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**THE RESEARCH INSTITUTE FOR  
AGRICULTURE ECONOMY AND RURAL  
DEVELOPMENT  
Bucharest, Romania**

**AGRARIAN ECONOMY AND RURAL DEVELOPMENT -  
REALITIES AND PERSPECTIVES FOR ROMANIA**

***INTERNATIONAL SYMPOSIUM  
10<sup>TH</sup> EDITION***

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## **SECTION 1**

### **PREMISES, DEVELOPMENT DIRECTIONS, PERSPECTIVES ON AGRO-FOOD TRADE, ECONOMIC SUSTAINABILITY ASSESSMENT, EFFECTS**

# THE INFLUENCE OF PREDOMINANTLY RURAL AREAS ON THE DEVELOPMENT PATH OF CENTRAL AND EAST-EUROPEAN REGIONS WITH STRUCTURAL SIMILARITY

ANCA DACHIN<sup>1</sup>

**Abstract:** *The real convergence process within the European Union at regional level is the main goal of the cohesion policy. Less developed regions belong mainly to Central and East European countries and aim at catching-up with other EU regions. According to Eurostat, Romania has 28 predominantly rural NUTS3 areas out of 42, situation that is usually associated with economic lagging behind. The paper focuses on the analysis of seven NUTS2 regions in Romania (excluding Bucharest-Ilfov) compared to other EU regions with structural similarity belonging to Bulgaria, Poland, Hungary, Czech Republic, Slovakia and Slovenia. All these regions have improved their GDP/capita in the period 2007-2017, but most of them still have about 30-50% of the EU28 average. The purpose of the paper is to determine, by using the descriptive statistical analysis, to what extent the predominantly rural regions contributed to the slow rate of economic development at NUTS2 level in the last decade*

**Keywords:** *regional convergence, predominantly rural regions, structural similarity, economic development*

**JEL Classification:** O18, R11, R23

## INTRODUCTION

Literature regarding regional issues has a special focus on agglomerations, clusters and regional innovation, these being favorable conditions for development. Often the lagging behind of the rural areas is highlighted, since none of these aspects is actually present there. The European Union pays special attention to the development of rural areas through specific policies and resource allocations to reduce the urban-rural disparities (European Commission, 2013). The rural development policy is part of the regional integration policies and it promotes economic and social cohesion.

However, it is still difficult to estimate to what extent the EU support for the peripheral regions in the Central and East European countries will contribute to their favorable development (Abraham, 2011) and consequently to the regional convergence within the EU.

The rural-urban divide is serious in many countries. The long-term trend indicates the increase of the degree of urbanization, largely by attracting young people, so that it has become a worldwide problem to create opportunities for young people from the rural areas to determine them not to emigrate (IFAD, 2019). Some authors, however, criticize the idea of urban-rural or center-periphery comparisons (Souza, 2018).

Romania has progressed economically, increasing GDP (in PPS) from 43% of the EU average in 2007 (the year of EU accession) to 64% in 2018, but the pace of development is relatively slow. This situation is intensely debated, one of the causes frequently mentioned being the weak dynamics of the rural areas.

According to the new typology of the regions (Dijkstra & Poelman, 2014), the predominantly rural regions in the EU are identified at the level of NUTS3 regions where at least 50% of the population live in rural grid cells. Romania has a number of 28 counties classified as predominantly rural regions out of a total of 42 counties, and these cover 67.8% of the area and comprise 54.4% of the country's population (Eurostat, GISCO, based on 2011 population grid, LAU 2014 and NUTS 2013).

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We note that, at EU level, there are numerous countries comprising predominantly rural regions with a significant share of the population, such as Ireland (60.7%), Slovenia (59.3%), Austria (41.6%), Finland (40.9%), Croatia (39.7%), Slovakia (37.6%), Poland (35.3%), France (32.4), Portugal (32%) etc. But between these countries there is a development gap, which has multiple causes.

The paper starts from a comparative analysis of NUTS2 regions in the European Union structurally similar to the development regions in Romania (exclusive Bucharest -Ilfov region). The purpose of this analysis is to identify the common characteristics related to the spatial and population dimensions of predominantly rural regions and their influence on the level of development.

## **MATERIALS AND METHODS**

In Romania, the NUTS2 development regions North-West, Center, North-East, South-East, South-Muntenia, South-West Oltenia and West show significant development gaps compared to the Bucharest-Ilfov region, which is the only one that does not include predominantly rural regions and had a level of GDP per capita (in PPS) in 2017 44% higher than the EU28 average. To ensure the comparability of the regions, the Bucharest-Ilfov region was excluded from the present analysis.

The identification of some EU regions similar to the seven NUTS2 regions in Romania was based on data provided by the Smart Specialisation Platform (European Commission, 2013). This platform indicates similar reference regions in 2011-2012, considering several criteria (geo-demography, education level, technological specialization, sectoral structure, firm size, trade openness, institutions/values).

By using these criteria, the present analysis considers only 29 comparable EU regions. For the 29 selected NUTS2 regions, having similar characteristics, corresponding NUTS3 regions were identified (Eurostat, 2018), and of these the predominantly rural regions were specified, using Eurostat GISCO.

The economic performance of the regions is synthetically measured by GDP per inhabitant. The ranking of the selected NUTS2 regions according to this criterion shows the evolution of the regions during the period 2007-2017. The research hypothesis is that rural activities mark the path of development. Thus, for 2016, the calculations indicate the degree of correlation of the weight of the employed population in the four main sectors (agriculture, industry, construction and services) with the level of GDP per inhabitant. The lack of data for the regions of Poland between 2007-2015 and 2017 created difficulties for analyzing the time series 2007-2017.

## **RESULTS AND DISCUSSIONS**

The regions of the European Union with a high degree of structural similarity with the seven regions in Romania are located in Central and Eastern Europe, the majority in Bulgaria, Hungary, Poland and, to a lesser extent, in Slovakia, Slovenia and the Czech Republic (Table 1).

Although the surfaces, the total population and the administrative organization differ between the selected NUTS2 regions, some common features are observed:

- All regions lost population in the period 2007-2017, except for the Severovýchod region of the Czech Republic and Východné Slovensko of Slovakia. The most serious emigration is from the South-West Oltenia, South-East and North-West regions of Romania, to which are added Severozapaden and Severen tsentralen from Bulgaria.
- All regions recorded an increase of GDP per inhabitant, while this positive change is significantly higher in the regions of Romania. During 2014-2017 (the data allowed the calculation of the dynamics for Poland as well), the trend of improving GDP per inhabitant was maintained.

**Table 1: Population and GDP per inhabitant in selected NUTS2 regions of EU28 having structural similarity with Romanian NUTS2 regions (excluding Bucharest-Ilfov), 2007-2017**

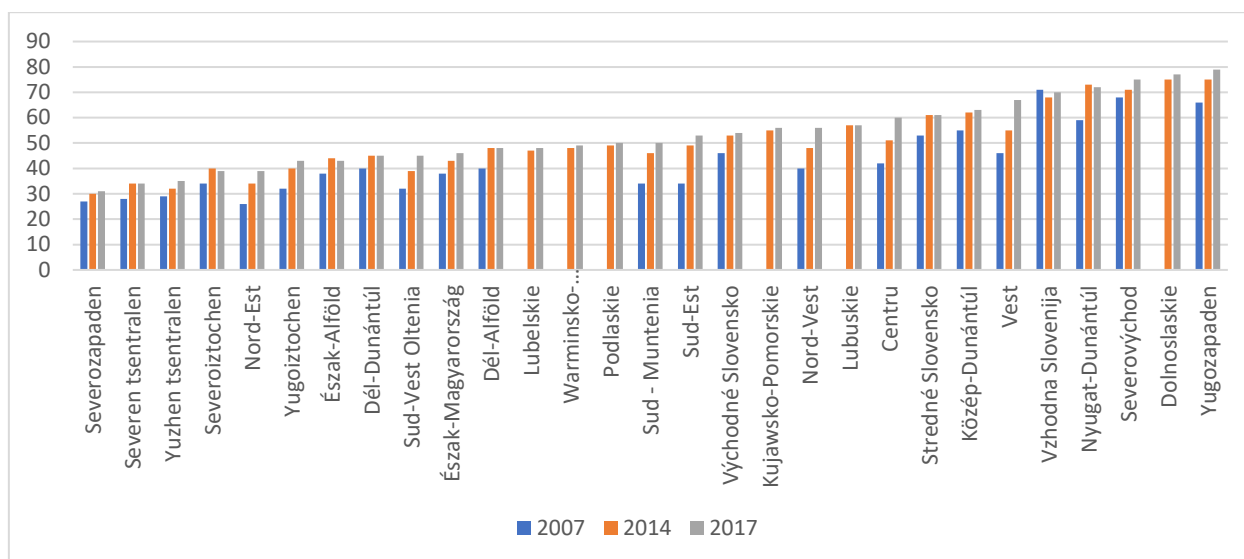
Code	NUTS2 regions	Population on 1 January by NUTS 2 region (Persons)	Change of total population (%)	GDP in PPS per inhabitant	Change GDP per inhabitant (%)	Change GDP per inhabitant (%)	Number of regions NUTS3	Of which: number of regions NUTS3 predominantly rural
		2017	2017/2007	2017	2017/2007	2017/2014	2016	2016
BG31	Severozapaden	769623	-16.0	9300	32.9	12.0	5	0
BG32	Severen tsentralen	805441	-11.5	10200	39.7	8.5	5	2
BG33	Severozitochien	939262	-4.8	11800	32.6	8.3	4	1
BG34	Yugoizitochien	1046125	-5.8	13000	52.9	18.2	4	0
BG41	Yugozapaden	2115344	-0.5	23700	38.6	14.5	5	1
BG42	Yuzhen tsentralen	1426064	-6.4	10400	38.7	18.2	5	2
CZ05	Severovýchod	1508527	1.5	22600	27.7	15.3	3	1
HU21	Közép-Dunántúl	1056097	-4.6	18800	29.7	10.6	3	0
HU22	Nyugat-Dunántúl	983251	-1.6	21500	40.5	7.0	3	1
HU23	Dél-Dunántúl	894223	-7.6	13500	28.6	7.1	3	2
HU31	Észak-Magyarország	1143902	-8.6	13700	37.0	15.1	3	2
HU32	Észak-Alföld	1468088	-3.8	12900	31.6	6.6	3	1
HU33	Dél-Alföld	1251924	-6.7	14500	40.8	8.2	3	0
PL81	Lubelskie	2112787	-2.8	14400	:	10.8	4	3
PL84	Podlaskie	1156947	-3.3	15000	:	11.1	3	2
PL43	Lubuskie	1004892	-0.4	17300	:	10.2	2	0
PL51	Dolnoslaskie	2866218	-0.6	23100	:	10.5	5	1
PL61	Kujawsko-Pomorskie	2060575	-0.3	16900	:	11.2	5	4
PL62	Warmińsko-Mazurskie	1410641	-1.1	14700	:	10.5	3	0
RO11	Nord-Vest	2568730	-5.9	16900	62.5	26.1	6	5
RO12	Centru	2332935	-7.6	17900	61.3	27.0	6	4
RO21	Nord-Est	3239612	-13.1	11600	70.6	24.7	6	5
RO22	Sud-Est	2446734	-13.7	15800	75.6	16.2	6	3
RO31	Sud - Muntenia	3003349	-9.1	15100	69.7	18.0	7	6
RO41	Sud-Vest Oltenia	1973140	-13.7	13600	63.9	25.9	5	4
RO42	Vest	1792503	-7	20000	65.3	30.7	4	1
SI03	Vzhodna Slovenija	1091159	-0.4	21000	13.5	11.1	8	8
SK03	Stredné Slovensko	1342287	-0.6	18200	32.8	7.7	2	1
SK04	Východné Slovensko	1620413	2.4	16300	37.0	10.9	2	1

Source: Own calculations based on Eurostat database

- It is noted that the number of predominantly rural NUTS3 regions is not a decisive factor for the level of economic performance. Thus, it is observed that NUTS2 regions that are composed of only or mostly of predominantly rural NUTS3 regions (Vzhodna Slovenija from Slovenia, North-West and South - Muntenia from Romania) are better positioned than those that do not include predominantly rural NUTS3 regions (Severozapaden and Yugoizitochien from Bulgaria or Dél-Alföld from Hungary).

Compared to the EU28 average, GDP per inhabitant (in the PPS) increased in the decade 2007-2017, reaching in 2017 a level ranging from 30 to 80% (Graph.1).

**Graph 1: GDP in PPS (% of EU28) in NUTS2 regions**



Source: Own representation based on Eurostat data

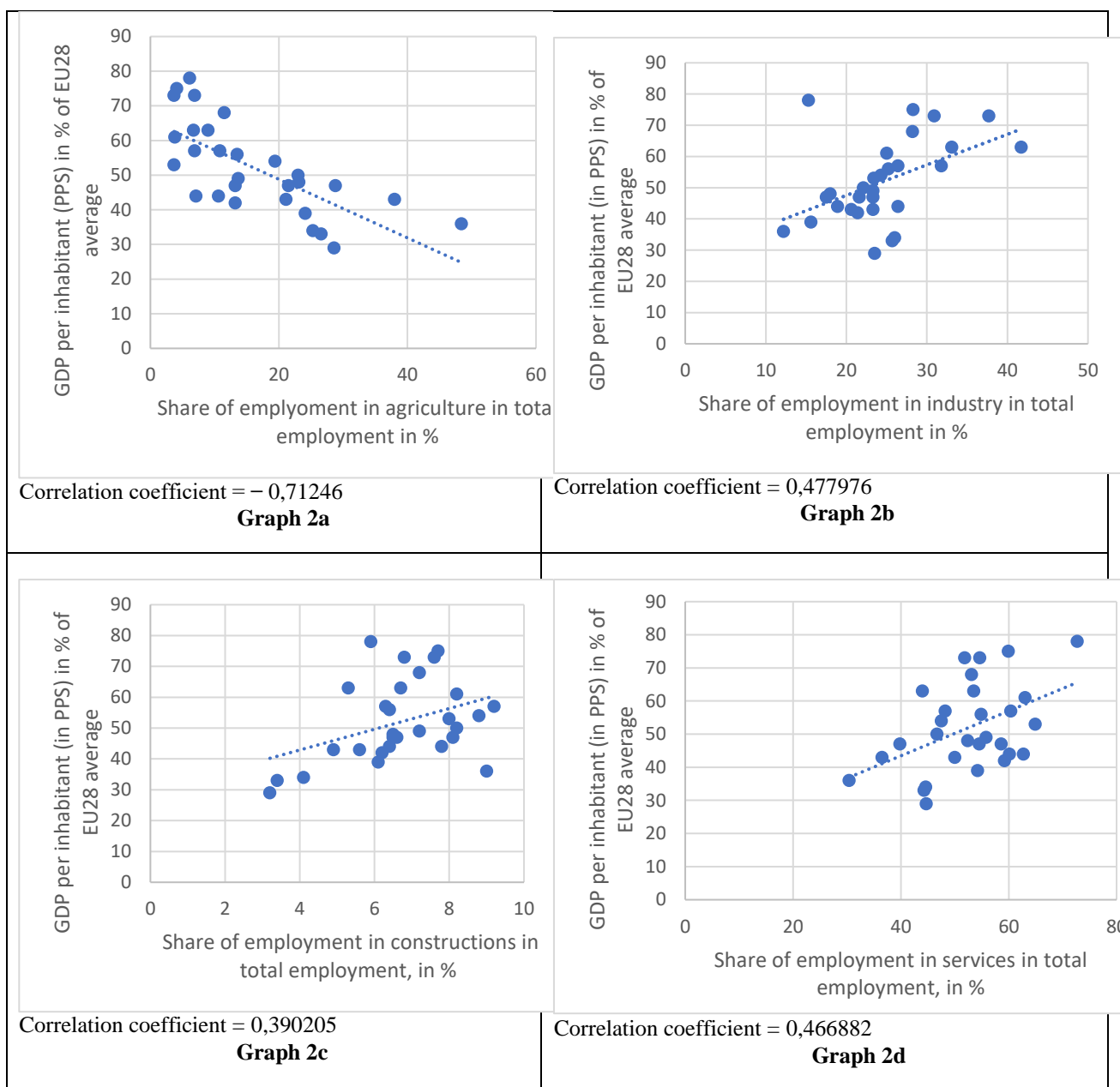
Improving the level of GDP per inhabitant in NUTS2 regions which largely comprise predominantly rural areas is strongly influenced by the decrease of the total population due to the natural demographic decline and to emigration. It is noted that the North-East region had the lowest level of development in 2007, but recovered slightly due primarily to the development of the city Iasi, which has attracted population especially from the rural area. Thus, we considered more relevant the share of the employed population in the economic activities carried out in the analyzed regions.

In Graph 2 are considered the same 29 NUTS2 regions previously selected. It represents the relationship between the share of the employed population in agriculture, industry, construction and services in total population, taken separately, and the GDP in the PPS of the EU28 average was represented. The graphs and correlation coefficients were obtained using Microsoft Excel. The analysis shows that most of the regions had the following structure of the employment in 2016 (Graph 2a-2c):

- weight of the population employed in agriculture was up to 20%, extreme situations being in North-East (48.4%) and South-East Oltenia (38%);
- weight of the population employed in the industry was about 20-30%, extreme cases being Severovýchod from the Czech Republic (37.7%) and West from Romania (41.7%). In the opposite extreme is Yugozapaden in Bulgaria (15.3%), the region with the best economic performance;
- weight of the population occupied in constructions was about 6-8%, with extreme situations in the regions Center (9.2%), North-East (9%) and North-West (8.8);
- share of the population employed in services was about 40-60%, with extreme situations in Yugozapaden (72.7%), Východné Slovensko (64.9%) and Stredné Slovensko (63%) from Slovakia.

The correlation between the share of the population employed in agriculture and the GDP per inhabitant is negative and significant (correlation coefficient =  $-0.71$ ), while the share of the population employed in the other three branches positively influences the GDP per inhabitant, but the relation is much weaker (coefficients of correlation varies between 0.39 and 0.47). From these representations results that the differences in economic performance are mostly associated with a lower share of the population employed in agriculture.

**Graph 2: Correlation between share of employment in economic activities (agriculture, industry, constructions and services) in total employment and GDP per inhabitant, in 2016, in selected NUTS2 regions with structural similarities**

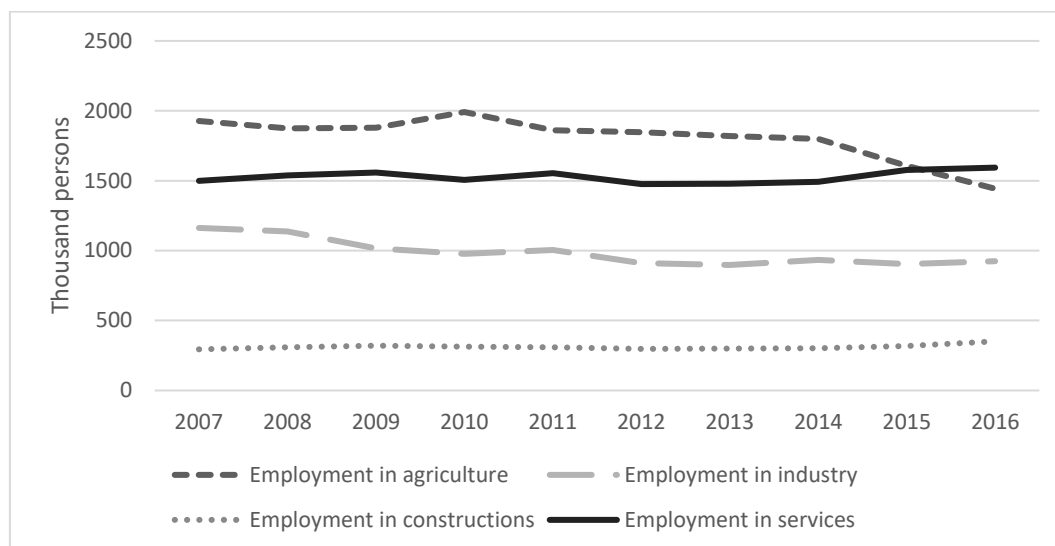


Source: Own calculations based on Eurostat data

In Romania, the massive reduction of the total population by emigration to urban areas or abroad, especially from the South-West Oltenia, South-East and North-East regions, meant first of all the reduction of the number of the population employed in agriculture. This phenomenon is observable throughout the predominantly rural areas (Graph 3). The population employed in the other activities, especially in services and constructions, has shown a slight increase in the last years. In the predominantly rural areas, the share of the population employed in agriculture during 2007-2016 decreased from 39.5% to 33.5%, especially on account of services (increase on average from 30.7% to 37%) and of constructions (increase from 6% to 8.1%). The industry has shrunk in the years of crisis, but has a slight comeback starting with 2016.



**Graph 3: Employed persons in predominantly rural NUTS3 regions in Romania, 2007-2016**



Source: Own representation based on Eurostat data

These changes reflect the abandonment to a certain extent of the subsistence agriculture and an increasing degree of diversification of economic activities in predominantly rural areas, but their positive effect is still incipient.

## CONCLUSIONS

Within the European Union some member countries comprise large rural regions, which occupy even 80% or more of the territory and have population in predominantly rural areas of about 40-60% of the total population, while other countries are highly urbanized. The structural similarity with the regions from Romania (with the exception of the Bucharest-Ilfov region) has led to the selection of NUTS2 regions from Central Eastern European countries mostly located in Bulgaria, Hungary and Poland. Thus, it can be said that the economic status of the regions depends to a large extent on their belonging to countries with a certain level of development and not necessarily on the size of the predominantly rural regions.

Considering 29 NUTS2 regions with structural similarity, it is found that they had a tendency to improve the level of development in terms of GDP per inhabitant in the period 2007-2016, but also face massive losses of population and other socio-economic difficulties. Even within this group of comparable regions, the rural-urban differences are specific to each country and cannot be generalized. Although rural areas are always associated with agriculture, the reduction of the population employed in agriculture and the development of other activities marks the positive development of these regions.

Since there are NUTS2 regions comprising only or mostly predominantly rural areas, but better developed than others, it can be concluded that favorable systemic transformations in the rural areas are already under way. Consequently, by applying the policies of capitalizing on the strengths of the rural regions, it is possible to reduce the rural-urban gap and the flow of emigration, as well as improve the regional convergence within the EU.

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# MOLDO-ROMANIAN TRADE WITH AGRI-FOOD PRODUCTS: RETROSPECTIVE AND PERSPECTIVES

ALEXANDRU STRATAN<sup>1</sup>, EUGENIA LUCASENCO<sup>2</sup>, SERGIU TIRIGAN<sup>3</sup>

**Abstract:** *The paper aims to present the trade relations with agri-food products between the Republic of Moldova and Romania during the period 2000 – 2018. Being neighbouring countries, connected not only through the existing border, but also through common historical aspect, the trade with agri-food products is of particular importance for both of countries. Analysis of the trade is carried out by product types, presented in 3 periods: 2000 – 2006, 2007 – 2014 when Romania became an EU member state and 2015 – 2018, after entering into force of DCFTA. Research methods are based on statistical analysis, using the data provided by the National Bureau of Statistics of the Republic of Moldova and UN Comtrade database and Ministry of Economy and Infrastructure of the Republic of Moldova. Overall, there is a growing trend in export and import increase between the countries, while Romania continues to be the top-partner for Moldovan export of agri-food products. The paper suggests further proposals for cooperation between the countries, with a focus on increasing export values by the both sides.*

**Keywords:** *trade, agri-food products, Republic of Moldova, Romania, European Union*

**Jel Classification:** Q17

## INTRODUCTION

Taking into account the sharp increase of Moldovan agri-food exports mainly to EU countries in the last years as a result of entering into force of DCFTA, research of the Moldova-Romania agri-food trade became of particular interest, as Romania represents the main trading partner from EU.

Research regarding the foreign trade of the Republic of Moldova with agri-food products in the framework of DCFTA was carried out by a number of national organizations, taking the shape of studies, scientific articles and informative notes (MIEPO, 2015; Savva, 2015). External trade from the perspective of competitiveness has been studied by Stratan A. (Stratan, 2017), in terms of comparative advantages with EU countries - by Cimpoeș L. (Cimpoeș, 2016), economic integration – Bulgari G. (Bulgari, 2015). A special attention to trade relations between Romania and Moldova has been given by Gavrilăscu C. (Gavrilăscu, 2016), with a specific focus on trade with agricultural goods.

The aim of the paper is to analyze the dynamics of agri-food trade flows between the Republic of Moldova and Romania during the period 2000 – 2018, with an emphasis on 3 periods: 2000 – 2006, 2007 – 2014 when Romania became an EU member state and 2015 – 2018, after entering into force of DCFTA (in September 2014).

## MATERIALS AND METHODS

In order to carry out a comprehensive analysis of the trade with agri-food products, the authors have taken into account tariff items 1-24 from the commodity list, at a 2 and 4-digit levels. Foreign trade data provided by UN Comtrade and World Integrated Trade Solution database served as the primary source for the carried out study. Other related sources refer to the Statistical Yearbook of the Republic of Moldova, data provided by the Ministry of Economy and Infrastructure of the Republic of Moldova, etc.

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The analysis of foreign trade indicators of the Republic of Moldova has been carried out using a series of research methods, such as: analysis and synthesis of statistical data, comparative method, induction and deduction method, as well as analysis of economic phenomenon.

The official statistics does not cover the small traffic and trade near the common borders, which also plays an important role for the small farmers from the frontier zone.

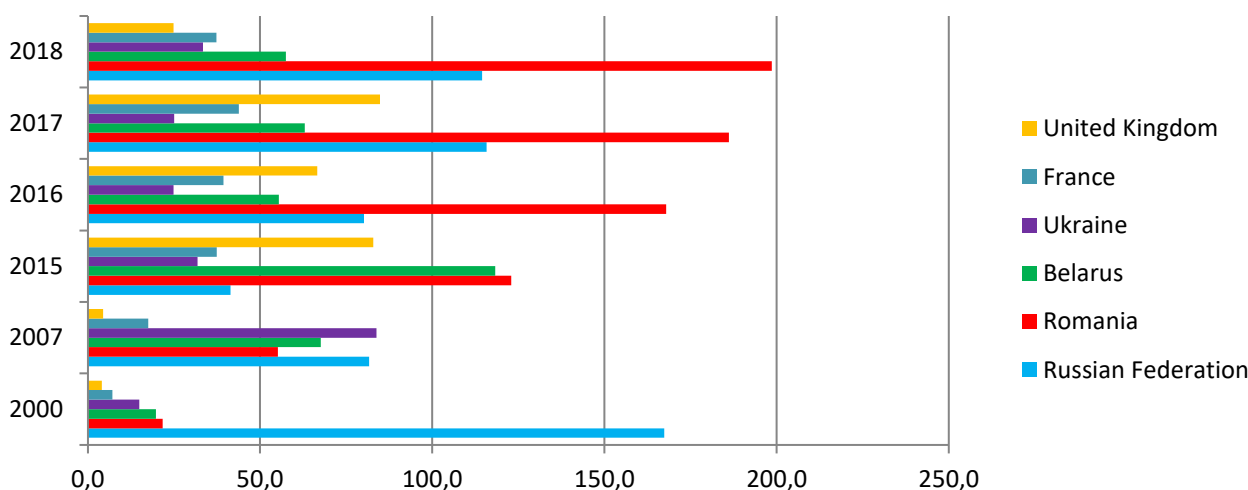
## RESULTS AND DISCUSSIONS

External trade with agri-food products of the Republic of Moldova plays an important role in the national economy, thus representing a basic pillar for the total trade. The share of exports of Moldovan agricultural products in the total volume of foreign trade amounted to 43.1% in 2018, while the share of imports – 13.4%. If the share of imports of agri-food products remains basically around the same values during 2000 – 2018 (13 – 14%), then the share of agri-food exports is declining over the analyzed period (from 61.6% in 2000 – to 43.1% in 2018), mainly due to increase of some industry branches producing insulated wires and cables, textile industry, packing industry, etc. (UN Comtrade database, 2019).

During 2000 – 2018, some changes in trade patterns can be notices, mainly related to the export of Moldovan agri-food products. Thus, if in 2000 Russian Federation was the main external partner of the Republic of Moldova (with a share of 60.9% of the total agri-food exports), then in 2018 the situation has changed dramatically, when about 17.0% of the agri-food exports are directed towards Romania and only 9.8% to Russian Federation (see Figure 1). Embargos imposed by Russian Federation on a series of Moldovan products (wine in 2006 and 2013; fruits like apples, peaches, cherries, etc. and canned fruits and vegetables in 2014), DCFTA agreement with EU, as well as diversification of external markets have represented the main causes in trade patterns changes.

In the last years, exports to EU have overtaken those to CIS countries, making Romania the first partner from EU in terms of export with agri-food products, being followed by France and United Kingdom.

**Figure 1. Moldovan top export partners, 2005 – 2018, mil. USD**



*Source: World Integrated Trade Solution database, 2019*

At the moment, Romania represents an important trade partner for the Republic of Moldova, both in terms of exports and imports. The agri-food trade between the Republic of Moldova and Romania has undergone some significant changes, increasing both, in natural and value terms. Since 2000, exports with agri-food products increased by over 9 times in monetary values (from 21.7 mil. USD in 2005 to 198.6 mil. USD in 2018), while imports – by almost 8 times (from 8.2 mil. USD in 2000 to 71.2 mil. USD in 2018) (see Figure 2).

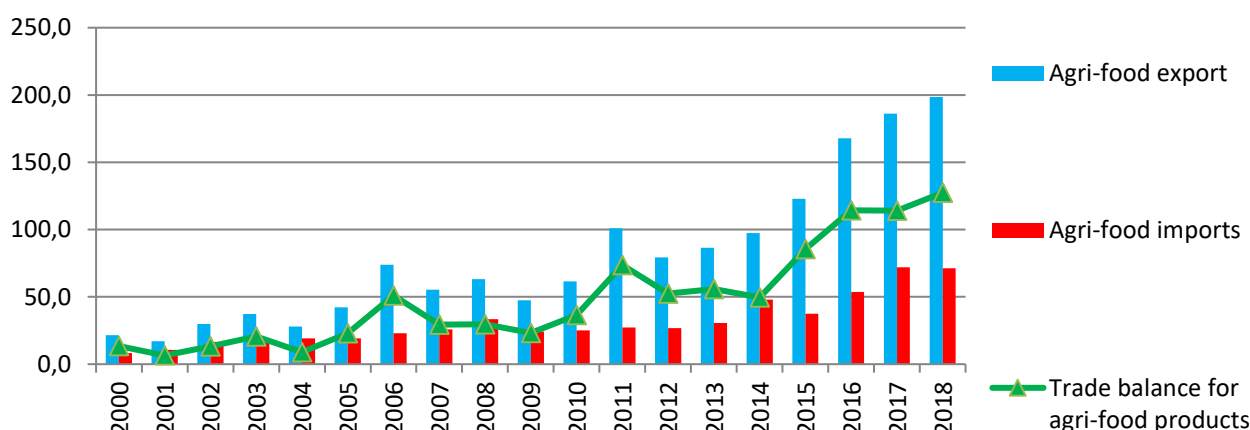
After becoming an EU member state, Romania became a more reliable partner for the Republic of Moldova. But, the most increased values of exports can be noticed since 2015, when

DCFTA entered into force and Romanian market became more close and attractive for Moldovan exporters, due to the liberalization of trade with EU. DCFTA boosted Moldovan exports of agri-food products to Romania, which increased by 2 times in 2018 compared to 2014. At the same time, agri-food imports have had a slower dynamic of increase of about 1.5 times during the same period.

Extension of the international retailers such as Metro and Kaufland in the Republic of Moldova by using their subsidiaries established in Romania is further contributing to the increase of the bilateral trade between the two countries, considering that elements of integrated supply and distribution management are applied. Increasing of the investments and extension of the businesses in both directions also represents a determinant for the enhancement of bilateral trade.

The trade balance for agri-food products has been always positive for the Republic of Moldova. Thus, in 2018, exports prevailed over imports by about 2.8 times.

**Figure 2. Moldova - Romanian trade with agri-food products, mil. USD**



*Source: World Integrated Trade Solution database, 2019*

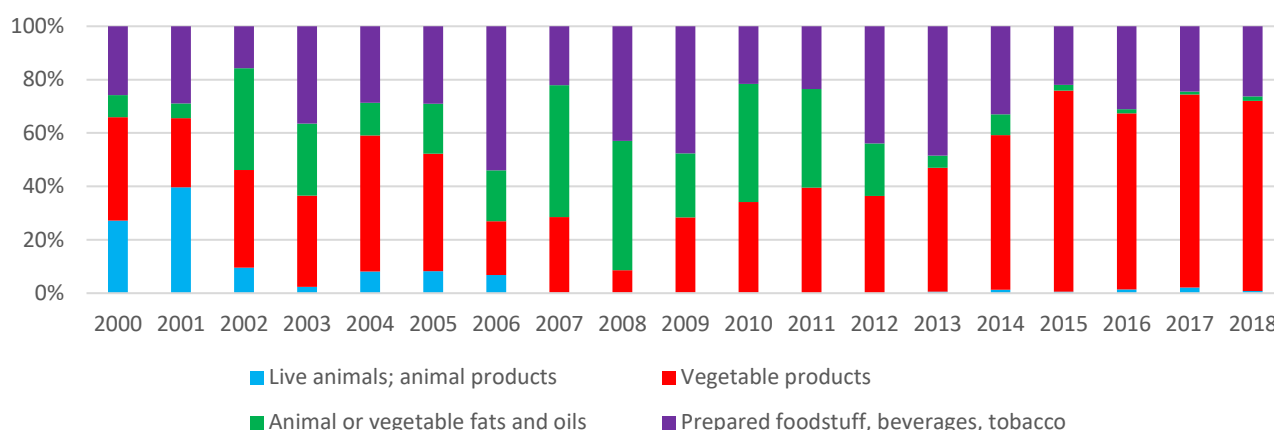
When analysing Moldovan exports by commodity groups, we can note that significant changes and shifts occurred during the selected period. Between 2000 – 2006, Republic of Moldova exported to Romania live animals and animal products, their share in the total agri-food exports to Romania varying between 2.3% in 2003 and 39.7% in 2001.

Starting with Romania's accession to EU in 2007, this percentage declined to 0.1, mainly due to the safety regulations for meat and meat products imposed by the EU, necessity for veterinary certifications, requirement for high standards of products with respect to hygiene and safety of consumers, etc. At the same time, Moldovan livestock sector is also declining in terms of production, as well as is lacking in modern processing equipment and infrastructure (see Figure 3).

At the same time, declining trend in its share in exports can be observed for the commodity group animal or vegetable fats and oils, where export of sunflower oil has the major share. The highest values of exported sunflower oil can be noticed after the Romania's accession to EU, when their share in the total export of agri-food products amounted to almost 50%.

Starting with 2013, the share of animal or vegetable fats and oils commodity group has started to diminish, reaching about 1.7% of the total exports of agri-food products to Romania in 2018. It is worth mentioning that overall, the export of sunflower oil did not diminish, but undergone some changes in terms of markets, which became more diversified in 2018. Thus, in 2018, Romania was overtaken by such trade partners like Italy, Spain, Portugal (all EU member states), as well as Sudan.

**Figure 3. Agri-food exports to Romania by the main types of commodity groups, 2000 – 2018, %**

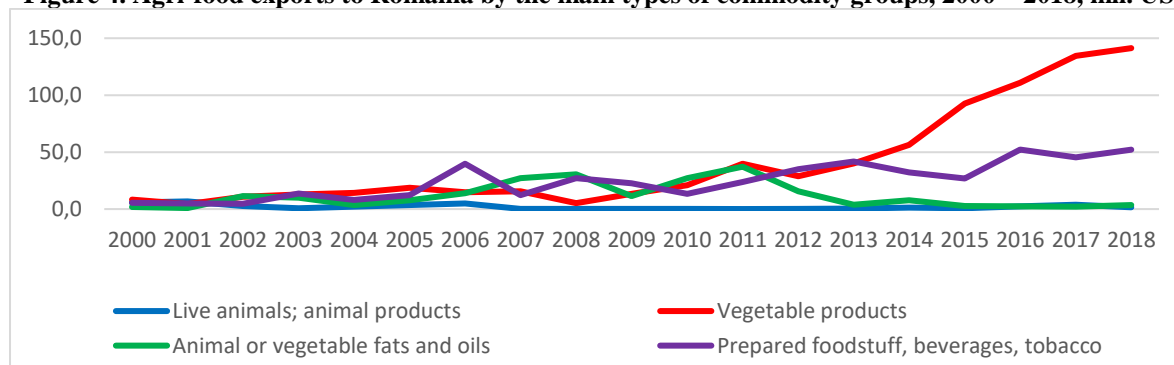


Source: World Integrated Trade Solution database, 2019

Prepared foodstuff, beverages, tobacco commodity group has had some oscillations during the analyzed period, in terms of share in the agri-food exports to Romania (ranging from 15.7% in 2002 to 53.9% in 2006). Nevertheless, it increased by 9.3 times in monetary values in 2018, compared to 2000. In 2018, the highest export values from this commodity group belonged to wine made of fresh grapes (15.9 mil. USD), bread and pastry products (9.3 mil. USD), chocolate (2.7 mil. USD), fruit juice (1.4 mil. USD), etc. Chocolate industry can represent an important determinant in the future development of external trade with Romania. Moldovan company “Bucuria” already access successfully the Romanian market, thus creating a corridor for other companies, mainly small-scale ones specialized in producing candies made of nuts or fruits in chocolate.

On the other hand, considerable increases can be found in the vegetable products commodity group, which increased by 16.9 times in 2018 compared to 2000 (see Figure 4).

**Figure 4. Agri-food exports to Romania by the main types of commodity groups, 2000 – 2018, mil. USD**



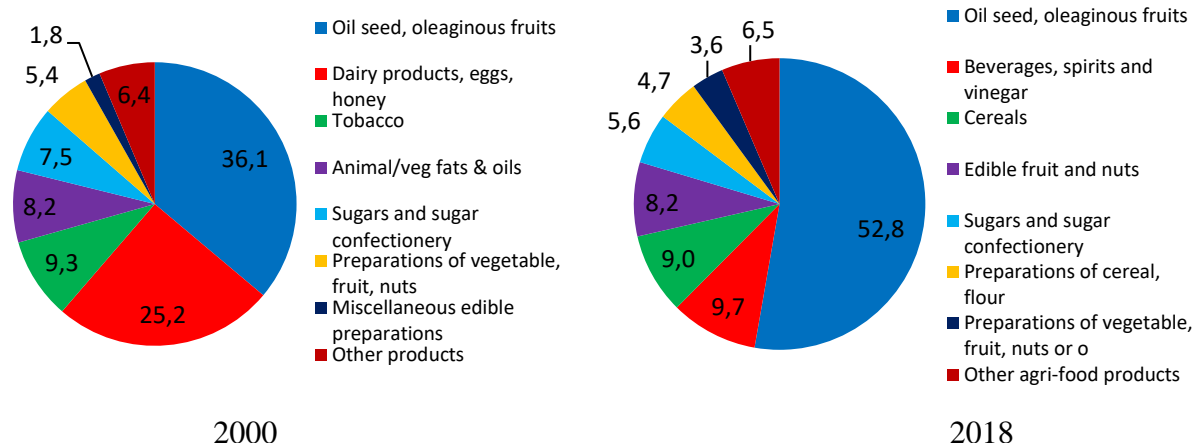
Source: World Integrated Trade Solution database, 2019

The highest rates of increase have occurred since DCFTA entered into force, when Romania became the main export destination for Moldovan vegetable products. DCFTA enhanced exports to Romania of such agri-food products as: sunflower seeds (73.7 mil. USD in 2018 compared to 15.7 mil. USD in 2014), rape seeds (24.3 mil. USD in 2018 compared to 9.8 mil. USD in 2014), wheat and meslin (9.7 mil. USD versus 6.1 mil. USD), grapes (10.3 mil. USD in 2018 versus 3.0 mil. USD in 2014), etc.

As a whole, when analyzing the 2-digit commodity data for the 01-24 product groups for 2000 and 2018, the following structures and changes of agri-food exports can be observed (see Figure 5):



**Figure 5. Main 2-digit commodities exports to Romania, %**



Source: World Integrated Trade Solution database, 2019

Since entering into force of DCFTA, the Republic of Moldova has had certain export limits in the EU for some product categories, these being the products subject to tax exemption for certain tariff quotas (Stratan A., 2017). Romania still remains one of the main partners for the Republic of Moldova in terms of tariff quotas valorization, as it receives high shares of Moldovan grapes and plums exported to EU.

At the same time, a number of agri-food products are subject to the anti-circumvention mechanism, which assumes that if the volume of imports of one or more categories of such products reaches 70% of the volume, the EU will notify the Republic of Moldova about the further volume of imports for these products. Thereafter, the Republic of Moldova is obliged to send the EU a reasoned justification, as it has the capacity to manufacture products for export to the EU in excess of the quantity mentioned in the Association Agreement. If the imports reach 100% of the indicated volume and the reasonable justification from Moldova is missing, the European Union may temporarily suspend the preferential conditions for the products in question (MIEPO, 2015). As previously mentioned, Romania absorbs a good share of cereals exports of the Republic of Moldova to EU.

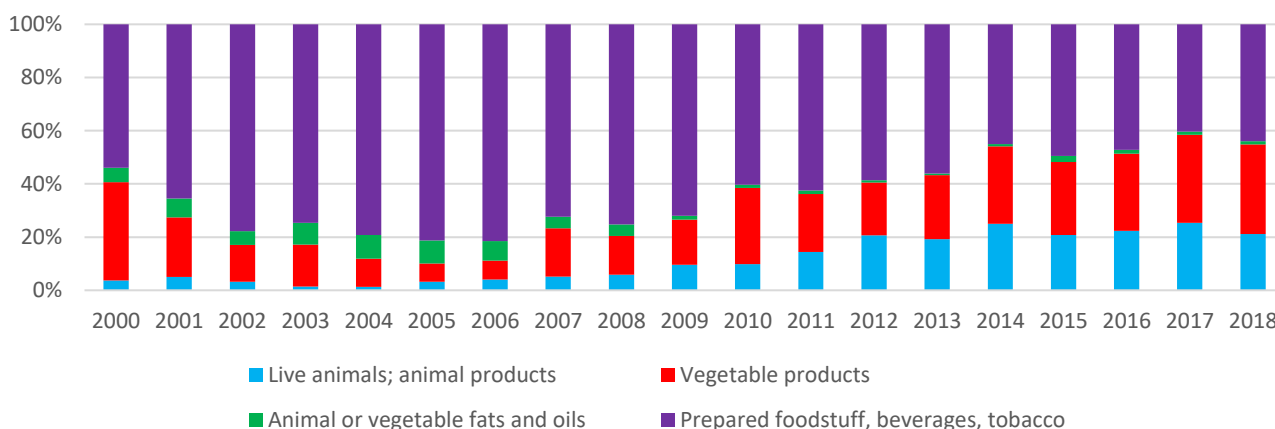
**Table 1. Valorization of tariff quotas for export to the EU**

Valorization of tariff quotas for export to the EU											
Products	Quota (tons)	Sept.-Dec. 2014		2015		2016		2017		2018	
		Quant. (tons)	%	Quant. (tons)	%	Quant. (tons)	%	Quant. (tons)	%	Quant. (tons)	%
grapes	10 000	7708	77	9366	93	10 000	100	1000	100	10000	100
apples	40 000	1585	3,96	746	1,8	74	0,19	2191	5,5	1859	5
plums	10 000	3948	39,4	6196	62	7534	75	10000	100	9862	99
tomatoes	2000	-	-	-	-	-	-	84	4	40	2
Valorization of tariff quotas for export to the EU with the application of the anti-circumvention mechanism											
Products	Quota (tons)	Sept.-Dec. 2014		2015		2016		2017		2018	
		tons	%	tons	%	tons	%	tons	%	tons	%
wheat	75 000	34 246	45	178 486	237,98	559 863	746	348077	464	375777	501
barley	70 000	15 607	22	78 360	111	77 555	110	72945	104	59394	85
maize	130 000	35 012	27	162 746	125	200 088	153	94228	72	456809	351
sugars	37 400	11 344	30	7985	21	66 133	176	31700	85	27907	75
processed cereals	2 500	522	20	5505	220	16 797	676	11021	441	9697	388
processed sugar	4 200	429	10	1011	24	1251	29	1014	24	1521	36
sweet corn	1 500	462	30	751	50	944	62	403	27	4570	305

Source: Ministry of Economy and Infrastructure data, <https://mei.gov.md/ro/dcfta>

As a result of the analysis of Moldovan agri-food imports from Romania, the commodity group of prepared foodstuff, beverages and tobacco still holds the largest share in the import structure in 2018. Nevertheless, since 2010, there is noted an ascend of the vegetable products group, as well as live animals and animal products (see Figure 6).

