10	3	7	4	6	2	8	1	5
11	1	2	6	7	5	3	8	4
12	7	5	4	6	1	3	2	8
13	1	7	5	6	4	3	2	8
14	1	7	2	5	6	8	4	3
15	3	7	4	5	2	8	1	6
16	5	7	4	3	2	8	1	6
17	1	8	7	4	2	5	3	6
18	1	7	6	5	3	8	4	2
19	4	3	5	6	2	7	1	8

Source: Own determination.

Based on the analytical hierarchic process (AHP), the forest fruits with the highest market potential from Neamț County were: cherries (*Prunus avium* L.), raspberry (*Rubus idaeus* L.) and the *Vaccinium* species, while the least sought out are cornel tree (*Cornus mas* L.) and blackthorn (*Prunus spinosa* L.).

The harvesting process complexity differs from one species to the other. As such, the forest fruits with an ample harvesting process are: sea buckthorn (*Hippophaë rhamnoides* L.), blackthorn (*Prunus spinosa* L.) and *Vaccinium* species, in comparison with raspberry (*Rubus idaeus* L.) and blackberry

(*Rubus hirtus* W. et K), whose harvesting process is much simpler (Fig. 2). Furthermore, the harvesting process is more developed for sea buckthorn and cherries which have a larger distribution range. Based on criterion number 3, the highest quantity of forest fruits harvested in eight hours was recorded in the case of the cherries and raspberry, while the quantity of sea buckthorn and blueberry is much lower as it requires more harvesting devices.

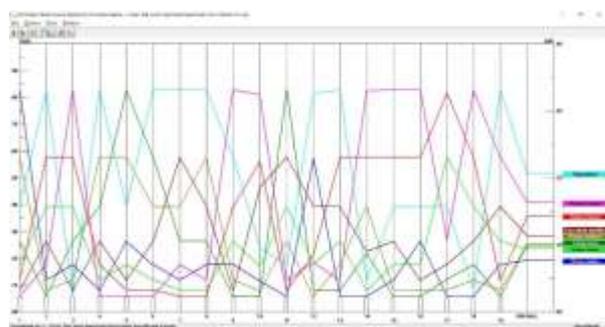


Fig. 2. The ranking of the selected NWFPs  
Source: Own determination

The harvesting period of the forest fruit species is essential as knowledge. As such, if the harvesting is not realised at the most opportune moment, the fruits will not be capitalized at their true value. The harvesting of forest fruits is realized when they reach the maturation moment.

Sea buckthorn (*Hippophaë rhamnoides* L.) is a shrub (2-3 m in height) with orange fruits. The plant has an important role in protecting and improving soils [2], [5]. The sea buckthorn fruits are rich in vitamin C, being used both in the food and pharmaceutical industries [4]. The fruit harvesting is realized from August until September [16], [21]. The harvesting process is vaster, and can be achieved through numerous methods. One of these methods is the classical one, namely manual harvesting which requires a large workforce. However, over time, mechanical harvesting methods were also developed. Amongst the specialists who have developed mechanical methods for sea buckthorn fruits we mention: Koch [15] who chose pneumatic shears, Savkin and Mukhamadiev [19], who have designed a pruning machine that organizes sea buckthorn in hedges, which are

easier to harvest, Olander [17], who created a harvesting machine that removes branches with fruits and then the fruits themselves by shaking the branches axially, or Wolf and Wegert [24], who have removed entire branches and freeze them during the night at a temperature of  $-36^{\circ}\text{C}$ , after which the frozen fruits were removed by shaking the branches [10], [16].

In the case of perishable forest fruits (wild strawberry, blueberry, raspberry, cornel tree, blackthorn, blackberry etc.), the harvesting must be realized manually: directly from the shrubs or trees, by approaching the branches or through drying with the help of tree stairs [13]. *Rubus* fruits are easy to detach from the elongated receptacle resembling a cone, but they are also very delicate and have a short conservation term (1-2 days) due to the fact that they soften very fast. These fruits must be harvested before they reach their complete colour [11], [14], [28].

Manual harvesting decreases the production efficiency and increases the workforce cost. However, mechanical harvesting can be used only for fruits that are not fallible to bruising and intended to the processing market [25].

In order to improve work productivity, the development of new mechanical harvesting technologies is required.

## CONCLUSIONS

The importance of forest fruits both on a commercial level, as well as an economical level (in the case of Neamț County) results from the information mentioned above.

The most representative forest fruits for the research area were: sea buckthorn, cherry and raspberry.

The scores obtained within our study offer precise information in regard with the possibility of harvesting forest fruits, as well as for the management of their harvesting.

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## REFERENCES

- [1]Cesaro, L., Lindall, M., Pettenella, D., 1995, The economic role of non-wood forest products and services in rural development. *Prospettive e Proposte Mediterranee-Rivista di Economia, Agricoltura e Ambiente*.
- [2]Constandache, C., Peticilă, A., Dincă, L., Vasile, D., 2016, The usage of Sea Buckthorn (*Hippophae rhamnoides* L.) for improving Romania's degraded lands, *AgroLife Scientific Journal*, 5(2): 50-58.
- [3]De Beer, J.H., McDermott, M., 1989, The economic value of non-timber forest products in Southeast Asia. Manuscript by Netherlands Committee for IUCN, Amsterdam., pp. 200.
- [4]Dincă, L., Holonec, L., Socaciu, C., Dinulică, F., Constandache, C., Blaga, T., Peticilă, A., 2018, *Hippophae Salicifolia* D. Don - a miraculous species less known in Europe. *Notulae Botanicae Horti Agrobotanici Cluj-Napoca*, 46(2): 474-483.
- [5]Enescu, C.M., 2014, Sea-buckthorn: a species with a variety of uses, especially in land reclamation, *Dendrobiology* 72: 41-46.
- [6]Enescu, C.M., 2017, Which are the most important non-wood forest products in the case of Ialomița County?, *AgroLife Scientific Journal* 6(1): 98-103.
- [7]Enescu, C.M., Dincă, L., Vasile, D., 2017, Importance of non-wood forest products for Maramureș County. *Revista de Silvicultură și Cinegetică* 40: 92-97.
- [8]Enescu, C.M, Dincă, L., Crișan, V., 2018, The most important non-wood forest products from Prahova County, *Revista Pădurilor* 1:45-51.
- [9]Enescu, C.M., Dincă, L., Cântar, I., 2018, Which are the most common non-wood forest products in Timis County?, *Research Journal of Agricultural Science* 50(1): 51-56.
- [10]Fu, L., Su, H., Li, R., Cui, Y, 2014, Harvesting technologies for sea buckthorn fruit. *Engineering in Agriculture, Environment and Food*, 7(2):64-69.
- [11]Haffner, K., Rosenfeld, H. J., Skrede, G., & Wang, L., 2002, Quality of red raspberry *Rubus idaeus* L. cultivars after storage in controlled and normal atmospheres. *Postharvest Biology and Technology*, 24(3):279-289.
- [12]Hegedűs, A., Balogh, E., Engel, R., Sipos, B. Z., Papp, J., Blázovics, A., Stefanovits-Bányai, É, 2008, Comparative nutrient element and antioxidant characterization of berry fruit species and cultivars grown in Hungary. *Hort Science*, 43(6):1711-1715.
- [13]Holmes, B., Pelican, S., Wilson, D.W., 2011, Wild berries and other wild fruit. University of Wyoming Cooperative Extension Service. College of Agriculture and Natural Resources, B1210.3,pp 28.
- [14]Iannetta, P.P.M., van den Berg, J., Wheatley, R.E., McNicol, R.J., Davies, H.V., 1999, The role of ethylene and cell wall modifying enzymes in raspberry (*Rubus idaeus*) fruit ripening. *Physiol Plant* 105: 338–347.
- [15]Koch, H.J., 1981, Cultivation of sea buck-thorn for fruit production for the fruit processing industry. *Gartenbau* 28:175–177.
- [16]Li, T. S., Schroeder, W. R, 1996, Sea buckthorn (*Hippophae rhamnoides* L.): a multipurpose plant. *Hort Technology*, 6(4): 370-380.
- [17]Olander, S., 1995, Mechanical harvesting of Sea Buckthorn. *Proc. Intl. Sea Buckthorn Workshop 1995*. Beijing, Chin
- [18]Saaty, T.L., 2008, Decision making with the analytic hierarchy process. *International Journal of Services Sciences* 1(1):83-98.
- [19]Savkin, V.A., Mukhamadiev, S.M, 1983, Effect of branch detachment from sea buck-thorn bushes on their regeneration and fruiting. *Ekologiya Rastenii i Zhivotnykh Zapovednikov Uzbekistana* (1983) 29–32. (*Hort. Abstr.* 54:8055).
- [20]Schreckinger, M.E., Lotton, J., Lila, M.A., de Mejia, E.G., 2010, Berries from South America: a comprehensive review on chemistry, health potential, and commercialization. *Journal of medicinal food*, 13(2): 233-246.
- [21]Șofletea, N., Curtu, L, 2008, *Dendrologie*. Ed.“Pentru Viața”, pp. 418.
- [22]Timiș-Gânsac, V., Enescu, C.M., Dincă, L., Oneț, A., 2018, The management of non-wood forest products in Bihor county, *Natural Resources and Sustainable Development*, 8(1): 27-34.
- [23]Vasile, D., Dincă, L., Voiculescu, I., 2016, Wild berries collected in 2016 from national forest fund managed by RNP Romsilva, *Revista de Silvicultură și Cinegetică*, 38:72-75.
- [24]Wolf, D., Wegert, F., 1993, Experience gained in the harvesting and utilization of sea buckthorn, p. 23–29. In: *Cultivation and utilization of wild fruit crops*. Bernhard Thalacker Veriag GmbH & Co.
- [25]Yu, P., Li, C., Takeda, F., Krewer, G., Rains, G., Hamrita, T., 2012, Quantitative evaluation of a rotary blueberry mechanical harvester using a miniature instrumented sphere. *Computers and electronics in agriculture*, 88:25-31.
- [26]Monografia județului Neamț Monography of the Neat County), 2011, [www.bnr.ro](http://www.bnr.ro), Accessed on November 23, 2018).
- [27]Regia Națională a Pădurilor ROMSILVA, 2018, <http://neamt.rosilva.ro/>, Accessed on November, 26 2018).
- [28]Raspberries: Management of autumn fruiting cultivars, 2013, <http://agriculture.vic.gov.au/agriculture>, Accessed on December 7, 2018.
- [29]Non-wood forest products, 2018, <http://www.fao.org>, Accessed on December, 18 2018.