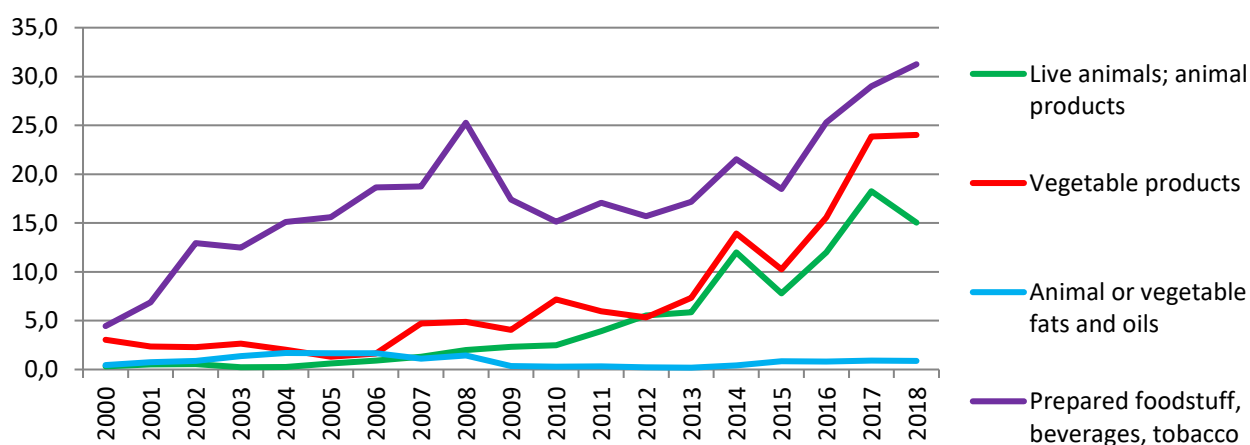
**Figure 6. Agri-food imports from Romania by the main types of commodity groups, 2000 – 2018, %**



Source: World Integrated Trade Solution database, 2019

In monetary values, during the researched period, import of live animals and animal products increased in 2018 compared to 2000 by almost 50 times (see Figure 7), but it is worth mentioning that the initial figures were very low (0.3 mil. USD in 2000 and 15.0 mil. USD in 2018). At the moment, the most imported products from this commodity group are dairy products, with a share of 66.8%. As a result of recent negotiations regarding some commodity groups, there is expected the increase of import quota for animal products in the Republic of Moldova. Therefore, Romania could represent an important future partner in terms of supply with livestock production.

**Figure 7. Agri-food imports from Romania by the main types of commodity groups, 2000 – 2018, mil. USD**



Source: World Integrated Trade Solution database, 2019

At the same time, regarding the structure of the vegetable products group, some changes occurred during the analyzed period, when there is noted an important increase in cereals (particularly maize), oil seed (sunflower seeds intended for consumption) and vegetable imports (potatoes, cucumbers and tomatoes).

Import of animal or vegetable fats and oils increased almost 2 times during 2000 – 2018, accounting for less than 1 mil. USD in monetary terms. In 2018, prepared foodstuff, beverages and tobacco commodity group is subject to imports mainly of residues and wastes of the food industry

(oil-cake and other solid residues), beverages (natural and mineral waters) and miscellaneous food preparations.

Overall, DCFTA has also had a positive influence on Romanian exports of agri-food products to Moldova (especially dairy products), which present some increasing trends in the last years.

## CONCLUSIONS

The external trade of the Republic of Moldova with agri-food products is increasing constantly, both in terms of exports and imports, maintaining a positive trade balance during the period 2000 – 2018. At the same time, there are observed increasing trends in exports and imports of agri-food products in the external trade with Romania. DCFTA has contributed directly to enhancing the trade between the two countries, with a particular high impact over the exports of vegetable products from the Republic of Moldova. At the same time, access to the Romanian market supported some Moldova industries to decrease the impacts of the embargos and restrictive measures adopted by the Russian Federation.

Cultural proximities and single language facilitate the access to the market, branding and promotion of the products and integration of the economies. Romania, even if it will not be able to absorb all the volumes of fruits, still represents an important platform for Moldovan producers to train and start the access to the EU market (e.g. plums and table grapes). Therefore, the expected increase of export quotas on the EU market for these products could be redirected to other EU markets.

At the same time, extension of the international retailers (Metro and Kaufland) using their subsidiaries established in Romania is further contributing for the increasing of the bilateral trade, considering that elements of integrated supplying and distribution management is applied. Increasing of the investments and extension of the businesses in both directions, of Moldovan companies to Romania and of Romanian companies to Moldova, also facilitates the access of goods on to the markets (e.g. investment of “JLC” JSC in dairy processing factory “Prod lacta” from Brasov, Romania).

Considering difficulties registered by the Republic of Moldova in developing the animal husbandry sector, this fact could represent a platform for a further extension of the exports from Romania. Nevertheless, these exports will have to face an important competition with other exporters like Poland and Ukraine.

Both markets provide opportunities for selling of processed products and breweries in order to cover the consumer demand for a diversification of the products. Despite the fact that Romania has its own wine industry, it is absorbing an important volume of exports of Moldova wine.

Future focus in bilateral trade with Romania should be made on export of high value added products, which will also contribute to the development of small and large value chains in the agricultural sector of the Republic of Moldova, modernization of post-harvest infrastructure and food processing industry. Development and further integration of the production and supplying clusters will contribute to both, to the increase of the bilateral trade and in accessing new external markets.

At the same time, there is a need for diversification of traded commodity groups with Romania, which can be also achieved due to the existing opportunities in the framework of DCFTA.

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# AN ANALYSIS OF THE TRADE BALANCE FOR THE MAIN AGRI-FOOD PRODUCTS

CAMELIA GAVRILESCU<sup>1</sup>

**Abstract:** *The Romanian agri-food trade has registered a permanent deficit during the last three decades (with a brief exception period, 2013-2014). The deficit was deepened by the negative trade balance with the EU countries, but since 2010, the deficit has been partially offset by the trade surplus with the non-EU countries. The paper analyzes the evolution of the agro-food trade balance detailed by the main product groups, and the results highlight the product groups that were the main contributors to the deficit and have remained over time the main import goods (fruits, meat, vegetables, milk and dairy products), those with balances shifting from negative to positive depending on the economic situation (poultry, eggs), as well as those with a permanent positive balance (cereals, oilseeds). The imports of pork, apples and tomatoes are analyzed in detail, in terms of the quantity, value and countries of origin of the imports.*

**Keywords:** *agri-food trade deficit, pork, apples, tomatoes*

**JEL Classification:** F14, Q17

## INTRODUCTION

In the last three decades, Romania's international agri-food trade has undergone major changes from the point of view of trade policies, and imports and exports geographical orientation and composition. The economic and political reforms have led to major changes in the agri-food sector, in the functioning of the agri-food chains, resulting in significant imbalances between the domestic supply and demand; as a consequence, imports exceeded exports by far. The negative agri-food trade balance has been (with a brief exception in 2013-2014) a constant during the last three decades. Accession to the European Union opened unprecedented opportunities for Romania; and despite severe health, sanitary, veterinary and quality requirements, the Romanian products have gradually entered the European and world markets, registering a spectacular expansion. Although the value of trade flows increased significantly, Romania still has a negative agri-food trade balance, due to the growing deficit in relation to the other EU member countries. This deficit is partially offset by the positive balance in the relation with non-EU countries. The analysis of the trade balance by product groups shows that the largest deficits are registered for some basic products: meat, dairy products, fruit, vegetables. The present paper tries to analyze these deficits: the main evolutions of imports and exports of these products in terms of value, volume and geographical orientation of the trade flows, elements that influence significantly the presence and competitiveness of Romanian products on domestic and international markets.

## MATERIAL AND METHOD

In this paper, the analysis was made on the agro-food trade flows: the value of imports and exports, their (quantitative) volume on the 2 main directions (EU and extra-EU), with the detailed geographical orientation on the main countries of origin and destination, for the main product groups. Eurostat data (HS classification, chapters 01-24) were used at 2 and 4 digits, respectively 6 digits where necessary.

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## RESULTS AND DISCUSSIONS

In the pre-accession period, which was a period of general economic growth, both general and agri-food trade showed upward trends. Romania's accession to the European Union marked the moment of opening to the Single Market, which meant a significant increase of the trade, not restricted by tariff barriers, but also a more important presence on the extra-European markets (table 1).

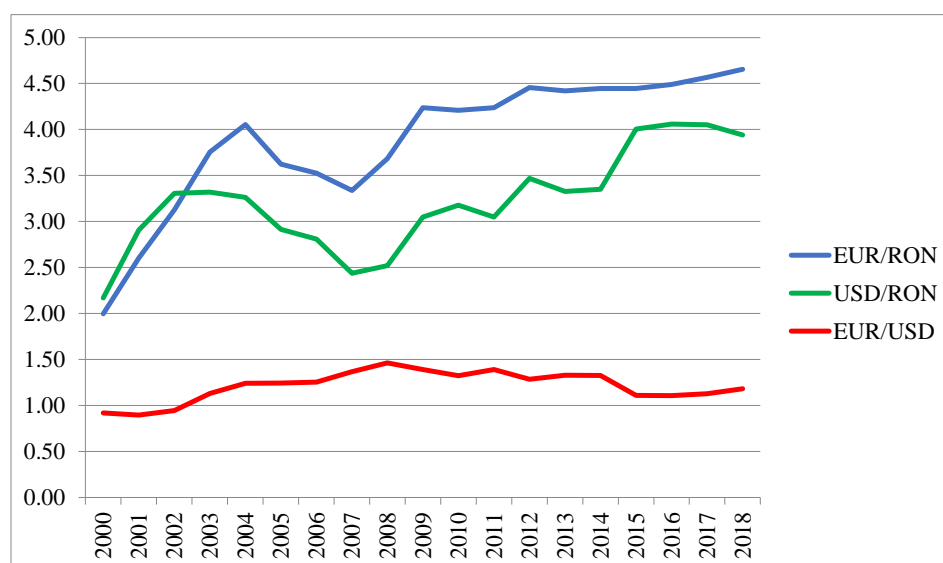
Table 1 – Romania's general and agri-food trade dynamics

Item	Flow	Pre-accession period average (2000-2006) (EUR billion)	Post-accession period average (2007-2018) (EUR billion)	2007-2018 ----- 2000-2006	2018/2006
Total general trade	export	17.33	47.04	2.71	2.42
	import	24.47	58.89	2.41	1.86
Total agri-food trade	export	0.56	4.38	<b>7.81</b>	<b>5.71</b>
	import	1.62	5.22	3.23	3.06
General trade with the EU	export	11.80	34.34	2.91	2.71
	import	14.87	43.73	2.94	2.25
Agri-food trade with the EU	export	0.33	2.92	<b>8.88</b>	<b>8.19</b>
	import	0.72	4.26	5.95	4.69

Source: calculations using Eurostat data (2019)

Thus, agri-food exports increased on average 7.8 times in the post-accession period compared to the pre-accession period (up to EUR 6.5 billion in 2018), notably those to the EU, which increased on average 8.9 times (up to EUR 4.5 billion in 2018). The expansion of exports was also favored by the devaluation of the national currency (32% against EUR and 62% against USD in 2007-2018) (fig. 1).

Figure 1 – Exchange rate RON/EUR/USD

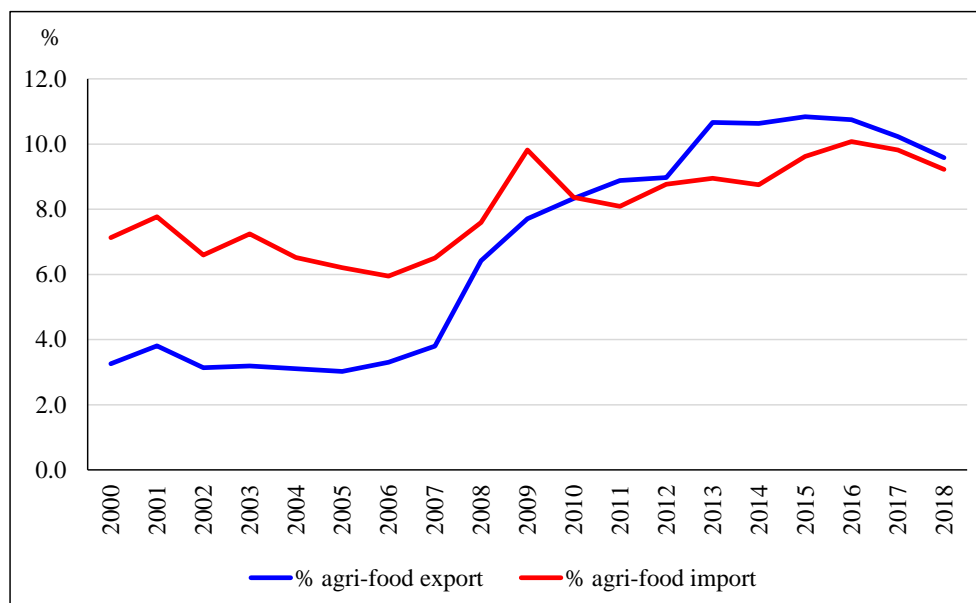


Source: calculations using NBR (2019) data

In absolute terms, agri-food exports have increased continuously since 2000, as well as their share in general trade (fig. 2).



**Figure 2 – Share of agri-food trade in Romania's general international trade**

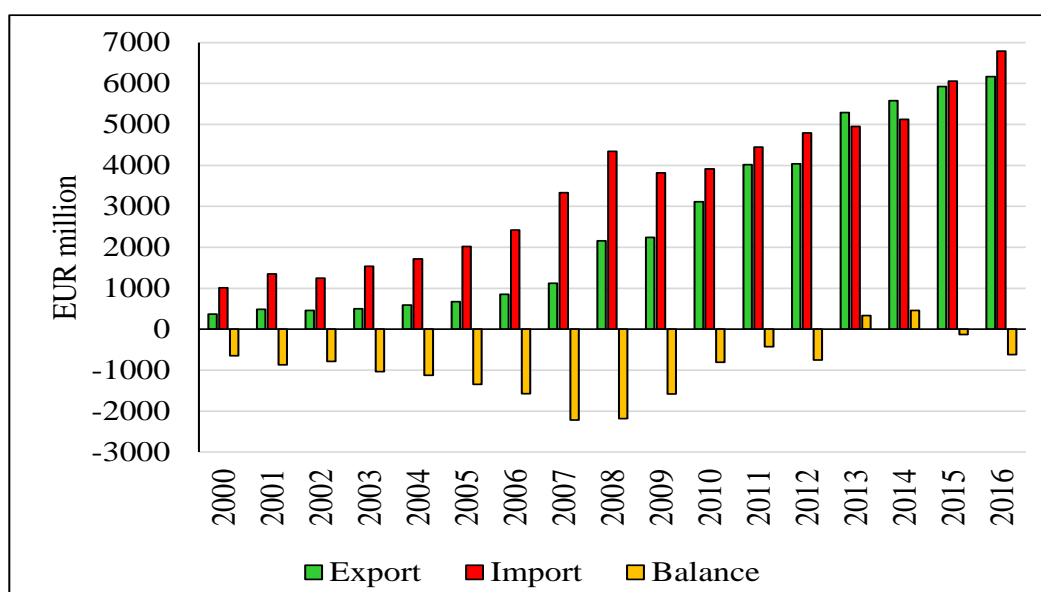


Source: calculations using Eurostat data (2019)

At the same time, imports also increased, but at a slower rate: 3.2 times total imports (up to 7.6 billion euros in 2018) and 5.9 times imports from the EU (up to 6.4 billion EUR).

As a result, the deficit of the total agri-food trade balance, which registered maximum values in 2007-2008, decreased steadily until 2012 and shifted to surplus in 2013-2014. Since 2015, the balance has turned negative again, the deficit increasing sharply to EUR -1.15 billion. However, the agri-food balance with the EU has been permanently negative, reaching EUR -1.93 billion, Romania failing to recover the competitiveness differences from other Member States for most agri-food products. The penetration of some Romanian basic products (cereals, oilseeds and live animals) on extra-EU markets (mainly in the Mediterranean area and in the Middle East) has meant the registration of a surplus of the agri-food trade balance with the extra-EU countries since 2010, which partially offset the trade deficit registered with the EU (Gavrilescu et al., 2017; Gavrilescu, 2018).

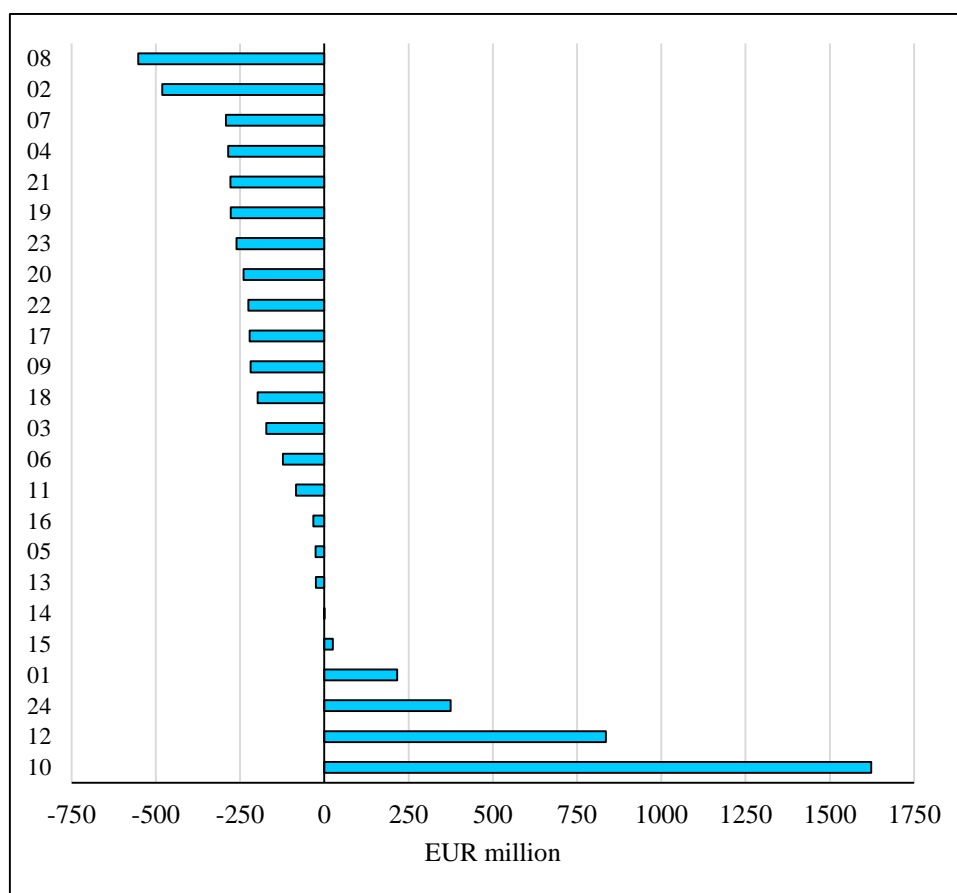
**Figure 3 –Romania's international agri-food trade in 2000-2018**



Source: calculations using Eurostat data (2019)

The average values of exports, imports and balance were calculated, detailed by the main groups of agri-food products (01-24 in the classification of the Combined Nomenclature). In figure 4 are represented hierarchically the average values of the balance for the period 2016-2018.

**Figure 4 – Trade balance by the main agri-food product groups (2016-2018 averages)**



Notes: chapters HS (Harmonized System) 01-24, which are covering all agri-food products: 01-live animals; 02-meat and offal; 03-fish and seafood; 04-dairy products, eggs and honey; 05-other animal products; 06-live plants; 07-vegetables; 08-fruit; 09-coffee, tea and spices; 10-cereals; 11-products of the milling industry; 12-oilseeds; 13-lacs, gums and resins; 14-other vegetable products; 15-oils and fats; 16-meat and fish preparations; 17-sugar and confectionery; 18-cocoa and cocoa products; 19-cereal baking and pastry products; 20-vegetable and fruit preparations; 21-miscellaneous edible preparations; 22-beverages; 23-animal feed; 24-tobacco and tobacco products.

Source: calculations using Eurostat (2019) data

There are 4 groups of products with a significant trade surplus: cereals (+ € 1.6 billion), oilseeds (+ € 836 million), tobacco and tobacco products (€ 374 million) and live animals (€ 216 million). Cumulated, they represent 69.4% of the total value of the Romanian agri-food exports. This very high concentration of exports on a small group of products is unfavorable, due to the vulnerability to fluctuations in international markets.

Out of 24 groups of agri-food products, Romania registers trade deficits in 18 groups. The largest deficits (over EUR 200 million) occur in the groups: 08 - fruits; 02 - meat and offal; 07 - vegetables; 04 - milk and dairy products; 21 - various food preparations; 19 - bakery and pastry products; 23 - animal feed; 20 - vegetable and fruit preparations; 22 - beverages; 17 - sugar and sugar products and 09 - coffee, tea and spices.

Table 2 shows the quantitative share of imports of certain groups and sub-groups of agri-food products in human consumption.

**Table 2 – Share of imports in human consumption (%)**

Item	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Meat and offal	32.1	27.6	31.0	32.7	31.1	27.8	30.8	30.0	33.3	34.0	34.7	36.0	39.7
- pork	33.3	31.1	38.1	39.9	36.0	31.0	33.1	32.8	36.0	38.4	38.5	41.5	48.4
- chicken meat	33.6	30.9	29.5	30.1	27.7	28.0	33.4	30.5	32.7	30.1	32.0	32.4	30.7
- beef	26.0	7.6	10.4	12.8	13.8	10.9	13.0	14.7	21.8	27.2	26.7	18.8	20.8
- mutton + goat meat	2.1	1.9	1.9	2.0	2.1	2.2	4.1	2.1	2.2	2.3	2.2	2.2	2.3
Fish	84.7	82.7	87.1	85.3	0.0	91.0	89.3	0.0	88.8	87.0	82.1	83.7	86.2
Milk and dairy products <sup>1)</sup>	1.4	4.7	6.2	8.9	9.0	10.4	10.2	11.1	10.3	12.6	16.3	19.3	52.2
Butter	38.5	41.7	46.2	50.0	38.5	38.5	35.7	45.6	46.7	47.4	50.0	47.8	21.4
Sugar and confectionery <sup>2)</sup>	25.4	22.6	41.2	42.9	53.7	42.1	40.0	38.4	50.5	39.6	51.0	54.8	94.3
Vegetables and vegetable products <sup>3)</sup>	10.9	13.8	12.7	12.3	13.9	12.8	14.0	13.3	15.3	17.6	20.9	20.8	21.5
- tomatoes	22.0	25.3	23.5	25.9	30.9	25.0	26.8	23.8	31.1	32.5	36.7	32.2	33.4
- potatoes	12.6	7.5	8.6	8.0	8.0	11.2	15.4	15.1	13.4	14.1	19.8	18.2	21.8
Fruit and fruit products <sup>4)</sup>	41.6	48.4	54.7	45.5	50.2	46.2	53.6	51.4	54.9	54.9	65.3	66.5	58.6
- apples	12.2	16.0	15.1	12.1	13.4	15.7	21.1	17.9	20.3	26.9	34.3	36.9	27.1

Notes:

- 1) In equivalent milk with 3.5% fat, butter excluded)
- 2) In equivalent refined sugar
- 3) In equivalent fresh vegetables
- 4) In equivalent fresh fruit

Source: calculations using NIS (2019) data

Of all products listed in table 2, only for sheep + goats and potatoes, the self-sufficiency rate exceeds 100%. These figures show that the main agri-food supply chains are not able to cover domestic demand. The fragmentation of agricultural land into numerous small farms, with low productivity and efficiency, inserted in the commercial chains, as well as the lack of concentration of supply through various producers' association forms are the main internal causes of the imbalance between the demand and the domestic supply. To these are added the changes in the food consumption model, expressed by an increasing demand for varied and better-quality products, which the current supply of the domestic food industry cannot satisfy.

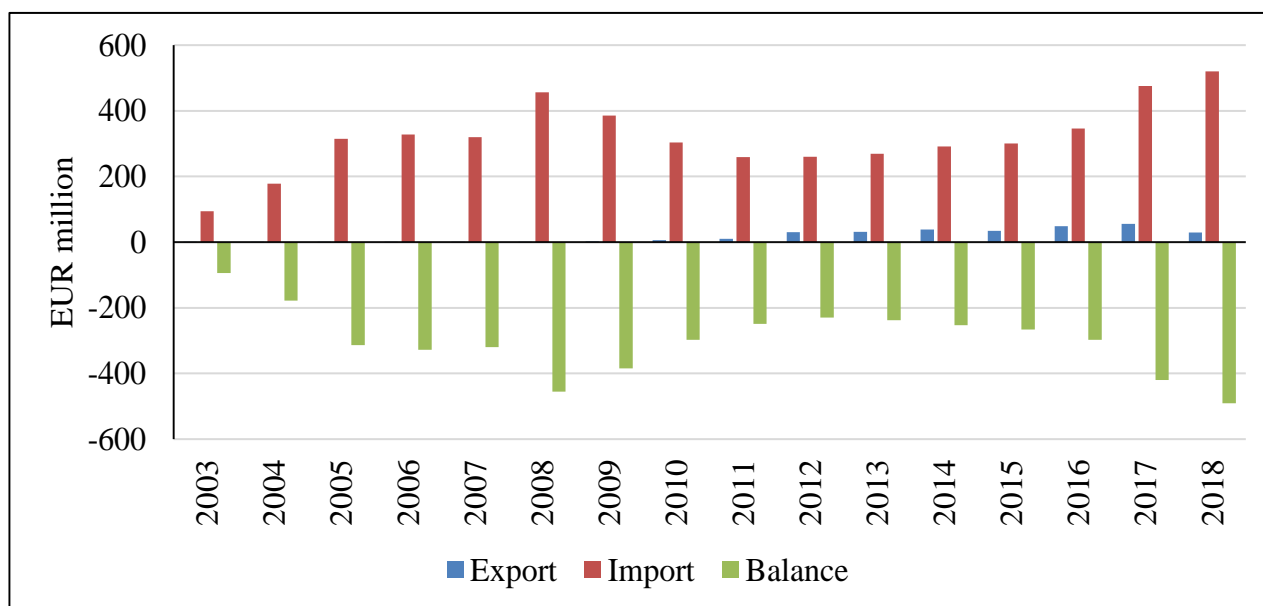
One may also notice an increase in the share of imports in human consumption for a number of commodities in recent years, such as: meat and offal (especially pork), fish, milk and dairy products, sugar and confectionery, vegetables and vegetable products (especially tomatoes). This increase may be partially correlated with the increase in population incomes in recent years, also reflected in the increase in food demand.

From the first three product groups with the highest trade deficit, we selected for analysis the most important product: from group 02 - meat and offal, we detailed the analysis in pork (code 0203); from group 08 - fruits, we detailed the analysis in apples (code 080810), and in group 07 - vegetables, we detailed the analysis in tomatoes (code 0402).

Trade in pork has resulted in a permanent deficit (after 1997, once Romania joined CEFTA); the imports were important in terms of quantity, and coincided in the first years after 1997 with the dissolution of the large state-owned pig breeding enterprises. The private sector started with significant difficulties, and Hungary and Poland were the main suppliers at that time. In the

pre-accession period, imports increased both in terms of quantity and value (figure 5), then decreased during the economic crisis; since 2010 they have resumed their upward trend, but at a lower growth rate, due to the increase of the domestic production of pork.

**Figure 5 – Romanian international trade in pork**



Source: calculations using Eurostat (2019) data

The growth of domestic production has been slower than the increase in consumption in recent years; as a result, imports have increased. The average values of pork imports and their origin in 2016-2018 are shown in table 3.

**Table 3 – Pork imports origin (2016-2018 averages)**

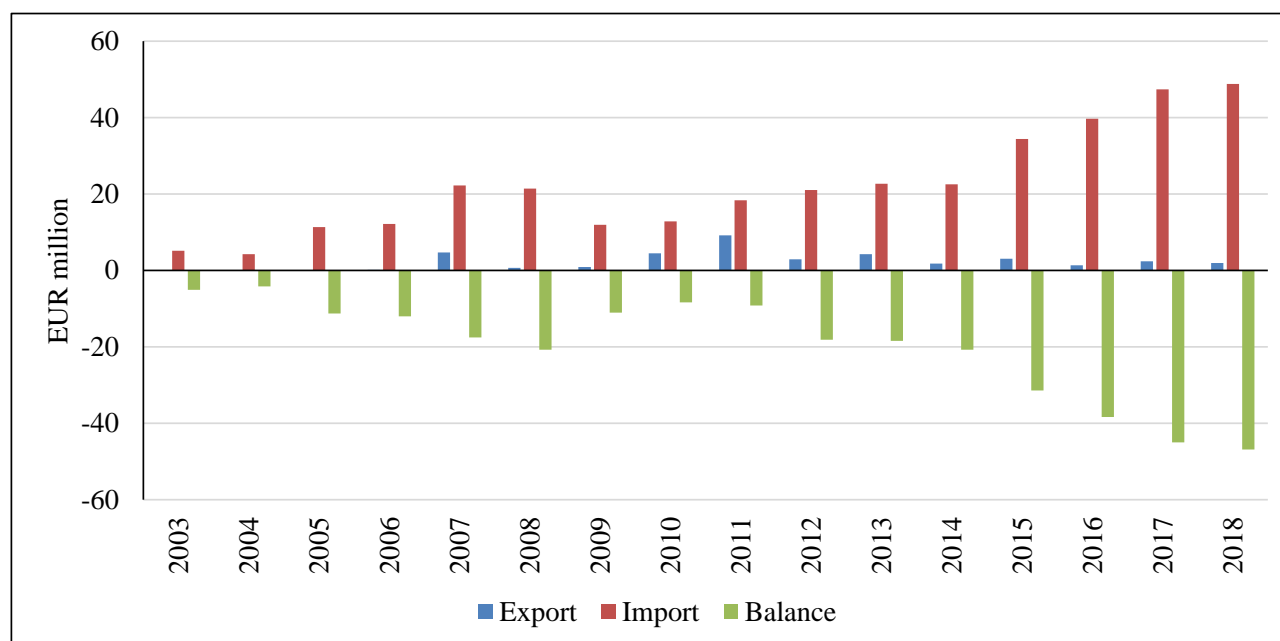
Item	Import - quantity		Import - value	
	1000 tons	%	EUR million	%
<b>Total</b>	<b>717</b>	<b>100,0</b>	<b>1342</b>	<b>100,0</b>
Germany	180	25.1	328	24.4
Spain	157	21.9	356	26.5
Hungary	127	17.8	219	16.4
Netherlands	72	10.0	132	9.8
Poland	57	7.9	96	7.2

Source: calculations using Eurostat (2019) data

The Romanian international fruit trade is worth EUR 676 million annually (average 2016-2018). Most of it is the trade in citrus fruits and bananas. Of the temperate zone species (cultivated in Romania), apples account for the most part (22%).

The self-sufficiency rate in apples has been on average 80% in the last 5 years, but to this it contributes largely to the high level of on-farm consumption; a relatively small quantity of apples from domestic production enters the commercial chains, and the supply of urban consumers is mainly provided by modern retail networks (supermarkets and hypermarkets), which, due to the atomization of the domestic supply, are mainly supplied by import. The decrease of the areas under apple orchards and the decrease of the domestic production of apples after 2011 also contributed to the increase of imports (fig. 6).

**Figure 6 – Romanian international trade in apples**



Source: calculations using Eurostat (2019) data

The average values of the apple imports and their origin during the period 2016-2018 are shown in table 4. The main suppliers are Poland (the largest producer of apples in the EU) and Italy. Among the non-EU countries, the Republic of Moldova is also a supplier.

**Table 4 – Apples imports origin (2016-2018 averages)**

Item	Import - quantity		Import - value	
	1000 tons	%	EUR million	1000 tons
<b>Total</b>	<b>105.8</b>	<b>100.0</b>	<b>45.3</b>	<b>100.0</b>
Poland	65.9	62.2	26.4	58.4
Italy	17.8	16.8	8.1	17.9
Germany	7.0	6.6	4.2	9.3
Hungary	4.2	3.9	1.6	3.5
Rep. Moldova	2.6	2.5	0.8	1.7

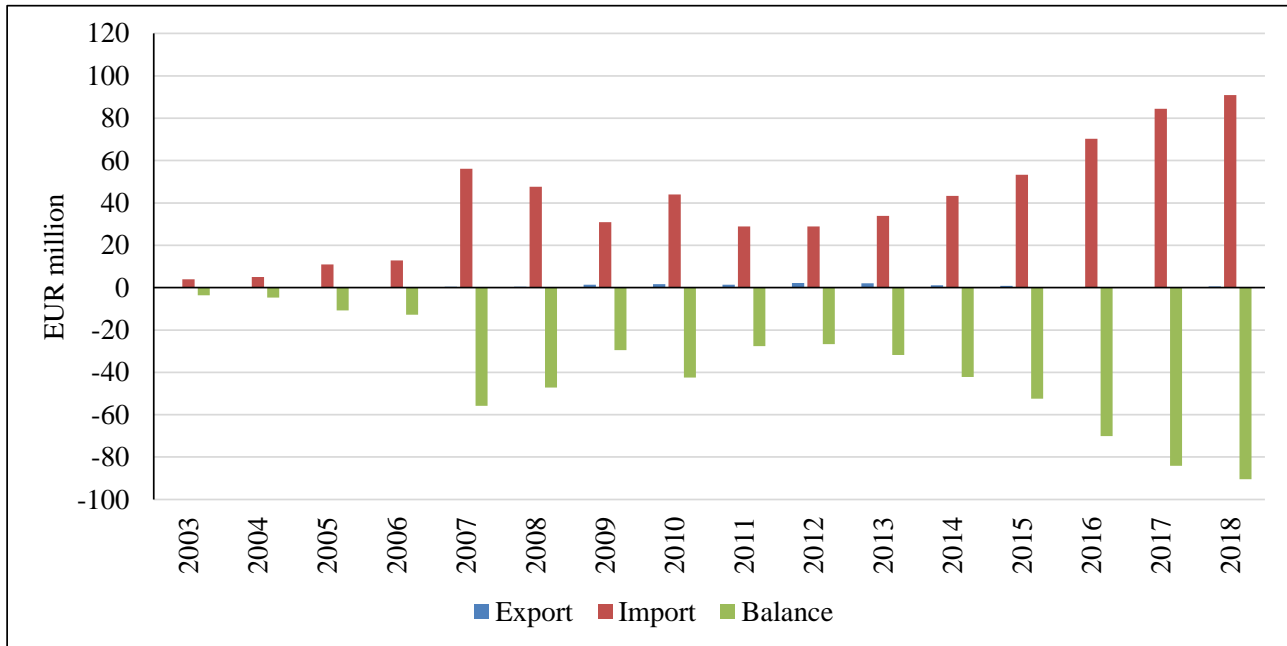
Source: calculations using Eurostat (2019) data

Similar trends were also recorded in vegetable production and trade. The total value of the Romanian international trade in vegetables amounts to EUR 508 million annually (2016-2018 average), of which only tomatoes represent 16%.

The self-sufficiency ratio in tomatoes has been on average 73% in the last 5 years, where again the on-farm consumption had a significant share. Tomato imports accounted for 32% of human consumption on average. The decrease in tomato production until 2017 contributed substantially to the increase in imports. Recent measures to stimulate tomato production under plastic tunnels (implemented from 2018) have led to an increase in domestic tomato production, but still to a lesser extent to help reduce imports (fig. 7).

The average values of tomato imports and their origin during 2016-2018 are shown in table 5. The main supplier is by far Turkey, where 46% of the imported tomato quantities come from.

**Figure 7 - Romanian international trade in tomatoes**



Source: calculations using Eurostat (2019) data

The hierarchical differences between the countries of origin of tomato imports (e.g. Italy ranks 3rd in terms of quantities exported to Romania, but 5th in value) are explained by the price differences of the tomato batches (differences given by the quality products and the period during which imports are made).

**Table 5 – Tomatoes imports origin (2016-2018 averages)**

Item	Import - quantity		Import - value	
	1000 tons	%	EUR million	1000 tons
<b>Total</b>	<b>79.7</b>	<b>100.0</b>	<b>81.9</b>	<b>100.0</b>
Turkey	36.4	45.8	34.5	42.1
Italy	8.7	10.9	7.5	9.2
Spain	7.9	9.9	8.6	10.4
Germany	6.2	7.8	9.5	11.6
Netherlands	5.9	7.4	8.9	10.9

Source: calculations using Eurostat (2019) data

## CONCLUSIONS

Since early 1990, with the resumption of imports of agri-food products at the demand level, Romania has become a net importer. The agricultural and food production sector has been severely affected both by the destruction of the old agri-food chains of the centralized economy, but especially by the inefficiency of the economic agents faced with the tough demands of the market economy, which has led to a partial and dysfunctional re-creation of these chains. Their structuring under the new conditions and their efficiency has been intensely affected by external competition, intensified by the partial liberalization of trade during the membership of CEFTA (1997-2006), and then by the total liberalization in the post-accession period.

Unfortunately, Romania is net importer of most agri-food products, including the basic ones (meat, milk, fruit, vegetables).

The average values of the share of imports in the human consumption of the products studied in the present work (41% in pork, 29% in apples and 29% in tomatoes) illustrate the

inefficiency of domestic production and the lack of concentration of supply, thus a lack of competitiveness, both on the domestic market and on the international market.

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# EVALUATION OF ECONOMIC SUSTAINABILITY ECOLOGICAL PRODUCTION VEGETABLES ON FAMILY FARMS IN SERBIA<sup>1</sup>

JONEL SUBIĆ, SVETLANA ROLJEVIĆ NIKOLIĆ, ZORAN SIMONOVIĆ<sup>2</sup>

**Abstract:** *The tendency of conventional agriculture to achieve high yields has imposed a need for specialization of production and intensive application of mechanization, irrigation, pesticides, mineral fertilizers and new plant varieties. In this way, on the one hand, the profit of farmers is significantly increasing, while on the other hand serious harmful consequences are caused to the environment. Therefore, in recent decades developed different models of sustainable agriculture, which are environmentally friendly and socially just, but they are often criticized that was not economically payable as conventional production method. The research was conducted in the period from January to October 2018, following the production of tomatoes, cv. Big beef, in a greenhouse, on two family farms. The paper presents a gross margin of conventional and ecological production of tomatoes, then gives an overview of the structure of the variable costs and the critical value of production, as well as the way of changing the gross margin due to the growth of variable costs and / or decline in yields and product prices. The results of the research showed that the total value of environmentally friendly production of tomatoes in the greenhouse increased by 29.6% compared to conventional production of the same crop. However, costs of laboratory analyzes of the quality of soil, irrigation water and fruits, as well as labor costs significantly increase the amount of variable costs in ecological production, which results in lower gross margin for 13.5% compared to conventional cultivation practices. It was also found that the decline in production value has a greater impact on the gross margin than the increase in the cost of the production both in environmentally friendly and conventional agriculture.*

**Keywords:** *ecological production, economic sustainability, calculation of production costs, gross margin*

**Classification JEL:** *Q12, Q15, Q16*

## INTRODUCTION

The increasing pressure because of the growth in the global population has imposed the need for intensive use of mechanization, large quantities of agrochemicals and new crop varieties in order to increase crop productivity. According to FAO data, 4,088.168 tons of pesticides and 197,504.394 tons of fertilizers were consumed in the agricultural sector, only in 2016. Such an intensive system of food production has led to environmental pollution and numerous risks for human health considering that it primarily serves the needs, not of humans or the planet, but the needs of capital (Tirado, 2015).

The current situation in world agriculture shows that the demand for quality food is permanently grows, particularly in industrially developed countries, while the production capacity of many areas is drastically reduced. Therefore, in recent decades, various models of sustainable agriculture have been developed, which imply the rational use of natural resources without challenging technical progress (Roljević Nikolić and Vuković, 2017). Although they differ from each other depending on the regional specificities of the production area, common to all environmentally sustainable production systems and techniques in agriculture is that they take care of preserving and improving the health of the environment and humans, they are economically profitable and socially righteous (Roljevic, 2014).

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Eco-based farming systems are the most often criticized by lower productivity (Röös et al., 2018), although the yield obtained is only part of the range of environmental, social and economic benefits that agriculture provides. For example, in the organic production system, which is the most often compared to conventional farming practices in researches, lower yields were observed in the range of 5 to 34% (Seufert et al., 2012) and even up to 80% (Ponisio et al., 2015) which depends on the crop variety, agroecological factors and applied agrotechnical measures. When it comes to vegetable crops, yields are, on average, 33% lower in the organic production systems (Seufert et al., 2012). On the other hand, products obtained in an environmentally friendly way are characterized primarily by health safety and correctness, quality and good taste, for which insightful consumers are ready to pay a significantly higher price. The prices of certified products obtained in an environmentally friendly way are, on average, 50% higher than conventional products, which reflects higher costs in production, processing and distribution (Seufert et al., 2017).

Beside crop productivity and yield, an important issue in ecologically sustainable agricultural systems is the labour participation, which is, on average, 10% - 20% higher per hectare of used agricultural land than conventional ones, which on the other hand highly depends on the production orientation of the farms (Nieberg and Offermann, 2000). On horticulture farms, labour requirements are much higher on ecological than on conventional farms. A low intensity of employment is registered for conventional farms (Cisilino and Madau, 2007).

In order to establish the economic sustainability and profitability of a production line, it is necessary to monitor all costs appeared in the production process, especially variable costs, where significant differences can be observed from year to year. The coverage of variable costs as a percentage of total revenues indicates the profitability of some production and enables comparison of different agricultural systems and crops (Hadelan et al., 2015). The aim of this paper is through the coverage of variable costs to examine the economic effects of environmentally friendly vegetable production in a protected area, apropos that compared plants, with the controlled use of external inputs, creates health-safe products. Conventional cultivation practices involve the use of all agrotechnical measures and the necessary agrochemicals in order to obtain maximum yield.

The survey was conducted on two family farms. The first farm is located in the northern part of Serbia, on the territory of the town of Pancevo (the village of Glogonj) and is characterized by a long-standing orientation towards environmentally friendly vegetable production. The second farm is located in the southern part of Serbia, in the territory of the city of Jagodina (the village of Suljakovac) and is committed to a conventional system of growing vegetables in a protected area.

Manufacturers recorded every operation, including the date of completion, the time and labor invested, as well as the materials and equipment used, with real market prices at the time of purchase. The record of this information was necessary to make analytical calculations based on variable costs, apropos to compare the economic effects of environmentally friendly and conventional vegetable growing practices. Better comparability of the obtained results is ensured by expressing all revenues and costs within the observed production per uniform unit of production area (one acre) in national currency (RSD) and monetary union currency (EUR).