## SYRAH - GRAPEVINE AND WINE- A CRITICAL REVIEW

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### Abstract

*The Syrah grape vine variety was introduced to us in the country relatively recently, after 2000, although in other wine-producing countries in Europe and even on other continents the wine obtained from it is highly appreciated. Syrah wines have strong character and personality, are tanned and strongly colored, with high alcohol content. Wines have floral (violet) or fruity flavour (raspberry, blueberries, blackberries, and dried plums etc.). Most Syrah wines have a great maturation and aging capacity, due to the compositional characteristics (mainly tannin richness), maturing, resulting in a complex aroma, spicy characteristic of black, red or green pepper, spices, olives, anise, etc. On our lands, studies about variety and Syrah wine are few and low significant, although in recent years there is already talk in the oenological field about very valuable Syrah Romanian wines assortment.*

**Key words:** Syrah, Shiraz, Côtes du Rhône, Cornas appellation

### INTRODUCTION

The *Syrah* or *Shiraz* variety, as it is called in the "New World" of viticulture (Australia, South Africa, Argentina etc.), is a grape vine variety of *Vitis vinifera* L., intended to produce high-quality red wines.

Although grown in France, Australia and other countries since the pre-philoxic period is appreciated at its true value only in the last decades, the wines obtained are considered among the best wines in the world [25].

As far as the origin of the variety is concerned, it has long been believed to originate in Iran, in the same name (*Shiraz* city), in Cyprus or in Syracuse (Sicily), from where it was brought to France by the 13th century by the knight Gaspard de Stérimberg and grown in the Hermitage area (Vallée du Rhône). According to other authors, the *Syrah* was brought back from the 3rd century and cultivated in this area of France [20].

Based on DNA studies, it has recently been proven that the variety originates in south-eastern France as a result of hybridization between *Dureza noir* and *Mondeuse Blanche*.

These studies, initiated in 1998 at I.N.R.A. Montpellier and the University of California, Davis, confirmed the theory of the French ampelographers J. André and L. Levadoux, who since 1964 introduced the *Syrah* into the group of serins, along with the varieties: *Mondeuse noire*, *Mondeuse blanche*, *Marsanne*, *Roussane*, *Viognier*, *Dureza* etc. [7], [24]. Serins represent a group of vine varieties belonging to the *Vitis vinifera* species with common morphological characteristics and ultimately of common genetic origin [31].

Today, the most famous *Syrah* wines (Hermitage, Crozes-Hermitage, Côte Rôtie, St. Joseph) are obtained in France, also in the same area, in the northern part of the Côtes du Rhône.

*Syrah* or *Shiraz* wine produced today in countries like France, Australia, South Africa, Spain, etc. already has a reputation, being considered a wine with a special aromatic and chromatic complexity. This is different from the wine of this sort produced a few decades ago, more so than wine produced in different countries under the name of *Shiraz* wine [32].

Lately, *Shiraz* producers dropped the high yields of grapes, by applying different wine practices and methods. At the same time, they practiced a modern wine-making and special methods aimed at highlighting the full potential of the variety and obtaining known today wines for the undeniable quality [23].

## MATERIALS AND METHODS

A series of databases on the origin, morphological, physiological and agrobiological characterization of the *Syrah* variety, the vineyards areas occupied with the *Syrah* grape vines, the wines obtained, and the main producing countries were studied.

## RESULTS AND DISCUSSIONS

Description of the *Syrah* variety. The leaves are medium in size, orbicular, 5-lobate, with edges with short and ogival teeth and the petiolar sinus in the form of lire or "U" is marked at the petiole point (Fig. 1). The young strings covered with a fine white fluff, they are fragile and can be easily broken; that's why they are bound at espalier, spring in March [19].

The grapes are of medium size, cylindrical or cylindrical-conical shape, quite compact, sometimes winged; in autumn the peduncle is rapidly wooding, and the leaves get a rusty colour on the edges of the leaf.

The berries are small, oval, blue-black colour, with smooth but strong skin, covered with abundant pruin (Fig.1). The mesocarp is juicy, with pleasant taste, without flavour [15].



Fig. 1 Shape of leaf and grape in *Syrah* variety  
Source: en.wikipedia.org.

The period of vegetation of the variety is long, 190-200 days, the maturing is late (in the V-

VI age, September 20-October 15, depending on the vineyard placement).

The variety has a medium to high force, poor fertility (about 65% fertile) and low yield. The production is 10-12 tons/ha, but it can grow under the conditions of fertilization (with P, K, foliar fertilizers, etc.). Also, the yield of the variety may increase when applying a long or mixed cut (Guyot, single or double type); in the Mediterranean regions to obtain a good yield but also a quality wine is enough to practice a short cut [8].

*Syrah's* variety adaptability is quite high, although it prefers the continental climate with sunny and moderately hot summers with cooler nights, low humidity, climatic features found for example in France, in the Vallée du Rhône and even in Bordeaux, but up to the Toulouse [2].

This climate leads to the making of *Syrah* premium, strong, elegant and delicate flavors wine. A climate with too high temperatures makes the wine appear dark blackberry, jammy and fruit plum characters. In fact, the *Syrah* is a drought-sensitive variety but also has low frost tolerance.

As for the soil, *Syrah* is a variety with a high sensitivity to ferrous chlorosis, which leads to the obligation to avoid heavy soils with insufficient ventilation, with excessive calcium. He prefers stony, well-drained soil with a higher iron content, with a more acidic pH. The organoleptic characteristics of the *Syrah* wine vary depending on the soil of the plantation: the stony, acidic lands lead to more robust wines, personalized yet elegant and delicately flavoured wines; and the sandy ones to fine wines with discreet aroma. The shale structure of soil, although favourable to the variety, still lead to the production of wines with a high pH, generally *Syrah* being characterized by a low acidity [29].

The variety is quite vulnerable to disease attack (downy mildew, gray rot) and pests (*Eriophyes vitis*, red spider).

The wine is strongly colored (dark violet red), with a high content of phenolic compounds, tannin even astringent, with spicy flavor, fruit, etc. Recent studies have highlighted the fact that among the red wines, *Syrah* has the highest content in resveratrol, which is very

important for food hygiene and consumer health [4], [11].

Its high tannin content makes it particularly suited for maturing and aging, the wine achieving outstanding organoleptic qualities after 10-15 years [5]. So, if *Syrah* wine is highly tannic even astringent in the youth, sometimes with a bitter temptation, after maturation it becomes an elegant and fine wine with spicy flavors, pepper, mint, herbs, dried fruit, olives, anise etc. [26]. Some *Syrah*'s wines show "heavy" spices aroma, dried truffles and prunes, along with great chocolate shades [29].

The surface cultivated with the *Syrah* variety is constantly expanding, both in France and in other European countries or in the "New World". If in France, at the level of 1958, the cultivated vineyard area was about 1,000 ha, it evolved continuously, at 12,300 ha in 1980, to the 37,000 ha in 1997 and today being the country with the highest production of *Syrah* wine, reaching a surface cultivated over 64, 000 ha.

On worldwide level, cultivated area in the 31 producing countries of *Syrah* grapevine is 190,000 ha (the area registered in 2016) being distributed as follows: France 64,000 ha (7.9% of the country's vineyard area); Australia 40,000 ha (26.8% of the country's vineyard area); Spain 20,000 ha (2.1% of the country's vineyard area); Argentine 13,000 ha (5.8% of the country's vineyard area); South Africa 11,000 ha (10% of the country's vineyard area); USA (California) 9,000 ha (2% of the country's vineyard area); Chile 8,000 ha (3.8% of the country's vineyard area); Portugal 6,000 ha (3% of the country's vineyard area); China 1,000 ha (0.1% of the country's vineyard area) [21]. *Syrah* wine is also produced in Mexico, Switzerland, New Zealand etc. (Fig. 2).

In Romania, from 180,200 ha of area under vineyard cultivation 170,292 ha are occupied with varieties intended for wine production [30].

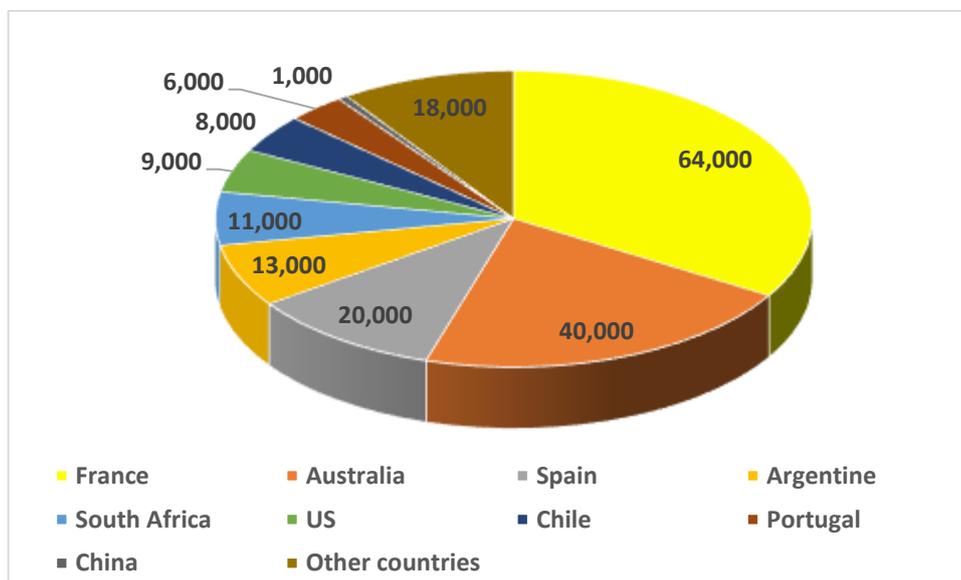


Fig. 2. The main *Syrah* grapevine variety producing countries (ha cultivated area)  
 Source: Organisation Internationale de la Vigne et du Vin, 2017

Out of this area about 16% (27,135 ha) is the area planted with vines intended to produce red wines, the remaining 84% being represented by grapevines for white wines (143,157 ha). Table 1 shows the total area planted with vines at the level of 2017, which

is distributed in the main wine regions of Romania [30].

In Romania, the *Syrah* variety is grown on small surfaces, although there is a concern among wine producers to increase these areas. *Syrah* grapevine is grown currently only in some geographic regions, such as: Oltenia

(South-west area), Muntenia (South area), Dobrogea (the southeast area), Crişana (northwest area) and Maramureş (North area), [9]. The most famous wine cellars that produce *Syrah* wines are, according to the Gault & Millau Guide (2018), are [13]:

-In Oltenia region: *7Arts Wine cellar* (in Breasta and Banu Mărăcine village), this wine cellar focused on the production of premium wines; *Oprişor Wine cellar* (Golul Drancei village, Mehedinţi county). The Oprişor Wine cellar was the first *Syrah* Romanian wine producer.

-In Muntenia region: *Budureasca Wine Cellar* (Gura Vadului village, Dealu Mare vineyard); *Metamorfozis Wine Cellar* (Ungureni village, Dealu Mare vineyard); *1000 Faces Wine Cellar* (Urлаţi city, Dealu Mare vineyard); *Lacerta Wine Cellar* (Finteşti town, Dealu Mare vineyard).

Table 1. The Romanian vineyard area, spread over the main Wine Regions

Wine Regions	Vineyard area (hectares)
Dealurile Moldovei (Moldova Hills)	65,200.3
Dealurile Olteniei si Munteniei (Oltenia& Muntenia Hills)	51,942
Colinele Dobrogei (Dobrogea hillock)	16,330.9
Sands and other favorable land in the south of the country	12,596
Terasele Dunării (Danube Terraces)	10,778.1
Dealurile Crişanei si Maramureşului (Crişana & Maramureş Hills)	9,588.8
Podişul Transilvaniei (Transilvania Plateau)	6.695.8
Dealurile Banatului (Banat Hills)	4,016

Source: <http://www.madr.ro>

-In Dobrogea region: *Bogdan Domain Wine Cellar* (Peştera vilage, Murfatlar vineyard); this winery practice biodynamic viticulture, including the variety *Syrah*.

-In Crişana region: *Maximarc Wine Cellar* (Masca vilage, Miniş vineyard);

-In Maramureş region: *Nachbil Wine Cellar* (Beltiug vilage, Sătmarului Hill vineyard), where the vineyards in this area enjoy a cool and abundance climate in precipitation.

Winters are gentle and sheltered by cold winds and blizzards. Also, in September the temperature drops sharply by minus 3-4°C, which leads to the preservation of the aromas and acids of the grapes; *Hetei Family Wine Cellar* (Beltiug vilage, Silvaniei vineyard).

The main *Syrah*'s wine producing countries:

**France** is the world's largest producer of *Syrah* wines, the country with the largest area cultivated with this variety (64,000 ha). The largest areas are located in the northern part of Rhône, between the towns of Lyon, north (rather Vienne) and Valence and Dauphiné in the south, the Hermitage area being the most famous (Crozes-Hermitage, Tain-l'Hermitage) In this area *Syrah* variety finds the ideal conditions for giving premium wines with an original home name: hot summers, but not drought, low humidity, hot days alternating with cold nights, high brightness, protection against the northern winds, acidic, stony soils. The average annual minimum temperature is about 6.5°C and the maximum average temperature is about 16°C (the highest temperatures are recorded in July and August (average temperature 26°C).

The quality levels of the Côtes du Rhône wines are:

-The Côtes du Rhône AOC (or AOP), represents about 50% of the total wine production obtained in the Vallée du Rhône, the largest share being the *Syrah* and *Grenache* coupage;

-Côtes du Rhône Villages AOC, which includes structured, complex wines, suitable for maturation and aging;

-Côtes du Rhône nommé AOC Villages (21 AOC locality);

-the Crus: in the Rhône Valley there are 17 locality called AOC, the wines produced here representing about 20% of the wine production of the Rhône Valley. In Cornas vilage is produced only red wine of the *Syrah* variety [28].

The local names of northern Côtes du Rhône: Cornas (100% *Syrah* wine), Côte-Rôtie (minimum 80% *Syrah* wine), Hermitage (minim 85% *Syrah* wine), Saint-Joseph (minim 90% *Syrah* wine).

*Syrah* is authorized to produce red wines of the Cornas appellation as a unique variety; for

the Hermitage, Crozes-Hermitage and St. Joseph appellations *Syrah* is blended with Marsanne and Rousanne wines (10 and 15% of the coupage respectively); for Côte Rôtie appellation *Syrah* is coupled with *Viognier* wine (20% of the coupage).

The most famous *Syrah* wines (Hermitage, Cornas, Côte Rôtie, Saint-Joseph) obtained in this area, are well-structured wines, strong but especially elegant, intensely colored (dark red) and with the complex aroma, imprinted by the special terroir [17]. The characteristic aromas are floral (violet) and spiced, of pepper. After maturation, the flavors evolve to shades of truffles, ripe fruit and amber.