The calculation of variable costs coverage (coverage margin) in the production of a particular crop on the farm is calculated on the basis of the total realized revenues generated by the production of that crop less the total variable costs generated. Total realized revenues imply the market value of the primary and secondary products plus the incentives associated with the observed production line. with conventional cultivation practices examine the level of economic sustainability of the concept of organic production on small family farms in Serbia.

## MATERIALS AND METHODS

An examination of the economic effects and sustainability of the concept of environmentally friendly vegetable production on small family farms was conducted by monitoring the production cycle of tomatoes (*Lycopersicon esculentum* Mill., cv. Big beef) in the protected area, from February to September 2018. For comparison of results, tomatoes were grown in two ways: in environmentally friendly and conventional cultivation practices.

In the context of this paper, environmentally friendly production implies a system of sustainable management in agriculture, where rational use of land, water and genetic resources of

The variable costs in vegetable production have most of the inputs needed to realize the planned production activities, such as: seeds, seedlings, mineral and organic fertilizers, substrates, pesticides and biostimulants of growth, fuels and lubricants, agricultural mechanization services, hiring labour, and in some cases even and members of the farm, manuals and more (Subić and Jeločnik, 2019).

For the analytical calculations on the basis of variable costs in this research was used the following formula:

$$PVT = Q - VT, \text{ while } Q = (q \times c) + p$$

Where analytical elements represents:

PVT – contribution margin (coverage of variable costs);

Q – achieved production value;

VT – gained variable costs;

q – volume of product per unit of measure;

c – price of product per unit measure;

p – subsidies per unit of production area.

The easiness and speed of application of the mentioned method is of particular importance for farms that are not under pressure from the obligation to keep business records on the farm (Vasiljević and Subić, 2010), because through them they are in a position to gain insight into the financial result they generate. The method is an excellent tool to support the decision-making process during the economic analysis of the existing situation within the applied production lines, since it provides an adequate assessment of the sustainability of the adopted technical and technological approach and the achieved results (Jeločnik et al., 2016).

Considering that in the conditions of organic production climate and market conditions have a very significant impact on the results of the farm business, it is necessary to analyze the production results in uncertain conditions. For this purpose, the most commonly is used the method of determination of critical production values, apropos values at which the coverage margin equals zero, where the calculation of indicators is carried out according to the following formulas (Nastić et al., 2014):

$$\text{Critical price: } KC = (VT - p) / OP$$

$$\text{Critical yield: } KP = (VT - p) / OC$$

$$\text{Critical variable costs: } KVT = (OP \times OC) + p, \text{ pri čemu je:}$$

OP – expected yield;

OC – expected price;

p - subsidy;

VT – variable costs.

Also, in conditions of uncertainty, the method of "sensitivity analysis" is used to monitor the pace of change in the coverage margin because of the decrease in yield or sales price, apropos because of the increase in variable production costs (Subić and Jeločnik, 2012).

## RESULTS AND DISCUSSIONS

With calculations on the basis of variable costs determine the ability of the manufacturer to cover the variable costs upon realization of the product and to obtain a certain value from which after covering the fixed costs would make a profit (Subić and Jeločnik, 2019). Table 1 shows the production results achieved on the farm which is characterized by a focus on environmentally friendly vegetable production in the protected area. In the shown production line, on the observed farm, analytical calculation on the basis of variable costs shows the following:

- It was achieved the positive coverage margin (EUR/a 236.43), which should be sufficient for covering fixed production costs and achieving a positive financial result;
- It was achieved the average sales price amounted to EUR/kg 0.56, based on the following budget: total realized production value (EUR/a) / total realized production volume (kg/ar) = 703.02 / 1,250.00);
- Realized incomes are 1.5 times higher than the generated variable costs.

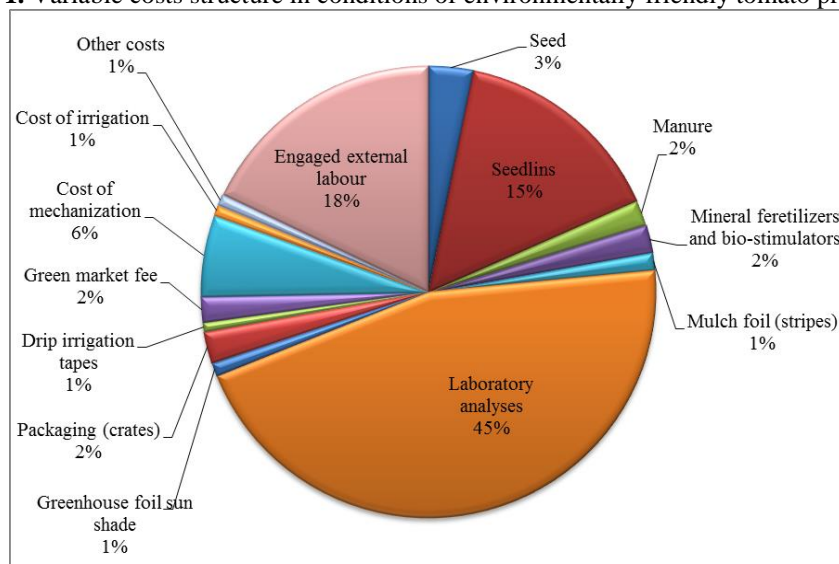
**Table 1.** Cover margin of environmentally friendly production of tomatoes in a greenhouse:

Element	Quantity	UM	Price per UM (in RSD)	Total RSD/ar	Ukupno EUR/ar
<b>A – Incomes</b>					
Tomato	1,250.00	kg	-	-	-
I class (90%)	1,125.00	kg	70.00	78,750.00	666.02
II class (10%)	125.00	kg	35.00	4,375.00	37.00
Insurance premium				-	-
Subsidies				-	-
<b>Value of production (total A)</b>				<b>83,125.00</b>	<b>703.02</b>
<b>B - Variable cost</b>					
Seed	250.00	seed	7.00	1,750.00	14.80
Sedlins	250.00	stalk	33.50	8,375.00	70.83
Manure	1,000.00	kg	1.00	1,000.00	8.46
Mineral fertilizers and bio-stimulators				1,100.00	9.30
Pesticides				76.20	0.64
Binder	0.71	hank	145.00	103.57	0.87
Mulch foil (stripes)	62.50	m	11.00	687.50	5.81
Laboratory analyses	1.00	set	25,000.00	25,000.00	211.43
Greenhouse foil sun shade	1.00	set	535.00	535.00	4.52
Packaging (crates)	125.00	pcs	10.00	1,250.00	10.57
Drip irrigation tapes	62.50	m	6.00	375.00	3.17
Green market fee	14.00	day	200.00	1,000.00	8.46
Cost of mechanization				3,199.00	27.06
Cost of irrigation				420.00	3.55
Other costs				450.00	3.81
Engaged external labour				9,848.29	83.26
<b>Variable costs (total B)</b>				<b>55,169.56</b>	<b>466.58</b>
<b>C – Contribution margin (A-B)</b>				<b>27,955.44</b>	<b>236.43</b>

Analyzing the variable costs structure of environmentally friendly production of a given crop in a protected area (Table 1 and Graph 1), the following are noted:

- Low cost share of plant protection products (0.1%) and mineral fertilizers (2%);
- High cost share of laboratory analyzes of soil, water and fruit (45%). However, it should have in mind that several crops are also grown in the greenhouse during the year which also are involved in covering this type of cost. Beside, soil and water analyzes are done every other year, while fruit analysis is required for each crop grown in the greenhouse during the year;
- A high share in variable costs also are labour costs (18%), which represent a significant factor in the sustainability of crop production based on ecological principles.

**Graph 1.** Variable costs structure in conditions of environmentally friendly tomato production



Based on the data from the coverage margin calculation, critical values of tomato cultivation were determined based on the principles of environmentally friendly production practices (Table 2). Based on the results obtained, it can be observed that the critical production values, at which the coverage margin equals zero, have the following values:

- Critical price amounts EUR/kg 0.37;
- Critical yield amounts kg/a 829.61;
- Critical variable costs amount EUR/a 703.02.

**Table 2.** Critical production values

Description	RSD(kg)/ar	EUR(kg)/ar
Expected yield (OP)	1,250.00	1,250.00
Expected price (OC)	66.50	0.56
Subsidy (p)	-	0.00
Varijable costs (VT)	55,169.56	466.58
<b>Critical price: <math>KC = (VT - p) / OP</math></b>	<b>44.14</b>	<b>0.37</b>
<b>Critical yield: <math>KP = (VT - p) / OC</math></b>	<b>829.61</b>	<b>829.61</b>
<b>Critical variable costs: <math>KVT = (OP \times OC) + p</math></b>	<b>83,125.00</b>	<b>703.02</b>

Note: Tomato fruits are classified into two classes, so the expected price represents the average price per 1 kg of tomatoes.

The sensitive analysis of environmentally friendly tomato production in the greenhouse, based on analytical calculation results, is shown in Tables 3 and 4. This analysis shows the degree of sensitivity, apropos the level of change in the coverage margin because of decreasing in yield or sales price (Table 3), as well as because of growth of variable production costs (Table 4).

**Table 3.** Change in coverage margin because of falling yield or falling price

Fall of tomato yield or price (%)	Value of contribution margin (RSD/ar)	Value of contribution margin (EUR/ar)
5.00	23,799.81	201.28
10.00	19,643.56	166.13
15.00	15,487.31	130.98
20.00	11,331.06	95.83
25.00	7,174.81	60.68
30.00	3,018.56	25.53
35.00	-1,137.69	-9.62

**Table 4.** Change in coverage margin because of rising variable costs

Growth of variable costs (%)	Value of contribution margin (RSD/ar)	Value of contribution margin (EUR/ar)
5.00	25,197.61	213.11
10.00	22,439.17	189.78
15.00	19,680.72	166.45
20.00	16,922.27	143.12
25.00	14,163.83	119.79
30.00	11,405.38	96.46
35.00	8,646.93	73.13
40.00	5,888.48	49.80
45.00	3,130.04	26.47
50.00	371.59	3.14
55.00	-2,386.86	-20.19

The values shown in Tables 3 and 4 show that the coverage margin of environmentally friendly tomato production in the protected area is more sensitive to a fall in production value than to a rise in variable costs. At the same time, the margin of coverage is at zero in the event of a fall in production value by 33.63%, or due to a rise in variable costs by 50.67%.

The production results achieved on the farm applying the conventional vegetable growing system in the protected area are shown in Table 5. In the shown production line, on the observed farm, the analytical calculation on the basis of variable costs shows the following:

- It was achieved a positive margin (EUR/a 273.46), which should be sufficient to cover fixed costs and profit;
- It was achieved a average sales price amounted to EUR/kg 0.38, based on the following estimate: total realized production value (EUR/ar) / total realized production volume (kg/ar) = 494.76 / 1,300.00);
- Realized incomes are almost 1.8 times higher than the generated variable costs.

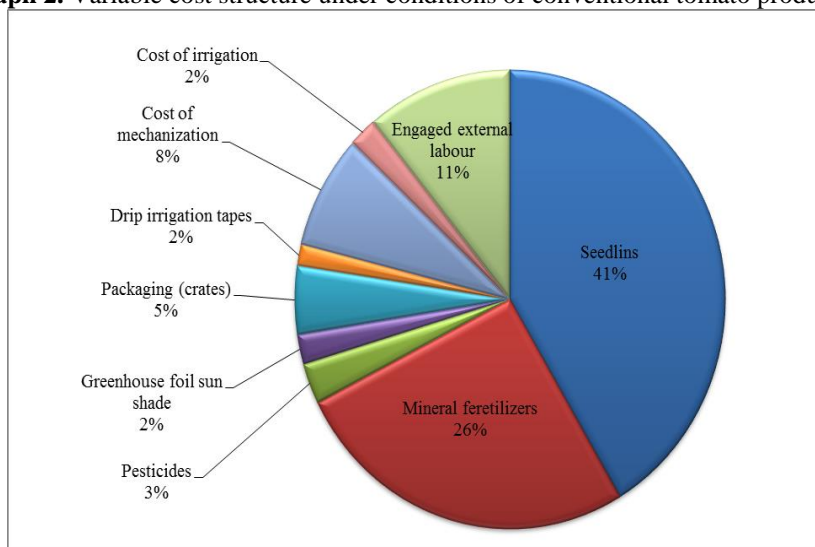
**Table 5.** Cover margin of conventional tomato production in the greenhouse

Element	Quantity	UM	Price per UM (in RSD)	Total RSD/ar	Ukupno EUR/ar
<b>A – Incomes</b>					
Tomato	1,300.00	kg	45.00	58,500.00	494.76
Insurance premium				-	-
Subsidies				-	-
<b>Value of production (total A)</b>				<b>58,500.00</b>	<b>494.76</b>
<b>B - Variable costs</b>					
Seed	0.00	seed	0.00	0.00	0.00
seedlings	270.00	stalk	40.00	10,800.00	91.34
Manure	-	kg	-	-	-
Mineral fertilizers				6,800.00	57.51
Pesticides				750.00	6.34
Binder	0.80	hank	145.00	116.00	0.98
Mulch foil (stripes)	-	m	-	-	-
Laboratory analyses	-	-	-	-	-
Greenhouse foil sun shade	1.00	set	550.00	550.00	4.65
Packaging (crates)	125.00	pcs	10.00	1,250.00	10.57
Drip irrigation tapes	100.00	m	4.00	400.00	3.38
Green market fee	-	day	-	-	-
Cost of mechanization				2,100.00	17.76
Cost of irrigation				550.00	4.65
Other costs				-	-
Engaged external labour				2,850.00	24.10
<b>Variable costs (total B)</b>				<b>26,166.00</b>	<b>221.30</b>
<b>C - Contribution margin (A-B)</b>				<b>32,334.00</b>	<b>273.46</b>

By analyzing the variable cost structure of conventional cultivation practices of given crop in a protected area (Table 5 and Chart 2), it is noted that:

- The largest share of variable costs is purchase of seedlings costs (41%) and mineral fertilizers costs (26%);
- Labor costs account for 11% of total variable costs;
- Costs of mechanization, which include performing basic and additional land cultivation, fertilization, planting of seedlings, measures of care and protection of crops, as well as transportation of fruits make 8% of variable costs of conventional production of tomatoes in the protected area;
- Other costs have a significantly smaller share of variable costs.

**Graph 2.** Variable cost structure under conditions of conventional tomato production



Critical values of tomato cultivation in conventional cultivation practices were also established on the basis of the coverage margin calculation (Table 6). Based on the results obtained, it can be observed that the critical production values, at which the coverage margin equals zero, have the following values:

- Critical price amounts EUR/kg 0.17;
- Critical yield amounts kg/ar 581.47;
- Critical variable costs are EUR/ar 494.76.

**Table 6.** Critical values of conventional tomato production in a protected area

Description	RSD (kg/ar)	EUR (kg/ar)
Expected yield (OP)	1,300.00	1,300.00
Expected price (OC)	45.00	0.38
Subsidy (p)	0.00	0.00
Variable costs (VT)	26,166.00	221.30
<b>Critical price: <math>KC = (VT - p) / OP</math></b>	<b>20.13</b>	<b>0.17</b>
<b>Critical yield: <math>KP = (VT - p) / OC</math></b>	<b>581.47</b>	<b>581.47</b>
<b>Critical variable costs: <math>KVT = (OP \times OC) + p</math></b>	<b>58,500.00</b>	<b>494.76</b>

The sensitive analysis of conventional tomato production in the greenhouse, established on the basis of analytical calculation results, is presented in Tables 7 and 8.

**Table 7.** Change in coverage margin in conventional production because of falling yield or falling tomato price

Fall of tomato yield or price (%)	Value of contribution margin (RSD/ar)	Value of contribution margin (EUR/ar)
5.00	29,409.00	248.72
10.00	26,484.00	223.99
15.00	23,559.00	199.25
20.00	20,634.00	174.51
25.00	17,709.00	149.77
30.00	14,784.00	125.03
35.00	11,859.00	100.30
40.00	8,934.00	75.56
45.00	6,009.00	50.82
50.00	3,084.00	26.08
55.00	159.00	1.34
60.00	-2,766.00	-23.39

**Table 8.** Change in coverage margin in conventional tomato production because of rising variable costs

Growth of variable costs (%)	Value of contribution margin (RSD/ar)	Value of contribution margin (EUR/ar)
10.00	29,717.40	251.33
20.00	27,100.80	229.20
30.00	24,484.20	207.07
40.00	21,867.60	184.94
50.00	19,251.00	162.81
60.00	16,634.40	140.68
70.00	14,017.80	118.55
80.00	11,401.20	96.42
90.00	8,784.60	74.29
100.00	6,168.00	52.17
120.00	934.80	7.91
130.00	-1,681.80	-14.22

The results of the sensitive analysis showed that the coverage margin of conventional tomato production in a protected area is more sensitive to a fall in production value than to a rise in variable costs. At the same time, the margin of coverage of conventional production becomes negative in case of a fall in production value by over 55%, that is, due to an increase in variable costs by over 120%.

## CONCLUSIONS

The analysis of the realized coverage margin, apropos gross financial result at the level of family farms applying two different concepts (environmentally friendly and conventional) in the production of the same crop in the protected area, points to the following conclusions:

- ✓ The yield of tomatoes in environmentally friendly production is lower by 3.8% compared to the conventional practice of growing the same crop apropos variety;
- ✓ The total value of environmentally friendly tomato production is bigger for 29.6% compared to conventional production of the same crop;
- ✓ The high share of variable costs in organic (66.4%) compared to conventional production (44.7%), influences that the realized incomes in organic production is 1.5 and in conventional one 1.8 times higher than the generated variable costs;
- ✓ Laboratory analysis costs (45%) and labour costs (18%) have the largest share in the variable cost structure of environmentally friendly tomato production;
- ✓ The largest share in the variable costs structure of conventional production of the same crop, in addition to the purchase of seedlings (41%), have the costs of acquiring fertilizers (26%), while significantly less resources are allocated for hiring labour (11%);

- ✓ The results of a sensitive analysis showed that the coverage margin of both tomato production methods (environmentally friendly and conventional) in the protected area is more sensitive to a fall in production value than to an increase in variable costs.
- ✓ Although the margin of coverage in terms of environmentally friendly production is 13.5% lower than conventional, the results showed that such a system of growing tomatoes on family farms is economically sustainable, because it provides a positive and stable income for producers.

Considering that in the variable costs structure of environmentally friendly production, significant expenditure relates to laboratory analyzes, if this item were included in the variable cost structure of conventional production, the realized margin of coverage would be reduced by the same cost, while the final result would be lower compared to the realized margin of coverage of environmentally friendly tomato production.

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# ANALYSIS OF INCOMING AND OUTGOING CASH FLOWS OF DAIRY SHEEP BREEDING FARMS IN BULGARIA

TSVETANA HARIZANOVA-METODIEVA<sup>1</sup>, NIKOLA METODIEV<sup>2</sup>

**Summary:** *The aim of the study is to explore cash flow categories (incoming, outgoing and net cash flow per ewe), generated by dairy sheep breeding farms in Bulgaria. The study was carried out with 3 conventional dairy sheep farms (511 ewes totally, all from the breed – Synthetic Population Bulgarian Milk), in which extensive farming system was applied. The information was collected through a questionnaire from farm owners in 2016. The study found that all three farms have positive net cash flow (735 EUR, 6415 EUR, and 32034 EUR). The cash flows of farms vary according to the specifics of their activity, but the largest share of the outgoing cash flows have that for labour payments (from 30.8% to 50.5%) and for the purchase of forages (from 10.8% to 47.3%). Fuel costs vary considerably (from 1.8% to 7.2%). From the incoming cash flows, substantial portion took the sales of sheep milk (from 32% to 54.8%) and lambs (from 23.6% to 38.4%), followed by subsidies (from 17% to 27.7%). The net cash flow per ewe greatly varied and took values of 7 EUR, 77 EUR, and 99 EUR, meaning that the profitable operation of each farm depends on local factors of the natural environment, business conditions and management decisions of the farm owners. It is necessary for the farmers to take precautions to keep lambs alive and healthy in order to maximize the financial effectiveness of the farm, as well as to sell milk at better price.*

**Keywords:** *dairy sheep farms, sales, cash flows, Bulgaria*

**JEL Classification:** Q12

## INTRODUCTION

Dairy sheep breeding is a sector that engages a relatively low skilled labor force, uses crude feed and waste raw materials from the food-processing industry, uses effectively depleted lands and pastures and provides basic or additional incomes to the rural population of Bulgaria. Dairy sheep breeding could be a profitable business even in harsh climate conditions [6]. Sheep can be reared on lands, inappropriate for other kinds of agribusiness [9]. Prevailing share of sheep milk is used for the production of cheese [3].

One of the factors having an impact over the profitability of dairy sheep farms is the average milk yield of the flocks, as well as the motivation of people to deal with dairy sheep. In this respect, a number of authors have studied the various categories of revenues, costs and efficiency of the sector in Bulgaria [7], [10], [12].

A study, established that in the Mediterranean countries, found that dairy sheep farming as a whole had generated higher income compared to meat direction of sheep breeding [5] and in Spain most of dairy Assaf farms were economically profitable [8].

The prospects of the sector in Bulgaria depend to a large extent on its subsidization, both by subsidies for ewes, including those under selection, as well as subsidies for arable land and pastures. Sheep farmers in Bulgaria can also receive financial support through the resources of the Programme "Rural development" 2014-2020, including for "Animal welfare", for young farmers and other measures.

Sheep-farmers may apply for financial aid *de minimis* for their ewes: for farmers, who have between 10 and 300 ewes – up to 15 BGN/ewe and for farmers, rearing more than 300 ewes – up to 7 BGN per ewe. Also farmers may receive subsidies for ewes, if they have 50 or more ewes under selection from one and the same breed or if they raise from 10 to 49 ewes in the mountain regions of the country. For organic farming, farmers may also apply for financial aid [13].

As an alternative to conventional farming, in recent years organic sheep breeding becomes more and more appealing to the farmers: 21072 heads of sheep for 2018 were under organic farming in comparison to 2015, when there were 18792 heads [1], [2]. According to a study [11] Bulgaria and Romania are countries with a great scope for growth in organic agriculture.

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Sheep takes the second largest share of organic livestock husbandry in Bulgaria after bees [4]. The aim of the study is to explore cash flow categories (incoming, outgoing and net cash flow per ewe), generated by dairy sheep breeding farms in Bulgaria.

## MATERIALS AND METHODS

The study was carried out with 3 conventional dairy sheep farms (511 ewes totally, all from the breed – Synthetic Population Bulgarian Milk), in which extensive farming system was applied. In the studied farms sheep were bred naturally once per year and the lambs were born in December and in January. The lambs were sold at live weight between 20 and 28 kg at the end of April to the middle of June. Pastures had an important role for these three sheep farms as a forage source. The average milk yield in the farms was from 80 to 90 liters per ewe for 120 days lactation period. Between 55% and 92% of ewes in the studied farms were from first to third lactation. Data about incoming and outgoing cash flows, incurred in the investigated dairy sheep farms were collected through a questionnaire from farm owners in 2016. Also information was gathered about the number of ewes, number of sold lambs per year and number of sold ewes and rams per year for each farm. The net cash flow per ewe was found. The three farms had realized revenues from the sale of sheep production (sheep milk, lambs, culled ewes and rams) and from subsidies (received for the pastures and for the animals). The outgoing cash flows include: labour payments, purchased fodders, fuels, medications and veterinary services, accounting, selection, disinfectants, electricity, water, repair of agricultural machinery, rent of pastures, and other. The percentage for each type of outgoing and incoming cash flows was calculated.

## RESULTS AND DISCUSSIONS

Table 1 shows the cash flows of the studied three dairy sheep breeding farms and the net cash flow per ewe.

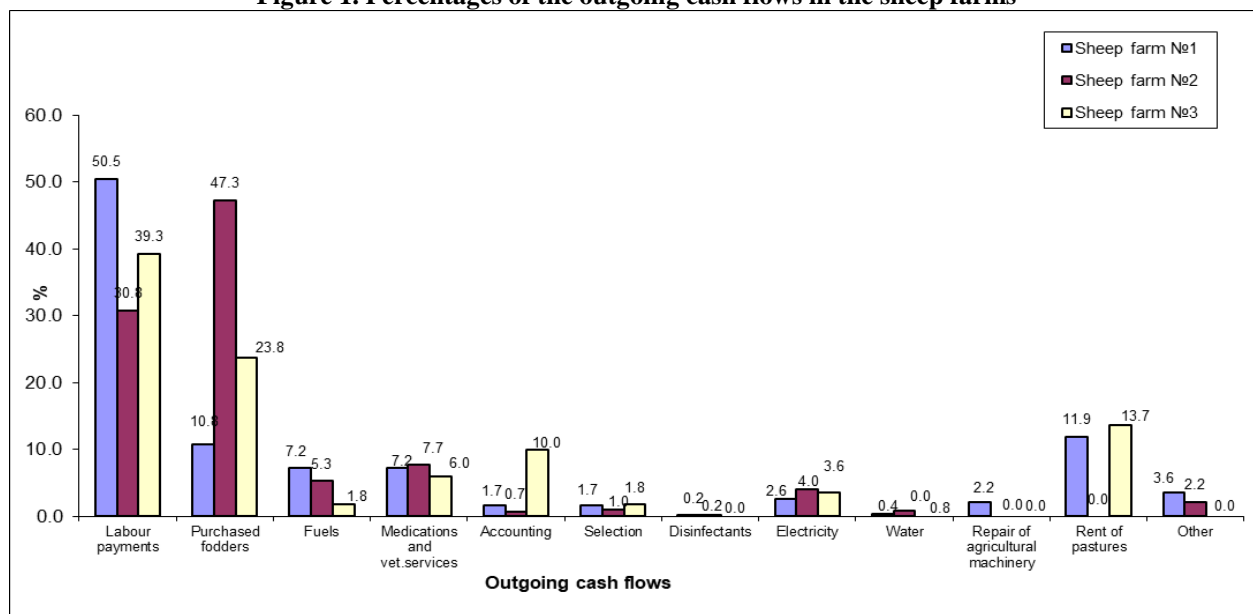
**Table 1. Cash flows of three dairy sheep breeding farms**

<b>№</b>	<b>Variables:</b>	<b>Sheep farm №1</b>	<b>Sheep farm №2</b>	<b>Sheep farm №3</b>
1	Number of ewes	83	325	103
2	Number of sold lambs per year	70	270	30
3	Number of sold ewes and rams per year	15	33	5
4	<b>OUTGOING CASH FLOWS (EUR):</b>	<b>6935</b>	<b>22716</b>	<b>8390</b>
5	Labour payments	3500	7000	3300
6	Purchased fodders	750	10750	2000
7	Fuels	500	1200	150
8	Medications and veterinary services	500	1750	500
9	Accounting	120	161	840
10	Selection	115	225	150
11	Disinfectants	15	50	0
12	Electricity	180	900	300
13	Water	30	180	0
14	Repair of agricultural machinery	150	0	0
15	Rent of pastures	825	0	1150
16	Other	250	500	0
17	<b>INCOMING CASH FLOWS (EUR):</b>	<b>13350</b>	<b>54750</b>	<b>9125</b>
18	Sales of sheep milk	4500	17500	5000
19	Sales of lambs	4200	21000	2150
20	Sales of ewes and rams	950	2025	425
21	Subsidies	3700	14225	1550
22	<b>NET CASH FLOWS (EUR) (17 - 4)</b>	<b>6415</b>	<b>32034</b>	<b>735</b>
23	<b>NET CASH FLOW PER EWE (EUR) (22/1)</b>	<b>77</b>	<b>99</b>	<b>7</b>

Source: data, collected through a questionnaire and own estimations.

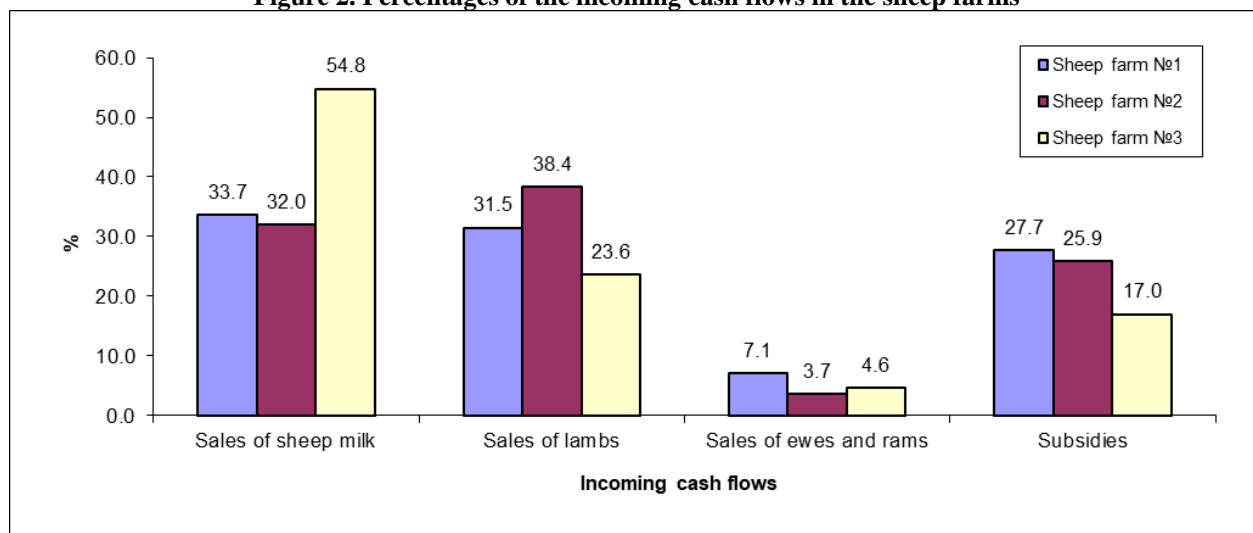
Figure 1 and Figure 2 show the percentage of each type of outgoing and incoming cash flows in the sheep farms.

**Figure 1. Percentages of the outgoing cash flows in the sheep farms**



Source: data, collected through a questionnaire and own estimations.

**Figure 2. Percentages of the incoming cash flows in the sheep farms**



Source: data, collected through a questionnaire and own estimations.

The number of ewes in the studied dairy farms is 83, 103 and 325. The number of sold lambs per year is from 30 to 270 and the number of sold ewes and rams per year is from 5 to 33.

The study found that all three farms have positive net cash flow (735 EUR, 6415 EUR, and 32034 EUR). The farms' cash flows vary according to the specifics of their activity, but the largest share of the outgoing cash flows have that for labour payments (from 30.8% to 50.5%) and for the purchase of forages (from 10.8% to 47.3%). The farmer with 103 ewes have bought forage for a sum of 2000 EUR per year and the rest of needed feed for animals is own production. The farm with 325 ewes have bought all the forage (excluding grass for grazing): 600 bales alfalfa (2 EUR per bale); hay – 1000 bales (1.5 EUR per bale); straw – 500 bales (0.5 EUR per bale); wheat – 20 tons (150 EUR per ton); corn – 20 tons (165 EUR per ton); forage mixtures – 4 tons (375 EUR per ton). The farm with 82 ewes have bought only corn – 5 tons (150 EUR per ton), the rest of feed is own production.

Our results were in accordance with a study [12], according to which the labour costs in a farm, rearing the same breed (Synthetic Population Bulgarian Milk) varied from 42.3% to 45.8% and the forage costs took values from 37% to 41%.

Fuel costs vary considerably (from 1.8% to 7.2%) in our study. Medications and veterinary services take similar percentages in the three farms: between 6% and 7.7%. Accounting services vary substantially between 0.7% and 10%. Selection expenses take between 1% and 1.8%. Rent of pastures is between 0% and 13.7%. Electricity is between 2.6% and 4%. Disinfectants and water take the smallest share of outgoing cash flows of the dairy farms.

From the incoming cash flows, substantial portion take the sales of sheep milk (from 32% to 54.8%) and lambs (from 23.6% to 38.4%), followed by subsidies (from 17% to 27.7%).

The selling price of lambs varied from 2.75 EUR to 3 EUR per 1 kg live weight. The selling price for 1 kg live weight of sold ewes and rams varied from 1 to 1.5 EUR. The selling price of sheep milk per 1 liter was between 0.6 EUR and 0.69 EUR, but for high quality sheep milk, used for cheese production, the price had reached 1 EUR per liter.

In the conducted study the net cash flow per ewe greatly varies and takes values of 7 EUR, 77 EUR, and 99 EUR, respectively for each farm. It was established in a research [7], that the gross margin per ewe can take value of 110 BGN, or approximately 56 EUR, for a flock of Synthetic Population Bulgarian Milk breed.

One of the reasons for relatively small value of the net cash flow per ewe in the third farm (with 103 ewes) was that the farmer had sold only 30 lambs. It was due to high mortality rates of lambs (20-30% mortality rate) and ewe lambs (10% mortality rate). For comparison in the other two farms the mortality rate for lambs took values from 5% to 9% and for ewe lambs – from 0% to 1%. The other reason for the low net cash flow per ewe in the third farm was the selling price of sheep milk – 0.6 EUR per liter. The other two farms had sold milk for 0.69 EUR per liter.

So, we can conclude that the profitable operation of each farm depends on local factors of the natural environment, business conditions and management decisions of the farm owners. It is necessary for the farmers to take precautions to keep lambs alive and healthy in order to maximize the financial effectiveness of the farm, as well as to sell milk at better price.

## CONCLUSIONS

The study found that all three farms have positive net cash flow (735 EUR, 6415 EUR, and 32034 EUR). The farms' cash flows vary according to the specifics of their activity, but the largest share of the outgoing cash flows have that for labour payments (from 30.8% to 50.5%) and for the purchase of forages (from 10.8% to 47.3%). Fuel costs vary considerably (from 1.8% to 7.2%). Medicaments and veterinary services take similar percentages in the three farms: between 6% and 7.7%. Disinfectants and water took the smallest share of outgoing cash flows of the dairy farms.

Substantial share of the incoming cash flows, takes the sales of sheep milk (from 32% to 54.8%), followed by the sale of lambs (from 23.6% to 38.4%) and subsidies (from 17% to 27.7%).

All the three dairy sheep breeding farms have realized positive net cash flow and positive net cash flow per ewe respectively. The net cash flow per ewe greatly varies and takes values of 7 EUR, 77 EUR, and 99 EUR, meaning that the profitable operation of each farm depends on local factors of the natural environment, business conditions and management decisions of the farm owners. It is necessary for the farmers to take precautions to keep lambs alive and healthy in order to maximize the financial effectiveness of the farm, as well as to sell milk at better price.

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# AGRICULTURAL PRODUCTION ZONING. HISTORICAL AND CURRENT ISSUES

AUREL LUP<sup>1</sup>

**Abstract:** *This paper brings back to the specialized research circuit, as well as to the political decision makers' attention the zoning work of agricultural production by counties, namely over the period 1980-1985-1990. The author considers it the most important research work carried out by the Institute of Agricultural Economics within the Academy of Agricultural and Forestry Sciences. In the paper are established, according to the territorial profile at the county level, the following: the area of agricultural land by uses, the quality of the land expressed by the natural bonitation grades, their enhancement taking into account the qualitative evolution of the production technologies, the assurance of the main factors of production, but especially the realization in stages of land reclamation works. The following are also established: the geographical space of each crop or species of animals, the average yields per hectare and per head of livestock. The synthesis consists of a number of 20 macro zones hierarchized according to importance: national, county, specialized areas. The paper includes numerous tables and maps. It is similar to works from almost every country in the world. It is drawn up in agreement with the political decision makers, being an event which seems unique in the economic history of Romania.*

**Key-words:** *agriculture, zoning, macro zone, land reclamation*

**JEL Classification:** *Q15; Q16; Q18*

## INTRODUCTION

As a research topic, the zoning of agricultural production is always current, due to a complex series of natural and human factors, the latter having an increasing influence. From a historical point of view, the spatial distribution of agricultural production was a natural one, determined by the set of environmental factors, which allowed the cultivation of certain species of plants and the breeding of animals in certain regions. The competition for satisfying the human need for food - quantitative and qualitative - and not least the productivity and the cost of obtaining some products had an important role in the territorial redistribution of agricultural production. In the last two centuries, for example, the more productive, cheaper and more consumable maize has largely replaced millet and buckwheat.

In modern times, the development of scientific research in the field, the technical and technological progress, the increase in the speed of transport of the products and the proportional reduction of the cost, the improvement of the storage technologies have greatly influenced the territorial zoning of the agricultural production in which the economic and social factors, the market, largely decide the spatial distribution of agricultural production, both globally and within national economies. The present paper is a case in which the political decision through the program *territorial self-provisioning* (2) canceled significant research efforts materialized in massive investments.

In the countries of the former Soviet bloc - including Romania - sophisticated economic-mathematical models were elaborated with the aim of optimizing the territorial distribution of agricultural production, taking into account a multitude of technical and economic factors and coefficients, more or less controllable (Gavriliev, Kravcenko, Popov 1968, 1969, 1970). As for France, we mention the works elaborated by Klatzman (1968), Tirel (1969), Frigola (1972). In the United States, Brokken and Headz (1968) developed models for the simultaneous zoning of plant and animal production (3).

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## MATERIAL AND METHOD

**Stages, coordination, guidance, executions.** Precursors: Ion Ionescu de la Brad, C.Murgoci, Popovici-Lupe.

During the socialist agriculture period:

- I. Central Commission for Agricultural Production Zoning, MA, 1961-1964.
- II. After the completion of collectivization (1962) the work is resumed under the new circumstances.
- III. Coordination and Synthesis Study IEA, 1976.

Phases:

- deepening the study and extending the period until 1990;
- trainings: topographic specialists, researchers from experimental stations, county commissions, methodological guides, programmers, etc.

Coordination:

- Angelo Miculescu, Minister of MAIA; Nicolae Giosan, president of ASAS, the presidents of the County Agricultural Directorates.
- B. Burlacu, S. Hartia, D. Teaci, secretariat.

Methodological guides, authors of linear programming models at central and county level.

At the top level S. Hartia. At county level: a number of 40 people, of which 31 researchers from ICEA and 9 from universities and agronomic institutes (Constanța and Tulcea counties, A. Lup).

### **Working hypotheses**

A certain evolution of the number of tractors and the quantity of chemical fertilizers:

	1972	1980	Proposals		
			V <sub>1</sub>	V <sub>2</sub>	V <sub>3</sub>
Number of tractors thousand units	115	126	175	185	200
Chemical fertilizers (thousand tonnes)	639	3033	3100	3965	4850

This working hypothesis was not fulfilled. In 1990, in Romania's agriculture only 152 thousand tractors were operating, and the quantity of chemical fertilizers benefited by the Romanian agriculture was only 1159 thousand tonnes, respectively 23.9% compared to the forecast (6). Even though Romania had the necessary production capacities, both for the production of tractors and for chemical fertilizers, the main destination was the export.

Relying on the ambitious figures released by the plenaries and congresses of the Romanian Communist Party, a certain evolution of the land reclamation works was considered, depending on which production levels per hectare were predicted in increasing variants:

Variant 1. An irrigated area of 2750 thousand ha.

Variant 2. An irrigated area of 3700 thousand ha.

Variant 3. An irrigated area of over 5000 thousand ha, and the quantity of fertilizers.

Variant 4. An irrigated area of over 5000 thousand ha, and the quantity of chemical fertilizers provided would be about 4850 thousand tonnes.

Variant 5. The irrigated area of over 5000 thousand ha and all land reclamation works would be carried out (draining, drainage, soil erosion control, etc.), the amount of chemical fertilizers would be about 5500-6000 thousand tonnes, and the number of tractors would be about 200-240 thousand physical units.

I would like to mention here that at the end of 1989, there were 151.745 tractors in Romania's agriculture, 33.463 fewer units than in 1986, when their number was 185.208. In fact, considering the statistical system of the time nobody will ever know the real figure. What few people know, and those who know neglect the fact that according to a *downward provision* in the last years of the totalitarian communist regime, scrapping worn-out equipment was forbidden. Even so, the statistics of the time would acknowledge the reduction in the number of tractors in recent years: 184.850 in 1987, 165.072 in 1988 and 151.745 in 1989 (6). For the last variant, the great master of the zoning work, Sergiu Hartia also suggested other research achievements such as:

- high productivity plant varieties and hybrids;



- the functional exploitation of the entire complex of land reclamation and agropedo-ameliorative works (improvement of soil reaction, sandy lands);
- the appropriate training and qualification of the agricultural workers;
- an efficient management system (5).

At the research level, all these conditions were met by their transposition into the great agricultural production never achieved both due to the inability of the economy to provide works, substances in sufficient quantities and corresponding quality and to the intervention of the political factor as *decision-maker*.

**Foundation of the technical and economic parameters of the zoning activity.** In the previous paragraph I mentioned that the parameters that the zoning work would propose for the three periods of time (1980, 1985 and 1990) were conditioned by the provision of levels of endowment and supply with inputs of industrial origin. In parallel, the setting of the operating parameters of the zoning was dependent on the accomplishment of works in stages, that had to significantly correct the parameters of the natural environment: drought, excess humidity, erosion. To this end, the specialists in the field were appealed to, first of all for the bonitation works that synthesized the zoning of the parameters of the natural framework and those resulting from land reclamation works in particular. Their parameters materialized in areas functionally set up in stages (established only in 1983) were assumed to be achieved, i.e. 5500 thousand ha arranged for irrigation (26.8% set up in 1975), 5530 thousand ha drained (35.6% arranged in 1975) and 5300 thousand ha anti-erosion facilities (18.5% set up in 1975). In these conditions, the qualitative bonitation of the soils at the county level was operated establishing at this level the natural and the intensified grade (the latter considering that the arrangements will be made until 1990, the last zoning period (table 1). Maps that described the conditions of the natural environment (the climatic ones in figure 1) were used in determining the intensified bonitation notes.

**Table 1**

Natural and intensified notes in some counties for the main cultures and country mean

County	Wheat		Maize		Sunflower		Soy		Sugar beet		Potato	
	Nat.	Int.	Nat.	Int.	Nat.	Int.	Nat.	Int.	Nat.	Int.	Nat.	Int.
Alba	30	58	21	48	22	47	27	57	20	47	21	47
Brăila	55	68	60	92	59	78	51	78	54	86	47	68
Constanța	47	74	47	97	47	74	41	84	42	86	36	75
Dolj	48	71	49	83	50	73	46	80	43	74	38	68
Ialomița	59	84	61	112	63	94	57	103	58	107	50	93
Mureș	40	63	25	41	23	33	31	51	45	65	31	51
Teleorman	59	84	57	93	59	82	57	84	54	85	47	74
Timiș	53	77	49	86	59	82	44	63	54	85	40	68
Tulcea	44	67	40	75	41	63	40	75	37	69	32	59
Country mean	47	72	42	74	42	64	41	72	41	73	38	68

Source: (5)

**Table 2**

Production - kg - land judging point depending on plant technology evolution

Culture	1978	1990	2000
Wheat	60-70	90	100
Maize	80-90	110	130
Sunflower	30-35	40	50
Potato	450-550	600	700
Sugarbeet	500-600	700	800

Source: (4).

The data regarding the evolution of the technological development were provided by pedologists and technologists, so that based on them the values of the bonitation point intensified for different cultures were designed (table 3).