The famous Hermitage wine is grown in the vineyard of Tail-l'Hermitage, Crozes-Hermitage and Larnage locality, in the Mediterranean climate, with slopes, southern exposure and limestone and granite soils [27]. In other parts of France (Bordeaux, Bourgogne-Beaujolais, Languedoc-Roussillon, Provence, Corse, Rhône-Alpes), successful coupage wines are produced between *Syrah* with *Cabernet Sauvignon*, *Merlot*, *Grenache noir*, *Carignan*, etc. Also, rosé wines with fruity, fresh aroma are obtained [14].

In **Australia**, the world's second-largest producer of *Shiraz* wines after France, wines are obtained in almost all the wine regions of this country, intensely colored, tanned wines with strong personality and distinctive flavors. *Shiraz* has been grown here since the 19th century (1830), although the growth of vineyards for red wines, especially between 1980 and 1990 [1]. Today, *Shiraz* is the most famous variety with the largest share in Australia, with the cultivated area being over 40,000 ha. Australia is also a renowned exporter of *Shiraz* wines, of great quality [3]. Representative viticulturally regions for *Shiraz* variety cultivation and wine production are Barossa Valley (*Shiraz*'s oldest and best-known region for *Shiraz* culture), McLaren Vale, Clare Valley, Eden Valley, Hunter Valley, Heathcote, Canberra. Here, besides *Shiraz* wines and famous blends, with a long tradition where it is combined, in varying proportions with *Grenache* and *Mourvedre* wines, or with *Cabernet Sauvignon* wine [16].

Wine Penfolds Grange is Australia's most famous *Shiraz*, being the most award-winning and appreciated for export, wine which, according to some authors, managed to bring out Australian wine from anonymity [28].

The wine also contains a small percentage of *Cabernet Sauvignon*, and lately 4% of *Viognier* white wine, to add a fresher shade of coupage, apricots, acacia and citrus flowers. The addition of *Viognier* wine to *Syrah* wine is a practice taken from France, the Côte-Rôtie area [27].

The reason for the practice, it seems, is not only the complexity of the flavor but also the color of the wine. As we know, anthocyanins are phenolic compounds that give the color of young red wine, but these substances are unstable over time, reacting with oxygen, sulfur dioxide, etc. and thus losing its importance for the color of evolving wine [10]. In the mature wine color, other compounds, such as polymers pigments that are born during alcoholic fermentation following the reaction between anthocyanins and tannins, the link being stronger and providing a stable color over time [6].

There are also pigments, resulting from the combination of anthocyanins with other phenols, as well as aldehydes or other compounds [22]. A special group, important for the stable color of mature wines, is represented by the co-pigmented anthocyanins, which are molecular associations resulting from the combination of anthocyanins with uncoloured organic components [12]. These co-pigments ensure the intensity and stability of the mature wine color, which explains the addition of *Viognier* wine, rich in copigment, to the *Shiraz* wine [18], [25].

**South Africa** is famous, especially for *Cabernet Sauvignon* and *Chenin Blanc* wines.

Of the total surface area of 94,545 ha, the *Cabernet Sauvignon* variety represents about 11% of the area occupied by the wine-producing varieties, and the *Chenin* variety 18.6% of this area. The *Shiraz* variety occupies 10.3% (11,000 ha) of the area under vines for South Africa, the third variety as the cultivated area.

The vineyards of the country are grouped in 5 wine regions and 20 districts. Most South African wines are produced in the Western Cape Province of South Africa. The most important vineyards are: the vineyard of Stellenbosch, the vineyard of Paarl, the vineyard of Constantia, the vineyard of Swartland, with Malmesbury and Darling (in Cape South Coast); the vineyard of Robertson, vineyard of Worcester (Breed Valley), vineyard of Douglas, etc.

The *Shiraz* variety is mainly grown in Stellenbosch and Paarl, cold areas, the *Shiraz* wines obtained here are savoury, fruity flavors.

*Shiraz* wine is also produced in the Swartland and Robertson regions, areas with a drier climate that lead to richer, stronger, more complex wines [33].

South African *Shiraz* becomes famous only in 2007 when the producers of this wine quit high yields and focus on quality. It is thus exported to the "Old World" of wine, but also to USA, premium *Shiraz* wines with exotic flavors, spices and black chocolate shades, making this *Shiraz* characteristic of South Africa.

**Spain.** The Spanish vineyards are spread over 69 major wine regions with "Designation of Origin" (D.O). Of these, the most famous in the world of wine are: Rioja (in North-Central Spain, the most representative varieties are *Tempranillo*, *Maturana tinta*, *Grenache*); Penedés (in Catalonia, North-East Spain); Priorat (in Catalonia); Ribera del Duero (in the Burgos region, on the Duero river valley); Valencia; Navarra; La Mancha (in Central Spain); Rueda (in Castilla y Leon); Murcia and Castilla-La Mancha; Ribera del Guadiana (in Extremadura); Madrid [29].

The *Shiraz* variety is cultivated in several wine regions: Penedés, Priorat, in La Mancha, Murcia, Jumilla, Madrid, Ribera del Guadiana etc. *Syrah* wines from La Mancha and Mediterranean regions (Murcia) are among the most popular.

The Spanish *Syrah* wine is different from the French or Australian, being more alcoholic and more robust. In the Priorat region *Shiraz* variety finds wonderful conditions of climate

and microclimate, soil and exposure of plantations on sunny terraces.

In the Priorat region wine is obtained "Barranc dels Comellars Negre". This wine is appreciated and well received for export. Wine is actually a blend of *Shiraz* with *Garnatxa negra*, *Cabernet Sauvignon* and sometimes with *Grenache* and *Merlot*.

## CONCLUSIONS

*Syrah* or *Shiraz* wines are famous all over the world, be it the old continent or the "New World" of wine. As they are known today, some of the world's finest wines, have been produced for only a few decades. The largest *Syrah* wine producers are France, Australia, Spain, Argentina and South Africa, only in these countries the surface cultivated with *Syrah* being nearly 150,000 ha.

*Syrah* wines are characterized by an intense color due to a high content of phenolic compounds, especially anthocyanins and tannins; are rich in tannins, savory and with a fruity or floral flavor. Due to the chemical composition, especially the polyphenols, they respond very well to maturing and aging.

The ripened wines for 10-15 years are unique in their complexity, with various flavors, from pepper, herbs, peppermint, to truffles, spices and black chocolate.

The Romanian *Syrah* was produced in the early 2000s and today it is a high-quality and perspective wine, although it is produced only by a few wine cellars, especially in southern Romania.

## REFERENCES

- [1] Anderson, K., Aryal, N., 2015, Growth and Cycles in Australia's Wine Industry: A Statistical Compend., 1843 to 2013, University of Adelaide Press: 20.
- [2] Anivin de France, Vin de France & cepages, Encyclopédie des Cepages de France, 2019.
- [3] Australian Wine and Brandy Corporation: Areas of Vines and Grape production by variety, 2008.
- [4] Beer, P., Strever, A., Du Toit., W.J., 2017, Do differences in the colour and phenolic composition of young shiraz wines reflect during ageing?, South African Journal of Enology and Viticulture, 38 (1):29-34.
- [5] Bindon, K.A., Kassara, S., Cynkar, W.U., Robinson, E.M.C., Scrimgeour, N., Smith, P.A., 2014,

- Comparison of extraction protocols to determine differences in wine-extractable tannin and anthocyanin in *Vitis vinifera* L., Shiraz and Cabernet Sauvignon grapes, *J. Agric. Food Chem.*, 62: 4558-4570.
- [6]Boulton, R., 2001, The Copigmentation of Anthocyanins and Its Role in the Color of Red Wine: A Critical Review, *American Journal of Enology and Viticulture.*, 52(2): 67-87.
- [7]Bowers, J.E., Siret, R., Meredith, C.P., This, P., Boursiquot, J.M., 2000, A Single Pair of Parents Proposed for a Group of Grapevine Varieties in Northeastern France, *Acta Horticulturae*, 528: 129-132, Proceeding of the Seventh International Symposium on Grapevine Genetics and Breeding.
- [8]Clarke, O., Rand, M., 2001, Oz Clarke's Encyclopedia of Grapes, Ed. Hardcover:252-253.
- [9]Crame, 2013, <https://www.crameromania.ro/crame>, Accessed on January 10, 2019.
- [10]Downey, M., Harvey, J., Robinson J., 2003, Analysis of tannins in seeds and skins of Shiraz grapes throughout berry development, *Aust. J. Grape Wine Res.*, 9: 15-27.
- [11]Downey, M., Harvey, J., Robinson J., 2004, The effect of bunch shading on berry development and flavonoid accumulation in Shyrax grapes, *Aust. J. Grape Wine Res.*, 10: 55-73.
- [12]Fulcrand, H., Duenas, M., Salas, E., Cheynier, V., 2005, Phenolic reactions during winemaking and aging, *Am. J. Enol. Vitic.*, 57: 289-297.
- [13]Gault&Millau, 2019, Guide to Romanian Wines, Bucuresti.
- [14]Gregutt, P., 2007, Washington Wines and Wineries: The Essential Guide, University of California Press.
- [15]Günata, Z., Wirth, J., Guo, W., Baumes, R., 2001, C13-Norisoprenoid Aglycon Composition of Leaves and Grape Berries from Muscat of Alexandria and Shiraz Cultivars, Carotenoid-Derived Aroma Compounds, ACS Symposium Series, edited by Winterhalter P and Rouseff R.
- [16]Halliday, J., 2004, Syrah in Australia Since 1800, The Syrah Producers' Club, Syrah Worldwide Roma: 10-14.
- [17]Harbertson, J.F., Kennedy J.A., Adams D.O., 2002, Tannin in skins and seeds of Cabernet-Sauvignon, Syrah and Pinot noir berries during ripening, *Am. J. Enol. Vitic.*, 53: 54-59.
- [18]Kilmister, R.L., Mazza, M., Baker, N.K., Faulkner, P., Downey, M.O., 2014, A role for anthocyanin in determining wine tannin concentration in Shiraz, *Food Chem.*, 152: 475-482.
- [19]Larousse, 1997, Vins et Vignobles de France, Le Savour Club, Larousse-Bordas, Paris, France.
- [20]Meredith, C.P., Boursicot, J.M., 2008, Origins and importance of Syrah N around the world, International Syrah Symposium, Lyon: 17-20.
- [21]Organisation Internationale de la Vigne et du Vin, Focus OIV, 2017, Distribution variétale du vignoble. dans le monde.
- [22]Peng, Z., Iland, P.G., Oberholster, A., Sefton, M.A., Waters, E.J., 2002, Analysis of pigmented polymers in red wine by reverse phase HPLC, *Aust. J. Grape Wine R.*, 8:70-75.
- [23]Ribéreau-Gayon, P., Pontallier, P., Glories, Y., 1983, Some interpretations of colour changes in young red wine during their conservation, *J. Sci. Food Agric.*, 34:505-516.
- [24]Robinson, J., 2005, Viognier – it's everywhere nowadays, [www.jancisrobinson.com](http://www.jancisrobinson.com), Accessed on Januarie 10, 2019.
- [25]Roggero, J., Coen, S., Raponet, B., 1986, High performance liquid chromatography survey on changes in pigment content in ripening grapes of Syrah. An approach to anthocyanin metabolism, *Am. J. Enol. Vitic.*, 37: 77-83.
- [26]Shiraz, 2004, <http://catalinpaduraru.ro/2004/06/shiraz/>, Accessed on January 10, 2019.
- [27]Tannins, 2018, <http://www.wineanorak.com/tannins.htm>, Accessed on February 2, 2019.
- [28]The Guide to Côtes-du-Rhône Wine, 2013, <https://winefolly.com/review/cotes-du-rhone-wine>, Accessed on January 10, 2019.
- [29]The Oxford Companion to Wine, Third Edition, Oxford University Press, Ed. Robinson J. and Harding J.: 676.
- [30]Viticultura/Vinificatie, 2017, <http://www.madr.ro/horticultura/viticultura-vinificatie>, Accessed on January 10, 2019.
- [31]Vouillamoze, J.F., Grando, M.S., 2006, Genealogy of wine grape cultivars: Pinot is related to Syrah, *Heredity*, 97: 102-110 .
- [32]Wine & Spirits Education Trust, 2012, Wine and Spirits: Understanding Wine Quality, Second Revised Edition, London: 6-9.
- [33]Wine of South Africa, 2017, Statistics on South African wine-grape vineyards over the past decade (2007-2017), [www.wosa.co.za](http://www.wosa.co.za), Accessed on January 10, 2019.



## INNOVATIVE METHODOLOGIES FOR ESTIMATING THE PERSONNEL OF AGRICULTURAL ENTERPRISES IN UKRAINE

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### Abstract

*Developing an effective staff assessment system is crucial for businesses. Labor effectiveness influences on the results of enterprise activity. It is possible to improve labor effectiveness by introducing system of assessment and motivation of employees. Modern practices in assessing and motivating the staff of agricultural enterprises that are used in the world are rapidly developing. However, the peculiarities of functioning of developing enterprises and general economic processes do not allow to use existing best practices for agricultural enterprises. Possibilities of introducing innovative methods for personnel assessment that are adapted for modern agricultural enterprises are still not fully researched. On the basis of comparison of personnel management systems according to American, European and Japanese approaches, the peculiarities of the management system are determined by the Ukrainian approach. The complex system of personnel assessment for agricultural enterprises is substantiated in the form of a matrix. This system takes into account two descriptive criteria: periodicity (systematic and final assessment) and on object of assessment (current activity and trends of employee development). The proposed system of personnel assessment based on the KPI method has been shown in details, as well as the criteria of evaluation and indicators by the KPI method have been substantiated. The developed system for the personnel assessing of agricultural enterprises is relevant for the specifics of the activity of farms, and allows assessing the current activity and trends of employees' development in the context of systematic and final evaluations.*

**Key words:** *personnel assessment, labor effectiveness, agricultural enterprises, system of motivation; management*

### INTRODUCTION

Active changes in the social and economic formations, entry of foreign investors into the Ukrainian market, and emigration processes result in rapid transformations of the labor relations organization at the enterprises of our country. During the last years, the personnel management has been changing faster than the scientific approaches that describe this process. The modern methods of the personnel management, the new types of relationships in a team, paradigms of the personnel motivation and attitude towards the work process and result emerge.

At the same time, it should be noted that the object of this research is the agricultural enterprises of Ukraine (as an example of a emerging market), which are somewhat lagging behind in the pace of development in comparison with the business structures of

other industry branches of the country. The outdated methods of the personnel management prevail on the research sites.

The topical issue for today is a practically absence of personnel assessment and motivation practices at agricultural enterprises. Insufficient attention is paid to the problems of personnel development and recreation. This leads to a certain imbalance in the organization of an efficient personnel management system in the agricultural sector. Modern practices in assessing and motivating the staff of agricultural enterprises that are used in the world are rapidly developing. However, the peculiarities of functioning of Ukrainian enterprises and general economic processes in Ukraine do not allow the use of existing best practices for agricultural enterprises. Therefore, the purpose of this study is to develop an innovative methodology for assessing personnel at

agricultural enterprises, taking into account the peculiarities of their activities in modern conditions for developing countries (on the example of Ukraine). The practice of countries that have recently joined the European Union [5], [3] shows that their level of agricultural development is growing. Therefore, for Ukraine, which is at the stage of European integration, it is important to increase the level of organization of activity of agricultural enterprises, including the personnel management system.

An analysis of the results of scientific research on the issues of developing an optimal system for staff assessment showed that there are three main approaches: American, Japanese and European.

Some scholars believe that it is worthwhile to allocate only two basic scientific approaches: American and Japanese: Culpan, R., Kucukemiroglu, O. [9], Anderson, R. V. [1], Yooyanyong, P, & Muenjohn, N. [29].

Proponents of the Japanese management model believe that the basis of an effective system of personnel assessment is the assessment of the results of continuous improvement of the work team team: Hayakama, N., Okachi, M., & Kalbermatten, P. [6], Fields, G., Katahira, H., & Wind, J. [11], Clarry, J. [7], Hentschel, B., & Haghirian, P. [19], Arthur M. [2].

Proponents of the American management system, believe that the most important thing in ensuring a rational system for staff assessment is to take into account an individual approach to the analysis of the

results of work and self-assessment of employees: Grayson, D. [13], Haghirian, P. [16], Yakokka, L. [26], Kalleberg, A., Reskin, B., Hudson, K. [20].