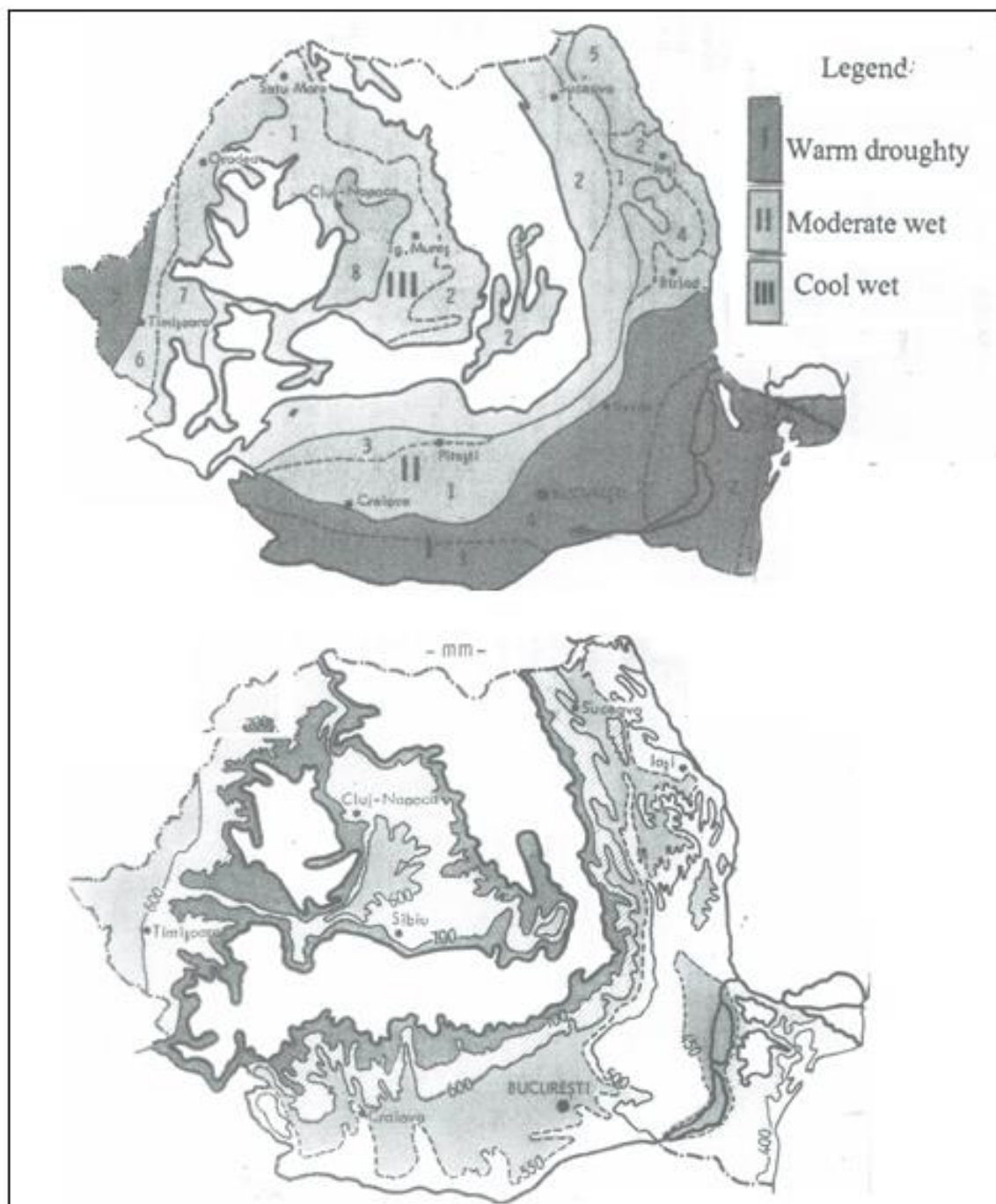
Considering that over time the cultivation technologies will be improved (more efficient biological material, more fertilizers and pesticides, more equipment and more efficient, more competent management) the value in production increase of the bonitation point will also increase (table 2).

**Table 3**

Production - kg – and land judging point established for level of five variants yields on hectar

Culture	Variants				
	1	2	3	4	5
Wheat	45	50	52	55	60
Maize	60	75	80	90	100
Sunflower	34	36	37	45	50
Sugarbeet	500	600	700	800	900

Source: (5)



Source: (1)

**Figure 1.** Agroclimatic zones of Romania (above) and territorial distribution of the rainfall (below)

Based on these data established for each county, average productions per counties were proposed for all crops (for wheat, maize and a few counties in table 4).

**Table 4**  
Wheat and maize yields by variants proposed in any (some) representative counties

County	Wheat					Maize				
	V <sub>1</sub>	V <sub>2</sub>	V <sub>3</sub>	V <sub>4</sub>	V <sub>5</sub>	V <sub>1</sub>	V <sub>2</sub>	V <sub>3</sub>	V <sub>4</sub>	V <sub>5</sub>
Alba	2610	2900	3016	3190	3480	2880	3600	3840	4320	4800
Brăila	3060	3400	3536	3740	4080	5520	6900	7360	8280	9200
Constanța	3330	3700	3848	4070	4440	5820	7275	7760	8730	9700
Dolj	3195	3550	3692	3905	4260	4980	6225	6640	7470	8300
Ialomița	3780	4200	4368	4620	5040	6720	8400	8960	10080	11200
Mureș	2835	3150	3276	3465	3780	2460	3075	3280	3690	4100
Teleorman	3780	4200	4370	4620	5040	5500	6975	7440	8370	9300
Tulcea	3015	3350	3484	3685	4020	4500	5625	6000	6750	7500
Total country	3240	3600	3744	3960	4320	4440	5550	5920	6660	7400

Source: (5)

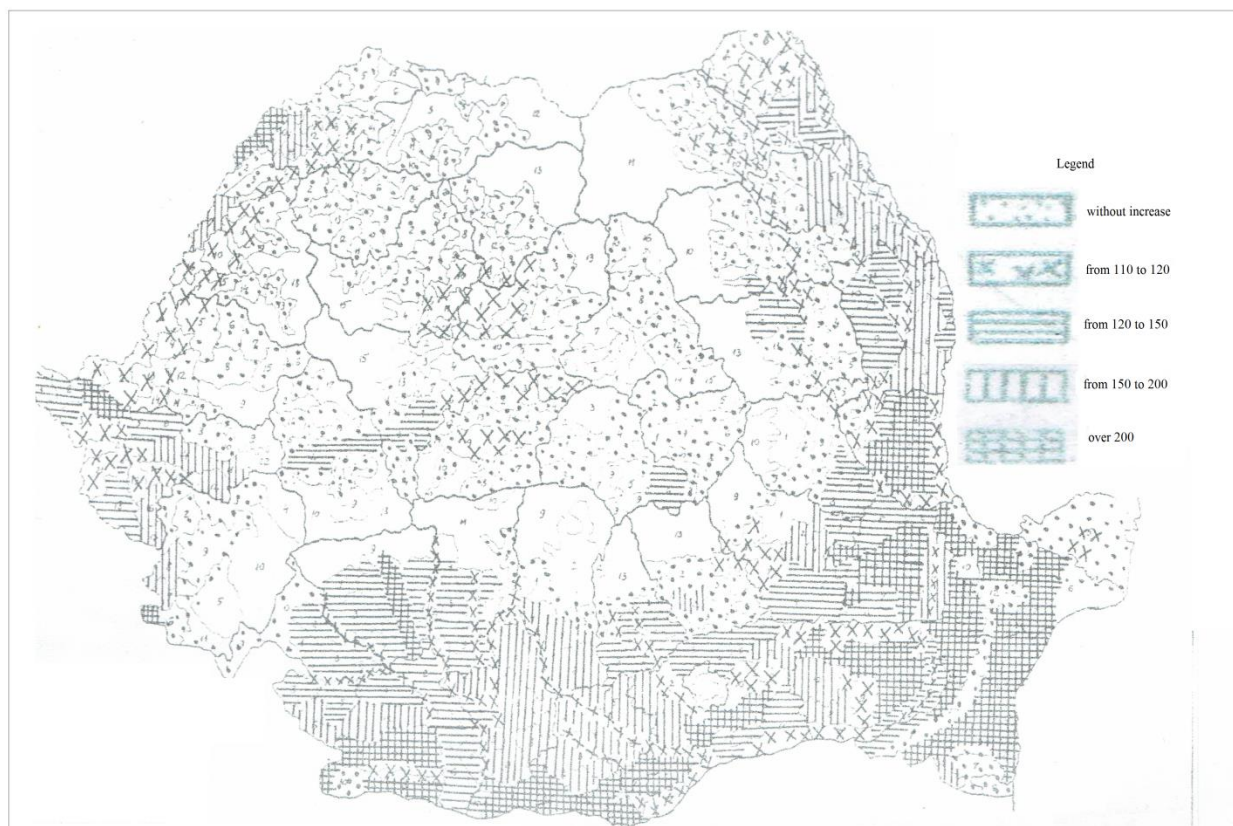
We only mention at country level the five variants of average productions in sunflower and sugar beet crops.

Sunflower (kg / ha): V<sub>1</sub> – 2176; V<sub>2</sub> – 2304; V<sub>3</sub> – 2368; V<sub>4</sub> – 2880; V<sub>5</sub> – 3200.

Sugar beet (kg / ha): V<sub>1</sub> – 40150; V<sub>2</sub> – 47450; – ; V<sub>3</sub> – 52100; V<sub>4</sub> – 58400; V<sub>5</sub> – 65700.

We should mention that the sugar beet was only planned for the cooperative sector and only in 1989 it was cultivated by the state agricultural enterprises.

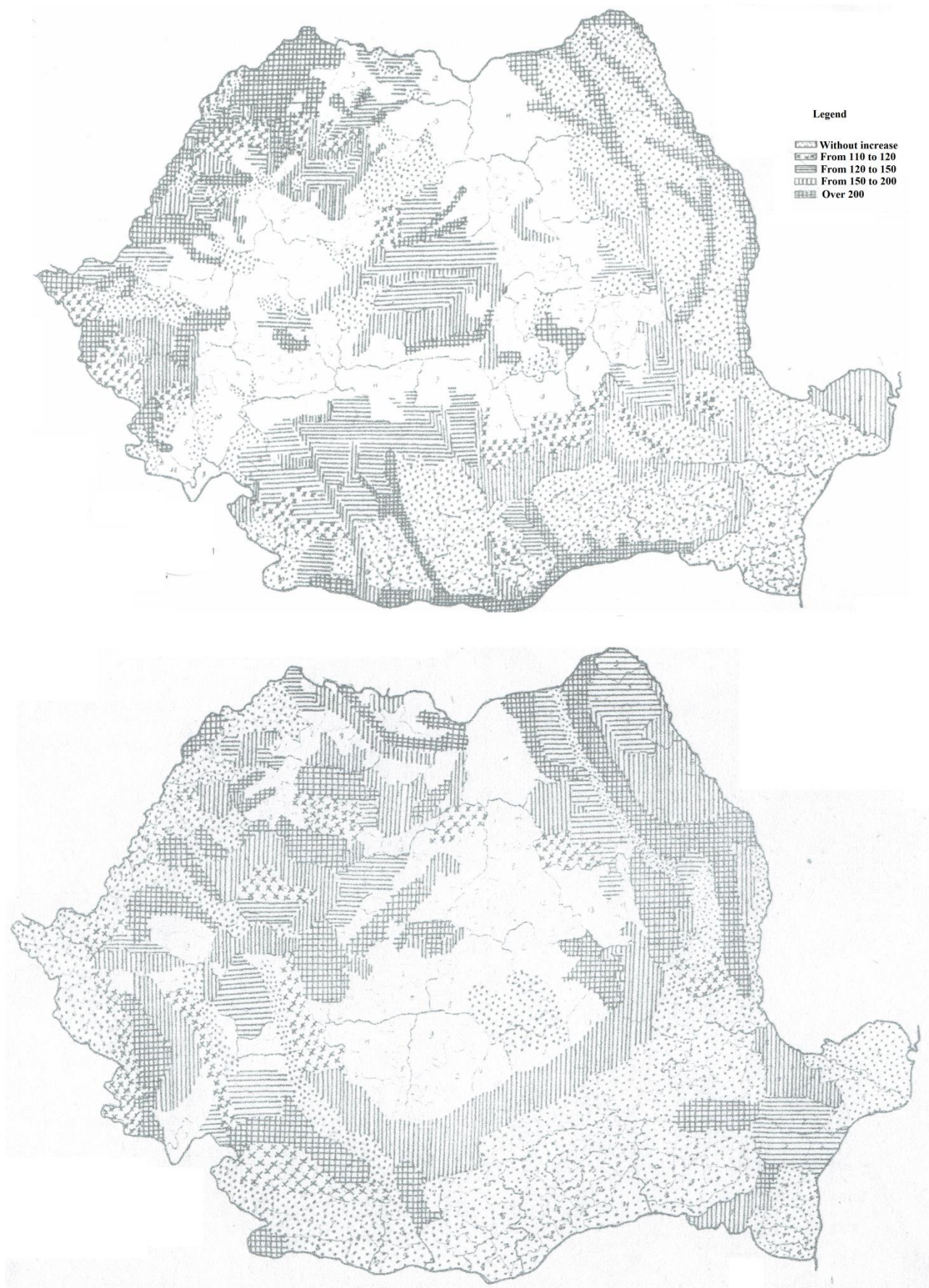
At the same time, according to the data provided by pedologists and geographers, maps were drawn up in which it is mentioned - depending on the area - the possible increase obtained through irrigation, drainage or soil erosion control (figures 2-3).



Source: (5)

**Figure 2.** Territorial effect of irrigation. From without increase to over 200





Source: (5)

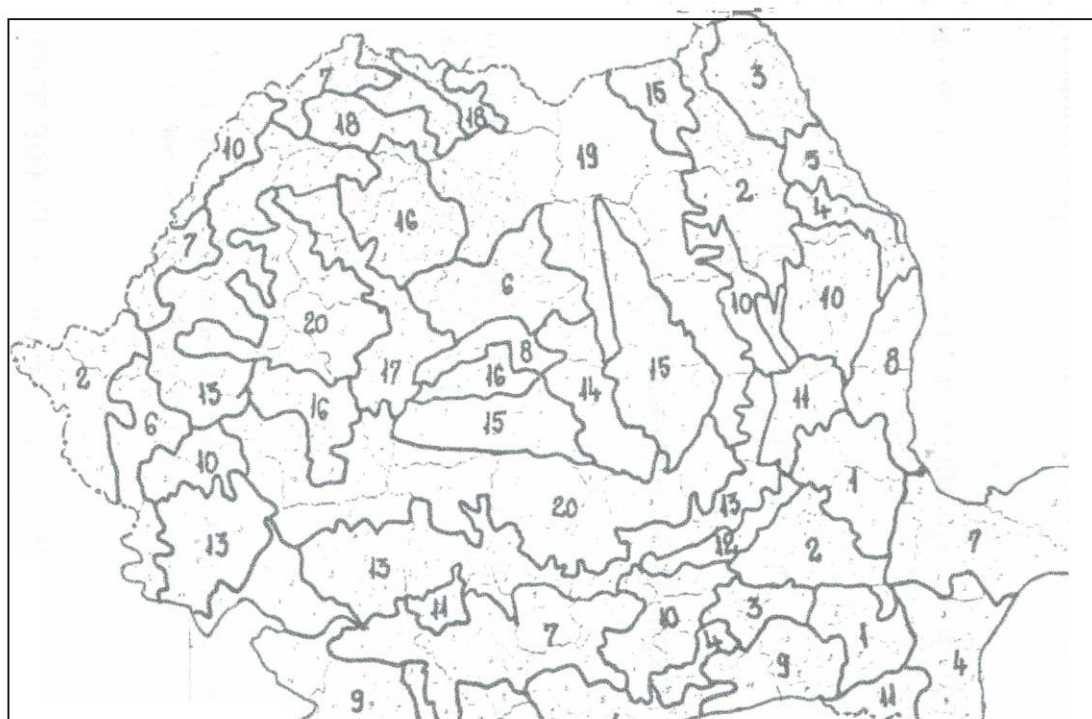
**Figure 3.** Territorial effect of the dewatering (above) and of the fighting erosion from without to over 200

Ever since the time of the zoning paper elaboration, the authors had doubts regarding the achievement of the proposed productions in variants, both at country level and in some counties, for some cultures decreasing average productions being proposed (table 5).

**Table 5**  
County and county yields proposed for some cultures

Cultures	Some		Country	Counties					
				Alba	Brăila	Constanța	Ialomița	Teleorman	Tulcea
Wheat	1980		3310	2700	4190	4160	4240	3510	3370
	1990	V <sub>1</sub>	3540	2770	4460	3850	4690	4360	4000
		V <sub>2</sub>	3710	3000	4450	4400	4500	4500	4200
Maize	1980		4260	3030	6190	6240	6320	4720	4970
	1990	V <sub>1</sub>	5330	3530	6750	6190	7190	6860	5700
		V <sub>2</sub>	5770	3100	6800	6600	7300	7200	6100
Sunflower	1980		2200	-	2500	2520	2580	2260	2150
	1990	V <sub>1</sub>	2460	-	2460	2330	2690	2580	2360
		V <sub>2</sub>	2380	-	2450	2350	2600	2550	2350
Sugarbeet	1980		40000	36000	44900	45000	45000	42000	44800
	1990	V <sub>1</sub>	41430	35250	46800	41200	47420	39700	-
		V <sub>2</sub>	44120	38000	46800	52500	52500	48000	-
Potat	1980		18800	17600	17900	17600	16000	16300	16400
	1990	V <sub>1</sub>	23250	17620	26380	24000	23000	26700	25000
		V <sub>2</sub>	23110	17400	26100	22150	26300	23800	22780

Source: (5)



Source: (5)

**Figure 4.** The map of the complex zones at country level

Finally, a number of 20 complex areas (figure 4) were set up, in which the complex profile (the list of areas) of plant, animal or mixed products is presented in order of importance for the respective area. For example, 14: milk, potatoes, wheat.

Table of complex zones at country level

1. Meat, milk, maize, sugar beet, sunflower	11. Vines, meat
2. Meat, milk, maize, sugar beet	12. Vines, milk, meat
3. Meat, milk, maize, sugar beet, sunflower	13. Trees, meat, wheat
4. Meat, milk, maize, vegetables	14. Milk, potatoes, wheat
5. Meat, maize, sunflower	15. Milk, potatoes, wheat, flax, tow
6. Meat, maize, sugar beet	16. Milk, wheat
7. Meat, maize	17. Wheat, milk
8. Meat, maize, vines	18. Wheat, milk, trees
9. Meat, maize, soy	19. Meat, milk, wool, potatoes
10. Milk, meat	20. Meat, milk, wool

## CONCLUSIONS

The author considers that the work of agricultural production zoning by counties is by far the most important work of the Institute of Agricultural Economics ASAS (the only specialized one at that time).

Being carried out under political command (recorded in the directives of the XI congress of the Romanian Communist Party) and coordinated at the highest political level (deputy prime minister) and scientifically (by the president of the Academy of Agricultural and Forestry Sciences), it collects and processes data of all the agricultural research in the country, it uses the most advanced working methodologies and calculation techniques of that time.

Of the 40 economic-mathematical models, 31 were prepared by researchers of the Institute of Agricultural Economics, and 9 by academics of the Agronomic Institutes and ASE (Academy of Economic Sciences).

It was for the first time that the results of research in the field from all over the country were gathered and processed with the most advanced computing equipment and it seems to be the only time when the research side and the political one, through the representatives of the state at all levels, were in agreement.

The forecasts advanced through the zoning work were realistic and achievable if the fertilizers and tractors exported were at the service of the Romanian agriculture, if land reclamation (about \$ 50 billion) corresponded qualitatively and were properly exploited.

Unfortunately, only 5 years later in October 1981, the same supreme leadership would cancel the zoning results: *Decree of the State Council on territorial self-provision* according to which each administrative unit was obliged to produce its entire assortment of products for self-consumption, in addition to export quotas.

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# COMPARATIVE STUDY ON THE USE OF STATISTICAL METHODS FOR THE DISTRIBUTION OF AUTOCORRELATION TO ANY INFLUENCE FACTOR

CRISTIAN MERCE<sup>1</sup>, MANEA DRĂGHICI<sup>2</sup>, EMILIAN MERCE<sup>3</sup>  
RALUCA-ALEXANDRA NECULA<sup>4</sup>

**Abstract:** *Three methods reported in the literature are subject to comparative analysis in the present paper:*

1. Classic method [1,5];
2. Merce E., Merce C.C. Method[2,3];
3. Merce E., at al Method[4];

*It is shown that in the case of the first two methods mentioned above, the attempts to distribute interactions on influence factors have as a prerequisite the determination of the simple correlation coefficients and of the partial correlation coefficients, the methods being of this particularly laborious nature. With obvious computational facilities, compared to the first two methods, the authors propose the use of a new method based on the principle of proportional distribution of autocorrelation with the coefficients of simple determination, and the following five steps are being performed: 1) Calculation of multiple correlation coefficient and simple correlation coefficients using the Regression function of the Microsoft Excel Data Analysis component; 2) The recording of the multiple correlation coefficient and the simple correlation coefficients in the Excel table used for this purpose; 3) Calculating the coefficients of the simple determination and the multiplication factor; 4) Sum of coefficients of simple determination; 5) Calculating the proportions of simple determinations, considering their sum equal to 100; 6) Determination of the influence of each factor as a product between multiple determinations and the proportion of simple determinations. Note that the last four steps in the Excel work table are generated instantly after the first two steps.*

**Keywords:** *autocorrelation, comparative analysis methods, distribution of autocorrelation on each method, method and program.*

**JEL Classification:** C36

## INTRODUCTION

Collinearity is an objective reality in the investigation of complex causal relationships, which is outlined, as demonstrated in the literature (Merce E., et al, 2004; 2017), whenever information about the causal complex is incomplete. The presence of collinearity alters the accuracy of numerical determinations between factors, on the one hand, and the effect studied, on the other. The phenomenon of collinearity cannot, however, always be avoided. This is primarily about economics, sociology, psychology, but also about complex agro-biological experiments.

It is, therefore, natural to be concerned about assessing collinearity and then correcting the relationship between determining factors and effect. For this purpose, a method for individualizing the influence of each factor has been outlined, based on the calculation of the coefficients of the simple correlation and the partial correlation (Merce E.,1986); Moineagu C.,1974).

Another method of distributing collinearity on the influence factors recommended in the literature is based on the calculation of the influence of factors in a certain causal complex as the average of simple and partial determinations in all possible successions (Merce E., et al; 2017).

In these two working hypotheses, the researcher must evaluate the collinearity numerically and then proceed to correct the relationship between the factors studied and the effect. However, the use of the two mentioned methods is difficult, requiring extremely laborious calculations to determine the coefficients of partial correlation, especially in the case of causal relationships with more than two factors.

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We propose and offer in this sense a new calculation method based on the distribution of the autocorrelation on the factors of influence, using the principle of the proportionality of the determinations with the simple correlation coefficients. To individualize the influence of each factor, a working method has been imagined that harnesses the benefits offered by Microsoft Excel as a workbook. With obvious computing facilities, compared to the first two methods, the authors suggest using this original method, following the next six steps, the first being mandatory, the next four being resolved instantly:

1. Calculation of the multiple correlation coefficient and simple correlation coefficients using the Regression function of the Microsoft Excel Data Analysis component;
2. The recording of the multiple correlation coefficient and the simple correlation coefficients in the Excel table;
3. Calculating the coefficients of the simple determination and the multiple correlation coefficient;
4. The sum of the coefficients of the simple determination;
5. Calculating the proportions of simple determinations, considering their sum equal to 100;
6. Determination of the influence of each factor, as a product of multiple determinations and the proportion of simple determinations.

## MATERIALS AND METHODS

The complexity of causal relationships in different areas of activity, as well as the set of variables investigated, often make it impossible to obtain complete databases. Studies, observations, and concrete processing are grounds that have led us to conclude that the source of collinearity is incomplete information about all possible combinations of variants of influence factors.

And in the case of agricultural experiments there are often encountered situations that comprise only a few of the possible combinations of variants of influence factors. We assume, in this respect, an experience with the evolution of average maize production depending on nitrogen and phosphorus fertilizers doses (Table 1).

Table 1

The evolution of average maize production according to NP quantities (conventional data)

Dose	Kg/ha	Dose	Kg/ha	Dose	Kg/ha	Dose	Kg/ha
N <sub>0</sub> P <sub>0</sub>	5072	N <sub>50</sub> P <sub>80</sub>	6466	N <sub>100</sub> P <sub>120</sub>	8517	N <sub>150</sub> P <sub>160</sub>	8732
N <sub>0</sub> P <sub>40</sub>	5452	N <sub>100</sub> P <sub>40</sub>	6720	N <sub>150</sub> P <sub>80</sub>	8622	N <sub>200</sub> P <sub>120</sub>	8875
N <sub>50</sub> P <sub>40</sub>	6593	N <sub>100</sub> P <sub>80</sub>	8368	N <sub>150</sub> P <sub>120</sub>	8748	N <sub>200</sub> P <sub>160</sub>	8726

## RESULTS AND DISCUSSIONS

The picture of the possible combinations of NP variants and the corresponding average outputs is shown in Table 2.

Table 2

The range of possible combinations of the five variants of each factor

X <sub>2</sub> \ X <sub>1</sub>	0	50	100	150	200
0	5072	?	?	?	?
40	5452	6593	6720	?	?
80	?	6466	8368	8622	?
120	?	?	8517	8748	8875
160	?	?	?	8732	8726

This is a typical example of incomplete information that generates collinearity and all attempts and achievements on how to redistribute it.

Correspondences between the levels of the factors allocated and the average outputs obtained as incomplete data are centralized in Table 3.



Table 3

Correspondence between NP combinations and average outputs on incomplete data base

N	P	Kg/ha
0	0	5072
0	40	5452
50	40	6593
50	80	6466
100	40	6720
100	80	8368
100	120	8517
150	80	8622
150	120	8748
150	160	8732
200	120	8875
200	160	8726

The three mentioned methods are presented comparatively, illustrating the distribution of autocorrelation on the factors of influence.

For all three methods, for the distribution of autocorrelation, it is necessary to determine the correlation coefficients in the hypothesis of a certain theoretical regression model. In order to express the causal relationship between the average production versus two factors it was hypothesized that the link could be expressed by a bifactorial linear model and by mono-factorial models respectively.

Through the processing of the database, the following concrete forms of the models were obtained:

$$\bar{y}(x_1x_2) = 5396.9 + 13.05x_1 + 9.44x_2 ; R_{yx_1x_2} = 0,934 ; D_{yx_1x_2} = 87,2 \%$$

$$\bar{y}(x_1) = 5619.5 + 18.76x_1 ; r_{yx_1} = 0,914;$$

$$\bar{y}(x_2) = 5489.2 + 24.06x_2 ; r_{yx_2} = 0,862;$$

$$\bar{x}_1(x_2) = 7,08 + 1,12x_2 ; r_{x_1x_2} = 0,824;$$

Taking into account the concrete form of calculated regression models, the methodological content of the three methods can be emphasized. It is specified that for the first two methods it is also necessary to calculate the partial correlation coefficients.

#### Method 1 (Moineagu C, 1974):

According to this method, the individualization of the influence of the two factors implies the redistribution of the interaction between them. To this end, it is mandatory to determine the partial correlation coefficients by using specific calculation relationships (Moineagu C, 1974).

$$r_{yx_1 \bullet x_2} = \frac{R_{yx_1x_2} \cdot r_{yx_1}}{\sqrt{r_{yx_1}^2 + r_{yx_2}^2}} = \frac{0,934 \cdot 0,914}{\sqrt{0,914^2 + 0,862^2}} = 0,6795$$

$$d_{yx_1 \bullet x_2} = (0,680)^2 \cdot 100 = 46,2 \%$$

$$r_{yx_2 \bullet x_1} = \frac{R_{yx_1x_2} \cdot r_{yx_2}}{\sqrt{r_{yx_1}^2 + r_{yx_2}^2}} = \frac{0,934 \cdot 0,862}{\sqrt{0,914^2 + 0,862^2}} = 0,641 ;$$

$$d_{yx_2 \bullet x_1} = (0,641)^2 \cdot 100 = 41,0 \%$$

**Method 2 (Merce E. et al., 2009; 2017):**

And this method of distributing collinearity by factors is recommended in the literature [Merce E. At, al., 2009; 2017]. It includes the calculation of the determination of each factor as an average of the averages of all simple and partial determinations in all possible sequences for a particular causal complex. The judgments are graphically illustrated in Figure 1.

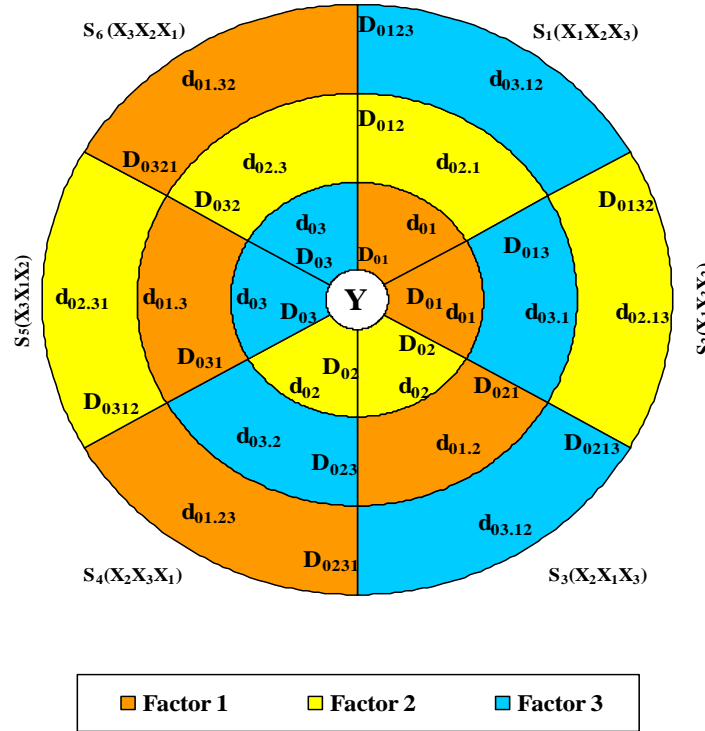


Fig.1 - Determinations in a causal complex of three partially auto-correlated factors

The calculation relations, respectively the calculations made according to the judgments of Method 2, are as follows:

**a. The three-factor case:**

$$r_{01 \bullet 23} = \sqrt{\frac{R_{01}^2 + \frac{+(R_{012}^2 - R_{01}^2) + (R_{013}^2 - R_{03}^2)}{2} + (R_{0123}^2 - R_{023}^2)}{3}}$$

$$r_{02 \bullet 13} = \sqrt{\frac{R_{02}^2 + \frac{+(R_{012}^2 - R_{01}^2) + (R_{023}^2 - R_{03}^2)}{2} + (R_{0123}^2 - R_{013}^2)}{3}}$$

$$r_{03 \bullet 12} = \sqrt{\frac{R_{03}^2 + \frac{+(R_{013}^2 - R_{01}^2) + (R_{023}^2 - R_{02}^2)}{2} + (R_{0123}^2 - R_{012}^2)}{3}}$$

**b. The two-factor case and the related calculations:**

$$r_{y_{x_1} \cdot x_2} = \sqrt{\frac{r_{01}^2 + (R_{012}^2 - r_{02}^2)}{2}} = \sqrt{\frac{(0,914)^2 + [(0,934)^2 - (0,862)^2]}{2}} = 0,694$$

$$d_{y_{x_1} \cdot x_2} = (0,694)^2 \cdot 100 = 48,2 \%$$

$$r_{y_{x_2} \cdot x_1} = \sqrt{\frac{r_{02}^2 + (R_{012}^2 - r_{01}^2)}{2}} = \sqrt{\frac{(0,862)^2 + [(0,934)^2 - (0,914)^2]}{2}} = 0,624$$

$$d_{y_{x_2} \cdot x_1} = (0,624)^2 \cdot 100 = 39,00 \%$$

**Method 3 (Merce E., et al., 2018)**

Each method is based on a certain hypothesis, the differences in the operability of the calculations may be substantial. The method that we present has as a hypothesis the distribution of the autocorrelation on factors according to the principle of proportionality with the coefficients of the simple determination. The method is characterized by a high degree of promptness, with substantial facilities in integrating calculations.

The distribution of autocorrelation on the factors of influence implies the preliminary determination of the simple correlation coefficients and of the multiple correlation coefficient in the hypothesis of a certain theoretical regression model. Considering the database presented in Table 1, a linear bifactorial model was used to express the causal relationship between the two factors and the average production.

All calculations were performed using the Regression function of the Microsoft Excel Data Analysis component.

And this method assumes the determination of the bi-factorial model and of the mono-factorial models, respectively the coefficient of multiple correlation and of the simple correlation coefficients, the results being emphasized in the preamble of the three methods.

The introduction of the multiple correlation coefficient and the simple correlation coefficients in the centralized Excel table, which synthesizes the calculation steps of the pure determinative factor, automatically leads to the individualization of the influence of each factor (Table 4).

Table 4

Case of a linear multifactor model **)					
Correlation and determination		Correlation coefficients	Determination Coefficients (%)	Percentage to one hundred (%)	Total and Factor Determination (%)
Sum of simple determinations		*	157.84	100.00	*
Simple correlation	Factor 1	0.914	83.54	52.93	46.17
	Factor 2	0.862	74.30	47.07	41.07
	Factor 3	0.000	0.00	0.00	0.00
	Factor 4	0.000	0.00	0.00	0.00
	Factor 5	0.000	0.00	0.00	0.00
Multiple correlation		0.934	87.24	*	87.24

\*\*) The results presented in Table 2 as well as possible additional simulations can be checked by activating the table designed in Method 3 based on Microsoft Excel.

By comparison, the total determination and determinations of the two factors for the three methods are illustrated in Table 5.

Table 5

Comparative situation of total and factor determinations (%)

Factor	Method 1	Method 2	Method 3
X <sub>1</sub>	46,2	48,2	46,2
X <sub>2</sub>	41,0	39,0	41,0
X <sub>1</sub> , X <sub>2</sub>	87,2	87,2	87,2

For all three methods, the assignment of the total factor determination is complete. Moreover, factor determinations are identical for Methods 1 and 3. Method 3, however, has the great advantage of promptness and convenience of calculations. These features may be preferable to the processing of statistical data by specialists for attributing self-correlation to influence factors in incomplete databases

## CONCLUSIONS

Colinarity is not a fiction. This is manifested in the context of the concrete realities caused by the impossibility of incorporating in experiments all the combinations of the many variants of the influence factors on the effect they are in a causal relationship. In such situations, the only way to individualise the pure influence of the factors is to distribute the collinearity according to working hypotheses with reasonable scientific support.

Concerns about the distribution of collinearity over factors of influence are numerous and have a substantial historical background (Moineagu C, 1974, Merce E. et al., 2009, 2017).

They are based on working hypotheses with appropriate scientific support, but the workload is impressive, making them even inapplicable in case of complex causal relationships with 3; 4; 5 or more factors of influence. The third method (Merce E., et al., 2018) is remarkable in terms of operability even in the case of particularly complex causal relationships, with only two steps to be taken. The first step is to run data using the Regression function of the Microsoft Excel Data Analysis component, assuming a specific regression model is used. The second step, recording the results obtained, in the first step, in the second column of the Excel table elaborated by the authors.

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# NITROGEN FERTILIZERS AND BIOECONOMIC AGRICULTURE – EXAMPLE ON WHEAT

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**Abstract:** All the scenarios and models made up by the most titled scientists in biology, agriculture, geophysics, and human health prove that the four main resources of the existence of the biosphere are so polluted that it is a matter of time until a major collapse of human existence occurs. The problem is not that it will occur, but when it will occur, in what form and how great the losses will be. Among the many factors to be applied in agriculture in order to get food, the nitrogen fertilizers play an important part. Nitrogen fertilizer application has increased crop production by about 3-4 times, but at the same time it has reduced the content of heteropoly condensate humus by 3-4 times, especially in the countries of the Eastern Europe. Both European and world specialists have found that there is a large difference in the environmental (qualitative) behaviour between the two major fertilizers applied - ammonium nitrate and urea. The research carried out by us in the experimental field of Poroschia (Teleorman County) between 2014 and 2016 showed a significant difference in the organic and productive-qualitative behaviour in favour of the ammonium nitrate. In wheat crops, the ammonium nitrate is superior to urea, at the same applied dose, averaging 3.5-8.0 q/ha and with a protein content of 0.3-1.5%. The degree of absorption of ammonium nitrate is about 15-20% higher than that of urea. The volatilization degree of the two products is different, with a difference of 15-20% in favour of urea, which at the same time pollutes the air by about 15 t CO<sub>2</sub>/ha and which leads to the warming of the atmosphere. Starting from here, we consider that ammonium nitrate, although not circumscribed to bioeconomic agriculture, is much closer to it than urea.

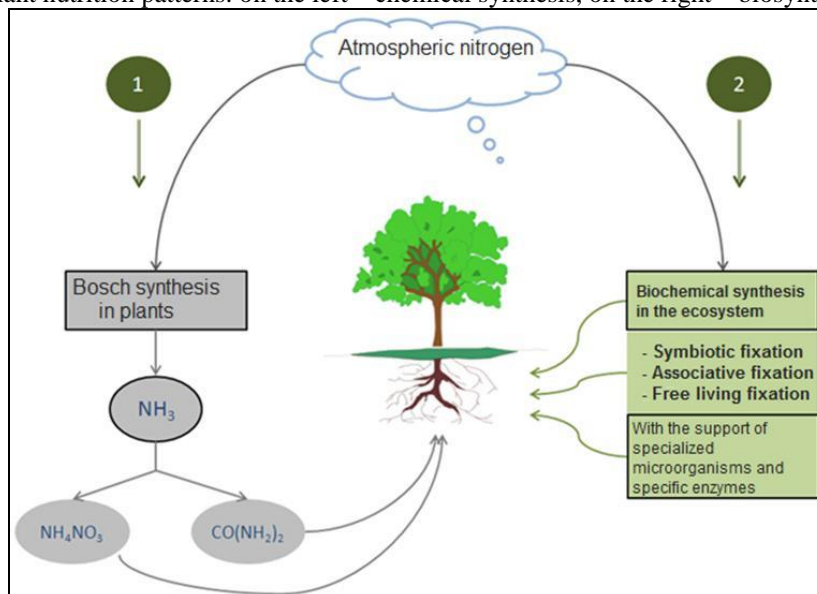
**Keywords:** nitrogen fertilizers, wheat, bioeconomic models, bioeconomic agriculture

**Classification JEL:** Q10, Q16, Q57

## INTRODUCTION

The nitrogen nutrition of plants uses as source the atmospheric nitrogen, which can reach the plants according to Fig. 1.

**Fig. 1.** Nitrogen plant nutrition patterns: on the left – chemical synthesis, on the right – biosynthesis (original)



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The difference between the two models of nutrition lies in the fact that the first one is extremely polluting and very expensive (Lacroix, 1995). However, it has the advantage of rapid results, frequently required by plant nutrition. The major environmental disadvantage of using Model 1 is the rapid destruction of humus, the acceleration of global warming and the destruction of the planet's bioeconomic potential (Raggam, 2009). With all the benefits of using the synthetic fertilizers, they are nowadays regarded as a less necessary evil (Berca et al., 2015). There are two major reasons behind the difficulties of implementing the bioeconomic Model 2:

- 1) The resilience of the world's political factors, which support by all means the economy that is based on hydrocarbons;
- 2) The insignificant profits brought by it, transforms this excellent bioeconomic model that derives from nature, into one which is scarcely used in food production.

Under these circumstances, some questions come up: "How do we approach the bioeconomic model of agriculture by using the nitrogen fertilizers manufactured through industrial synthesis?", "How much closer are we and is it worth the effort?"

The studies conducted by Lammel and Brentrup (2003), by ADA (2015, 2016) and by YARA GmbH & Co. KG (2011) have highlighted that the forms of nitrogen of the ammonium nitrate and urea have different behaviors in agricultural crops. At the same dose of nitrogen, the ammonium nitrate proved to be superior to urea, both in terms of production levels and environmental relations. Research has been carried out in universities and departments in Germany, France, England and other countries (Lesouder, 2014).

In the modern intensive agriculture, the amount of fertilizer to be applied is 150 to 200 kg N for a yield of 7-9 t wheat/ha. According to DEFRA (2003-2005) and EMEP (2007) data, with their use, the air pollutant nitrogen losses averaged 3% for ammonium nitrate, 14% for nitrogen solutions and 22% for urea (applied on agricultural land).

Once in the air by volatilization, the nitrogen is transformed into NO<sub>x</sub> (nitrogen oxides), which pollute the atmosphere 296 times more than CO<sub>2</sub>, with all the resulting consequences for the global warming phenomenon. At global level, the agricultural nitrogen pollution of the atmosphere reaches 20-25% (Berca, 2011).

## MATERIALS AND METHODS

The research was conducted in the field and in the laboratory and had the following goals:

- 1) Comparison of the various forms of nitrogen (NH<sub>4</sub>NO<sub>3</sub> and CO (NH<sub>2</sub>), as well as nitrogen (ammonium and urea) solutions on wheat yields and their quality (protein content) to two premium wheat varieties – Arnold and Adesso.
- 2) Comparison of the ecological and bio-economic effects, as well as the choice of the fertilizer that offers the best results of production, quality and ecological parameters. It is the one that comes closest to the desired goal in bio-organic farming.

The research was carried out on 3.7% humus soil, located on the Burns Platform in the 2014-2015 and 2015-2016 agricultural years. Climatic, the years have been thermally moderated, alternating the periods of drought with rain in the summer, due to the drought (in the soil).

Plots of 5000 m<sup>2</sup> were built for each treatment. The observations and determinations were made using various methods.

The method of measuring volatility, urea loss is proposed by Marshall and DeBell (1980) and perfected by San C.K. (1986). The determination with 20 cm diameter PVC tubes, which were filled with surfaces of absorbent material to retain the volatile N, which in turn was measured (Cancellier et al., 2016), it was carried out in the open field, on a circular surface, using a semi-open absorbent. N<sub>2</sub>H<sub>4</sub> is captured and then evaluated in ammonia, thus calculating the loss.

The absorption recovery of the potentially lost nitrogen was achieved at 95-97% (San, C.K., 1986). The results are presented as a percentage of the total amount of applied urea, expressed in kg/ha SC nitrogen. The process started from dry urea, with the parameters from the table below (Table 1).

**Table 1.** Some characteristics as seen comparatively between ammonium nitrate and urea

<b>Product Parameters</b>	<b>Urea</b>	<b>Ammonium nitrate</b>	<b>Specifications</b>	<b>Evaluation</b>
Density (kg/m <sup>3</sup> )	770 kg/m <sup>3</sup>	900 kg/m <sup>3</sup>	The granules are heavy; as a result, the dispersion distance is also great.	Nitrogen benefit
Average grain diameter (mm)	2.9 mm	3.5 mm	The diameter of the granules is high + increasing the spreading distance	Nitrogen benefit
Hardness / roughness (do N)	2.5 do N	>4 do N	Hardness is great - the fertilizer does not produce dust.	Nitrogen benefit
Regularity of physical characteristics	--	++	Regular presentation - application is adjusted with precision.	Nitrogen benefit
Nitrogen content	46.63	33.50	Larger amount of nitrogen, lower transport costs	Urea benefit

Urea has a 15% lower density than ammonium nitrate and a 17% smaller size range of granules than the ones of ammonium nitrate. Hence, the different volatilization in the mentioned soil conditions, which were detailed in Berca (2017) works. In order not to interfere with the nitrogen fixation association consisting of *Azospirillum brasilense* and wheat, the two forms of the nitrogen fertilizers were applied in the spring, after having reached 6.5°C in the soil. Moreover, irrespective of the nitrogen doses used, the fertilizers were applied only once.

The doses used, in kg / ha for the three types of nutrients: nitrogen, urea (32% N, LU\* type) and the nitrate solution, were as follows: 0, 40, 80, 120, 160 and 200 kg / ha. Thus, nutrition of nitrogen for about 8000 kg of wheat per hectare was provided, including the 14% protein.

Two premium wheat varieties (Adesso and Arnold) were used. Based on the material synthesis needs, only the average of the varieties and the average of the years have been used. In order to compare the volatilization at higher temperatures, these doses were also applied to black soil in the summer. Moreover, the harvesting was carried out on random plots, a total of five, of 10 m<sup>2</sup> each, with a special harvester for small plots.