A similar approach to American is the European approach, whose supporters: Weihrich and Koontz [25], Luthans F, Patrick RR, Luthans B.C. [21], Zhu, Y.-Q., Gardner, D.G, Chen, H.-G. [30], Crespo N., Simoes N., Pinto J.-C. [8], Green, F., McIntosh, S. [15], Gannon, B., Plasman, R., Rycx, F., Tojerow, I. [12], Hauff, S., Kirchner, S. [17] believe that an individual approach to the analysis of the results of work is important in assessing staff, but, unlike the previous important role, control over such results is given.

Based on the analysis of existing management models, we conclude that it is not impossible for Ukrainian enterprises to apply one of them, since there are significant differences in personnel management and employee values. Modern Ukrainian scientists are trying to explore the peculiarities of building a system of personnel management, namely: Oksentyuk, A., Oksentyuk, R. Oksentyuk. B. [24], Yakubiv, V., Horohotska, N., Yakubiv, R. [27], K. Melnyk [22].

On the basis of generalization of various scientific approaches, as well as our own researches, we have substantiated the main distinctive differences between American, Japanese, European and Ukrainian (as an example of a emerging market) concepts of the personnel management in the context of personnel assessment and motivation (Table 1).

Table 1. Characteristic differences in the organization of the personnel assessment and motivation according to the American, Japanese, European and Ukrainian (an example of a emerging market) approaches

American management system	Japanese management system	European management system	Ukrainian (an example of a emerging market) management system
<b>Assessment and motivation object</b>			
An individual employee with his personal and professional characteristics	Team of employees	An individual employee with his professional characteristics and abilities	Labor collective focused on the professional and moral characteristics of the employees
<b>Purpose of the assessment and motivation system</b>			
Enterprise profit maximization, adequate individual assessment of each employee's contribution into the total result	Improvement and harmonization of the social and labor relations system in the organization	Enterprise profit maximization, creating adequate working conditions for the employees	Enterprise profit maximization, costs optimization
<b>Personnel assessment and motivation principles</b>			
According to the results of the team work, work experience	According to the individual indicators of the employee's work	According to the individual indicators of the employee's work	According to the results of the team work, level of tasks performance

Source: own research.

Data in Table 1 indicate a gradual change in the personnel management system in Ukraine (as an example of a emerging market) through adaptation of the European concept. However, these processes are more active in IT, finance, consulting, and media industry. These processes are barely noticeable in such industries as agriculture, woodworking and heavy industry. Therefore, the researching processes in the "backward" sectors require urgent improvement.

Various scientists actively study issues of developing the latest methods for the personnel assessment at the agricultural enterprises. There are various scientific approaches to an effective assessment system development. Thus, Zhu, Y.-Q., Gardner, D.G, Chen, H.-G. [30] propose similar approach with the use of a complex of various methods for the employee's performance assessment.

Gough, Harrison G. [14], Borghans, L., Duckworth, A., Heckman, J., & Wter Weel, B. [4] emphasize the necessity to apply this testing method as one of the most appropriate methods for the employee assessment.

Clark, A. [6], Demoussis, M., Giannakopoulos, N. [10], Mumford, K., Smith, P. [23] believe that for a comprehensive assessment of staff it is expedient to apply different methods of evaluation simultaneously, in particular on the basis of a balanced system of indicators.

Melnyk K. [22], Yakubiv, V., Horohotska, N., Yakubiv, R. [27], Yakubiv, V., Hurmak, N. [28] believe that the criteria for diversification of the activities and professional skills of employees should be taken into account in the process of motivation of employees at the Ukrainian enterprises.

## MATERIALS AND METHODS

In the process of developing an optimum personnel assessment system for the agricultural enterprises the following empirical and specific methods were used:

(a) sociological survey — in the process of expert assessment of the effectiveness of various assessment methods and possibility of

their implementation at the agricultural enterprises, as well as in the formation of criteria to develop the assessment scale for the employees' development trends;

(b) comparison, grouping and generalization — in the process of analysis and generalization of existing scientific approaches to the personnel assessment at different enterprises;

(c) abstraction and modeling — in the process of developing a comprehensive personnel assessment system;

(d) calculation and construction — in the process of developing criteria introduced into the personnel assessment system for the agricultural enterprises.

To determine the prospects of the personnel assessment system for the agricultural enterprises in Ukraine, we have conducted a sociological survey on the expert evaluation of the effectiveness of various assessment methods in practice and possibility of their implementation at the agricultural enterprises. 184 respondents, 85% of whom are practicing managers of various enterprises, scientists engaged in research in the field of economics and management at the agricultural enterprises and graduates of the "Management" specialty, that is, the experts who have basic knowledge in the issue under study, took part in this expert survey.

The results of a sociological survey on the basis of an expert evaluation of the efficiency of certain personnel assessment methods at the modern agricultural enterprises are shown in Fig. 1.

The results of a sociological survey on the evaluation of the efficiency of various personnel assessment methods at the Ukrainian enterprises showed that the most effective methods are (in descending order from the most to the least effective ones): (i) assessment center method; (ii) 360° method; (iii) performance management method; (4) method of business games; (v) control method for goals.

In the process of a sociological survey on the feasibility of application of these personal assessment methods at the agricultural enterprises in Ukraine, it has been established that the same respondents consider that the

most effective methods for these enterprises, in descending order from the most to the least effective ones, are the ones which are presented in Fig. 2.

It is about: (i) performance management method; (2)normative method; (3)control method for goals; (4)assessment center method; (v) method of the manager standard estimates.

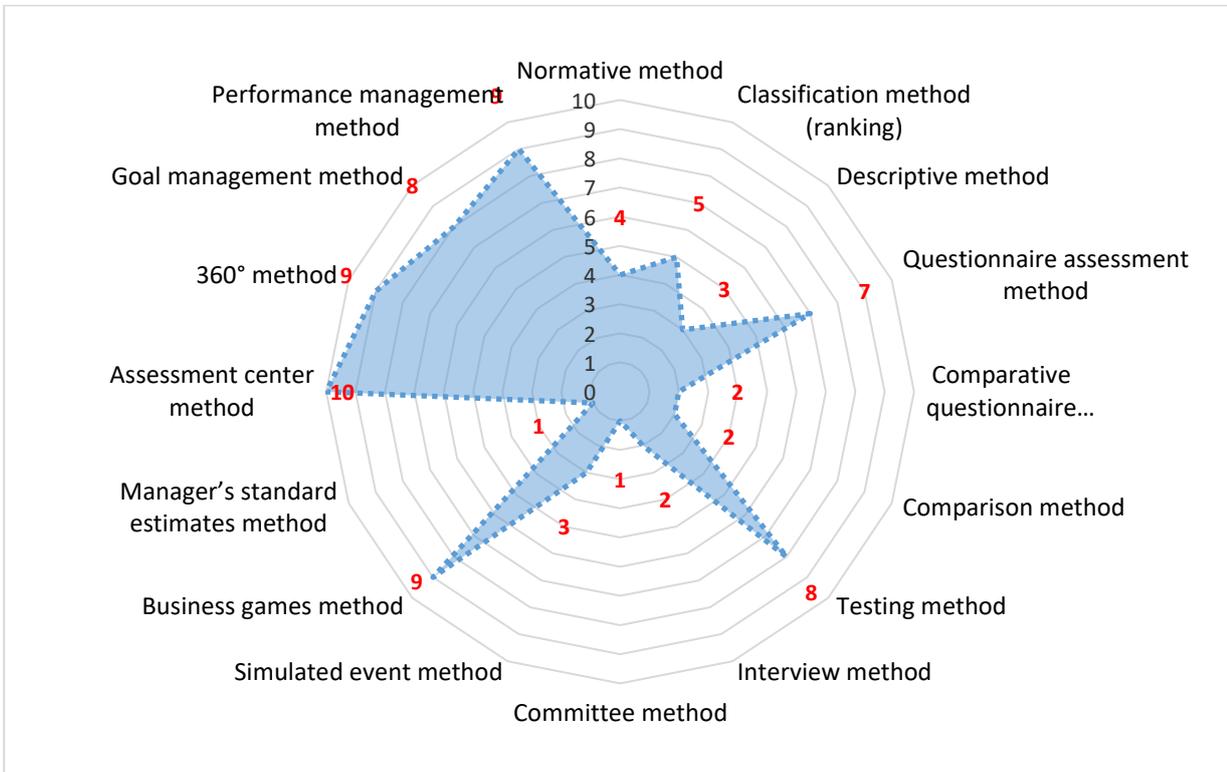


Fig. 1. Results of a sociological survey of the efficiency of various personnel assessment methods at the agricultural enterprises in Ukraine

Source: author's research based on the sociological survey results

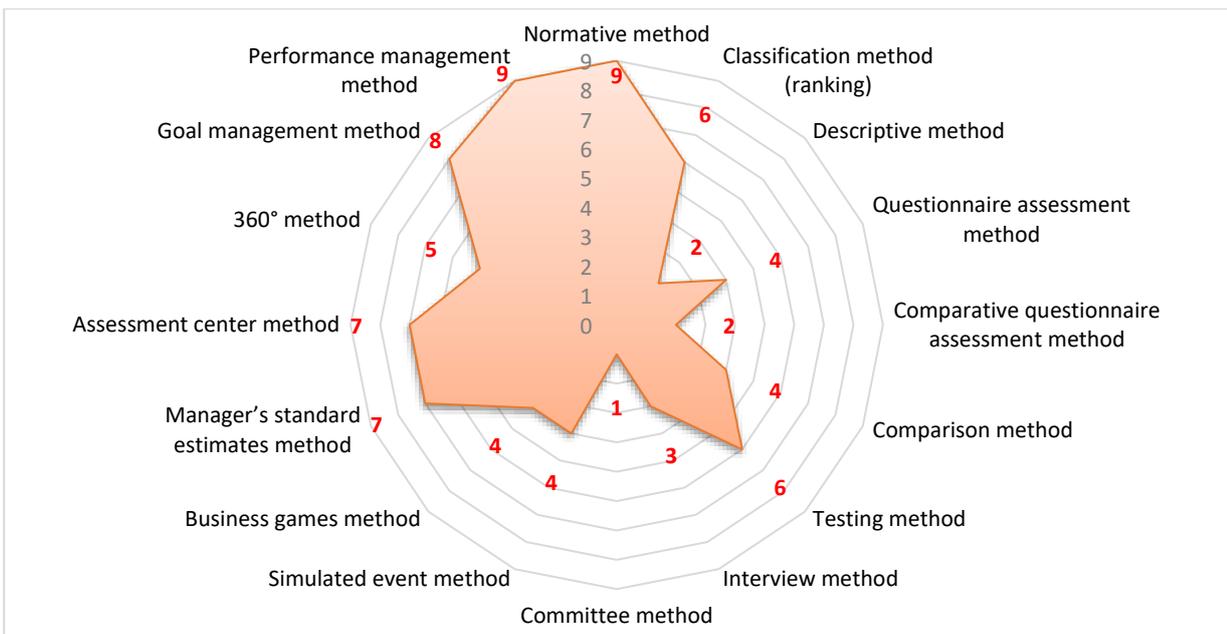


Fig. 2. Results of the sociological survey on the possibility of implementation of various personnel assessment methods at the agricultural enterprises in Ukraine

Source: author's research based on the sociological survey results

Developing an effective system for the personnel assessment and motivation system in the organizational and methodological aspects. On the one hand, the introduction of a powerful personnel motivation system brings good results, as a rule. However, on the other hand, it is important not only to increase labor productivity, but also effectiveness of the motivation and assessment system for the enterprise owner. That is correlation between the results from the introduction of an innovative personnel assessment and motivation system and cost of organizing such work.

## RESULTS AND DISCUSSIONS

In this scientific survey, under an effective personnel assessment and motivation system at the agricultural enterprises, we understand such a system which meets two conditions:

- (i) it has optimal conceptual and procedural organization;
- (ii) it is optimal in terms of the expense-income ratio, that is, the effectiveness of the implemented measures.

An important condition for the effectiveness of our system is its optimality in terms of the expense-income ratio, that is, effectiveness of the implemented measures. At the same time, we consider that an effective system is a set of assessment elements and motivation methods for different employees, provided that the following conditions are met (1):

$$\left\{ \begin{array}{l} \Delta LPL > \Delta AMC \\ \Delta NP > \Delta AMC, \end{array} \right\} \quad (1)$$

where  $\Delta LPL$  is a changing in labor productivity level of the employees;

$\Delta NP$  is a changing in net profit of an enterprise;

$\Delta AMC$  is a changing in the cost of the personnel assessment and motivation system functioning.

The basis of our effective methodology for the personnel assessment is two classification criteria: frequency and assessment objects. Thus, the conceptual framework for the development of an effective personnel assessment for the agricultural enterprises is shown in Fig. 3.

Matrix on Fig 3. shows that we consider it necessary to introduce such a personnel assessment system at the agricultural enterprises, which will include an analysis of the efficiency of the employee's work under 4 criteria:

- systematic assessment of work;
- final assessment of work;
- assessment of the employee's current activities;
- assessment of the employee's development trends.

Our assessment system is complex and multifaceted and provides a systematic and comprehensive assessment of various employees. It can be used for the most of typical medium and large agricultural enterprises. For the small (farmer) enterprises, it is appropriate to apply a significantly simplified method, that is, the individual elements of our methodology, depending on the needs arising in the process of the personnel management.

	<i>Systematic assessment of activities</i>	<i>Final assessment of activities</i>
<i>Assessment of the employee current activities</i>	<i>Quadrant 1</i> KPI <sub>i</sub>	<i>Quadrant 2</i> $\sum_{i=1}^n KPI_i$ <b>360° method</b>
<i>Assessment of the employee's development trends</i>	<i>Quadrant 3</i> Assessment scale (once every 3 months)	<i>Quadrant 4</i> Comprehensive assessment scale (once at the end of the year)

**PERSONNEL COMPREHENSIVE ASSESSMENT**

Fig. 3. Conceptual principles for the development of an effective personnel assessment system at the agricultural enterprises in Ukraine  
 Source: own research

KPI<sub>i</sub> – a key indicator of the estimation of the corresponding parameter of a personnel assessment system.

An important feature of such a system is the need to develop different assessment systems for the different categories of employees. For this purpose, we have divided the employees of all agricultural enterprises into several groups:

Group I — administrative employees (key managers). These include enterprise general director, deputies, chief specialists (chief accountant, chief engineer, financial director), i.e. those managers whose motivational payments will depend on the final enterprise results;

Group II — managers and employees of the productive work categories. These include sales managers and employees of the sales and marketing department.

Group III — managers and employees of other categories of administrative work. These include managers and employees of the accounting, planning and analytics department, personnel management department and other administrative personnel, as well as managers of the production divisions.

Group IV — employees of the production units, i.e. workers.

We have developed an innovative method to assess the personnel of the agricultural

enterprises which implies that the following methods of the personnel assessment will be used for categories I, II and III:

(1) for systematic assessment:

-assessment of current employees' activities will be carried out on the basis of the KPI method;

-assessment of the employee development trends will be carried out on the basis of a comprehensive assessment scale, which includes 3 methods: questionnaire assessment, assessment based on management according to goals and assessment on the basis of performance management;

(2) for the final assessment:

-assessment of the current employees' activities will be carried out by summing up the results using the KPI and 360° method;

-assessment of the employee development trends will be carried out on the basis of a comprehensive assessment scale (per year), which includes 3 methods: questionnaire assessment, assessment based on management according to goals and assessment on the basis of performance management.

Conceptual approaches to the KPI method application to assess the current activities of the agricultural enterprises' employees. The detailed methods of KPI application in the work of agricultural enterprises according to the established 4 groups of workers are given in Table 2.

Table 2. Criteria and indicators of work assessment of employees of different categories at the agricultural enterprises according to the KPI method

Group of employees	KPI general characteristics	KPI indicators	KPI blocking indicators
Group I	KPI indicators should be based on the main performance indicators of the enterprise as a whole	1) net profit; 2) profitability level of activities; 3) attracting new investments; 4) net present value of investments	1) lack of profit in the reporting period; 2) low profitability level of activities (threshold level is 10%)
Group II	KPI indicators should be based on indicators related to market share and sales volumes	1) share of products on the market; 2) sales volumes; 3) number of new regular customers; 4) number of new developed markets	Decline of sales volumes in comparison with the same period last year
Group III	KPI indicators should be based on an assessment of the level of task performance set for the employee and his performance level	Specific indicators for different managers and employees, depending on type of their activities	Percentage of achievement of the goals set for the employee is <90%
Group IV	KPI indicators should be based on an assessment of the performance level of the task (norm) set for the employee	Planning norms of the volumes of work	Percentage of fulfillment of the planned norms is < 100 %

Source: own research.

Table 2 shows that not only the control results of work, but also the so-called "blocking" indicators are the basis to the personnel assessment according to the KPI system. The purpose of such indicators is blocking of the KPI system (concerning bonus accrual and payments) in case of failure to fulfill the threshold criterion results of work. In other words, if there is a certain blocking indicator in the reporting period, the employee does not receive bonuses at all. This is an important motivating factor to maintain a normal level of the employee's performance.