The calculations and the presentation of the results were carried out by the dispersion analysis (of variance). The calculation of correlations in 2D and 3D systems was also used. It was aimed at observing:

- the level of wheat yields in relation to the doses applied;
- the level of protein content;
- the total amount of nitrogen lost through volatilization, for the three forms of fertilizer;
- the ecological and economic effects generated by the volatilization loss of nitrogen in the form of NH<sub>3</sub>.

## RESULTS AND DISCUSSIONS

In Fig. 2 it has been proposed to demonstrate to what extent the three forms of nitrogen used in doses from 40 to 200 kg/ha influence the overall production and especially at each dose.

Under the circumstances of the Alexandria chernozem and the climatic conditions of the agricultural years of 2014-2015 and 2015-2016, on average for the two studied varieties, it is demonstrated that:

- a) The maximum yield is achieved at 160 kg N/ha;

\* LU-type nitrogenous solutions are in the form of colourless to yellow liquid and contain 32% N: 7.75% NH<sub>4</sub><sup>+</sup>, 7.75% NO<sub>3</sub> and the remaining urea, all in aqueous solution.

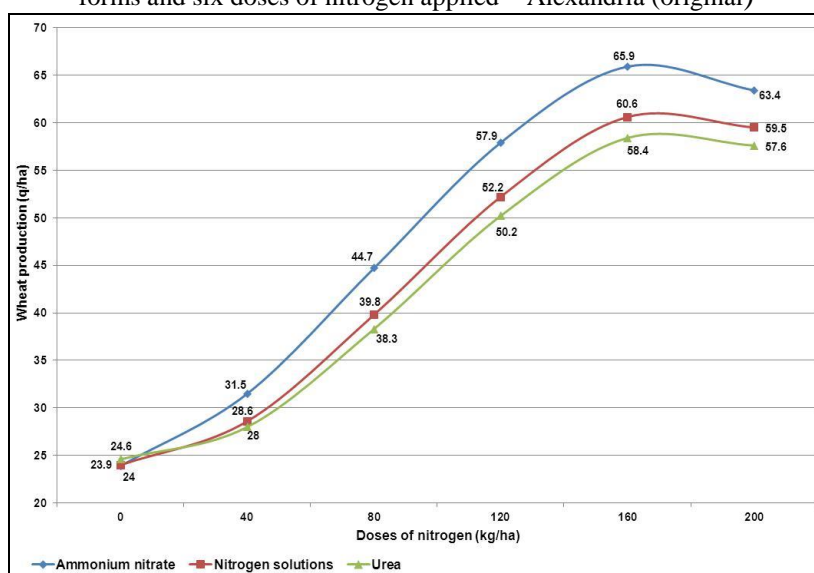
- b) There is a significant production difference of more than 6 q/ha between the ammonium nitrate and the nitrogenous solutions and of 7.5 q/ha between the ammonium nitrate and the urea at the maximum yield dose of 160 kg N/ha.

Our research confirms the results obtained in Germany, France and England, with the specification that at approximately equal doses of nitrogen (153-182 kg/ha), in our studies the difference in favour of the ammonium nitrate is double to the above-mentioned experiences, by comparison with both urea and solutions of ammonium nitrate and urea. Production increases obtained at doses of 160 kg N / ha are:

- 42.3 q/ha in the case of ammonium nitrate,
- 36.7 q/ha in the case of nitrogen solutions,
- 34.4 q/ha in the case of urea,
- 26.4 kg/1 kg N in the case of ammonium nitrate,
- 22.9 kg/1 kg N in the case of nitrogen solutions,
- 21.5 kg/1 kg N in the case of urea.

This proves that each kg of nitrogen additionally obtains 4.9 kg of grains in the case of the application of ammonium nitrate as compared to urea. The calculations show that in order to obtain the same wheat yields, the amount of urea should be increased by  $14 \times 1.4 = 20$  kg/ha. According to other authors, this figure would be of 40 kg/ha (DEFRA).

**Fig. 2.** Production of wheat (the average for two varieties) in the period 2014-2016 (average) according to the three forms and six doses of nitrogen applied – Alexandria (original)

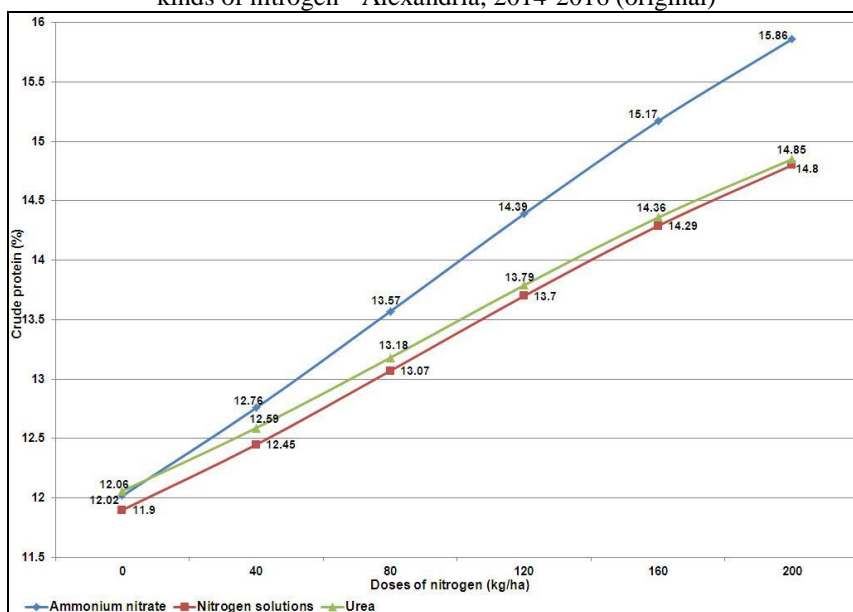


It is difficult to recommend the exclusive application of ammonium nitrate fertilizers on a global or European scale, as long as 80% of global nitrogen fertilizers are produced in the form of urea. In this case, the recommendations of the Brazilian researchers (Cancellier et al., 2016) would be the introduction of an anti-volatilization stabilizer into urea to reduce the losses below or at the level of the ammonium nitrate.

The quality of production, represented by the crude protein content, is shown in Fig. 3. The protein content, on average for the two wheat varieties, is continuously increasing from unbound to 200 kg N/ha (0 → 200). Both the slope and the growth angle are higher in the case of the ammonium nitrate. The three-dimensional model presented in the equation stated in the figure shows a very significant difference in protein content in favour of ammoniacal nitrogen, starting at a dose of 80 kg N/ha. From this dose, the differences are between 0.41-1% over the 80-200 kg N/ha range. At high dose, this means an extra of about 43 kg protein/ha, which is not supplied by the quantity of the fertilizer, but only by the fertilizer range (ammonium nitrate). On 1000 hectares of wheat, we will additionally have 4.3 t of protein, which is a very significant result.



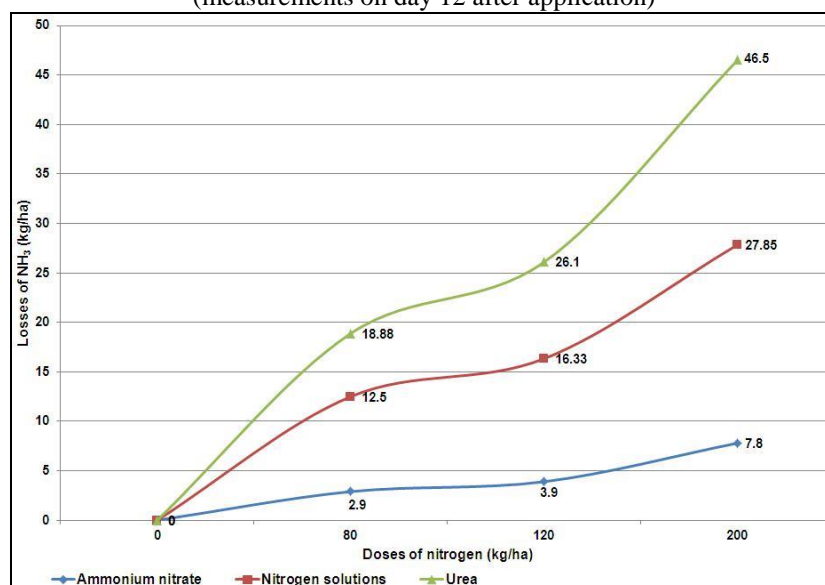
**Fig. 3.** Crude protein content for autumn wheat (an average for two varieties), dose-dependent and the three kinds of nitrogen - Alexandria, 2014-2016 (original)



The other two forms of nitrogen have a similar behaviour, their differences in protein content being permanently positive in favour of the nitrogen solutions when compared to urea, but statistically uninsured at the same time. Our data are confirmed by numerous researches made in the period 1999-2002 in the German Land of Rhineland-Palatinate (ADA, 2015), as well as in England (DEFRA) or France (YARA, 2011).

Why is this happening? Nitrogen volatilization is a cause. Perhaps the volatilization of nitrogen, especially in the case of urea, may be a cause, but not the only one (Fig. 4). Our measurements, performed according to the methodology, show that in the case of ammonium nitrate the maximum loss recorded was of 7.3 kg/ha at the maximum dose (200 kg N/ha), the model shows that for urea the maximum loss of  $\text{NH}_3$  at the same dose was 45.8 kg / ha.

**Fig. 4.** Nitrogen losses ( $\text{NH}_3$ ) in wheat crops under fertilization with three fertilizer forms - Alexandria, 2014-2016 (measurements on day 12 after application)

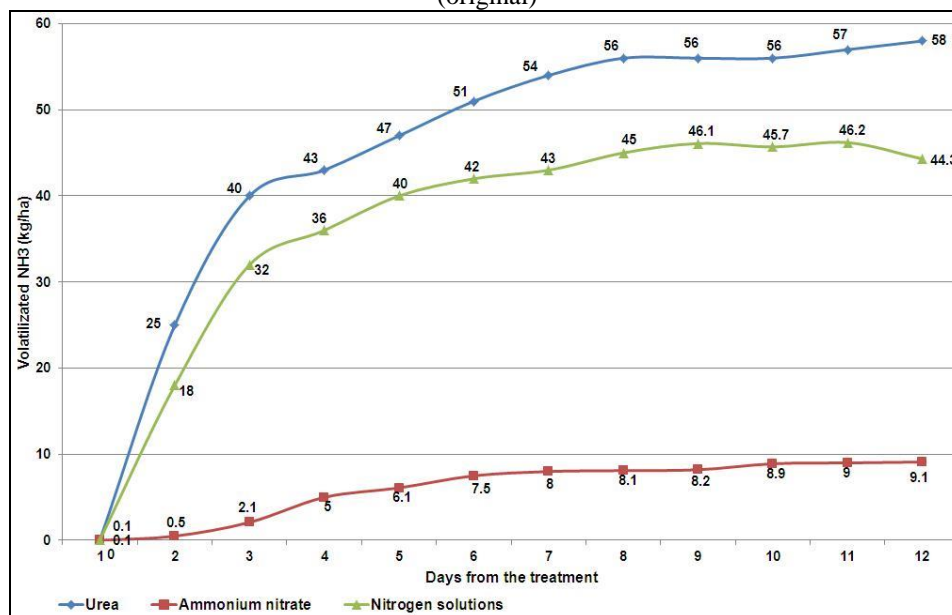


For all the nitrogen species applied, the increase in the loss was positively correlated with the applied dose due to the exposure of a larger quantity of fertilizer, the products being applied at the beginning of the vegetation period in the spring at 6-8° C in the soil on vegetation.

The nitrogen loss in the case of urea was 2.5 times higher at the 200 kg/ha dose compared to the one at 80 kg/ha. Similar reports are found in other assortments, but at much lower levels of losses.

The product volatilization model, shown in Fig. 5 demonstrates that the largest amount of nitrogen (NH<sub>3</sub>) was gone within the first 5 days of application, namely 71% in the case of urea, 86% in the case of the nitrate solution, and 6-7% for ammonium nitrate.

**Fig. 5.** Nitrogen volatilization model, expressed in NH<sub>3</sub> kg/ha, for three fertilizer forms - Alexandria, 2014-2016 (original)



In the first 12 days of application, the volatilization was practically carried out, the rest of the nitrogen entering the nutritional circuit of wheat plants.

*What happens to the volatilized nitrogen in the environment?* If the ammonium nitrate does not raise very high pollution problems through volatilization, the urea, on the contrary, at a volatile loss of about 23% (see Figure 4) can lead to a loss of only 100 kg N/ha at a loss of 23 kg N/ha and at about 500,000 ha treated with urea in Romania with wheat only, it results that 11,500 t of nitrogen are released into the atmosphere.

Only wheat crop has a loss in value:

- 1) at 1 ha = 23 kg N x 2.17\* x 1.52 lei/kg = 76 lei/ha = 17 €/ha;
- 2) Total for Romania = 500,000 ha x 76 lei/ha = 38,000,000 lei = 8.4 mil. €.

In a 1000 ha wheat farm where 160 kg N/ha is applied, the volatilization loss is:

$$1000 \text{ ha} \times 76 \text{ lei/ha} \times 1.6 = 121,600 \text{ lei} = 27.326 \text{ €}$$

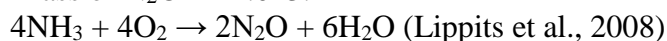
The loss for the farmer is equivalent to 27,326/0.15 €/kg = 182 t = 182 kg/ha. It is a significant loss, which nobody wants but which is present anyway.

According to the graph in Figure 2, the loss of production may be much higher, reaching 800 kg/ha at 180 kg N/ha, i.e. 800 x 0.15 = 120 €/ha, losses that could get us out of the economic area of wheat crops.

*But what happens to urea lost in the air?* We have already shown that the loss occurs as ammonia (NH<sub>3</sub>). This, in the presence of the air and water in the atmosphere, turns into oxides of nitrogen. The nitrous oxide (N<sub>2</sub>O) dominates:

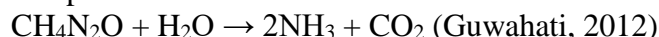
→ molar mass of ammonia = 17.03;

→ the molar mass of N<sub>2</sub>O = 44.013.



\* 2.17 = transformation coefficient from N to urea

Regardless of the chemical process, whether it is industrial or natural, the 4 molecules of ammonia result in 2 N<sub>2</sub>O nitrous oxide molecules. Taking into account the molecular weight, the conversion ratio is NH<sub>3</sub> → N<sub>2</sub>O = 1.29. On the other hand, at the time of volatilization, urea is converted to ammonia in the presence of water and measured as such:



This reaction takes place in the presence of the enzyme called urease, found in the upper layer of the soil. The fact that CO<sub>2</sub> results from conversion increases the degree of GHG pollution of the atmosphere.

One kg of ammonia (NH<sub>3</sub>) will result in about 52 kg of N<sub>2</sub>O, which equates to 52 x 296 = 15,392 kg of CO<sub>2</sub> in the atmosphere, and it is considered as GHG for each hectare where 180 kg of urea was applied as fertilizer without stabilizer. Nitrous oxide (N<sub>2</sub>O) has a capacity of warming the atmosphere which is 296 times higher than the CO<sub>2</sub> (carbon dioxide).

In this way, it can be partly demonstrated why agriculture participates in GHGs with over 25%. The agriculture accounts for 94% of total ammonia losses, of which 20% come from the mineral fertilizers (Berca, 2017).

## CONCLUSIONS

- 1) The studies conducted on the Burnas Plateau in the Alexandria area (Teleorman County) regarding the behaviour of the nitrogenous fertilizer varieties in the spring showed the following:
  - a) The average harvests for the two premium wheat varieties (Adesso and Arnold) led to a maximum yield of 160 kg N/ha, 66 g/ha for ammonium nitrate and 58.4 g/ha for urea. A significant advantage for ammonium nitrate (+ 11%).
  - b) The production quality, expressed as crude protein content, correlated positively with the application of nitrogen doses, reaching maximum at the highest dose (200 kg N/ha). The highest protein content (15.86%) is obtained with ammonium nitrate and the lowest with urea (14.8%). An advantage in favour of ammonium nitrate - 6.8% relative, which is a significant difference as well.
- 2) The lower wheat production and quality parameters in case of application of urea are due to the volatilization and the high nitrogen loss (NH<sub>3</sub>) in this fertilizer. Volatility values of 46.8 kg N/ha are recorded at the application of 200 kg N/ha in the spring and 66 kg N/ha in summer applications. The climatic conditions in the summer were favourable for the volatilization (the drought after the application). The loss ratio was 1/6 for the spring applications and 1/6.2 for the summer applications. The nitrogen solutions have provided intermediate parameters, whilst those from the summer applications were approaching urea.
- 3) The economic losses from urea volatilization amount to 76 lei or 17 €/ha for every 200 kg N in all spring applications. Taking into account the two advantages, the economic losses for ammonium nitrate are at least 7 times lower.
- 4) According to our calculations, approximately 40 kg of ammonia resulting from the volatile loss of urea lead to the production of 15,392 kg/ha of wheat equivalent to GHG, adding very large amounts of GHGs into the atmosphere. Only the nitrogen fertilizers contribute by 20% to the ammonia pollution of the atmosphere.

The proposed solutions consist mainly of the use of ammonium nitrate in 2-3 rounds in order to avoid losses at maximum. Moreover, avoiding the use of non-stabilised urea against volatilization is a process harmful to the environment and the shift of the agriculture to the bioeconomic area.

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# EFFECT OF DEFERENT LEVELS OF FERTILIZER 9DAP) IN CONTENT OF PLANT LEAVES FROM PHENOL COMPOUNDS AND (NPK)

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**Abstract:** Carried out the experiment in the Republic of Iraq in the capital Baghdad and in the Dora district to study the effect of different levels of fertilizer (DAP) in content of plant leaves (*Calotropis procera*) in terms of phenolic compounds, as well as content (N, P, K), in pots where the soil used sandy silt collected from the shoulder of the Tigris River where contained soil 750g/ kg sand, 200 g/kg Clays, 50 g/ kg clay, average virtual soil density 1.1 Mega grams/ m<sup>3</sup>, the average electrical conductivity (Ec) 1.8 ds/m, the degree of interaction (pH) 7.2, the concentration of nitrogen-ready 20 mg/kg, soil and phosphorus ready mg /kg 15 and 145 ready-potassium mg /kg soil. the experiment included add four levels (100 . 200 . 300 . 400 ) kg / h of DAP fertilizer (18:46 N: P) to the publican seedlings which are Elected age of one year and using fully randomized design (CRD) and in three replications. in dated 10/15/2014. After the sample was taken leaves of the plant to assess the content of phenolic compounds (Gallic acid, Vanillic acid, Epicatechin, P-coumaric, Ferulic acid, Queretin-3-β-D- glucoside, Rutin) as well as total chlorophyll and (N, P, K). Results of statistical analysis showed the least significant difference (LSD) at a level of 5% higher than the level of fertilization 400 kg DAP /h on the rest of the levels followed by a level 300 and level 200. Where the increase in the rates of securities content of phenolic compounds, especially Epicatechin (48.72, 87.20, 137.18%) compared to the first level of 100 kg DAP / h sequentially with significant differences. The percentage increase in the stock of the content of p- coumaric (43.82, 85.39 and 92.13) % to the level of the second, third and fourth sequentially compared to the first level. As for (Ferulic acid, Queretin - 3β-D-glycoside, Rutin and Chlorophyll) in fourth level of 400 kg DAP /h has achieved the highest concentration content where the percentage increase (1050, 86, 164.81 and 40.47) % sequentially compared to the first level 100 kg DAP /h. Nitrogen, Phosphorus and Potassium, where the focus accounted for an increase of (80.99 and 155.00 and 65.38%) compared to the first level and sequentially. The results show that the plant () showed a steady and flexible response to the levels of fertilizer DAP, Increase the speed of absorption of key nutrients (N and P), to increase the readiness of those elements in the soil solution, increasing the shoot and root. Increase the efficiency of absorption of the major key elements (K, P, N) content and increase the stock of vehicles and phenolic acids and thus increase in the proportion of plant chlorophyll content.

**Keywords:** *Calotropis procera*, phenolic compounds, dap fertilizer (N, P, K).

**JEL Classification:** Q3

## INTRODUCTION

(*Calotropis procera*) has been given several names. It is called pubic plant which is species of flowering plant. It is from the family Apocynaceae, a desert plant that spreads in North Africa, Tropical Africa, Western Asia, South Asia, and Indochina. It can be described as an evergreen tree with a height of 2-5 meters, having large branches and large leaves whose shape is oval between 5.7 cm - 15 cm. Its width is between 4.5 - 8.2 cm, with a sharp tip, and a light green color. The flowers are regular and have violet color. They are collected in coronal or inflorescence. The date of flowering is in May, June and July. The fruit is spherical or semi-elliptical, a large spongy apple color and shape. It is full of seeds bearing at its peak silky filaments known as fluff and all its tissues contain a liquid toxic substance with milky color, which is tart and extremely bitter.

The plant (*calotropis procera*) has a deep dense roots and it grows in areas of severe drought. Is a medicinal plant called *calotropis procera* of the family *Asclepiadaceae* (Parrotta, 2001). It is proposed to be on the list of plants that can be used to produce biofuels for its ability to produce an annual vegetable crop of 90 ton /ha (Al-Zahrani, 2002 and Boutraa, 2010 and Ibrahim, 2013). It is a plant that resists water and saline stresses. It is one of the promising plants that combats pollution due to its root system to absorb heavy elements such as Cd and Se without physiological damage (Al-Qahtani, 2012 and Al-Yemni et al., 2011). It is also an important source of pharmaceutical drug production (Silva et al., 2010). Its leaves can be a source of flavonoids and phenols such as, flavonoid quercetin, flavonoid glycosides, phenolic or polyphenol (Khasawneh et

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al. 2011, Murti et al., 2013). Phytochemicals are of great importance as they are natural sources of antioxidants. They are important for human health, food flavor and cosmetics, and are the most environmentally friendly and safest in consumption compared to their manufactured counterparts (Shrikumar & Ravi, 2007). The contribution of known plants to human health is mostly due to their phenolic compounds, mainly flavonoids and phenolic acids that act as antioxidants against ROS (Reactive Oxygen Species). ROS is a harmful oxidant of biomolecules such as, lipids, nucleic acids, proteins and carbohydrates. Fu and his colleagues (2011) found that there is a linear relationship between the amount of antioxidants and plant content of phenolic compounds in 50 medicinal plants. Multiple phenols have a role in reducing oxidation stress in plants and improving their resistance to diseases, especially viral ones. Oxidation and stress cause many diseases including rheumatism, cirrhosis, arteriosclerosis, diabetes and cancer (Ebadi, 2006).

Phenolic compounds are secondary plant products that are useful and important compared to other plant groups. They have a role in the production of various effective medical drugs (Pandey, 2013). (Harborne, 1989) has demonstrated that Phenolic or Polyphenol can be chemically defined as an aromatic substance known as Polyphenol (Hydroxyl Substituentases) including functional derivatives (esters, methyl and glycosides and others) (Harborne, 1989 or based on the number of phenolic rings and the structure of these rings).

Ammonium Diphosphate fertilizer (DAP) is an effective source of nitrogen, phosphorus and ammonium (IPNI, 2014). N and P are essential nutrients needed by the plant in large quantities for their important roles in building proteins, nucleic acids and energy (Mengel & Krikby, 1982). The quantities needed for each nutrient crop vary depending on the type of soil, the milieu in which the plant grows, the type of plant, its production capacity, as well as the surrounding environmental conditions. Ammonium Diphosphate fertilizer (DAP) (18 - 46 - 0) is one of the group of ammonium phosphate salts produced by the interaction of ammonia and phosphoric acid. It is used as a chemical fertilizer for plants, a source of nitrogen and phosphorus. It temporarily raises soil alkalinity, but after a period of time the treatment becomes more acidic due to Ammonium decomposition. Nitrogen is the main compound in the important substances that contribute in the structure of the plant as it forms 40-50% of the dry matter of the protoplasm. Therefore, *Calotropis procera* needs high amounts of nitrogen to complete the various growth processes. Some nitrogen substances move a lot inside the plant and this makes it able to reach to the developing peaks of the plant. That is, they move from the old tissues to the modern tissues, so the symptoms of the lack of nitrogen appear on the lower parts (old ones) while the upper parts (modern) are less affected. The symptoms of burning papers can be distinguished because of the lack of nitrogen element from the symptoms of leaf burning due to drought, which affected the parts of the plant, the upper and lower ones at one time.

Based on this, the study aims at achieving the following objectives:

- 1- Studying the effect of different levels of dap in the content of some phenolic compounds (Gallic acid, Epicatechin, Vanillic acid, p- coumaric, Ferulic acid, Quercetin-3- $\beta$ - glucoside and Rutin) in the leaves of the *Calotropis procera*.
- 2- Studying the effect of levels of DAP.
- 3- Studying the effect of DAP levels in the total chlorophyll content in the leaves of the *Calotropis procera*.

## MATERIALS AND METHODS

An experiment was carried out in a pot, each with a capacity of 20 kg with a sandy soil, where the ratio was used (750 g / kg of sand and 250 g / kg of soil). The average soil density was 1.1 mg / m<sup>3</sup>, the average electrical conductivity (EC) was 1.8 mlli mose / m; the temperature (7.2 pH); the nitrogen concentration was 20 mg / kg soil; ready-made phosphorus 15 mg / kg; and ready-made potassium 145 mg / kg soil . The experiment included the addition of four levels of DAP (N: P) (18:46, 100: 200, 300: 400) kg DAP / ha, which were added in four equal increments (10, 20, 30 and

40%) of the total amount of fertilizer to seedlings after selected at the age of one year and 20 days between one addition and another since the date of the first increment. At the start of the experiment, the irrigation process was carried out whenever necessary, as it is a desert plant that tolerates the water stresses. The treatments were repeated three times, thus the number of replicates is 12.

### Statistical Analysis

Design Random Complete (CRD) was used in the experiment. The results were analyzed with the least significant differences (LSD) and with a significant difference of 0.05 and with the use of the Iraqi compound mineral fertilizer 200 kg / e (10:18) N: P) for the experiment as a Starter. Evaluation of soil before planting was carried out according to the following methods in the analysis:

**Pipette method:** In the analysis of the size of the minutes and according to the method described (Day, 1965), the soil reactivity (pH) was estimated at 1: 1 using a PH-meter as described by (Jackson, 1958). Electrical conductivity (Ec) was measured in soil solution (1: 1) using Conductivity Bridge Electrical device (Jackson, 1958). Soil content of ready-made nitrogen was determined using the Microkjeldahl method (page, et al., 1982).

Soil content of phosphorus which is available in soil is ready to be absorbed by the plant was extracted by Olsen method using  $\text{NaHCO}_3$  with 0.5M concentration. It was colorized with ammonium molybdenum and ascorbic acid and was estimated using spectrophotometer at 882 nm (page, 1982). Soil content of potassium which is available in soil is ready to be absorbed by the plant. 1 M of  $\text{CaCl}_2$  was extracted and estimated using a Flame photometer (Martin & Sparks, 1983). The basis of the idea for the indirect method is to extraction of nitrogen from the soil by the KCl solution with a shake for half an hour then it is exposed to filtration then a certain size of the filtrate is put in a glass jug. The distillation process then starts with the presence of (Divarda alloy) and (magnesium acid). Ammonia is received in boric acid in the presence of a manual (green Bromariazole and methyl red) and it is then tied using the HCL known as strength.

On 15-10-2014, the leaf was taken from each treatment to estimate the nitrogen, phosphorus and potassium element. It was washed with distilled water and dried in the oven at 65 °c until the weight was stable. It was then crushed and placed in plastic cans for chemical analysis. The analysis was carried out after the procedure of wet acid (dissolving the acids that melt the crushed leaves and then disposing them in physical ways without affecting the ingredients to be studied). They were measured according to the methods which are referred to from (Hayens, 1980).

**Total chlorophyll measurement:** it was measured by the SPAD field chlorophyll measuring device (fresh leaf wash with water, of which 1 g is crushed in 5 ml of acetone 80. The extract is filtered by filter paper, isolated in a tube, and completes the size of the cylinder to 5 ml and zeros the device using a container tube on a Seaton 80%. The light density of the leaky is read by placing it in the cell of the spectrometer wavelength of 663 nanometer and 645 nanometer. The quantities of multiple phenolic compounds are estimated after being extracted from plant leaves using (Ethyl acitate) by the method of high-performance liquid technology HPLC (performance Liquid Chromatography) (Microgram /gram dry weight) in accordance with the following (Forsch, 1993). Data collected and analyzed by computer is according to the Gestates program for the lowest moral difference (LSD) at the level of confidence 0.05.

## RESULTS AND DISCUSSION

1. **The content of the leaves of Gallic acid (%):** Table (1) shows there is a significant increase at a level of 300 kg/ha of 1.91  $\mu\text{g/g}$  dry weight as compared to the level of 100 kg/ha of 1.2691  $\mu\text{g/g}$  DW and a rate of increase of 51.6% while the highest content of the papers Gallic acid at the level of 400 kg/ha is 2.01  $\mu\text{g/g}$  dry weight as compared to the level 100 kg/ha and the increase reached 59.52% while there was a discrepancy between the first and second level as well as between level III and IV but it was not significant.
2. **Leaf content from vanillic acid:** Table (1) shows that the results of the statistical analysis increase with the level of fertilization, where the content of the leaves at 200 kg/ha is about 0.65  $\mu\text{g/g}$  dry

weight compared to the first level which is 0.28 µg/g dry weight with a significant discrepancy and an increase of 132% while the third level of 300 kg/ha reached about 0.95 µg/g dry weight compared to the first level which is 0.28 µg/g dry weight with a significant discrepancy and an increase of 239.28%. However, a higher impact at Level IV 400 kg/ha is 1.05 µg/g dry weight compared to level I which is 0.28 µg/g dry weight and by a significant discrepancy and an increase of 275%. Here, the effect of using higher levels of DAP fertilizer is illustrated by the increased volume of leaf content from phenolic compounds and this leads us to study higher levels to see how the results interact with them but within the limits of economic feasibility.

**Table (1):** The effect of adding different levels of dab fertilizer in the leaf content of multiple phenolic compounds microgram/g dry substance.

Studied djective	Ferulic acid	p-coumaric	Epicatechin	Vanillic acid	Gallic acid
Fertilizer levels					
100 kg/ha DAP	0.08	0.89	0.78	0.28	1.26
200 kg/ha DAP	0.48	1.28	1.16	0.65	1.61
300 kg/ha DAP	0.79	1.58	1.46	0.95	1.91
400 kg/ha DAP	0.92	1.71	1.85	1.05	2.01
<b>L.S.D 0.05</b>	<b>0.061</b>	<b>0.11</b>	<b>0.126</b>	<b>0.061</b>	<b>0.454</b>

- Plant leaf content from Epicatechin (%):** The results of the statistical analysis in Table (1) indicates the lowest significant difference (LSD) at the level of 0.05 which is significant, and the content of the leaves of the Epicatechin increased when we used the second level of DAB fertilizer ( 200 kg/ha ) and the content of the leaves of the Epicatechin reached 1.16 µg/g (dry weight) compared to the first level of 0.78 µg/g (dry weight) and by an increase of 48.71% while the third level of 300 kg/e achieved a significant increase in the content of the leaves of the Epicatechin, which was 1.46 µg/g, relative to the first level and an increase of 87.17%. However, the fertilization effect reached a maximum in the content of the leaves of the Epicatechin and by a significant discrepancy of 1.85 µg/g (dry weight) compared to the third level and an increase of 137.18%.
- Plant leaf content from P-coumaric (%):** Table (1) shows that the P-coumaric is moving in the same direction to increase with all the levels of the total, with the content of the leaves estimated to be µg/g (1.28, 1.58 and 1.71) for the second , third , and fourth level in succession compared to the first level of 0.89. With significant variances, the rates of increase (43.82, 77.52 and 92.13) have been increased to the second, third and fourth levels in succession compared to the first level.
- The content of the leaves of Ferulic acid:** it can be noted from table (1) that the characteristic of Ferulic acid has been categorized to the level of significance where the highest content of the papers of Ferulic acid was affected at the highest level of fertilizer (DAP) which amounted to 0.92 µg/g dry weight where it was more significant than the rest of the levels including the first level of 0.08 microgram/g dry weight, while the second level reached 200 kg/h of 0.48 µg/gr from dry weight, with an increase of 5.00% compared to the first level of 100 kg/ha while the third level increase was 887.5%. The fourth level increased by 1050% compared to the first level.
- The content of the leaves of Queretin-3-β-D-glucoside:** With respect to the concentration of Queretin-3-β-D-glucoside in the leaves in table (2) it can be found that the highest level of DAP fertilizer 400 kg/ha has been given the highest concentration of 1.86 µg/gr from dry weight, and by a significant discrepancy of the first level 100 kg/h which reached 1.00 µg/gr from dry weight, with an increase of 86% compared to the first level. The effect of the second and third fertilization levels was in the same direction and the rate of increase was 41 and 74% in succession compared to the first level.



7. **Leaf content of Resin Substances:** It is noted from table (2) that all levels of fertilization increased the content of the leaves from the Resin substances and achieved qualitative and significant leaps, and values were (0.54, 0.94, 1.30 and 1.43)  $\mu\text{g/gr}$  from dry weight and the increase was (79.6, 40.7 and 64.8)% compared to the first level of 100 kg DAP/ha with levels (200, 300 and 400 kg DAP/ha sequentially).
8. **Leaf content of total chlorophyll (%):** In the table (2) it can be found that fertilization with DAP fertilizer at different levels may stimulate plants to grow and this was evident in total chlorophyll and the percentages were (47.97, 56.16 and 59.00) % for the second, third and fourth levels in succession compared to the first level, which is 42.00%, with significant differences. The rate of increase was (14.2, 33.7 and 40.4%) in succession compared to the first level.

**Table (2):**The effect of adding different levels of dab fertilizer in the leaf content of multiple phenolic compounds  $\mu\text{g/g}$  dry substance and chlorophyll SPAD and (N,P, K).

Properties Fertilizer levels	Queretin- 3- $\beta$ -D- glucoside	(Resin materials)	T.Chlorophyll l SPAD	N%	P%	K%
100kg/ha DAP	1.00	0.54	42.00	2.63	0.20	2.86
200 kg/ha DAP	1.41	0.97	47.96	3.73	0.29	3.30
300 kg/ha AP	1.74	1.30	56.16	4.26	0.40	3.73
400 kg/ha DAP	1.86	1.43	59.00	4.76	0.51	4.73
<b>L.S.D 0.05</b>	<b>0.14</b>	<b>0.11</b>	<b>4.28</b>	<b>0.61</b>	<b>0.21</b>	<b>1.40</b>

9. **Nitrogen concentration in the leaves (%):** The results of table (2) indicate that fertilization with chemical fertilizer has stimulated plants to take advantage of nitrogen which is available in soil and is ready to absorbed by the plant and this was clear as the concentration of nitrogen in the leaves was (3.73, 4.26 and 4.76)% for second, third and fourth level in succession compared to the first level which is 2.63%, with significant differences, while the hydrogen concentration between the second and third levels did not achieve any significant difference; the third and fourth levels did not produce any significant differences between them. The best nitrogen concentration in the leaves at the fourth level was 400 kg/h by an increase of 80.9% compared to the first level.
10. **Concentration of phosphorus in the leaves (%):**From the results of table (2) it can be noted that the addition of DAP at all levels has stimulated the plants to absorb phosphor and that is clear as the concentration of phosphorus was 0.40% for the third level compared to the first level which is 0.20% and with a significant difference and 100% increase ,while at the first and second levels, phosphorus did not achieve any significant differences; however, the concentration of phosphorus at the fourth level was 0.51% compared to the first level and by a significant increase of 155%.
11. **Potassium concentration in leaves (%):** The results of table (2) indicate that the levels of the DAP fertilizer have stimulated the plants to absorb potassium and this was evident at the highest level, as the concentration of potassium was (2.86, 3.30, 3.73 and 4.73)% to the first, second, third, and fourth level in succession and by an insignificant difference between first level and second level as well as between the third and the first as well as the third and second, while the concentration of potassium in the fourth level of 400 kg was (4.73%) compared to the first level and by a significant difference and an increase of 65.38%.The significant increase in leaf content from phenolic compounds and total chlorophyll, depending on the levels of added DAP fertilizer, is due to the containment of fertilizer on two essential elements, nitrogen and phosphorus, which played an important role in cell growth and division, protein building, energy industry sources, chlorophyll, various membranes, in addition stimulating roots growth by improving some characteristics of absorption mechanisms. Thus, this leads to the construction and formation of

phenolic compounds in addition to the role of the active DAP fertilizer in the improvement of nitrogen levels and phosphorus which are available in soil and are ready to be absorbed by the plant (Mengel and Krikby, 1982 and Havlin et al., 2005). The significant effect of the added DAP fertilizer in the leaf content of N, P, K% may be the ideal growth for the air parts and roots due to the levels of added DAP fertilizer that have led to the availability of elemental nitrogen, phosphorus and micronutrients by interception according to the good growth of the roots resulting in a moral increase in the absorption of N, P, K% (Havlin et al., 2005 and IPNI, 2014).

## CONCLUSIONS

1. The results show that the (*Calotropis procera*) has shown a flexible and steady response to the levels of manure added in the leaf content of phenolic compounds, while the fourth level gave the best content in the leaves of phenolic compounds and major nutrients N, P, K.
2. The addition of a dab fertilizer (DAP) has increased the absorption speed of the main nutrients (N and p) necessary for protein construction due to the increased effectiveness of these elements in the soil solution, which are absorbed easily by the plant.
3. The manure (DAP) with the two main components (N and P) stimulates the increase of the total vegetativeness leading to a more efficient metabolism and to increase the total root leading to a more efficient absorption of nutrients from the soil and thereby increase the plant content of the chlorophyll ratio.
4. Increasing in the growth of the total root, increasing in the absorption efficiency of major elements (K, P, N), and increasing in the content of the leaves of compounds and phenolic acids which are an important source of production of compounds and drugs and a source of extensive innovative components such as: flavonoid glycosides, flavonoid Quercetin, Polyphenol or phenolic.
5. The symptoms of nitrogen deficiency begin on the lower (old) parts while the upper (modern) parts are less affected and here we can differentiate the symptoms of the combustion of the leaves due to the lack of nitrogen element where the lower leaves are affected only by the symptoms of combustion of the leaves due to dehydration which affects the upper and lower parts of the plant simultaneously.

### Suggestions:

1. Conducting more complementary and in-depth experiments and studies with a view to optimize the levels of manure that should be used to achieve good economic results, given the plant's response in a steady increase when increasing the fertilizer dose for the four levels used in this experiment.
2. Due to its studies and research that are conducted by (al-Qahtani, 2012, Al-Yemni and others, 2011) regarding the ability of the plant to withstand the water and saline stresses and the ability of the total of root group to absorb the heavy elements of the soil such as Cd and Se without causing physiological damage to the roots, it is encouraging for the purpose of continuing studies on this subject because it has an impact in combating pollution and reducing the risks and harms of these elements in the soil, where it is considered a promising plant in this field.
3. Interest in the studies of this plant for its richness and large stock of many drug-producing compounds and a source of extensive innovative components such as, flavonoid glycosides and flavonoid quercetin.
4. Paying attention to the feasibility study of the production of biofuels from this plant due to its ability to produce an annual crop of (vegetative portion) by 90 ton/ha.



Figure (1): shows the whole plant is in the form of a tree height of 2-5 which has many branches and shows the large fleshy leaves.



Figure (2): shows the regular violets form separate top or axillary flowers.



Figure (3): shows the fruits that are open and appear full of seeds that carry filaments at their top silk known as fuzz.



Figure (4) shows a liquid white substance with a bitter taste called Calotropis procera.



Figure (5) shows the fruits before opening it having a spherical shape that is close to the oval shape. It is a spongy having a color like the color of an apple and its shape is also like the shape of an apple. It is full of seeds.



Figure (6): shows a flower at the beginning of its opening and a fruit in a floral axillary flower which indicates the size of the large leaves and fruits.

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# ECOLOGICAL AND GEOCHEMICAL ASSESSMENT OF ALLUVIAL SOILS IN THE MEDIAL DNIESTER AREA

TAMARA LEAH<sup>1</sup>

**Abstract:** *The alluvial soils are characterized by a very large variation in the physical, chemical and geochemical properties as a result of the different pedogenesis conditions, the zonal climate, the origin of the river deposits, their texture and composition, the depth and mineralization of the groundwater. The main characteristic of the heavy metal content in the arable alluvial soil profile is the relatively high content of the total and mobile forms in the humiferous horizon (0-23 cm) due to their biogenic accumulation. On the other hand, although a stratification of the alluvial soil profile persists, there is a general pattern of heavy metal distribution reflected by reduction of Mn, Cu, Pb, Ni, an increase Zn, Co, Cr, Cd and Fe content - from top to bottom of profile, with 3 accumulation maxima: biogenic, gleyic and carbonatic barriers. The typical arable alluvial soils are not polluted with heavy metals: their concentration in the soil does not exceed the maximum admissible limits for soils of Moldova.*

**Keywords:** *Alluvial soil, Biogeochemical barrier, Heavy metals, Lower Dniester.*

**JEL Classification:** *Q: Agricultural and Natural Resource Economics, Environmental and Ecological Economics; Q2: Renewable Resources and Conservation; Q24: Land.*

## INTRODUCTION

The appearance and condition state of ecosystems in the Medial Dniester area during the last decades had underwent cardinal changes. The prolonged period of drought led to a considerable decrease in the speeds of the water stream and in the fluvial portion of the Dniester River. This in turn favored negative changes in terrestrial and aquatic ecosystems, intensified soil resource degradation processes, increased erosion processes on the slopes, changed the vegetation composition of pastures, etc. [3]. In conditions of soil cover degradation and climate change, the food security in the Republic of Moldova can be ensured by using the typical and highly evolved alluvial soils from the Dniester river meadow and by expanding the areas with irrigated soils in these areas. In the territory of the Republic of Moldova, in the lands of agricultural destination the meadow alluvial soils occupy the area of about 120 thousand ha [14,18,19]. Alluvial soils are the main object for development of irrigated agriculture, because they can be easily provided with irrigation water from rivers. In this case, a major interest for the extension of agriculture and irrigation is presented by the evaluation of the sources of heavy metal pollution of the alluvial soils of the Medial Dniester meadow. Physical degradation of soils, characterized by deterioration of unfavorable physical structure and properties, takes place under the influence of agricultural technique and mechanisms, but also as a result of irrigation with water that does not meet the requirements. Most of the times, the degradation of the amelioration systems, especially the drainage systems, in the river beds causes salinization. Soil degradation is one of the critical factors that cause the imbalance of functioning and fragmentation ecosystems [2,4,23].

The influence of chemical fertilizers and phytosanitary products used in agriculture on different ecosystems has diminished considerably, but water and wind erosion of the soil leads to eutrophication of the river. Illegal grazing on the river banks also contributes to the deterioration of the vegetal cover and to the degradation of the meadow soils properties. Drainage systems no longer have full management. The canals are muddy and the water pumping is no longer undertaken due to high electricity prices. The malfunctioning state of the drainage system led to a dangerous degradation of the old Dniester riverbed and to the spread of soil salinization on the drained lands. On the other hand, this fact leads to the abandonment of land, the restoration of marshes and meadows, the stimulation of the transition to a justified ecological grazing and grazing [1,10].

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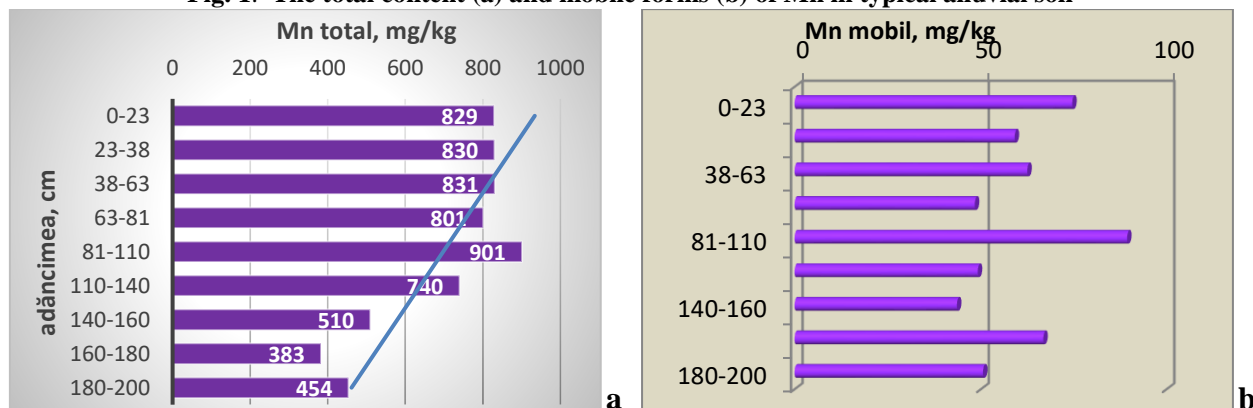
To assess ecological and geochemical assesment (migration and accumulation of heavy metals in the soil profile) of the alluvial soils, further research is needed for the correct use of these soils in sustainable agriculture. As an object, the arable typical alluvial soils from the middle Dniester meadow (Jora de Mijloc village, Orhei raion) were selected. Soil profiles up to 2 m depth were ampalased on the field used for vegetables. The soil samples were collected on genetic horizons. The heavy metals were determined by atomic absorption spectrophotometry methods.

## RESULTS AND DISCUSSIONS

Heavy metal pollution of meadow ecosystems occurs due to the lack of information on their impact on the environment and implicitly on the human body. Because of the conviction that the pollutants will be transformed or absorbed and thus the impact will be limited or non-existent [5,6]. The accumulation of heavy metals in agricultural soils is associated with the use in agriculture of fertilizers, plant protection products, organic waste, etc. Heavy metals are also considered microelements, as they are used by plants in very small quantities.

**Manganese (Mn)** is associated with Mg and Fe in silicate minerals. The distribution of MnO in soil is closely related to that of Fe<sub>2</sub>O<sub>3</sub>. The critical content of Mn is considered at 17 mg·kg<sup>-1</sup> (ppm). The excess of manganese produces toxic effects and manifests as brown spots, which appear on the older leaves [6]. The total Mn content in the alluvial soils is within the limits of 383 and 901 mg·kg<sup>-1</sup>. The values of the total Mn content fall within the limits determined for the soils of the Republic of Moldova (150-2250 mg·kg<sup>-1</sup>), the average content being 790 mg·kg<sup>-1</sup>. The upper horizon of the alluvial soil contains 830 mg·kg<sup>-1</sup> of Mn, and the lower ones (carbonate horizon) - 383-510 mg·kg<sup>-1</sup> of total Mn (Fig.1a).

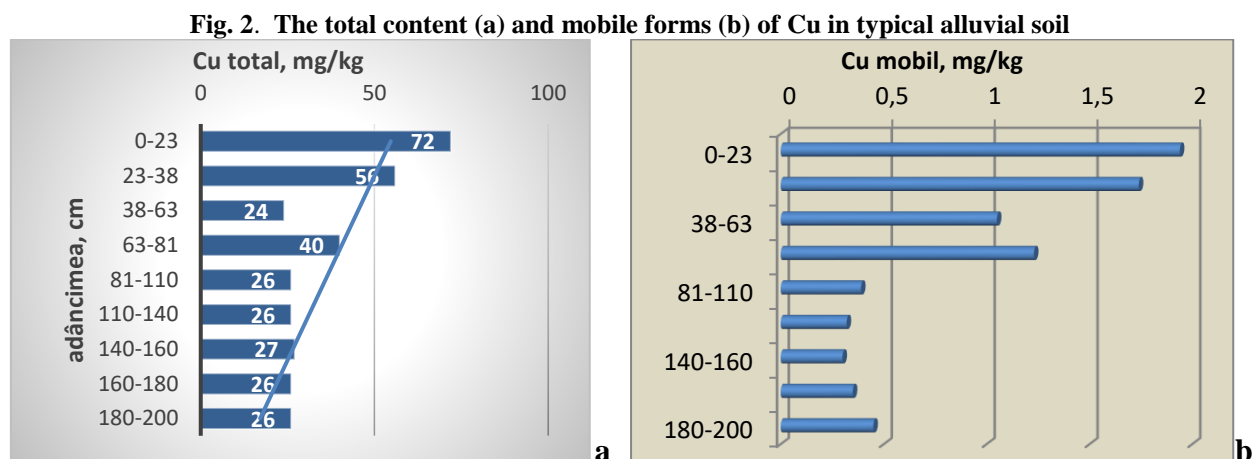
**Fig. 1. The total content (a) and mobile forms (b) of Mn in typical alluvial soil**



The content of mobile Mn in the upper horizon of the Republic of Moldova's soils varies between 0.4-195 mg·kg<sup>-1</sup> [8]. The content values of the accessible Mn in the studied alluvial soils are between relatively medium limits (43.6-89.4 mg·kg<sup>-1</sup>), with a very close distribution that described by the normal distribution law. As a result, the upper part of the soils has higher contents of accessible Mn, than the middle gleyic part. The highest content of Mn (89.4 mg·kg<sup>-1</sup>) was detected in the 81-110 cm of gleyic layer, which shows the existence of a geochemical gleyic barrier. In general, the content of mobile Mn has three maximum of accumulations in the studied soils: in the humiferous horizon of the profile (0-23 cm) - 74.6 mg·kg<sup>-1</sup>, in the gleic horizon (81-110 cm) - 89.4 and in the lithological horizons (160 -180 cm) - 66.8 mg·kg<sup>-1</sup>. Therefore, the distribution of Mn in the alluvial soil profile cannot be described as uniform (Fig. 1b).

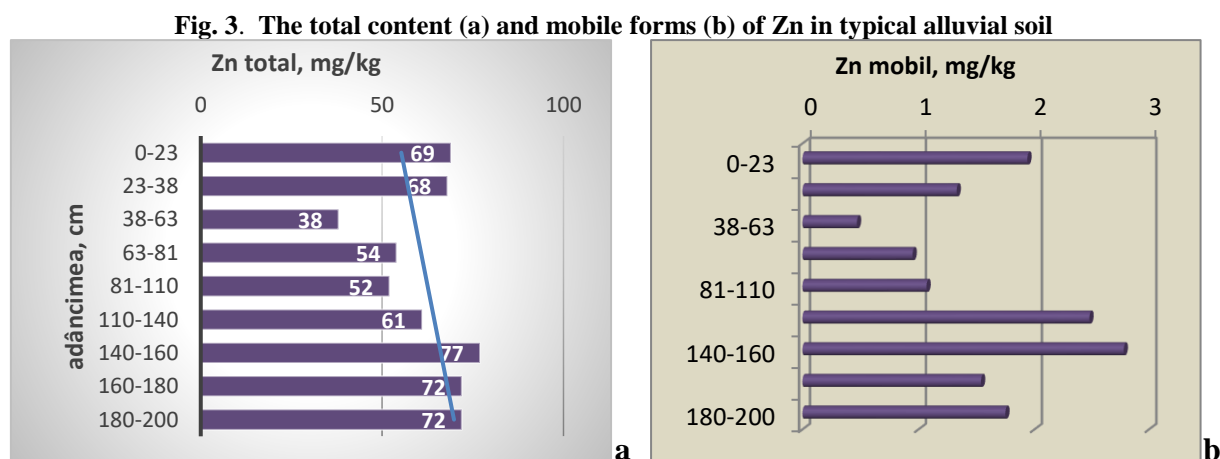
**Copper (Cu)** is association with other heavy metals: Pb, Zn, Mo, Ag, Ni etc. The geochemical mobility of Cu is intermediate, being controlled by the adsorption on oxides of Fe and Mn, by the presence of organic matter. Copper enters in the chemical composition of many substances used in agriculture. The maximum permissible limit for total Cu content in the soil is 100 mg·kg<sup>-1</sup>

[9,11]. The total Cu content in the Moldovan soils is estimated at 2 - 400  $\text{mg}\cdot\text{kg}^{-1}$ , with an average of 23  $\text{mg}\cdot\text{kg}^{-1}$ . In the studied soils The total Cu is within the limits of 24-72  $\text{mg}\cdot\text{kg}^{-1}$ , which exceeds the average content for soils of Moldova. The highest quantity is associated with the organic matter, in the humiferous horizon (0-38 cm) it contains is 56-72  $\text{mg}\cdot\text{kg}^{-1}$  of total Cu. Starting with a depth of 38 cm the total Cu content is decreasing (24-27  $\text{mg}\cdot\text{kg}^{-1}$ ). A higher amount of total Cu is detected at the beginning of the gleyic horizon - 40  $\text{mg}\cdot\text{kg}^{-1}$  (Fig. 2a).



The concentration of Cu mobile in Moldovan soils varies within the limits of 0.1-60.0  $\text{mg}\cdot\text{kg}^{-1}$ , with an average of 1.6  $\text{mg}\cdot\text{kg}^{-1}$ . The content values of mobile Cu in the investigated soils range between the limits (0.30-1.94  $\text{mg}\cdot\text{kg}^{-1}$ ). The distribution of mobile Cu demonstrates high concentrations in the humiferous horizon (0-38 cm) - 1.74-1.94  $\text{mg}\cdot\text{kg}^{-1}$  and in the depth of the gegleyed horizon (63-81 cm). In the carbonatic layer (110-180 cm) of the soil the content of Cu mobile constitutes 0.30-0.45  $\text{mg}\cdot\text{kg}^{-1}$  (Fig.2b).

**Zinc (Zn)** is present in soils, water, air and plants. At the topsoil part, Zn has a good correlation with Cd, Cu, Co, Mn, Fe, etc. The maximum permissible limit for the total Zn content in the soil is 300  $\text{mg}\cdot\text{kg}^{-1}$  [9]. In the superficial environment it has a moderately high mobility, limited by its tendency to be adsorbed on  $\text{MnO}_2$  and by the insoluble organic matter of soils [20]. The total Zn content in Moldovan soils is estimated at 10-166  $\text{mg}\cdot\text{kg}^{-1}$ , with an average of 71  $\text{mg}\cdot\text{kg}^{-1}$ . In alluvial soils the total Zn content is within the limits of 38 - 77  $\text{mg}\cdot\text{kg}^{-1}$ . Zinc accumulations are observed in humiferous layers - 69  $\text{mg}\cdot\text{kg}^{-1}$  and in carbonate layers - 72  $\text{mg}\cdot\text{kg}^{-1}$ , which does not exceed the average content for the soils of the Republic of Moldova. In the yellow horizons, lower content values are detected: 38-54  $\text{mg}\cdot\text{kg}^{-1}$  of Zn (Fig. 3a).

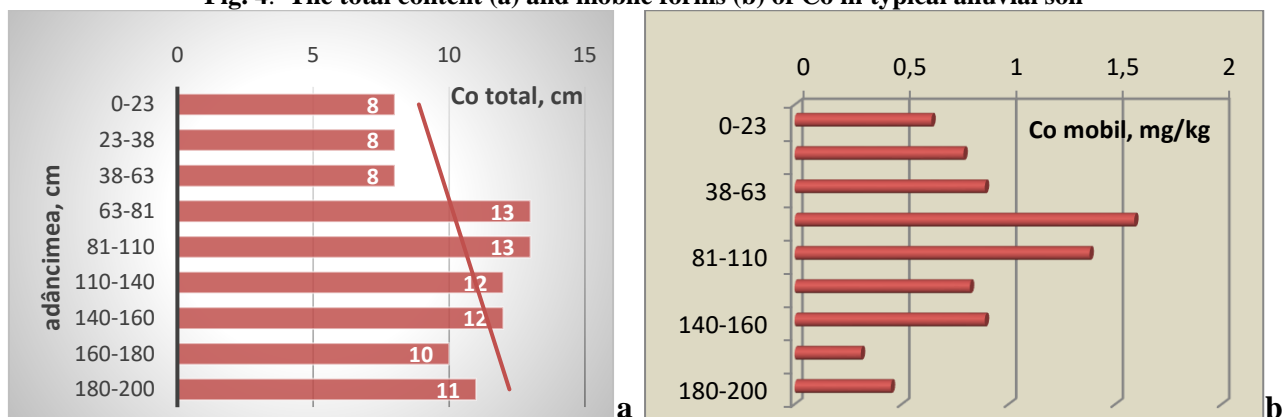


The mobile Zn determined in typical alluvial soils vary widely (0.47-2.78  $\text{mg}\cdot\text{kg}^{-1}$ ), with a significant dominance of the contents in the deep layers (110-160 cm), containing 2.4 -2.8  $\text{mg}\cdot\text{kg}^{-1}$  Zn.

These Zn concentrations are the result of lithological genesis (Fig.3b). In the soil profile the distribution is not uniform, it has two accumulations - in the humiferous and carbonatic layers. Zinc is an element with reduced mobility. The concentration of mobile forms Zn does not exceed the permissible limits for Moldovan soils ( $4.9 \text{ mg}\cdot\text{kg}^{-1}$ ).

**Cobalt (Co)** is present, in small quantities (traces), in rocks, soils, waters, plants and animals in the form of  $\text{Co}^{2+}$  ion. In the topsoil part, it has a strong correlation with Ni, Cr, Fe, Cu, and Mn [22]. The maximum permissible limit for total Co content in the soil is  $50 \text{ mg}\cdot\text{kg}^{-1}$  [9]. Geochemical mobility in soils is mainly controlled by adsorption and co-precipitation of Co with Mn and Fe oxides [7]. The total Co content in Moldovan soils is on average  $13 \text{ mg}\cdot\text{kg}^{-1}$ , and the limit values in the range  $4\text{-}18 \text{ mg}\cdot\text{kg}^{-1}$  [8]. In the studied soils the total Co is within the limits of  $8\text{-}13 \text{ mg}\cdot\text{kg}^{-1}$ . Higher quantities can be found at the bottom of the profile: in the gleyed layers -  $13 \text{ mg}\cdot\text{kg}^{-1}$  (Fig.4a).

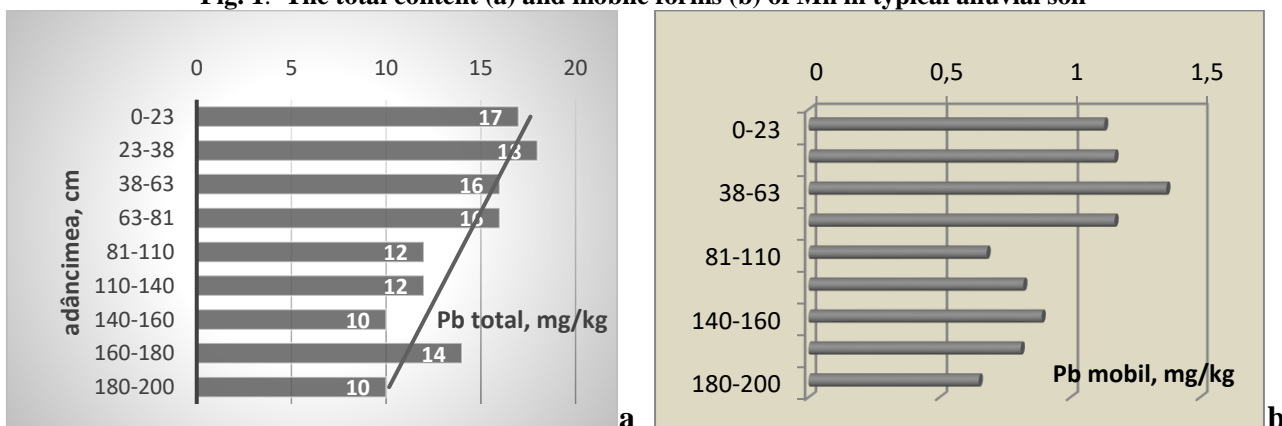
Fig. 4. The total content (a) and mobile forms (b) of Co in typical alluvial soil



The content of mobile Co in the upper horizon of the alluvial soils is  $0.64 \text{ mg}\cdot\text{kg}^{-1}$ , with a visible increase in depth, up to  $0.89 \text{ mg}\cdot\text{kg}^{-1}$  in the soil layer of 38-63 cm. Higher content was determined in the gleuic layer (63-81 cm) -  $1.59 \text{ mg}\cdot\text{kg}^{-1}$ , with a significant decrease in depth -  $0.35\text{-}0.45 \text{ mg}\cdot\text{kg}^{-1}$ . In the investigated soils, the Co content in the topsoil layer shows a weak association with the organic matter in the arable layer 0-23 cm. The concentrations of accessible Co recorded in the studied soils oscillate in a rather wide range, determined by the limits  $0.31$  and  $1.59 \text{ mg}\cdot\text{kg}^{-1}$ , which suggests a distribution belonging to the natural geochemical background (Fig.4b).

**Lead (Pb)** content in the various types of soil around the globe, in a quasi-natural regime, is usually between  $5\text{-}280 \text{ mg}\cdot\text{kg}^{-1}$ , with an average value of  $30 \text{ mg}\cdot\text{kg}^{-1}$  [12]. The maximum permissible limit for the total Pb content in the soil is  $100 \text{ mg}\cdot\text{kg}^{-1}$  [9]. Lead has no known biological function, but is recognized to be toxic to plant and animal life, when present in ionic form [6,7]. The total Pb content in soils is in the range of  $5\text{-}30 \text{ mg}\cdot\text{kg}^{-1}$ , average -  $20 \text{ mg}\cdot\text{kg}^{-1}$ .

Fig. 1. The total content (a) and mobile forms (b) of Mn in typical alluvial soil



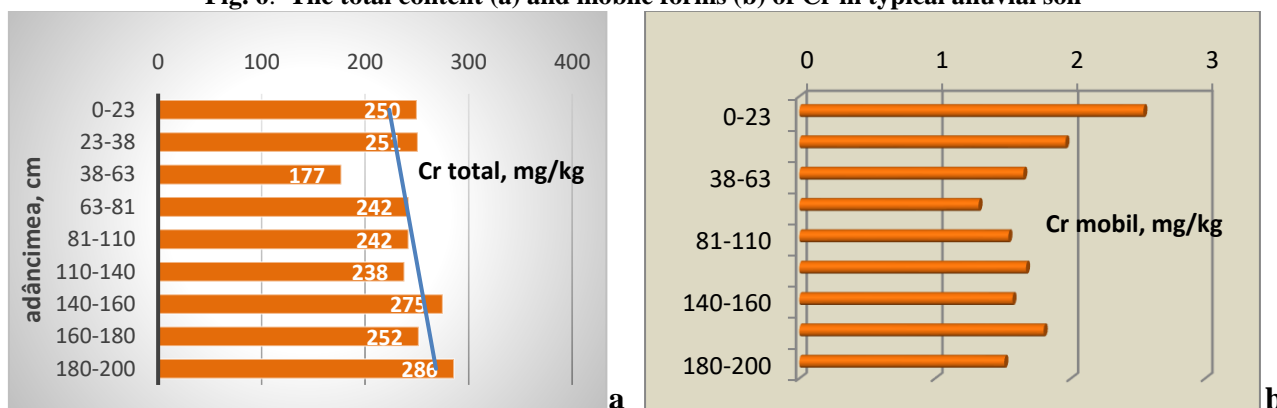


The values of total Pb content determined in alluvial soils fall within the average limits: 10-18 mg·kg<sup>-1</sup>, which suggests a distribution between the normal limits for this element. Typical alluvial soils are characterized by Pb content that decreases in the depth of the profile. In the profile of the studied soils, two accumulations are outlined: one at the top and the second, more pronounced at the bottom of the profile, at a depth of 160-180 cm (Fig.5a).

The mobile forms of Pb in the alluvial soils are estimated within the wide limits: 0.65-1.37 mg·kg<sup>-1</sup>, which exceed the average for the Moldovan soils: 0.4 mg·kg<sup>-1</sup>. Higher concentrations are detected in the upper part of the profile, with significant decreases in depth, which is characteristic for alluvial meadow soils (Fig.5b).

**Chromium (Cr)** in the upper horizon of the various types of soil in the world, is usually between 1.4 and 500 mg·kg<sup>-1</sup>, with an average value of 63 mg·kg<sup>-1</sup>. The maximum permissible limit for total Cr content in soil is 100 mg·kg<sup>-1</sup> [9, 12]. The total Cr content in alluvial soils was estimated at 177 and 236 mg·kg<sup>-1</sup>. The average values of Moldovan soils are 91 mg Cr/kg, the limits of variation constitute 25-145 mg·kg<sup>-1</sup>. Thus the alluvial soils contain total Cr above the permissible limits, accentuating a significant accumulation - 1.9-2.6 times more than the limits. These concentration is characteristic for meadow soils (Fig.6a).

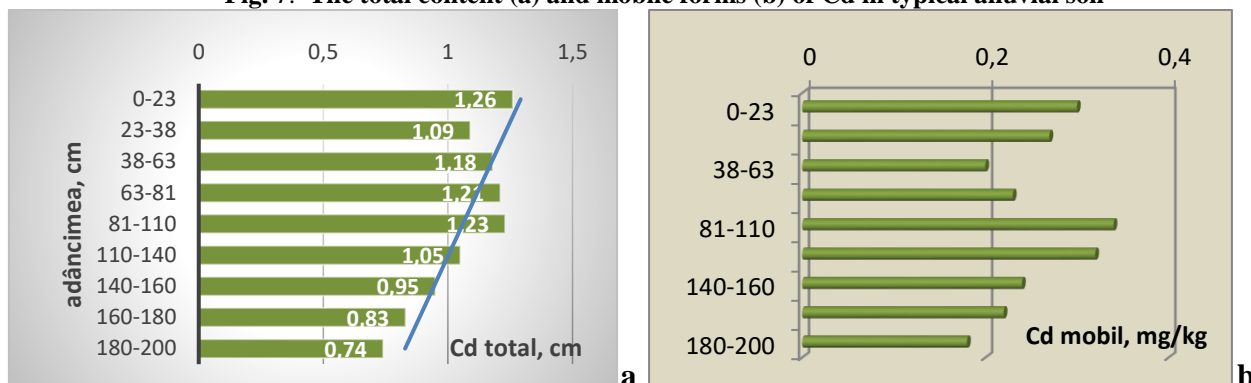
**Fig. 6. The total content (a) and mobile forms (b) of Cr in typical alluvial soil**



The content values determined for the mobile Cr in the soils in the investigated area range from 1.32-2.54 mg·kg<sup>-1</sup>. The distribution of Cr mobile in the investigated soils appears to be very close to the natural one, with higher concentrations in the humiferous horizon (0-23 cm) - up to 2.54 mg·kg<sup>-1</sup>. In the alluvial soils the biogenic accumulation takes place in the humiferous layers, with decreases in depths, proportional to the content of organic matter (Fig.6b).

**Cadmium (Cd)** has a good correlation with Zn, Mn, Pb and a weak correlation with Co and Cu [7,21]. The Cd content in the upper horizon of the various types of soil worldwide, in natural quasi-regime, is between 0.01 and 2.70 mg·kg<sup>-1</sup>, with an average value of 0.48 mg·kg<sup>-1</sup> [8,9]. The maximum permissible limit for total Cd content in the soil is 3 mg·kg<sup>-1</sup> [8]. The average concentration of total Cd in Moldovan soils is 0.41 mg·kg<sup>-1</sup> and the admissible limits 0.2-0.84 mg·kg<sup>-1</sup> [8]. Higher contents of Cd are detected in the upper part of the alluvial soil profile - up to a depth of 110 cm, constituting 1.09-1.26 mg·kg<sup>-1</sup>. These values can be considered high for alluvial soils compared to the average content for Moldovan soils. Taking into account the pedogenesis of these soils, these values are admissible in alluvial soils (Fig.7a).

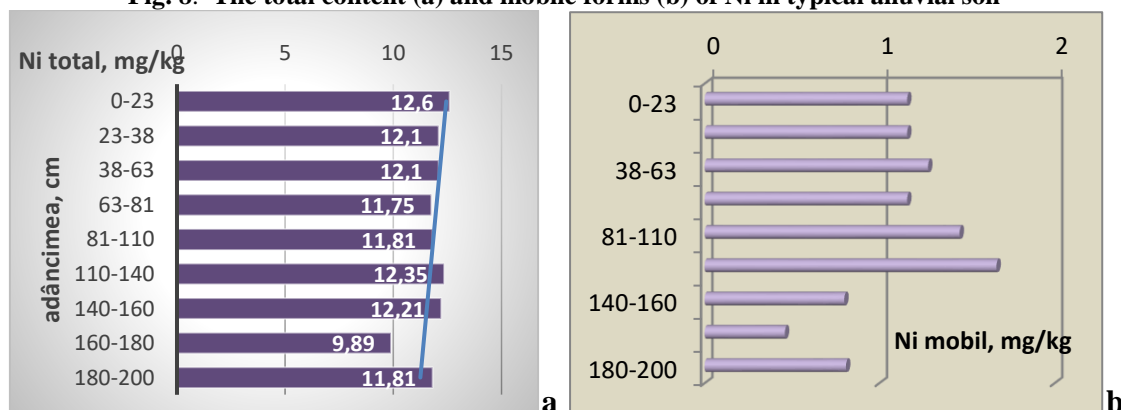
Fig. 7. The total content (a) and mobile forms (b) of Cd in typical alluvial soil



The mobile Cd content is within the limits of 0.01-0.3 mg·kg<sup>-1</sup> and the average constitutes 0.04 mg·kg<sup>-1</sup> [8,13]. Cd mobility in alluvial soils and their accumulation in the upper horizons is amplified by the low content of organic matter and their texture. In the upper part of the studied soil profile, the concentration of the mobile forms of Cd is higher (0.30 mg·kg<sup>-1</sup>), than in the depth (in the parent rock) - 0.18 mg·kg<sup>-1</sup>. Cadmium accumulates at a depth of 81-140 cm (gleyic horizon) - 0.33 mg·kg<sup>-1</sup> (Fig.7b). The arable alluvial soils studied are moderately evolved, which is why the Cd accumulates in dependence of the organic matter and the layers texture, but the abundance of Cd in the upper and middle part of the profiles predominates.

**Nickel (Ni)** enters into insoluble Fe oxides, which results in its relatively reduced mobility in the superficial environment. In ordinary waters it is present in very small quantities where it can withstand hydrolysis at pH > 6.5 [12,15,16]. The maximum permissible limit for total Ni content in the soil is 50 mg·kg<sup>-1</sup> [9,17]. No biological role is known for Ni. Anthropogenic sources of Ni include: use of fertilizers, detergents, etc. [21]. The total Ni contents in the alluvial soil profile are in average 11 mg·kg<sup>-1</sup>, values that fall within the allowable limits (5-75 mg·kg<sup>-1</sup>) for the soils of Moldova. The average content of total Ni in RM soils is estimated at 39 mg·kg<sup>-1</sup>. The total Ni content in the alluvial soils is 4 times lower than the average content (Fig.8a).

Fig. 8. The total content (a) and mobile forms (b) of Ni in typical alluvial soil



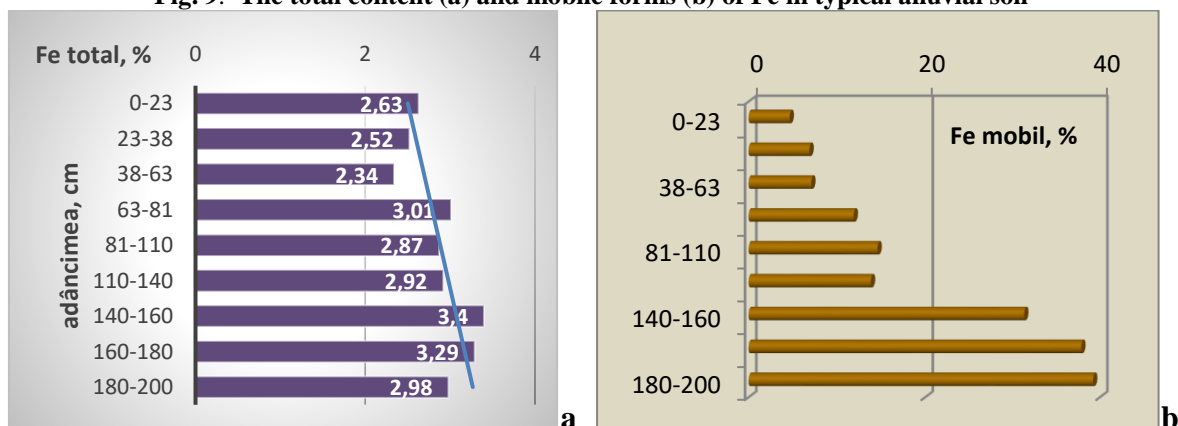
The contents of mobile Ni determined in the alluvial soils are between the limits: 0.46-1.67 mg·kg<sup>-1</sup>, values that exceed the limit of the normal ones (0.80 mg·kg<sup>-1</sup>) for Ni in the humic and gleyic layers. These concentrations suggest a natural distribution of Ni in the investigated soils, disturbed only to a small extent by irrigation. From this it can be deduced that, on the thickness of the soil profiles, the Ni contents have an increased variation (Fig. 8b).

**Iron (Fe).** The estimated crustal abundance for Fe is 6.71%. On the superior part of the soil, there is a strong correlation with Co, Mn, Cu, Zn, a good correlation with Ni, and a negative correlation with SiO<sub>2</sub> (-0.50), statistically verifying the inverse geochemical relationship between Fe<sub>2</sub>O<sub>3</sub> and SiO<sub>2</sub> [17,21]. The iron is found in the soil as amphoteric oxides or hydroxides.

In the surface horizons the most abundant are hydrated ferric oxides. In these horizons, the total iron content ranges from 1.5 to 3.0% Fe on average. In soils rich in organic matter, iron is present in soil solution as a bivalent ion or is retained by adsorption as ferric hydroxide, insoluble and inaccessible to plants [21,23,38]. In general, soils contain sufficient soluble iron necessary for plant nutrition. Insufficiency is caused by a number of factors, of which the most important are the alkaline reaction and the calcium carbonate content, most of which are active. Alluvial soils contain sufficient total iron: 2.34-3.40%. The distribution laws are manifested by the increase of the content in depth, the gleyic horizons with higher content of total Fe are highlighted (Fig.9a).

In the investigated soils, the distribution of mobile Fe content varies between high limits: 4.65-39.23 mg·kg<sup>-1</sup> of Fe (Fig.9b). This distribution is apparently a consequence of the variability of the pedogenesis of the alluvial soils in the investigated area, as well as of the various uses of the soil. The low Fe content is, with little exception, characteristic for the upper layers of alluvial soils. Soils with a Fe content more than 12 mg·kg<sup>-1</sup> are found in the deep-gleyic layers. The distribution of Fe in the studied alluvial soils can be proved to be natural, only slightly affected by anthropogenic factors - use in arable land and irrigation. The content of mobile forms of Fe in the depth horizons ranges from 31 to 39 mg·kg<sup>-1</sup>. The distribution of Fe in the alluvial soils indicates its accumulation at a depth of 160-180 cm, this is sufficient soluble iron for plant nutrition.

**Fig. 9. The total content (a) and mobile forms (b) of Fe in typical alluvial soil**



**The ecological situation.** The main problems that contribute to the degradation of the natural resources in the researched area refer to: 1) - the lack of an area administration body, which could protect agricultural ecosystems and provide sustainable development in the region. The natural forest and grassland ecosystems have a relatively small surface area and are isolated, being surrounded by extensive arable land and artificial plantations. Agricultural practice has largely contributed to the degradation of the steppe vegetation. The system of forest curtains along the waters is poorly preserved and protected; 2) - the lack of local territory development plans, including landscape development plans, anti-erosion measures and soil status monitoring, for improving the ecological situation; 3) - total lack of a correct crop rotation, based on perennial forage crops; some private agricultural sectors are located right on the waterfront.

The main sources of potential pollutant character in this area are: - impurities from fertilizers containing: Cd, Cr, Mo, Pb, V, Zn; - sludge from wastewater containing: Cd, Ni, Cu, Pb; Zn and many other elements; - organic residues from livestock (pigs and birds), containing: Cu, As, Zn; - pesticides containing: Cu, As, Hg, Pb, Mn, Zn; - composted wastes (not necessarily used in agriculture) containing: Cd, Cu, Ni, Pb. Most of the agricultural and horticultural soils in this area are regularly fertilized with chemical and organic fertilizers. The concentration of heavy metals in these materials used as chemical fertilizers, organic fertilizers, amendments and composts from waste in agriculture can be important sources of heavy metals.

## CONCLUSIONS

The main characteristic of heavy metals in the profile of arable alluvial soils is the content of the total and mobile forms (Mn, Cu, Zn, Cd and Pb) relatively high in the humiferous horizon (0-23 cm) due to their biogenic accumulation. In arable alluvial soils approximately 50% of the total reserve of heavy metal are concentrated in the upper part of the profile. Accumulation at the geochemical barrier (61 cm) is evident - the beginning of the gleyic profile. In the buried humiferous horizon (81-110 cm) the total and mobile forms of Mn ( $900 \text{ mg}\cdot\text{kg}^{-1}$ ) and Fe (3%) were accumulated. The maximum accumulations of Zn, Co, Cr, Ni and Fe are detected in the carbonate layers (140-200 cm). One of the significant characteristics of the distribution of heavy metals in the profile of these soils is the relatively high concentrations of the mobile forms of Fe and Mn in the depth horizons, due to their smoothing from the upper profile horizon and an additional supply with groundwater. On the other hand, although a stratification of the alluvial soil profile persists, there is a general pattern of heavy metal distribution, reflected by a reduction of Mn, Cu, Pb, Ni, Cd and growth content of Zn, Co, Cr, Fe from top to bottom, with 3 accumulation maxima: biogenic, gleyic and carbonatic. The typical alluvial soils investigated are not polluted with heavy metals: their concentration in the soil does not exceed the maximum permitted limits for soils of the Republic of Moldova. Under the conditions of proper management, the alluvial soils can be productive for a wide range of types of crops for dry farming, but, due to the dry climate without irrigation, the yields are small and very small. Barley, alfalfa and sunflower and, to a lesser extent, winter wheat, are the most suitable crops. Under irrigation conditions, alluvial soils are widely used in vegetable cultivation. The results regarding the heavy metal content can be used to elaborate the measures and recommendations regarding the sustainable use, protection and improvement of the alluvial soils quality in the Medial Dniester meadow.

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## **SECTION 2**

### **ECONOMY, MANAGEMENT AND MARKETING IN AGRICULTURE**

# STUDY ON GLOBAL ECONOMIC EFFICIENCY IN ROMANIAN AGRICULTURE

IONUȚ LAURENȚIU PETRE<sup>1</sup>

**Summary:** *This paper aims to analyze the economic efficiency at the macroeconomic level of the agricultural sector in Romania, in order to determine the level of profitability or feasibility regarding this economic sector, respectively agriculture. In order to be able to determine the global economic efficiency in the agriculture of Romania, first of all, indicators of the Economic Accounts from Agriculture will be analyzed, found in the national data bases, respectively the National Institute of Statistics; and, secondly, with the help of these indicators, a calculation system will be developed to determine the overall economic efficiency of the Romanian agricultural sector. Determining the level of profitability of agriculture is very important considering the context of globalization and the development of competitive markets, in order to have access to the market, the level of competitiveness can be measured by this analysis, mentioned above.*

**Keywords:** *agriculture, competitiveness, economic efficiency, performance, profitability.*

**JEL Classification:** *Q10, Q11*

## INTRODUCTION

The main objective of each economic agent is to ensure the efficiency of the activity carried out. The concrete form of manifestation of this principle is characterized by the determining element of the economic efficiency - the profitability. In this context, increasing profitability should be a permanent concern of the managers of the production units from all branches and, first of all, from agriculture.

Profitability, in general, consists in the ability of a farm to make a profit from its activity by judiciously using the factors of production and capital, which have different origins.

Profitability is a synthetic form of evaluating the efficiency of the economic-financial activity of a farm with reference to the means of production and labor used, taking into account the three stages of an economic circuit, namely: supply, production and sale.

In terms of quantifying profitability, two categories of indicators are used, namely profitability and profitability rates. The level of absolute profitability is represented by the profit, and the way in which the use of the resources of the farm brings profit constitutes the rate of profitability.

According to European Commission data, which issued a report in 2016, on the overall vision of the cereal sector from an economic point of view, most cereal prices have decreased by one third in the last period, and at the same time, the yield per hectare has not increased so much. a lot, and the cost of inputs increased by 5%. All these aspects presented by the European Commission negatively affect the rate of return of the respective culture, given that each of the 3 elements presented above is constituted as a factor of the rate of return.

## MATERIALS AND METHODS

In order to analyze the global economic efficiency at the agricultural sector level, a system of resulting value indicators will be used, which can be determined using the statistical data provided by the National Institute of Statistics, which refer to the economic accounts in agriculture. This set of indicators, which will determine the overall economic efficiency of agriculture, includes: gross added value (GVA), net added value (NVA), value of intermediate consumption, weight of intermediate consumption in production value, evolution and structure of GVA, NVA weight in the value of production, gross formation of fixed capital, net formation of fixed capital.

In order to calculate this set of indicators, we propose the presentation of the indicators from the national statistics, with the help of which the global economic efficiency will be determined, thus, we propose the definition of terms, according to the National Institute of Statistics.

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„The Economic Accounts for Agriculture (CEA) is a system of interconnected accounts that provides a systematic, comparable and as complete a picture as possible of the economic activity of agriculture in order to analyze the production process and the primary income generated by it within the branch of agricultural activity.

The CEA comprises the following accounts:

- the production account (the production of the agricultural branch is recorded as resources, the intermediate consumption as uses, and the account balance is the added value);

- the operating account (income generation account) records as net added value and other subsidies on production, for use the remuneration of employees, other taxes on production, and the balance of the account is the net operating surplus (mixed income);

- enterprise income account (net operating surplus / mixed income and receivables recorded as resources, leases and interest payable as utilities, account balance is the net income of the enterprise);

- the capital account includes the gross and net formation of fixed capital, the variation of product stocks and capital transfers.”

## RESULTS AND DISCUSSIONS

Analyzing the evolution of the indicators taken from the economic accounts in agriculture, for the reference period 2007-2018, the following can be observed, according to table 1.

Table 1 Evolution of the Economic Accounts in Agriculture

No. Crt.	INDICATORS	Millions (RON)											
		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
1	VEGETABLE PRODUCTION	28723	45742	35735	43488	54180	40169	53844	49058	43574	45155	53217	63390
2	ANIMAL PRODUCTION	14591	15695	17933	15314	16487	17804	17268	17629	17872	16973	18468	19490
3	AGRICULTURAL PRODUCTION OF GOODS (r.1+2)	43314	61437	53669	58803	70667	57974	71112	66688	61446	62128	71685	82880
4	Production of agricultural services	685	716	751	557	545	535	744	984	860	900	946	1246
5	AGRICULTURAL PRODUCTION (r.3+4)	43999	62153	54420	59360	71211	58509	71856	67672	62305	63028	72630	84126
6	Processing of agricultural products	3701	4841	5508	5093	5297	5751	6609	6852	6444	6321	5864	6080
7	PRODUCTION OF AGRICULTURAL BRANCH (r.5+6)	47700	66994	59928	64453	76509	64259	78464	74524	68750	69349	78494	90206
8	TOTAL INTERMEDIATE CONSUMPTION (sum.(8.1,8.11))	26874	36201	32827	36688	42133	36571	44786	42929	39849	39991	43265	52175
9	Seeds and planting material	2409	3416	2604	3501	4068	3117	4353	3921	3147	3520	3158	5716
10	Energy; lubricants	3189	5128	4612	6136	7748	6766	8510	8771	7977	8433	8558	10691
11	Fertilizers and amendments	1045	2479	1963	2525	3209	2891	3341	2887	2647	2937	3088	2767



12	Products for the protection of crops and pesticides	528	905	747	1065	1284	1089	1428	1283	1135	1367	1499	2043
13	Veterinary expenditure	674	1102	1280	1275	1290	1349	1430	1473	1463	1263	1119	1491
14	Feed	11880	13030	11313	12456	12549	12251	12993	11970	11225	11144	12184	13365
15	Maintenance of materials	1791	2560	2445	2307	2944	2312	2668	2379	2019	2164	3679	4141
16	Maintenance of buildings	338	325	316	251	445	420	444	456	497	547	471	603
17	Agricultural services	685	716	751	557	545	535	744	984	860	900	946	1246
18	Indirectly financed financial services (sifim)	272	293	221	128	117	81	243	192	134	148	148	148
19	Other goods and services	4064	6246	6575	6486	7934	5761	8631	8613	8745	7568	8416	9965
20	<b>Gross added value in base prices (r.7-8)</b>	<b>20826</b>	<b>30793</b>	<b>27101</b>	<b>27765</b>	<b>34375</b>	<b>27688</b>	<b>33679</b>	<b>31595</b>	<b>28901</b>	<b>29358</b>	<b>35229</b>	<b>38030</b>
21	<b>CONSUMUL DE CAPITAL FIX (sum.(10.1,10.4))</b>	<b>7535</b>	<b>7401</b>	<b>8172</b>	<b>9799</b>	<b>11649</b>	<b>11659</b>	<b>13334</b>	<b>12494</b>	<b>10888</b>	<b>10386</b>	<b>11927</b>	<b>13003</b>
22	Equipment	4270	3792	4581	6172	7742	7602	9089	8179	6603	6118	7517	x
23	Construction	1560	1695	1760	1751	1837	1888	2048	2105	2127	2131	2263	x
24	Plantations	618	741	592	562	670	736	707	703	656	662	650	x
25	Others	1087	1173	1239	1313	1400	1434	1491	1507	1502	1474	1498	x
26	<b>NET ADDED VALUE IN BASIC PRICES (r.9-10)</b>	<b>13290</b>	<b>23392</b>	<b>18930</b>	<b>17966</b>	<b>22726</b>	<b>16029</b>	<b>20344</b>	<b>19101</b>	<b>18013</b>	<b>18972</b>	<b>23302</b>	<b>25027</b>
27	Remuneration of employees	5860	7691	8974	11545	1490	1665	1730	1919	2217	2564	2782	3882
28	Other taxes on production	191	166	93	98	93	93	93	93	99	99	99	99
29	Other grants on production	1638	1467	3015	4264	5071	6050	6452	8173	7010	11802	11411	11133
30	<b>FACTOR INCOME (r.11-13+14)</b>	<b>14737</b>	<b>24693</b>	<b>21852</b>	<b>22132</b>	<b>27704</b>	<b>21986</b>	<b>26703</b>	<b>27181</b>	<b>24923</b>	<b>30675</b>	<b>34614</b>	<b>36061</b>
31	<b>NET EXPLOITATI ON OF OPERATING / MIXED INCOME (r.15-12)</b>	<b>8878</b>	<b>17002</b>	<b>12878</b>	<b>10588</b>	<b>26214</b>	<b>20322</b>	<b>24973</b>	<b>25262</b>	<b>22706</b>	<b>28111</b>	<b>31832</b>	<b>32179</b>
32	Payment lease	174	249	256	332	487	634	648	631	758	726	853	853
33	Interest to pay	23,05,2019	218	380	410	472	584	416	429	414	350	349	349
34	Interest to be received	14	37	50	57	35	51	51	43	42	39	21	21
35	<b>THE NET INCOME OF THE COMPANY (r.16-17-18+19)</b>	<b>8694</b>	<b>16572</b>	<b>12292</b>	<b>9903</b>	<b>25290</b>	<b>19155</b>	<b>23960</b>	<b>24245</b>	<b>21576</b>	<b>27074</b>	<b>30652</b>	<b>30999</b>
36	Brief formation of fixed capital - FBCF (without deductible VAT)	4342	3595	3849	4699	6357	4616	5787	4803	4155	4330	4894	x

37	Net fixed capital formation (without deductible VAT)	-3193	-3806	-4323	-5100	-5292	-7043	-7547	-7691	-6733	-6056	-7034	x
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Source: National Institute of Statistics (Agriculture Economic Accounts)

*The vegetal production* registers an increase of the value, at the current prices, during the analyzed period, thus, if in 2007 the vegetal production stood at the value of 28.7 billion lei, in the year 2018, it registered the highest level (taking into account also record productions) of about 63.4 billion lei, 2.2 times higher than in the first year. Analyzing on average, each year, there was an average growth rate of about 7.5%.