The essence of the final KPI (2) is that the KPI average level per year is determined by the results of the year:

$$KPI_f = \sum_{i=1}^n KPI_{if} / 12, \quad (2)$$

where KPI – is the final assessment of an employee according to the KPI,  
n – is the number of months in the reporting period, i.e. 12.

Decisions on motivation based on the annual premium fund are made on the basis of such final assessment of the employee. Taking into account the fact that many agricultural enterprises (especially in the crop field) have almost no current results (revenue from product sales) during the year, application of the final KPI may be the only rational decision, that is, without KPI calculation in the separate reporting periods.

## CONCLUSIONS

A comprehensive system for assessing the personnel at the agricultural enterprises has been developed on the basis of expert survey and own developments. This system is effective in terms of the income and expenses and its aim is to provide the possibility of applying a rational and effective system for the employee's motivation. Compilation of the most effective methods is in the basis of the developed system for the personnel assessment at the agricultural enterprises, in particular: KPI, 360° and scale to assess the employee development trends.

The proposed methodology in the article is based on staff assessment in two main areas:

assessment of current activity and assessment of development trends.

In the research the criteria and indicators of work assessment of employees of different categories at the agricultural enterprises are substantiated according to the KPI method and method 360°.

The developed system for the personnel assessment at the agricultural enterprises provides assessing the current activities and trends of the employees' development in the context of systematic and final assessment. This will facilitate to make rational management decisions on the implementation of an effective motivational mechanism at the enterprises.

The developed methodology of personnel assessment can be used at agricultural enterprises of different specializations, as well as from different countries with a emerging market, not only in Ukraine.

## REFERENCES

- [1]Anderson, R. V., 2009, Japanese and American management: Contrast of styles. [http://cob.jmu.edu/icpm/management\\_world/CMartMar09.pdf](http://cob.jmu.edu/icpm/management_world/CMartMar09.pdf), Accessed Jan 11, 2019.
- [2]Arthur, M., 1992, Whitehill «Japanese Management: Tradition and transition»: Routledge, London, 1992. 240 p.
- [3]Bencheva, N., 2006, Transition of Bulgarian agriculture: present situation, problems and perspectives for development. Journal of Central European Agriculture 6(4), July 2006, [https://www.researchgate.net/publication/27201767\\_transition\\_of\\_bulgarian\\_agriculture\\_present\\_situation\\_problems\\_and\\_perspectives\\_for\\_development](https://www.researchgate.net/publication/27201767_transition_of_bulgarian_agriculture_present_situation_problems_and_perspectives_for_development), Accessed Jan. 11, 2019.
- [4]Borghans, L., Duckworth, A., Heckman, J., Wter Weel, B., 2008, The economics and psychology of personality traits. Journal of Human Resources, 43, pp. 972-1059.
- [5]Chițea, M. A., 2018, Romania's labour force in regional profile after the accession to the European Union. Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development Vol. 18, Issue 1, 2018, pp. 123-130.
- [6]Clark, A., 2005, Your Money or Your Life: Changing Job Quality in OECD Countries, "British Journal of Industrial Relations", 43, pp. 377-400.
- [7]Clarry, J., 2010, Innovation and the patenting of knowledge in Japanese corporations. In P. Haghirian (Ed.), Innovation and change in Japanese management. London: Palgrave Macmillan, pp. 177-198.

- [8]Crespo, N., Simoes, N., Pinto, J.-C., 2017, Determinant factors of job quality in Europe. *Argumenta Oeconomica*, 1 (38), pp. 15-40.
- [9]Culpan, R., Kucukemiroglu, O., 1993, A comparison of U.S. and Japanese management styles and unit effectiveness, <https://www.questia.com/library/journal/1G1-14107132/a-comparison-of-u-s-and-japanese-management-styles>, Accessed Jan 11, 2019.
- [10]Demoussis, M., Giannakopoulos, N., 2007, Exploring Job Satisfaction in Private and Public Employment: Empirical evidence from Greece, "Labour", 21, pp. 333–359.
- [11]Fields, G., Katahira, H., Wind, J., 2000, *Leveraging Japan: Marketing for the new Asia*. San Francisco: Jossey-Bass, 362 p.
- [12]Gannon, B., Plasman, R., Rycx, F., Tojerow, I., 2007, Inter-industry Wage Differentials and the Gender Wage Gap: Evidence from European Countries, "Economic and Social Review", 38, pp. 135–155.
- [13]Grayson, D., 1991, American management at the dawn of the 21st century; per. from English DK Grayson, K. O'Dell: Moscow, Economics. – 176 p.
- [14]Gough, Harrison G., 2000, The California Psychological Inventory. In C.E. Watkins & V.L. Campbell (Eds.), *Testing and assessment in counseling practice*, Second edition. Mahwah, NJ: Lawrence Erlbaum Associates, pp.45-71.
- [15]Green, F., McIntosh, S., 2001, The Intensification of Work in Europe, "Labour Economics", 8, pp. 291–308.
- [16]Haghirian, P., 2010, *Multinationals and cross-cultural management: The transfer of knowledge within multinational corporations*. London: Routledge, 450 p.
- [17]Hauff, S., Kirchner, S., 2014, *Cross-national Differences and Trends in Job Quality: A Literature Review and Research Agenda*, Universität Hamburg Discussion Paper, 13, 346 p.
- [18]Hayakama, N., Okachi, M., Kalbermatten, P., 2009, Production management. In P. Haghirian (Ed.), *Japanese management: Fresh perspectives on the Japanese firm in the 21st century*. Bloomington, IN: iUniverse, pp. 147–179.
- [19]Hentschel, B., Haghirian, P., 2010, Nonaka revisited: Can Japanese companies sustain their knowledge management processes in the 21st century? In P. Haghirian (Ed.), *Innovation and change in Japanese management*. London: Palgrave Macmillan, pp. 199–220.
- [20]Kalleberg, A., Reskin, B., Hudson, K., 2000, Bad Jobs in America: Standard and Nonstandard Employment Relations and Job Quality in the United States, *American Sociological Review*, 65, pp. 256–278.
- [21]Luthans F., Patrick R.R., Luthans B.C., 1995, Doing business in central and eastern Europe: political, economic, and cultural diversity. *Business Horizon* September/October 38:9–16.
- [22]Melnyk, K. Yu., Tsesarsky F. A., Seletskyi O. V., 2018, Economic and legal analysis of premiums and increments to staff. *Scientific bulletin of Polissia*. – 2018. – № 2 (14). P. 1, pp. 232-241.
- [23]Mumford, K., Smith, P., 2004, Job Tenure in Britain: Employee Characteristics versus Workplace Effects, "Economica", 71, pp. 275–297.
- [24]Oksentyuk, A., Oksentyuk, R. Oksentyuk. B., 2012, Foreign and domestic experience of personnel management. *Galician Economic Journal*, 2012, № 1(34), pp. 66-72.
- [25]Weihrich and Koontz, 2000, *Management – A Global perspective*, McGraw-Hill International Editions, Tenth Edition, Singapore, 214 p.
- [26]Yakokka, L., 2011, *Career of the Manager*. Minsk: Poppuri, 2011, 544 p.
- [27]Yakubiv, V., Horohotska, N., Yakubiv, R., 2015, Management model for the development of agricultural enterprises through the introduction of diversification processes. *Actual problems of the economy*, 2015, № 8, pp. 58-66.
- [28]Yakubiv, V., Hurmak, N., 2017, Efficiency of Intermediary Activity of Agricultural Enterprises: Methods and Assessment Indicators // *Bulgarian Journal of Agricultural Science*, 23 (No 5) 2017, pp. 712–716. file:///C:/Users/Valentyna/Downloads/04-Humark%20Romaniuk%20(2).pdf, Accessed on Jan 11, 2019.
- [29]Yooyanyong, P, Muenjohn, N., 2010, Leadership differences: Comparison between American and Japanese expatriate managers. Retrieved February 2, 2013, from [http://jgxy.usx.edu.cn/DAOM/097\\_PisalYooyanyong.pdf](http://jgxy.usx.edu.cn/DAOM/097_PisalYooyanyong.pdf), Accessed on Jan. 11, 2019.
- [30]Zhu, Y.-Q., Gardner, D.G, Chen, H.-G., 2018, Relationships Between Work Team Climate, Individual Motivation, and Creativity. *Journal of Management*. Volume 44, Issue 5, 1 May 2018, pp. 2094-2115.