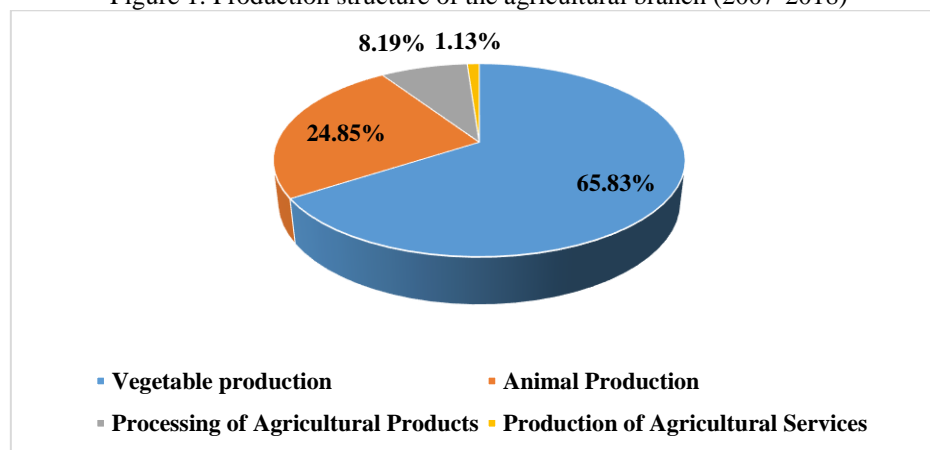
*Animal production* also registered increases during the reference period, in the year of accession to the European Union there was registered a value of this indicator of about 14.6 billion lei, and in the last analyzed year, 2018, the value of the animal production was of almost 19.5 billion lei, respectively 33.6% more. The average annual growth rate of 2.7% was recorded over the whole period analyzed

Regarding the *production of agricultural services*, it has also registered an increasing evolution, overall, registering a value of it, in the last year, of 1.25 billion lei, with about 82% more than in the first year, then when the value of agricultural services on the market was 685 million lei. The average annual rate of growth of the value of agricultural services is approaching the rate of increase of the value of vegetable production, being 5.6% per year.

From the *branch of agricultural production*, the processing of agricultural products is also included, the value of which has increased during the analyzed period, but not with the same frequency. Thus, if the value of agricultural production and services registered a somewhat constant increase from year to year, this increase in the value of processing of products is different, registering the highest value in 2014, of 6.85 billion lei, with 85 , 15% higher than in the first year, and 12.7% higher than the value processed in the last year (of 6.08 billion lei). The average annual growth rate was 4.6%.

Therefore, the evolution of the *value of the production of the agricultural branch*, obviously maintains the trend recorded in the previous indicators, respectively one of growth. In 2007, the value of the production of this branch was about 47.7 billion lei, and in 2018, there was an 89% higher value, respectively of 90.2 billion lei. Annually, an average growth rate of about 6% was recorded.

Figure 1. Production structure of the agricultural branch (2007-2018)

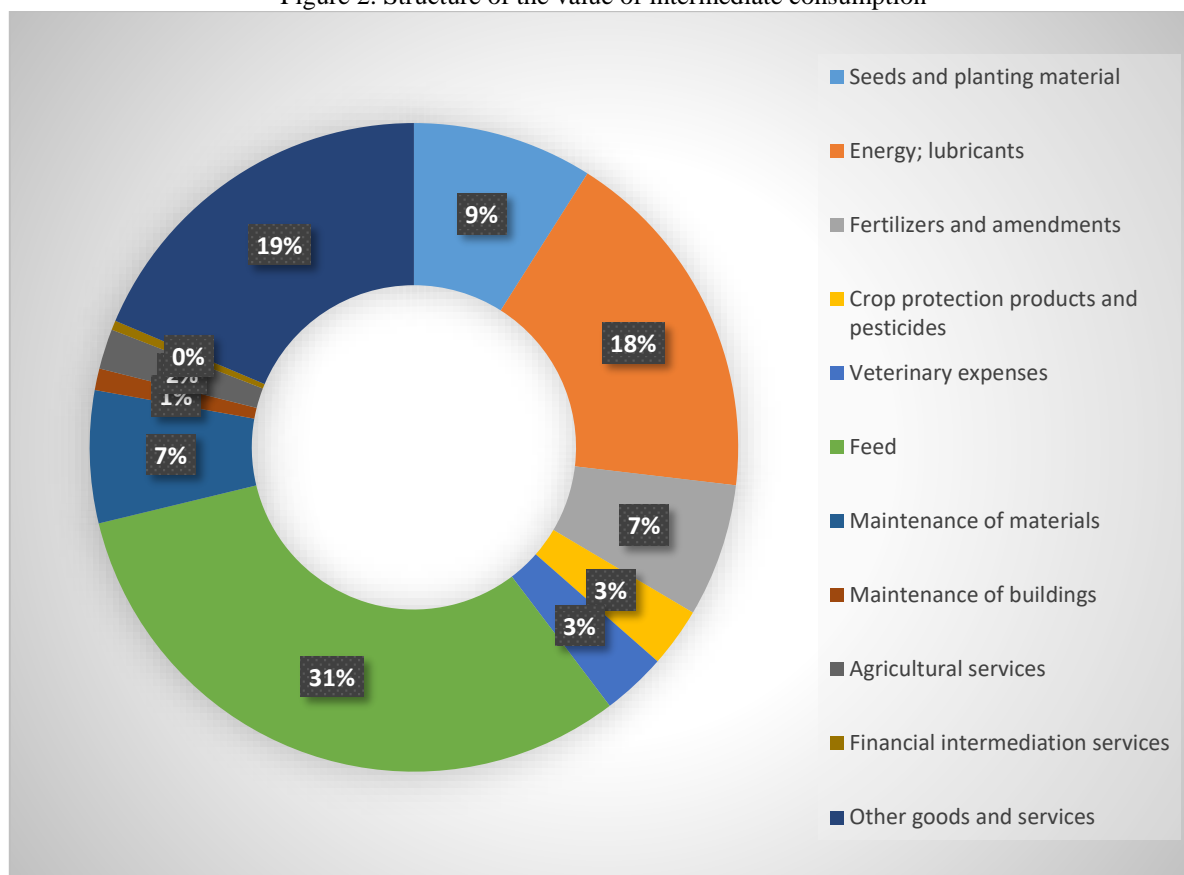


Source: own processing based on INS data

As can be seen from figure 1, in which the structure of the value of the agricultural production branch is presented, about 66% is represented by the plant production, and about 25% is represented by the animal production. Thus, summing the two components of the agricultural branch, it turns out that the value of the production of agricultural goods represents about 91%, on average (in the period 2007-2018), of the total branch. The production of agricultural services has a contribution in the value of the production of the agricultural branch of 1% (in the period 2007-2018),

thus, the total agricultural production is about 92% of the total agricultural branch. The processing value of the production is also part of this total, whose value represents 8% of the total value of the branch.

Figure 2. Structure of the value of intermediate consumption



Source: own processing based on INS data

Figure 2, shows the components that make up the value of *intermediate consumption*, being presented as an average weight in the analysis period 2007-2018. Thus, the most significant weight in the total of intermediate consumption is represented by the value of feed, which holds about 31.5% of the total. In the second position, depending on the weight in the value of intermediate consumption, the category of other goods and services, with a share of 18.6%, is located. Next, at a small difference, by weight, we find the category of energy, lubricants, which has a share in intermediate consumption of 17.9%. The following categories are positioned below; seeds and planting material, with a weight of 9%, fertilizers and amendments with 6.7%, maintenance of materials with 6.6%, veterinary expenses with 3.2%, plant protection products and pesticides with 3%, agricultural services by 2%, the maintenance of buildings by 1% and financial intermediation services by 0.5%.

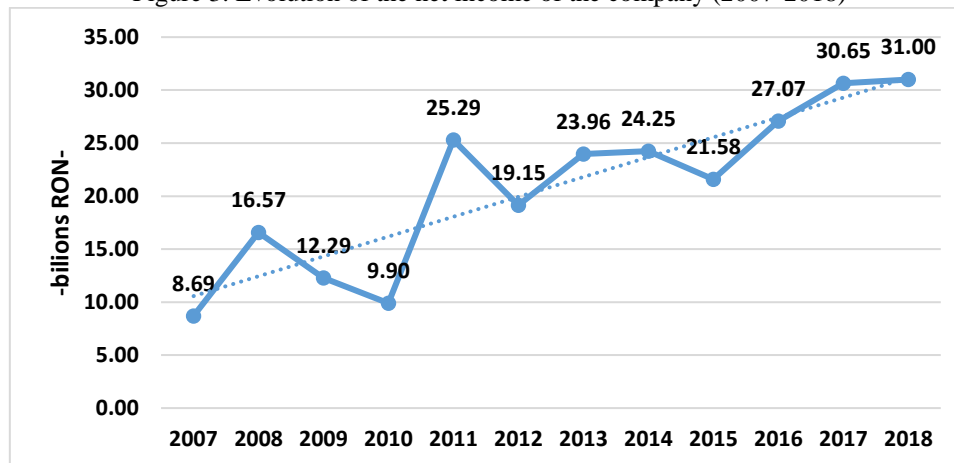
Realizing the difference between the production of the agricultural branch and the intermediate consumption, resulted, according to the National Institute of Statistics, *the gross added value* of agriculture. It registered an increase during the analyzed period, following the trend of the indicators with which it is calculated. Thus, in 2018 a gross added value of 38 billion lei was registered, 82.6% higher than in 2007 (when 20.8 billion lei was registered), being the smallest value in the analyzed period. On average, the annual growth rate did not deviate from those of the factor indicators, respectively the value of branch production and intermediate consumption, registering an average annual rate of 5.6%.

Eliminating from the value of the *income of the factors* and the remuneration of the employees (registering an average annual decreasing rate of -3.7%, taking into account the decreasing labor force in agriculture, and the migration of the population from the rural areas, even though the level of the wages has increased in this period) results in the *net operating surplus* (or mixed income).

This represents an average annual growth of 12.4%, reaching the level of 2018 to be worth 32.18 billion lei, 3.6 times higher than in 2007.

From this net operating surplus decreasing the leases (which record an average annual growth of 15.5%) and adding the interest balance (those to be paid with a growth rate of 28%, and those to be received only by 4%), the *net income of the enterprise* is obtained.

Figure 3. Evolution of the net income of the company (2007-2018)



Source: own processing based on INS data

The net income of the company registered increases, on average, during the analyzed period, thus, in the year of Romania's accession to the European Union, there was a net income of the enterprise of about 8.7 billion lei, but it registered growth fluctuations, reaching in 2018 it will be almost 31 billion lei, being 3.5 times higher than in the first year. Analyzing the average annual growth, a rate of 12.25% is recorded.

This significant increase comes on the one hand due to the reduction of the remuneration of wages (given the difficulty in the labor market in the rural area), but also through the reduction of taxes, and on the other hand a direct and significant influence has the value of subsidies. granted representing about 36% (in 2018) of the valuation of the net income of the company.

With the help of these indicators it was possible to determine the overall economic efficiency in agriculture, summarized in the following model.

Table 2. The overall economic efficiency in the agriculture of Romania in the period 2007-2018

Economic Efficiency Indicators	U.M	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Share of intermediate consumption in the value of prod. Agriculture	%	56,3	54,0	54,8	56,9	55,1	56,9	57,1	57,6	58,0	57,7	55,1	57,8
The share of VAB in the value of prod. Agriculture	%	43,7	46,0	45,2	43,1	44,9	43,1	42,9	42,4	42,0	42,3	44,9	42,2
VAB at a leu intermediate consumption	Coef.	0,8	0,9	0,8	0,8	0,8	0,8	0,8	0,7	0,7	0,7	0,8	0,7
VAN dynamics	%	100,0	176,0	142,4	135,2	171,0	120,6	153,1	143,7	135,5	142,8	175,3	188,3
Dynamics of producers' incomes	%	100,0	190,6	141,4	113,9	290,9	220,3	275,6	278,9	248,2	311,4	352,6	356,6
Producers' incomes in the value of agricultural production	%	18,2	24,7	20,5	15,4	33,1	29,8	30,5	32,5	31,4	39,0	39,1	34,4
Labor productivity in agriculture calculated at the value of agricultural production	Thousands. lei / person employed full time	19,4	27,8	24,9	26,4	31,3	25,6	33,0	32,4	34,3	40,2	45,1	x

Source: calculations based on INS data series

The share of intermediate consumption in the value of the production of the agricultural branch has ranged from 54% to 58% in the period 2007-2018, with an average of 56.44%. Thus, given the rather small oscillations, it can be appreciated that the evolutions of these two main indicators (intermediate consumption and the value of the agricultural branch production) analyzed previously were similar.

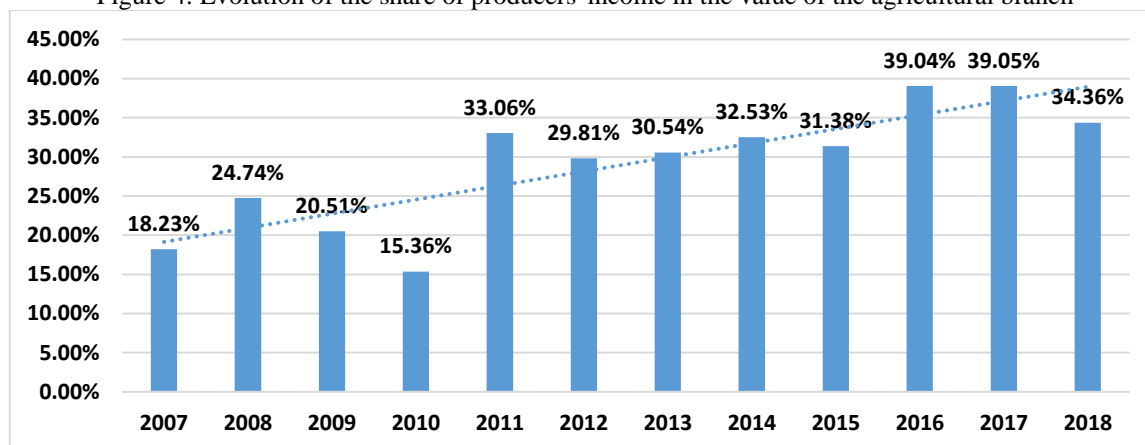
The share of the gross value added (GVA) in the value of the production of the agricultural branch registers, on average for the whole analyzed period, 43.56%, oscillating, as absolute difference between years with the previous weight, because this weight is part of the difference until the whole of the value of the production farm. The lowest share was registered in 2015, being 42%, and the highest was registered in 2008, being close to 46%, so it can be appreciated that the share of GVA in the value of the production of the agricultural branch is somewhat constant.

Analyzing the gross added value, calculated as a ratio of intermediate consumption (GVA to a leu intermediate consumption), it can be appreciated that, on average, following a consumed leu it is estimated that a GVA of 0.77 lei is recorded (2007-2018 average) ), registering in 2008 the highest value of 0.85 lei for a leu intermediate consumption, and the lowest value registering itself in the last year (2018), when for a leu intermediate consumption was obtained a GVA of 0.73 lei. Even if this amount may seem high, other depreciation expenses should be taken into account and not only has what affected this amount.

Analyzing also the dynamics of the incomes of agricultural producers, it can be observed that it registered a significant increase, registering relative differences, between 13.9% and 256.5%, compared to the reference year 2007. The main factor that intervened in this considerable growth of the income of the producers is related to the granting of subsidies, which represent, on average, 30% of this income, but among the causes can be mentioned: the decrease of the remuneration of wages, considering the decrease of the labor force, but also the decrease of the value of the taxes.

Next, the share of the producers' incomes was determined in the value of the productions of the agricultural branch, this weight being similar to the rate of commercial profitability. On average, over the entire period analyzed, this rate was 29%, with oscillations between 15% (in 2010) and 39% (in 2017). Thus, the value of the branch of agricultural production (respectively what share of the producers' incomes in the sale of agricultural goods and services) is around 30%, a threshold recommended in the economic literature.

Figure 4. Evolution of the share of producers' income in the value of the agricultural branch



Source: calculations based on INS data series

As can be seen, the profitability of the agricultural branch, depending on the production obtained (capitalized), fluctuated between 15.36% (2010) and 39.05% (2017) between 2007 and 2007, and these fluctuations can be attributed to both the factors climates that can significantly influence the level of production, but, given that this indicator measures the efficiency of the whole branch, we can consider that the production structure can also influence this indicator. It can be observed that the general tendency of the profitability is one of increase, reaching in the last years to surpass 35% reaching almost 40 percent.

## CONCLUSIONS

In order to have an overview of the current situation in agriculture regarding the profitability of this economic branch, at the beginning of this interim report, an analysis of the global economic efficiency of the Romanian agriculture was performed. For this, indicators of the Economic Accounts for Agriculture (CEA) were presented and analyzed. As a result of their evaluation, it can be appreciated that both the value of the plant production and the one of the animal production have increased during the analyzed period, the first of these recorded a more rapid growth rate than the last one. These increases can come, on the one hand, by increasing the obtained production (of the yield per hectare or per head of animal, which have registered increases in the last years), and on the other hand it can be stated that inflation has also contributed to this growth. of the value of agricultural production.

The services and processing sectors were also analyzed in order to determine the structure of the agricultural branch, on average, 66% of which is represented by plant production, 25% by animal production, 8% representing the processing sector and 1% that of services.

The intermediate consumption registered significant increases during the analyzed period, with a higher rate than the value of the agricultural branch, but the level of consumption still remains below that of the value of production. Therefore, it can be appreciated that, if the current trend is maintained, at a global level, in agriculture, the level of intermediate consumption will be above that of the value of agricultural production, thus a loss in this sector is expected, but granting subsidies can balance this ratio.

Realizing the difference between the value of the production of the agricultural branch and of the intermediate consumption resulted the gross added value (GVA), this also registering increases in the reference period, following the tendency of the indicators by means of which it is calculated.

Following the depreciation of the GVA, the taxation and by adding the balance of interest and subsidies, the net income of the company is finally determined, it records a fairly high average annual growth rate. This significant increase comes on the one hand due to the reduction of the remuneration of wages (given the difficulty in the labor market in the rural area), but also through the reduction of taxes, and on the other hand a direct and significant influence has the value of subsidies. granted representing about 36% (in 2018) of the valuation of the net income of the company.

Analyzing the weight of intermediate consumption in the value of the production of the agricultural branch, it was found that it ranged between 54% and 58% between 2007 and 2018, with an average of 56.44%. Thus, given the rather small oscillations it can be seen that the evolutions of these two main indicators (intermediate consumption and the value of the agricultural branch production) analyzed previously were similar.

The main factor that has intervened in the considerable increase of the producers' incomes is related to the granting of subsidies, which represent, on average, 30% of this income, but among the causes can be mentioned: the decrease of the remuneration of wages, taking into account the decrease of the labor force, but also lowering the value of taxes.

Analyzing the share of producers' incomes in the value of the production of the agricultural branch, which can be similar to the rate of commercial profitability of the agricultural branch, it is found that it fluctuated during the analyzed period between 15.36-39.05%, these oscillations can be put on account of the climatic factors that can significantly influence the level of production, but, given that this indicator measures the efficiency of the whole agricultural branch, it can be considered that the production structure can influence this rate as well.

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# THE EFFICIENCY OF THE ROMANIAN HORTICULTURAL SECTOR IN COMPARISONS WITH OTHER EU COUNTRIES

CORNELIA ALBOIU<sup>1</sup>

**Abstract:** *The purpose of the paper is to analyze the competitiveness of the Romanian horticultural sector in terms of production efficiency, using a few specific indicators such as land productivity, labour productivity, and share of costs in production. These indicators have been calculated on the basis of FADN (Farm Accountancy Data Network) at the level of other EU member states as well, to compare these with the Romanian horticultural sector. The results reveal a low efficiency of production in Romania as against the other investigated country, which denotes a reduced impact of CAP measures in the horticultural sector from Romania, a poorly organized chain and quite a low horticultural production integration in the food chain. Therefore, Romania's integration into the EU structures and the implementation of all CAP measures in this sector has not had the expected effect yet.*

**Keywords:** *horticultural sector, competitiveness indicators, CAP*

**JEL Classification:** *Q10, Q19.*

## INTRODUCTION

At present, there are numerous concerns with regard to the assessment of horticultural sector competitiveness, due to the Common Agricultural Policy (CAP) measures in the first place, as it is desired to observe their impact on total productions, yields and farmers' incomes. The scientific approach is also necessary in order to improve domestic supply and meet consumers' needs. These objectives can be reached by improving production efficiency and increasing the competitiveness of the sector. The horticultural sector is currently facing supply (production) instability and high volatility of prices, while the inability to provide the raw material needed for the processing factories further emphasizes the need to ensure a stable vegetable supply, and mainly to find solutions to improve the use of factors that contribute to competitiveness growth such as the functioning of the chain, application of inputs, technical progress, under the background of quite a low capitalization level of the sector and a domestic production still far to meet the consumption needs of the population and possibly creating a competitive producer status within Europe. At the same time, the precarious organization of the chain, the small number of producer groups and organizations in the sector contribute to maintain a low competitiveness level of the sector.

## MATERIALS AND METHODS

### Literature review

Competitiveness can be analyzed both in national or international context, through analyses at sector level. The competitiveness of a sector is reflected in its profitability and ability to stay on the domestic market and/or the export markets. Latruffe (2010) defines the competitiveness by using several categories of factors: i) actual production and commercial characteristics (competitiveness is measured by production trends and evolution, export or import indices, comparative advantage indices, etc.) and ii) strategic management referring to business structure and strategy (competitiveness is measured through indicators referring to costs, profitability/viability, productivity and efficiency). So far, there is no generally accepted definition of competitiveness measurement, so that comparative analyses and case studies can complement the analysis of competitiveness.

In other authors' opinion, e.g. Capalbo et al. (1998), Tasevska and Rabinowicz (2014), competitiveness should be rather measured at the level of primary production than at the level of the sector. On the other hand, certain authors consider that measuring the competitiveness of a nation or

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sector is meaningless, and it is individual competitiveness (firms or farms) that matters (for instance, Brinkman, 1987, Krugman, 1994, Harrison and Kennedy, 1997). At the same time, Brinkman (1987) considers, on the basis of research results, that government's intervention can superficially change competitiveness, without increasing real competitiveness. The author explains that in the cases when competitiveness is "bought" by public subsidies, one can speak about false competition.

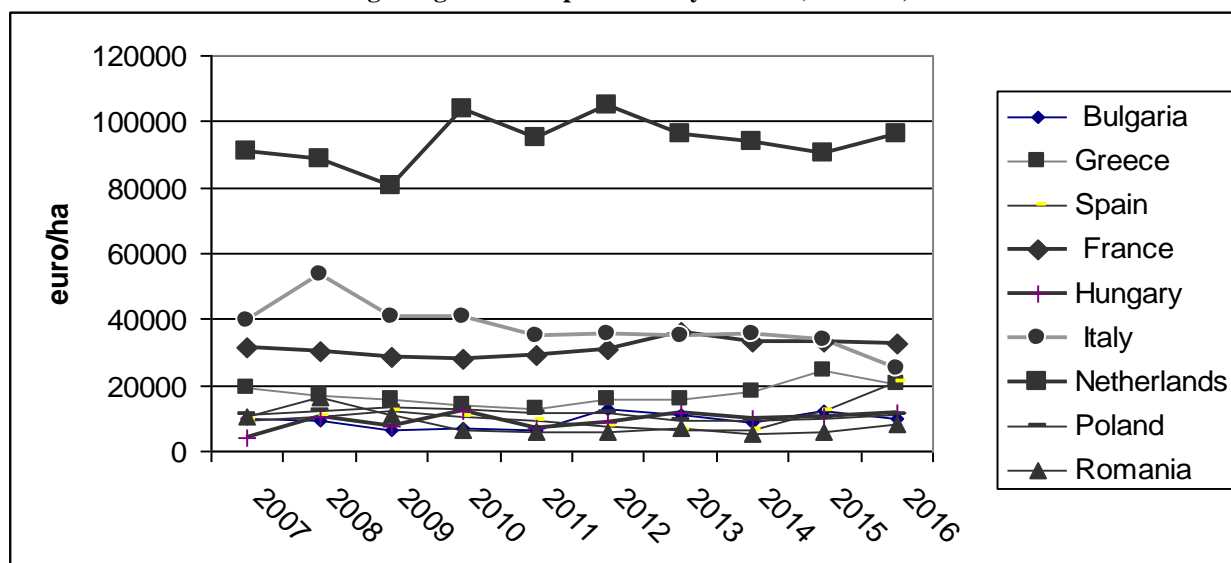
In this paper, competitiveness is analyzed at sector level in several EU member states, in order to make comparisons with Romania. More exactly, the evaluation of horticultural sector competitiveness was carried out for 7 EU member states for the period 2007-2016, for Romania inclusively, and the analysis was based on FADN (Farm Accountancy Data Network) and EUROSSTAT data. For this analysis the following indicators of production efficiency (factor productivity) have been used: land productivity (production obtained on 1 UAA ha), labour productivity (gross income of farm per annual work unit), total factor productivity.

## RESULTS AND DISCUSSIONS

### Agricultural productivity of land in Romania's horticultural sector compared to that of other EU member states

This indicator of competitiveness reveals land agricultural productivity and represents a partial productivity of the land factor. For the purpose of the analysis, comparisons were made with the following EU member states, as potential competitors in this sector: Bulgaria, Greece, Spain, France, Hungary, Italy, the Netherlands and Poland.

Fig. 1 Agricultural productivity of land (euros/ha)



Source: author's calculation based on FADN, 2018

In the case of this indicator, the results reveal that the Romanian horticultural sector has the lowest competitiveness, compared to the countries under analysis. The greatest contrast is noticeable at present, by comparison with countries such as the Netherlands (96 thousand euros/ha) and France, land productivity being 12 times lower in Romania's horticultural sector compared to the Netherlands and 4 times lower than in France.

After the accession to the EU, this indicator reached a maximum value in the year 2008, i.e. 16 thousand euros/ha, while in the year 2014 a historical minimum was noticed (5468 euros/ha). Romania's horticultural sector also has low land productivity compared to the new member states, being relatively close to that of Bulgaria, yet slightly lower, namely land productivity 1.2 times and 1.4 times lower than that of Poland and Hungary.

## Agricultural productivity of labour in the Romanian horticultural sector, comparisons with the EU

This is a competitiveness indicator that reveals the agricultural productivity of labour and represents a partial productivity of the labour factor. The calculation of this indicator allows the quantification of the labour factor to see the efficiency of production in relation to the technology used.

**Table 1.** Agricultural productivity of labour (thousand euros/ pers.)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Bulgaria	6.9	8.3	7.8	6.4	6.6	7.1	7.6	8.4	9.2	8.8
Greece	25.5	24.5	23.8	24.7	22.7	20.9	21.6	27.1	25.9	24
Spain	27	30.3	33.2	34.5	29.2	31.5	32.7	34.3	39.1	47.9
France	57.4	56.8	57.4	61.4	60.1	66.5	66.6	67.1	72.5	70.6
Hungary	24.3	26.8	20.9	27.5	25	28.6	30.1	26.3	31.1	33.4
Italy	51.6	56.7	59.5	58.2	54.4	55.3	53.9	60.6	60.5	51.9
Netherlands	117.8	121.1	121.4	141.4	132.5	137.2	140.4	139.7	144	146.5
Poland	20.3	21.5	19.7	20.6	19.1	21.2	21.3	21.6	24.2	21.2
Romania	6.2	9	5.7	7.6	6.2	5.5	7.6	6.4	5.6	6.7

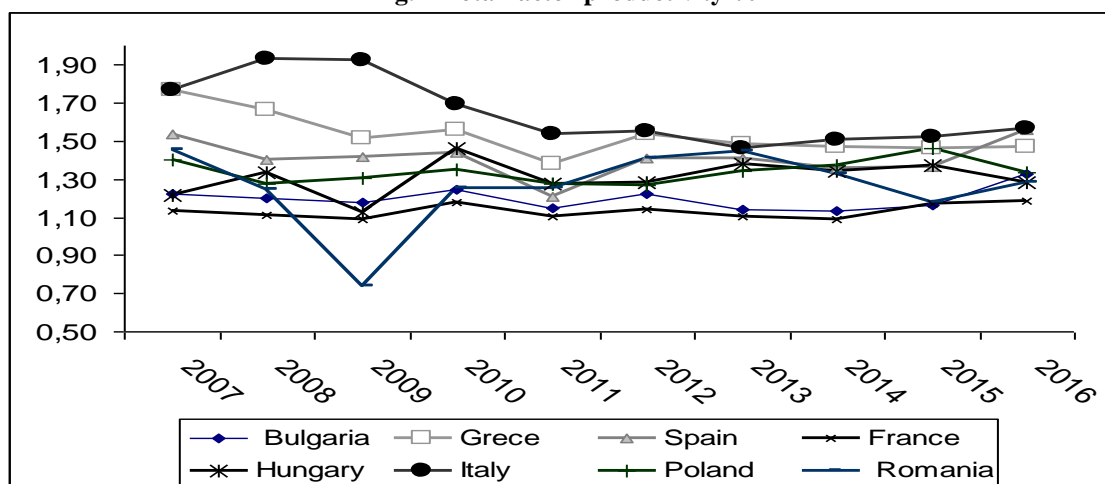
Source: author's calculation based on FADN, 2018

The results reveal that in the case of this indicator, the Romanian horticultural sector also has the lowest competitiveness level, with a minimum value in the year 2016, i.e. 5675 thousand euros/pers. The Netherlands stands out as the most productive and competitive country in terms of this indicator, too (with 144 thousand euros/pers.), followed by France (72 thousand euros/pers.) and Italy (60 thousand euros/pers.). In the case of the new member states under analysis, the results also show that labour productivity in the Romanian horticultural sector has the lowest level, 4.2 times lower than in Poland, 5.5 times lower than in Hungary and 1.6 times lower than in Bulgaria.

### Total factor productivity

Agricultural productivity is a measure of performance that reveals farm ability to increase production using fewer agricultural inputs. Agriculture productivity can be measured as ratio of the aggregated value of total production to the inputs used for production and partially, by relating the total production value to the value of a certain considered type of input (such as labour, capital, etc.) used in the production process. In this paper, the total productivity of factors in the horticultural sector is calculated for Romania and a few competitors from the EU in the period 2007-2016, also using FADN data. The total factor productivity index (FPI) was calculated as ratio of total production value to the value of agricultural inputs used on the farm in the horticultural sector.

**Fig. 2** Total factor productivity %



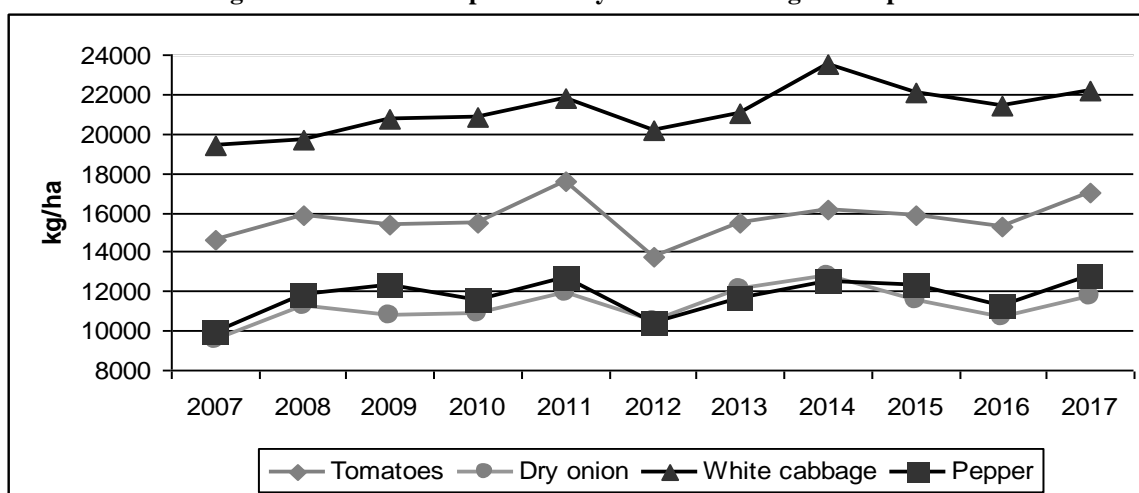
Source: author's calculation based on FADN, 2018

Figure 2 presents TFP for Romania and selected competitors among EU countries, in the period 2007-2016. According to the analysis, TFP had the lowest level in Romania in the year 2009, which suggests the existence of high input costs in relation to the value of production. In Romania, the obtained horticultural production value was 1.36 times lower than the necessary costs. Throughout the investigated period, a great variation of factor productivity in our country could be noticed, which can be explained by the variation of yields and production value (see Table 2), mainly due to weather conditions. Hungary and Bulgaria followed similar trends in TFP. Italy and Greece seem to be the countries operating on the highest total factor productivity curve. Compared to the other investigated countries, Romania's disadvantages are related to the variability of weather conditions that result in highly volatile yields, high labour and agricultural input costs. Large capital investments may be one of the reasons why countries like France and the Netherlands operate at low levels of total factor productivity.

### Average yields per hectare

The evolution of average yields is volatile, mainly due to the variation of weather conditions. The average yields per hectare in the period 2007-2016 are presented in Figure 3. Thus, in droughty years, yields have decreased, while in the normal years in terms of weather conditions, yields have had slightly increasing trends.

**Fig. 3 The evolution of productivity for the main vegetable species**



Source: tempo on line, INS, 2018

A slightly increasing trend in yields could be noticed for the main types of vegetables in the recent years, as a consequence of the increase of areas cultivated under greenhouses and solariums. The economic efficiency and the average yields per hectare in the vegetable farming sector depend on the weather conditions, on the technology used and on the way of getting adapted to the market. The volatility determined by the variation of weather conditions in recent years has been added to the lack of labour force, as well as to organizational difficulties in relation to production sale, which do not allow to obtain sufficient incomes to make capital investments like equipment and modern technologies, as well as to use quality inputs that contribute to the increase of average productivity.

### Share of costs in total production

This indicator reveals the competitive position of horticultural farms without taking into consideration the subsidies (and taxes). It is calculated as ratio of total costs to total production. Total costs have been calculated as sum of specific costs, general costs, factor costs (land, labour, capital) and occasional costs (for instance, depreciation + external factors). The lower their share, the more productive the sector can be considered.

**Table 2. Share of costs in total production %**

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Bulgaria	78%	81%	91%	100%	95%	96%	101%	89%	95%	90%
Greece	57%	60%	66%	64%	72%	65%	67%	68%	69%	68%
Spain	65%	71%	70%	69%	83%	71%	71%	74%	73%	64%
France	88%	90%	92%	85%	91%	88%	91%	92%	86%	85%
Hungary	82%	75%	89%	68%	78%	78%	73%	75%	73%	78%
Italy	57%	52%	52%	59%	65%	64%	68%	66%	66%	64%
Netherlands	91%	97%	99%	90%	95%	91%	91%	89%	84%	83%
Poland	71%	78%	76%	74%	78%	79%	74%	73%	68%	75%
Romania	69%	80%	135%	80%	80%	71%	53%	75%	85%	78%

Source: author's calculation based on FADN, 2018

## CONCLUSIONS

The calculation of competitiveness indicators referring to production efficiency in the Romanian horticultural sector reveals a low competitiveness level compared to all the other EU countries considered to be competitive in this sector. The Netherlands stands out as the most competitive country, followed by Italy, France and Spain. The impact of CAP measures on Romania's horticultural sector has been relatively modest, and the support received has not led to an improvement of the situation, mainly as the support to horticultural farms lacked consistency. The slightly higher yields in the recent years are mainly due to the increase of cultivated areas under greenhouses and solariums that allow the use of more productive varieties and the correct application of technologies. On the other hand, the value of obtained production is relatively modest, due to price and yield volatility and to the weak organization of the chain. The weak organization of the chain is perhaps one of the consequences of the low promotion and access level as well as of the way of thinking of the rural development programs so far. All these causes lead to a low competitiveness level of the sector, as revealed by the low values of competitiveness indicators calculated in the paper.

The increase of land areas cultivated under greenhouses and plastic tunnels could lead to the increase of average yields per hectare through the use of selected seeds, with high productive potential, as well as the correct application of technologies, including the procurement of equipment, logistics, new storage systems, which could result in the increase of sector competitiveness.

Although the supply of horticultural products is relatively diversified, the value added of products is low, mainly due to the lack of marketing knowledge and skills meant to ensure the necessary attractiveness and safety for consumers, to the lack of technical means for production sorting, packaging, storage and transport to the market, as well as to the absence of a system for production planning and its adaptation to the market requirements.

The policy of this sector must respond to the market exigencies through the diminution of price fluctuations and of the imbalance between supply and demand and to encourage the consumption of fruit and vegetables, while ensuring product competitiveness. The support to local production through coherent legislative measures, facilitating the access to EU funds, the creation of an organized distribution channel (through support to the creation of producer groups) could significantly contribute to the development of the horticultural sector in Romania.

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# THE ECONOMIC IMPACT IN THE VEGETABLES PRODUCTION SECTOR (TOMATOES) OF THE SUPPORT SCHEME FOR THE PROGRAM TO SUPPORT TOMATOES PRODUCTION IN PROTECTED SPACES FOR 2019

ROZI LILIANA BEREVOIANU<sup>1</sup>, ANCUȚA MARIN<sup>2</sup>, STELIANA RODINO<sup>3</sup>

**Rezumat:** *The paper presents the evaluation of the economic impact of the support scheme for the Program for the support of the product tomatoes in protected areas for 2019, on the vegetable production sector, with an emphasis on the results of the production, the market effects, the impact on the consumers and their preference for the Romanian tomatoes, the evolution of the trade balance. In this context, the study is based on extensive scientific documentation regarding the impact of financing from the National Budget and the support schemes established under the European CAP regulations. The objective of this work is to disseminate the results obtained and to promote the continuation of the implementation of the program to support the tomato production in protected areas. This program can also be developed and implemented for other deficient products that can benefit from government support programs during 2019-2020.*

**Keywords:** *tomato support scheme, economic impact, tomato production*

**JEL classification:** *Q13, Q18, Q28*

## INTRODUCTION

In Romania, the vegetables sector has benefited from financial aid, both by direct payments and by the possibility of accessing European funds for investments at sector level. The payments granted to the sectors and the productions are mentioned in art. 52 paragraph (2) of Regulation (EU) no. 1307/2013, and applies to those that are considered economically, socially and environmentally important, and which are facing difficulties. Thus, among the vegetables for which such support was granted include potatoes, tomatoes and cucumbers intended for processing industry, but also vegetables cultivated in greenhouses and solariums. However, the investments were not sufficient to ensure the domestic supply of fresh vegetables, Romania being dependent on imports from countries such as the Netherlands, Turkey or Italy. The main solution to reduce the dependence on imported vegetables is represented by the increase of the cultivated areas with vegetables in protected areas, which would allow the cultivation during the off-season.

The support scheme "Minimis aid for the application of the support program for tomatoes cultivated in protected spaces" is a multiannual government program that is applied according to the provisions of Regulation (EU) no. 1408/2013. The farmers which are cultivating tomatoes in protected spaces have benefited from the de minimis aid scheme provided for this sector since 2017 by GD no. 39/2017, program that continued in 2018 through the Decision no. 943 from December 20, 2017 and in 2019 by Decision no. 107/2019. The minimis scheme for 2019 is similar to 2017 and is implemented by the County Agricultural Directorates (DAJ). The financial resources necessary to implement the minimis aid scheme are provided from the budget for 2019 and reach an amount of 233,190 thousand lei, representing the equivalent of 50,000 thousand euros.

## MATERIALS AND METHODS

The scientific research aims to develop methods and techniques of analysis with concrete, original solutions regarding the economic impact in the sector of vegetables production (tomatoes) through the support scheme for the Program for the support of tomatoes cultivation in protected spaces.

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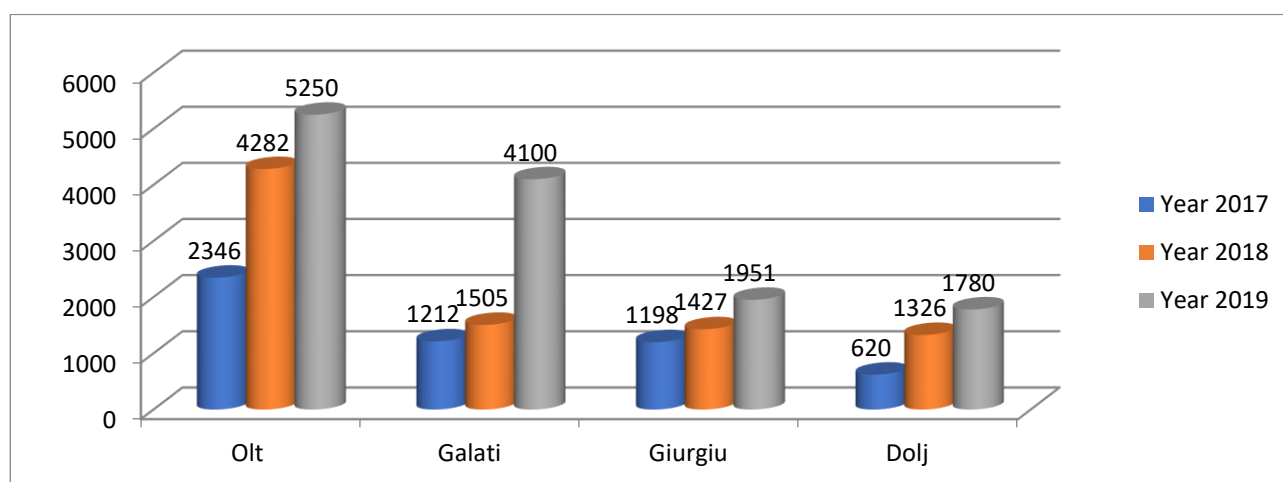
Thus, the paper involves the use of methodologies, techniques and equipment specific to an analytical study, data processing and data interpretation. As a method of collecting information, the quantitative survey was used, and as the investigation technique, the investigative one was used, structured as questionnaire. The survey is a questionnaire-based survey for collecting information regarding the problems that are facing the tomato producers.

## RESULTS AND DISCUSSIONS

During August-September 2019, an opinion poll was carried out among tomato producers for the identification of the *economic impact in the sector of vegetables production (tomatoes) through the support scheme for the Program to support the cultivation of tomato in protected spaces* and for collecting their opinions, in order to develop solutions / models for efficient commercial valorification of vegetables production. The questionnaire was applied to a number of 156 farms.

Based on the top counties ranked when analysing the number of farmers who benefitted from this support scheme, the questionnaire was applied to Olt, Galați, Giurgiu, Dolj (Figure 1.)

Figure 1 – Number of farmers who benefitted from tomatoes support scheme 2017 -2019



Source: MARD – Beneficiaries of the suport programme for tomatoes

The questionnaire was applied to a number of 156 respondents, sampled by gender, age, and occupation.

To summarize the results obtained, we will present in the following the most significant answers received from the respondents. All respondents started their activity (cultivation of tomatoes) after 1990, as follows: 11% started their activity in the period 1990-2000, 34% started their activity in 2001-2010, 55% started their activity the activity after 2010. One third of the respondents carry out their activity as natural persons, one third as Authorized Physical Person (PFA), and the rest are LLC or Individual enterprise, etc.

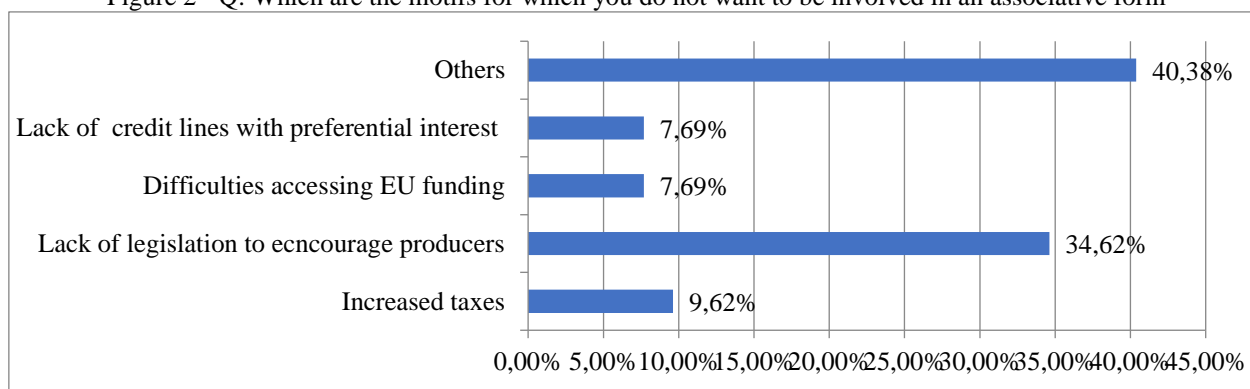
The overwhelming majority of the respondents (93%) consider that it is not necessary to adhere to an association form, while 1.79% belong to an association form, 3.57% belong to a group of producers, and 1, 79% are organized in cooperatives.

Unfortunately, more than half (67.31%) of the farmers who are not involved in an associative form are not interested in accessing such an organization in the future.

Regarding the motivation underlying the decision not to involve in an associative form, the first place is the lack of legislation to support the producers (34.62%), followed by high taxes (9.62%), the difficulties faced when applying for European funds (7.69%). Also, farmers claim the lack of loans with preferential interest for farmers belonging to an associative form (7.69% of the total participants in this study) (Figure 2).



Figure 2- Q: Which are the motifs for which you do not want to be involved in an associative form



Most of the participating farmers, ie 78.6%, own a farm with an area between 1-5 ha, while only 7 respondents own large farms, over 20 ha (12.5% of the total respondents). The remaining farmers own farms between 5-10 ha (7.14%) or 10-20 ha (1.79%).

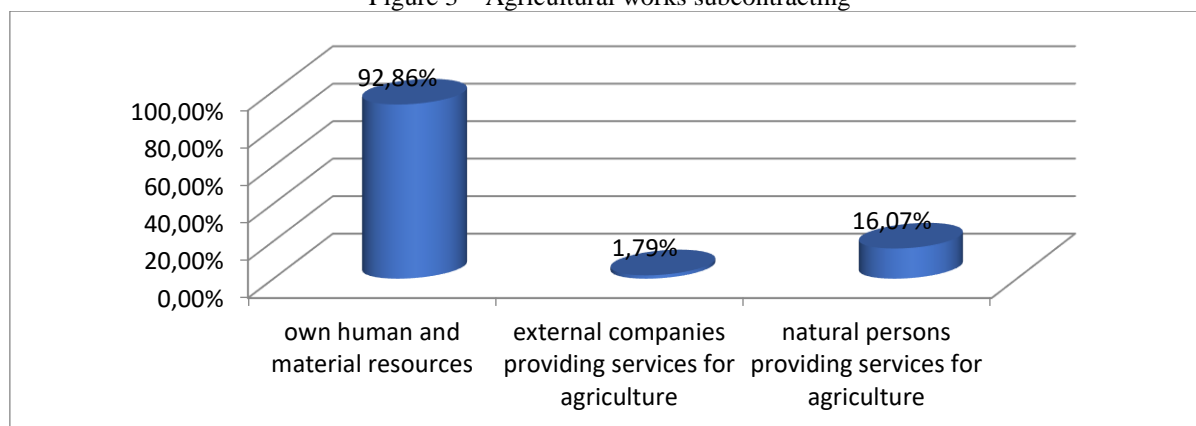
Of the 156 people surveyed, 37 (ie 66%) are cultivating vegetables in open field on areas less than 1 hectare, while 15 (26.8%) cultivate areas between 1-5 hectares.

Regarding the size of the cultivated protected spaces, the situation is different. Thus, the majority (57%) have greenhouses and / or solariums with surfaces between 1000-1500 square meters, almost a quarter cultivating vegetables in protected spaces over 2000 square meters.

The questioned farmers use varieties / hybrids of national origin or from import, and the seedlings are produced in a proportion of 86% in their own farm.

Regarding the mechanization of the works, mostly own resources are used (93%), and very rarely the agricultural work are done with companies specialized in providing services for agriculture, ( 1.79% of the total respondents). Almost 16% of the respondents use external individuals for providing the works (Figure 3).

Figure 3 – Agricultural works subcontracting



The structure of the human resources used reflects the fact that, generally, in farms with a small number of employees, family members are those who work on the farm, and only occasionally they employ seasonal workers or persons providing services for agriculture. Moreover, following the analysis of the questionnaires it was observed that the share of skilled workers is generally lower than that of unskilled workers.

The fertilizers used in the current agricultural practices, are classified both in the category of synthetic chemicals and in organic fertilizers. The questioned vegetables farmers do not exclusively use chemical fertilizers, they apply 34% organic fertilizers, the rest using a mixed (chemical + organic) variant.

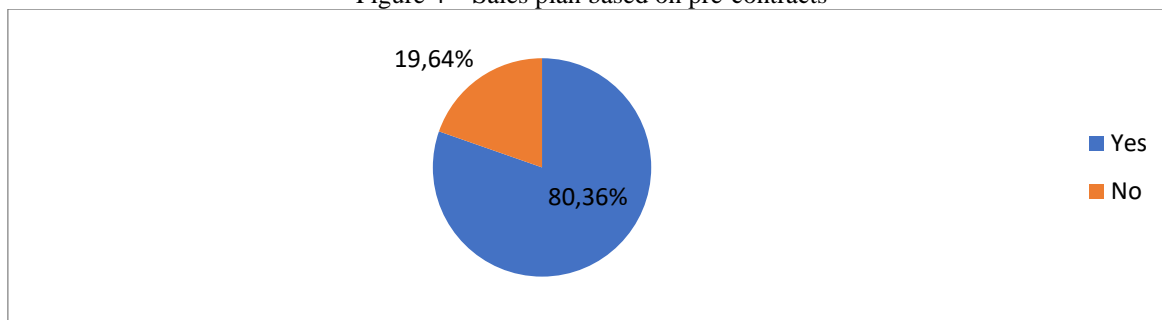


In the case of the phytoprotective treatments used by the farmers who participated in this study, an overwhelming majority of those applying conventional treatments, insecticides and pesticides in the category of synthetic chemicals (over 82%) was observed. A number of 150 producers from the 156 respondents replied that the main irrigation method used is "drip", 3 use the "sprinkler" method and 3 "furrow irrigation".

The market for the tomatoes harvested is another aspect taken into consideration when conducting this study. Both pre-harvest activities, such as pre-contracts for marketing the production, as well as the actual sales activity, from the point of view of the sales chains, and of the realized revenues, were taken into account.

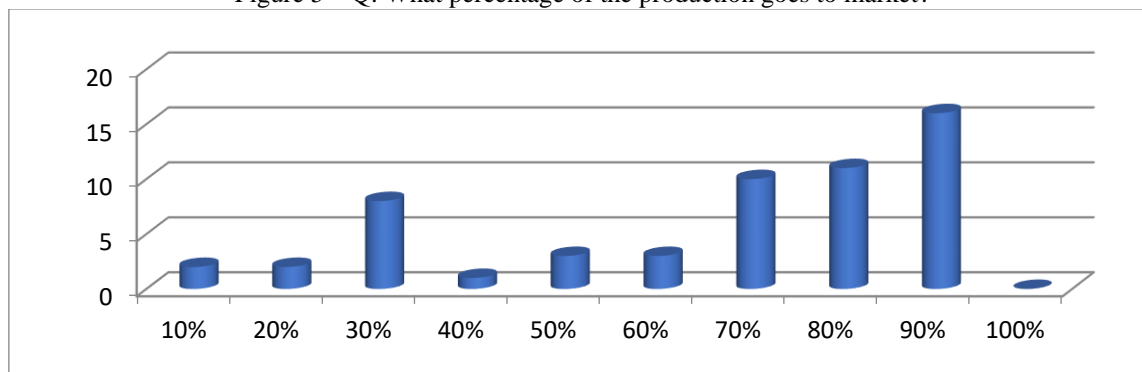
Thus, it is observed that 80% of the respondents plan their production structure based on contracts concluded in advance, having a well structured, predictable management plan, following the achievement of well established indicators (Figure 4).

Figure 4 – Sales plan based on pre-contracts



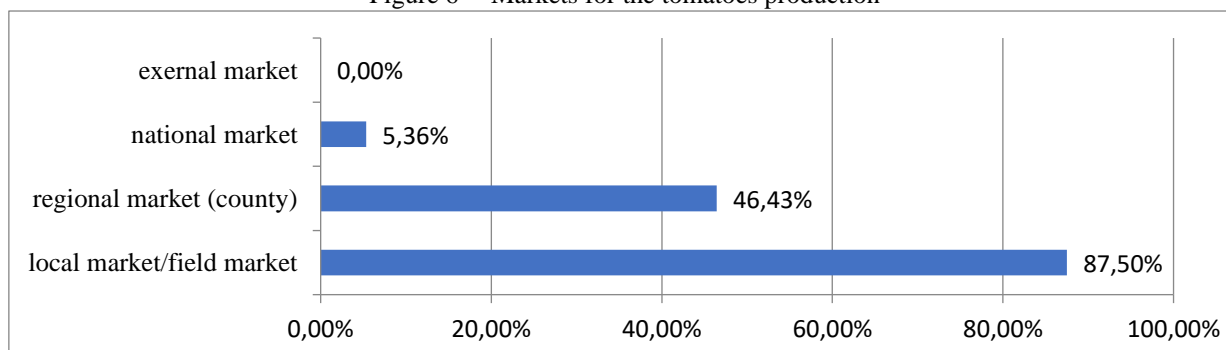
In the case of tomatoes, most of the production obtained goes to sale, even though a percentage is usually kept for self-consumption. A number of 103 (66.02%) of the interviewed producers are selling between 70-90% of the obtained production (Figure 5).

Figure 5 – Q: What percentage of the production goes to market?



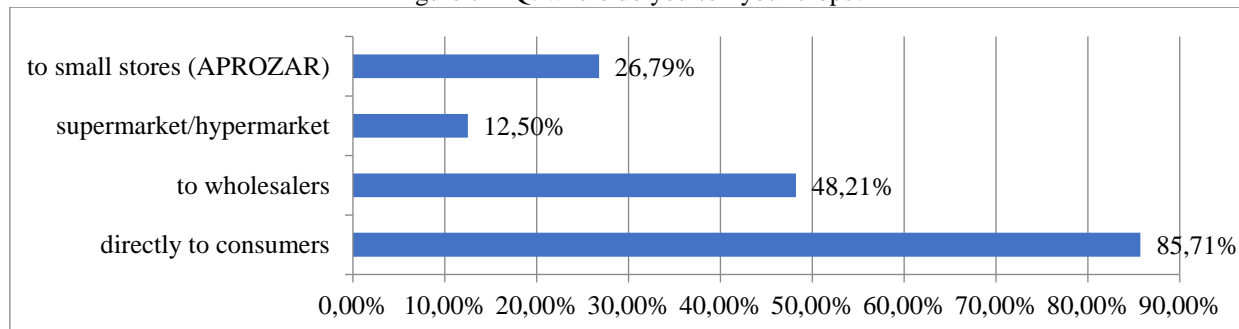
The results showed that the tomatoes are sold either in local markets / at the „farm field”, in county or national markets. None of the responding farmers export the obtained production. Most farmers (over 87%) market their products in local markets, probably to wholesale buyers (Figure 6).

Figure 6 - Markets for the tomatoes production



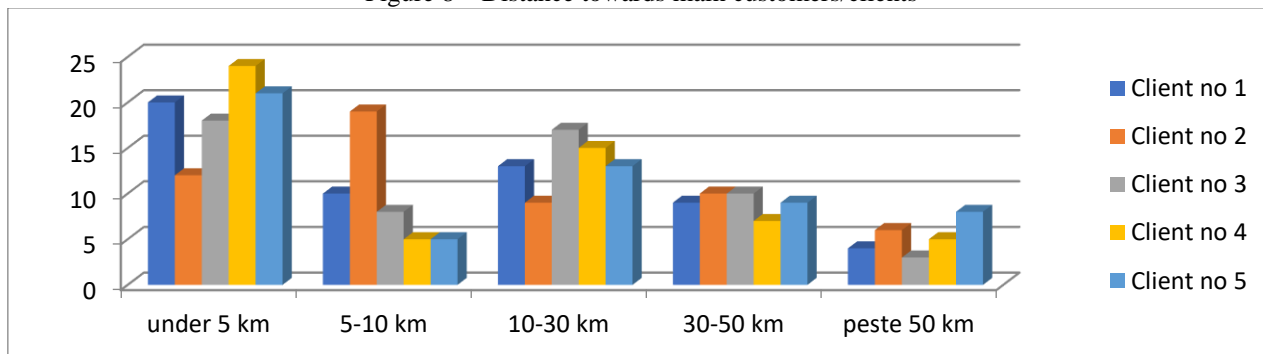
A very small number of producers have access to the large supermarket / hypermarket networks, (12.50% of the 156 respondents), the vast majority (about 86%) trading their production directly to consumers (Figure 7).

Figure 7 - Q: where do you sell your crops?



The main clients of the farmers taken in the study are located in the immediate vicinity of the farm (under 5 km). However, there are also farmers who have clients within a 50 km range of their own farm, with no rule in the distribution of customers (Figure 8).

Figure 8 – Distance towards main customers/clients



The revenues obtained from the sale of tomatoes are either very low, under 4,500 lei (44.64%) or over 10,000 lei (46.43%), the extremes being explained by the existence of a large number of small and very small farms, and the high incomes can also be put on account of the support scheme granted for tomatoes (Figure 9).

The issue of financing needed to carry out agricultural activity was also addressed through the use of own resources or access to funds available through national programs or EU funds. For the most part, the activities are supported by own funds. 70% of those surveyed are running their activity from own funds in a percentage of 70-90%), the differences being covered by bank loans, supplier credits and / or subsidies (Figure 10).

Figure 9 – Revenues from selling the harvested tomatoes

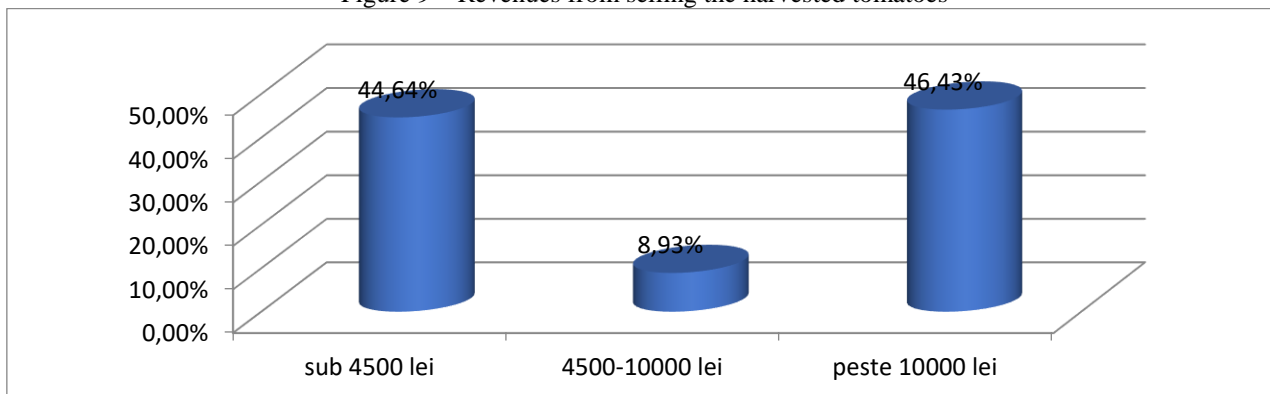
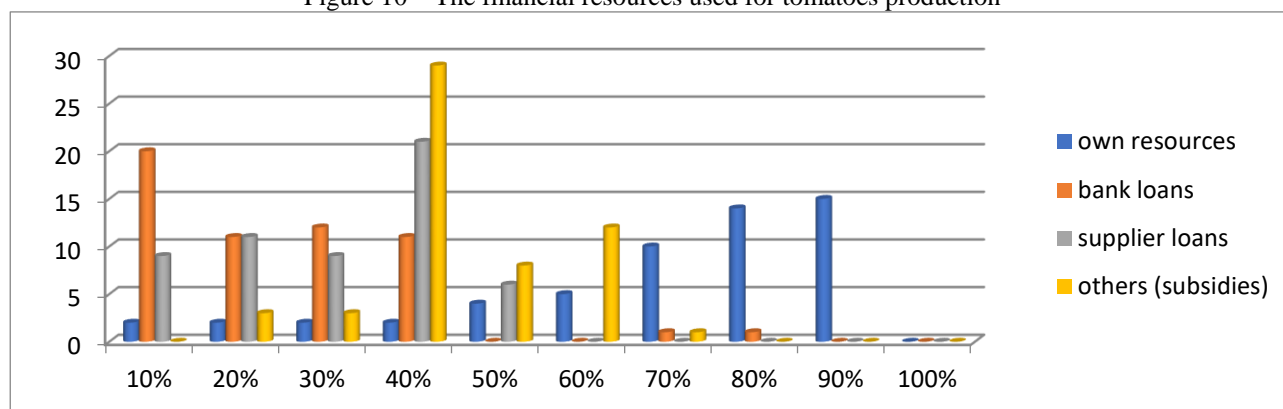


Figure 10 – The financial resources used for tomatoes production

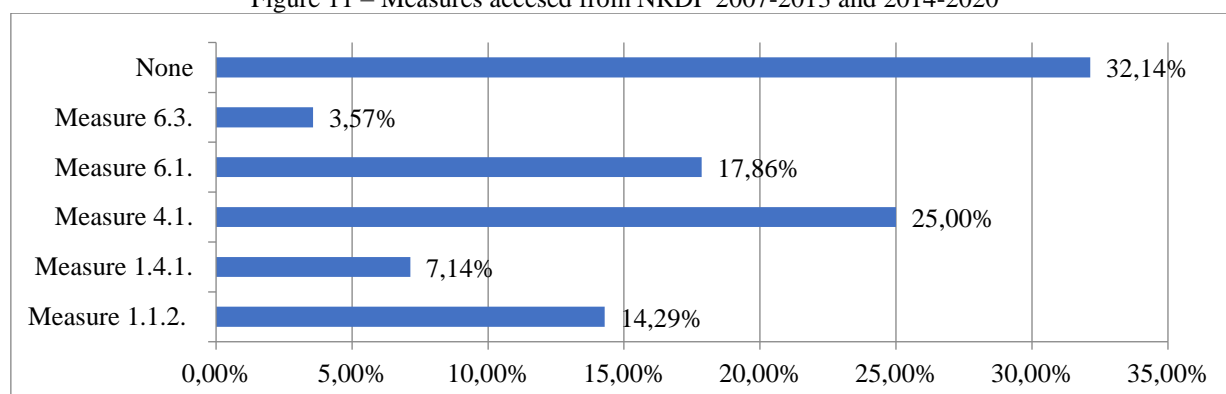


Most of the respondents (75%) are currently receiving subsidies from APIA. When asked if the activity could be profitable under the conditions of no subsidies, only 19.64% of the farmers claimed that they could face the market.

Moreover, over half of the farmers (57.14%) consider the support provided by the government as insufficient, 3.57% consider it insignificant, while only 39% consider the support provided by the government as sufficient.

The interviewed farmers are relatively well connected to the present realities, a percentage of almost 52% of them have already accessed EU funds. Also, the majority (67.86%) accessed funds from NRDP program, the most accessed measures being: 1.1.2. "Modernization of agricultural holdings" of the 2007-2013 program, 4.1. "Investments in agricultural holdings" and 6.1. "Support for the installation of young farmers" from the 2014-2020 program (Figure 11).

Figure 11 – Measures accessed from NRDP 2007-2013 and 2014-2020



For the creation of the framework of application of Regulation (EC) no. 1221/2008 from 5 December 2008 amending Regulation (EC) no. 1580/2007 establishing the norms of application of the Regulations (EC) no. 2200/96, (EC) no. 2201/96 and (EC) no. 1182/2007 of the Council in the fruit and vegetables sector regarding the marketing standards, published in the Official Journal of the European Union (OJ L 336 of 13/12/2008), the technical regulation "Quality and marketing requirements for fresh fruits and vegetables" was adopted. This fact led to the implementation of the *Support Scheme for the program to support cultivation of tomatoes in protected spaces*. A share of 71.43% of the farms surveyed in this study benefited of „tomatoes program”.

In the next period 64.29% of the respondents intend to access EU funds or national support programs for vegetables cultivation, while 10.71% have not yet decided.

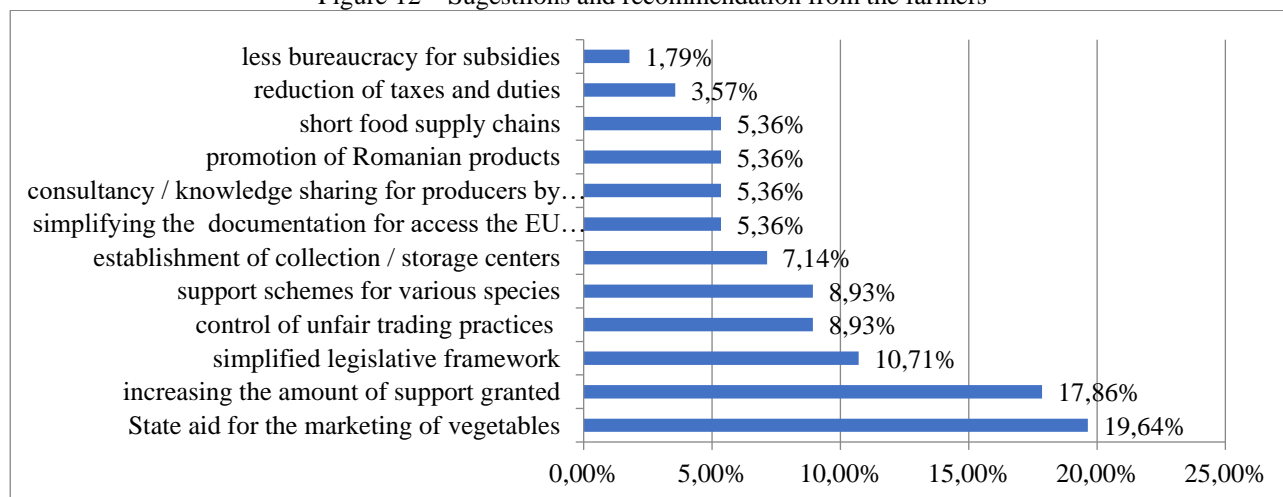
Most of the questioned farmers (73%) consider that the authorities have to get more involved by increasing the amount of support granted for various vegetables, possibly increasing the number of vegetables whose cultivation should be supported. As many as 50% of those interviewed believe that the intensive promotion of Romanian products would lead to an increase of the demand and

respectively of the consumption of local products. Last but not least, adopting more flexible legislation, more in line with their concrete needs, would be beneficial for all farmers in Romania.

Farmers accuse the lack of support legislation for small and medium-sized producers (loans with preferential interest, over-bureaucracy in accessing loans and in general any kind of support). The inexistence of storage facilities for fresh production, leads to important losses.

In this context, the questioned farmers come with a series of suggestions and recommendations (Figure 12).

Figure 12 – Sugestiions and recommendation from the farmers



## CONCLUSIONS

Analysing the responses resulted from the survey among tomato producers, the following conclusions are stated:

- The profile of the Romanian vegetables farmer is: male, between the ages of 30-60, with specialized studies.
- Vegetables farmers are not organized in associative forms, the production is fragmented in small and very small farms (under 5 ha).
- The agricultural works are carried out by own means, using the family members as a labor force.
- The problems raised by farmers are related to the valorisation of the production, their activity not being profitable without the support granted through the „tomatoes programe”.

The economic impact in the sector of vegetables production (tomatoes) through the support scheme for the program to support tomatoes in protected spaces, with emphasis on the results from production, the market effects can be expressed by:

- the positive effect on increasing the number of farmers (doubling them);
- the positive effect on increasing cultivated areas with tomatoes;
- the positive effect on increasing vegetables production in general, of tomatoes in particular (+ 18.45%) in 2 years after the support scheme was first implemented;
- the positive effect on the price increase from the producers point of view, generating higher revenues

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# THE TAX INCIDENCE ON THE REVENUES OF ROMANIAN CROP FARMS

ANCA-MARINA IZVORANU<sup>1</sup>, MIHAELA KRUSZSLIKA<sup>2</sup>, CAMELIA TOMA<sup>2</sup>

**Abstract:** *Taxation plays a fundamental role in the context of decisions made by Romanian farmers on agricultural holdings. The fear of failure of a farmer is accentuated by taxation, which gives increasing importance to the treatment of this subject. This paper aims to analyze the effect of fiscal policies on the financial capacities of the actors in agriculture and follows the degree of socio-economic affective of the farmers from 28 counties of Romania. In order to know the concrete problems and to gather current information on the situation of the agricultural producers and the realities of the cereals market, case studies were carried out in farms and representative areas for the analyzed product. These were performed in several counties of the country (Buzău, Salaj, Maramureș, Sibiu, Călărași, Olt, Neamț, Iași, Bacău, Alba, Teleorman, Ialomița, Vrancea, Prahova, Galați, Satu Mare, Cluj, Timiș, Brăila, Bihor, Mureș, Giurgiu, Ilfov, Dambovița, Dolj, Vaslui, Argeș, Tulcea), in order to generate an overview on the level of taxation affectivity on the financial capacities of certain farmers in the respective counties. The case studies focused on medium to large farms, which have a commercial production, specialized on a certain product, respectively cereals.*

**Keywords:** *fiscal system, agriculture, cereals, Romania*

**JEL classification:** *E62, H20, Q14*

## INTRODUCTION

The present paper is intended to be a plea in front of all the stakeholders on the problems of agriculture today, as agriculture, as specified by the great state man C. Argetoianu in the interwar period, is the only branch that "surely has the capacity to get us out of the fray. where we are today" (C. Argetoianu, 1930). And if we refer to the present and interpreting what Argetoianu said, it is important not to get out of the underdevelopment path, which we have overtaken anyway, but to enter into the performance path, which defines the future knowledge society.

Taxation is involved in all areas of life, economic, social and cultural. These sides are permanently correlated, interconnecting each other, inducing specific behaviors, each at the level of the other. The importance of the studied theme lies in this interdependence of the areas of control. Fiscal measures do not determine strictly economic characteristics, but they produce more or less profound social and cultural changes. Human actions, in general, take place with a certain direction, duration and intensity. The direction is established, most of the times, according to the objectives pursued, and the other two instruments, the duration and the intensity are relatively clear. The same aspects are also within the framework of taxation, the objectives are intensively pursued and are foreseen with certain periods of time. These, the objectives, are different from one period to another, changing in intensity and duration. That is why it is very important to know what their effects are on the economic and social field, because they are created by the public power in order to positively affect both subjects, the state budget and the taxpayers.

The actuality of the subject results from the premises of the future when, of course, the present system of taxation, which is eminently in the national responsibility, will manifest itself in a framework with common rules at the level of the European Union, following the model of the monetary policy and of the community policies, with which it will be in a symbiotic relationship.

Agriculture, as an important branch of the national economy, requires the involvement of its actors in the fiscal field, thus correlating their status with the level of performance of the field and with the requirements of the national budget. In the following, we will discuss the means and methods by which taxation can influence the activity of farmers and we will try to offer positive ideas, both through the scenarios made in comparison with the other Member States, but also by exemplifying concrete situations.

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All these aspects have helped to shape the theme of this paper, which highlights the importance of approaching a thorough study, regarding what it means for agriculture and in particular, for farmers, fiscal obligations.

## **MATERIAL AND METHODS**

In order to achieve the objectives of the research and to verify the assumptions pursued, it was decided to carry out a qualitative research based on the questionnaire, survey carried out throughout the country. Thus, through a questionnaire applied online, persons belonging to individual households, farmers, individuals and legal entities were interviewed. In this questionnaire, on the basis of 24 questions (Q1-Q24) were selected - from the database of the Agency for Payments and Interventions in Agriculture - farmers with place of activity in Romania, so that each of them is covered the eight development regions: North-East development region comprising Bacau, Botoșani, Iași, Neamț, Suceava and Vaslui counties, South-East development region comprising Brăila, Buzău, Constanța, Galați, Tulcea and Vrancea counties, the region of South-Muntenia development comprising Argeș, Călărași, Dâmbovița, Giurgiu, Ialomița, Prahova and Teleorman counties, South-West development region comprising Dolj, Gorj, Mehedinți, Olt and Vâlcea counties, West development region comprising Arad counties -Severin, Hunedoara and Timiș, the North-West development region comprising the counties of Bihor, Bistrița Năsăud, Cluj, Maramureș, Satu-Mare and Sălaj, the region d Development Center, which includes Alba, Brașov, Covasna, Harghita, Mureș and Sibiu counties and the Bucharest-Ilfov development region, which includes Bucharest and Ilfov county.

The tool used for data collection was the online survey - the questionnaire (attached in the annexes), through the online platform Jotform, which was structured on two parts:

- The first part deals with information regarding the identification of the farm and includes both demographic questions, respectively the village, the locality, the city or the county in which they carry out their agricultural activity, the legal status of the farm, the age of the respondent, studies, number of family members, occupation, source of income. , the monthly income of the family, as well as questions related to the exploitation, such as the ownership of the land, the ownership of the exploitation of a cooperative, associations, producer group, the area cultivated with each of the crops included in the list of income rules, which have a lower limit of payment of taxes. , such as cereal crops, oil plants, potatoes, sugar beet, tobacco, vegetables in the field, vegetables in protected areas, hops on fruit, trees on fruit, vine on fruit, flowers and medicinal plants, but also the number of animals that also, they fall into income rules with non-taxable limits.
- The second part deals with tax information and fiscal transparency, the concern of taxpayers regarding taxation, its influence on the decisions made and on the activities, the payment capacity of the farmers and the suggestions of the respondents for the subject of study.

The period of elaboration and realization of the research was February 2019 - May 2019, and the data processing was done with the help of the SPSS program, which provided a transparent and indisputable approach to the analysis.

## **RESULTS AND DISCUSSIONS**

The perception of taxpayers on the subject of taxation should be treated equally with the impact that the taxation has on their financial capacity. In this regard, farmers from 28 counties were questioned regarding their monthly income and the area of land cultivated with cereals. Both household income and land area are tools that help determine the amounts they pay to the local budget and the national budget for agricultural activities.

The results obtained will be balanced with the incomes of the peasant households participating in the survey, in order to determine their financial capacity. According to the legislative framework, a farmer has the following obligations to the state budget (national and local) and to the social insurance budget: the income tax - which is calculated according to the county agricultural norms and

the number of hectares; land tax - which is calculated according to the area of land, the category of use and the rank of the locality; social contributions - which are calculated according to the income established by the county norms and paid only insofar as it exceeds twelve gross minimum wages in the country. Social contributions are not compulsory for taxpayers whose income is less than 24,960 lei (twelve minimum gross salaries of 2,080 lei), but they can opt for their payment.

From the data of the questionnaire the following values regarding the income tax, the land tax and the social contributions that fall to the farmer's burden, as well as their share in the monthly income of a farmer, have resulted. (Table 1)

Table 1. Impact of taxes and social contributions on income taxpayer in agriculture

	County	Monthly income per hectare (lei)	Total taxes and contributions per hectare (lei)	How much is the value of taxes and contributions in the monthly income (per hectare)
1	Buzău	350	207,44	59,27
2	Salaj	312,00	167,75	53,77
3	Maramureș	387,34	200,04	51,64
4	Sibiu	415,38	213,25	51,34
5	Călărași	514,29	263,66	51,27
6	Olt	426,92	217,20	50,88
7	Neamț	414,55	210,24	50,72
8	Iași	436,36	217,58	49,86
9	Bacău	466,67	229,01	49,07
10	Alba	494,12	240,78	48,73
11	Teleorman	551,72	262,26	47,54
12	Ialomița	654,55	310,95	47,51
13	Vrancea	600,00	276,56	46,09
14	Prahova	600,00	275,70	45,95
15	Galați	600,00	273,35	45,56
16	Satu Mare	688,89	312,63	45,38
17	Cluj	750,00	329,22	43,90
18	Timiș	720,00	312,70	43,43
19	Brăila	975,00	422,55	43,34
20	Bihor	830,77	358,78	43,19
21	Mureș	758,82	327,71	43,19
22	Giurgiu	825,00	350,75	42,51
23	Ilfov	864,00	365,15	42,26
24	Dambovița	6000,00	2160,92	36,02
25	Dolj	7200,00	2578,80	35,82
26	Vaslui	240,00	66,78	27,83
27	Argeș	432	65,40	15,14
28	Tulcea	545,45	56,51	10,36

Source: Author processing based on data provided by the farmers participating in the survey

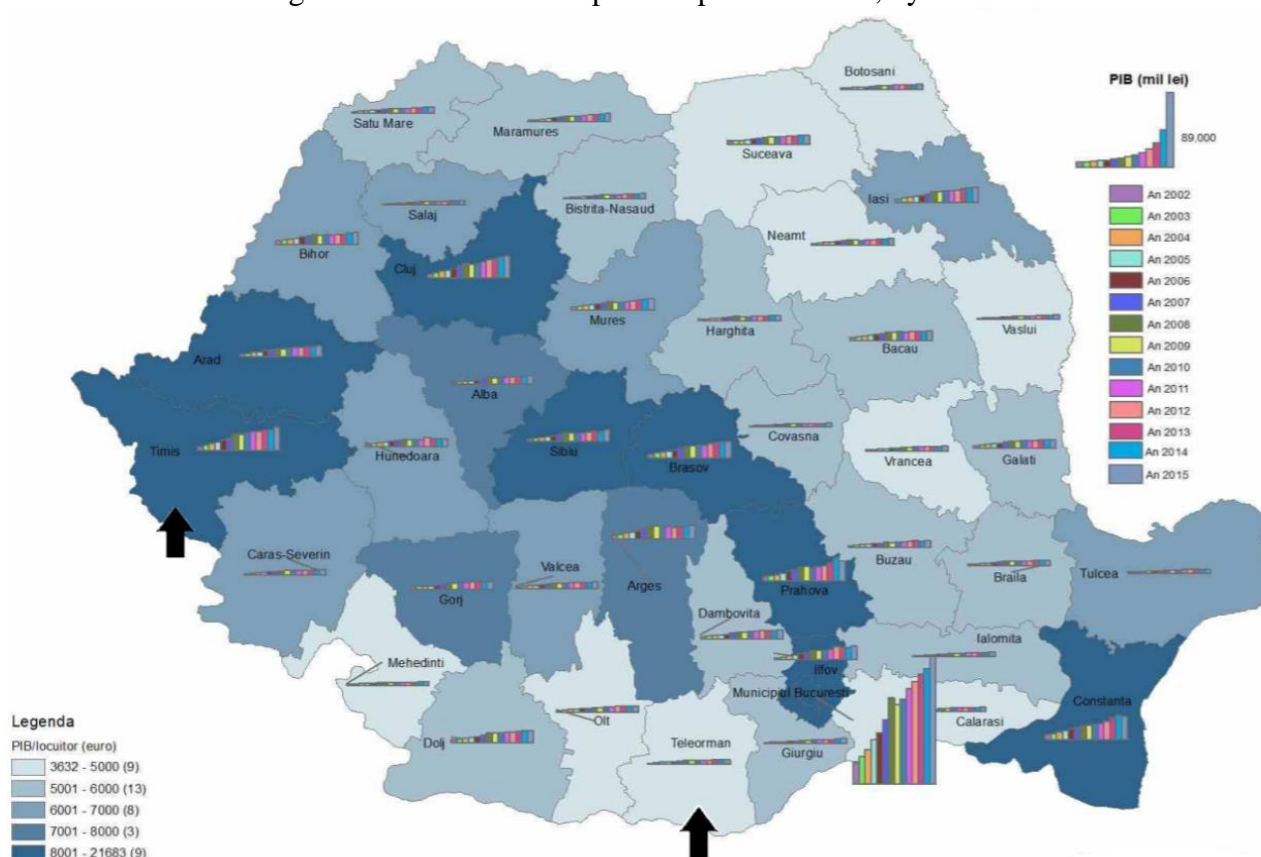
In order to balance and efficiently analyze the impact of taxation on the taxpayers' income, the amounts were transposed on the unit of measure lei / hectare. The fiscal burden thus resulted from the calculation is between 15.14% (in the case of a farmer from Argeș county, who makes an annual income of 21,600 lei) and 59.27% (in the case of a farmer from Buzău county, who makes an annual income of 42,000 lei). It should be noted that the situations presented cannot be considered as general cases for a county, because they are treated on the interviewed peasant households.



In the context of the analysis of the impact of taxes and social contributions on the financial capacity of the taxpayers, aspects related to income, culture, the area of cultivated land and / or the heads of animals held were addressed, for 8 peasant households in Teleorman county and 8 in Timiș county. At the base of the election of these counties were located the statistics of the Ministry of Regional Development, which ranks the two territorial administrative units by extreme development levels. On the one hand, according to the "Report on the state of the territory", Teleorman county is ranked in the last places, in terms of Gross Domestic Product per capita, next to Botosani and Vaslui. On the other hand, Timiș county is in the top of the counties, in terms of Gross Domestic Product per capita, along with Ilfov, Arad, Cluj, Sibiu, Brașov, Prahova and Constanța. (Figure 1)

According to the available data, GDP per capita is the indicator that highlights significant territorial discrepancies. Thus, Teleorman is different from the other counties in South Muntenia; Timiș vis-à-vis Caraș-Severin, Bihor and Hunedoara; Brașov to Covasna and Harghita etc. These discrepancies are accentuated or maintained in recent years, according to figure 1. However, it should be mentioned that most of the counties have registered upward trends of GDP per capita, especially after 2011.

Figure 1. Gross domestic product per inhabitant, by counties



Source: Processing based on data provided by the National Institute of Statistics

The results of the analysis of the impact of taxes on the peasant households from Teleorman and Timiș counties show that the fiscal burden is felt more in the less developed areas, against the background of lower incomes. In this context, a fiscal burden of over 90% is observed in three of the eight peasant households analyzed in Teleorman County, a burden felt especially by the taxpayers whose only source of income is agriculture (especially the cultivation of cereals and oil plants, but and vegetables in protected areas and legumes for grains).

For taxpayers who make income from both agriculture and wages, the social contributions will be paid only once, in order to avoid double taxation. In this case, the social insurance contributions for the farmers obtaining income and wages were eliminated, assuming that they will already be paid.

Table 2. Impact of taxes and social contributions on the incomes of peasant households from Teleorman and Timiș counties

ID	County	The source of income	Monthly family income lei	Annual income lei	Income tax lei/an	Social health insurance contributions lei/year	Social insurance contributions lei/year	Land tax lei/year	Total taxes lei/year	Total taxes in total income %
1	Teleorman	Agriculture	4800	57600	17963	5760	14400	3402	41525	72,09
2		Salary and agriculture	2750	33000	9720			8148	17868	54,15
3		Agriculture	4100	49200	21955	4920	12300	4116	43291	87,99
4		Salary and agriculture	5500	66000	31792			5880	37672	57,08
5		Salary and agriculture	1550	18600	5301			798	6099	32,79
6		Agriculture	6000	72000	35459	7200	18000	6552	67211	93,35
7		Agriculture	6800	81600	43571	8160	20400	6510	78641	96,37
8		Agriculture	5400	64800	32452	6480	16200	6006	61138	94,35
9	Timiș	Salary	9000	108000	42990			5964	48954	45,33
10		Agriculture	5700	68400	24960	6840	17100	5712	54612	79,84
11		Agriculture	5000	60000	12750	6000	15000	3654	37404	62,34
12		Salary and agriculture	6100	73200	28830			6258	35088	47,93
13		Salary and agriculture	4950	59400	24180			4788	28968	48,77
14		Salary and agriculture	1500	18000	4250				4250	23,61
15		Agriculture	4000	48000	5550	4800	12000	1554	23904	49,80
16		Salary	3400	40800	10890			2478	13368	32,76

Source: Processing based on the data provided by the farmers participating in the survey

As for the tax burden felt by the eight peasant households in Timiș County, its upper limit (about 80%) is found in the case of a farmer with 91 hectares cultivated with cereals and 45 hectares cultivated with oil plants. The lower limit of the fiscal burden felt by the eight peasant households in Timiș county is about 24% and is applied to a peasant household that deals with raising 19 cows. From the 8 cases analyzed in Timiș county, an influence of the size of the peasant households on the degree of control is distinguished, but also an influence of the sources of income of the farmers.

## Conclusions

The conclusions of this study can be a starting point for the public authorities, regarding the understanding of the taxpayers in terms of their perception of taxation. The role of taxpayers' confidence in tax compliance can be a support in the most efficient development of fiscal policies, which will help to move from the antagonistic climate, which is presently found, to a climate based on synergy.

Fiscal policies should focus on increasing the taxpayers' confidence in tax authorities, increasing transparency, efficient spending of public money, a consistent reduction of bureaucracy and corruption currently existing in Romania, but especially on promotion. of fairness and equity at the micro and macroeconomic level.

In the process of transiting the climate between the taxpayer and the tax authorities, a high degree of trust would contribute to a higher level of compliance, as it is called in the specialized literature, voluntary compliance. This would allow governments a better collection of taxes, taxes and social contributions. In this context, the benefits produced would be manifested, firstly, by more money in the state budget, and secondly, by a lower expense of tracking, identifying and punishing fraudsters.

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# EVOLUTION OF AGRICULTURAL ACTIVITIES IN THE COASTAL AREAS OF ROMANIA-CASE STUDY TULCEA COUNTY

STELIANA RODINO<sup>1</sup>

**Abstract:** Coastal areas are commonly defined as the interface or transition areas between land and sea, including large inland lakes. Coastal areas are diverse in function and form, dynamic and do not lend themselves well to definition by strict spatial boundaries. Unlike watersheds, there are no exact natural boundaries that unambiguously delineate coastal areas. On land, the coastal area is increasingly used for intensive agriculture, industry, energy generation electric, mining, transport, development urban and, of course, tourist activities. Inside the hinterland, the agriculture is the main one way of exploiting the land, being a source important income for the rural community. The agricultural activities in the coastal areas of Romania are subjected to regulatory framework law 202/2002. Rural areas occupy more than 50% of Europe's surface, housing more than 20% of the population. Rural areas play an important role in the national and European regional economy, looking for natural resources and offering jobs through agro-food, tourism, and processing industries. However, rural areas face many challenges such as global competition, automation, market dynamics and, last but not least, environmental challenges. According to national regulatory framework rural areas from Romania occupy 87,1% of the country surface, with 43,7% of total population. This article is an overview of the evolution of agricultural sector in the coastal area in the covering the last three decades.

**Keywords:** Romania, coastal area, agriculture

**JEL classification:** Q10,R14

## INTRODUCTION

Situated at the cross border of land and sea, coastal areas are regions with a wealth of natural resources and biodiversity, sometimes environmentally vulnerable, but still having potential for a large variety of business opportunities. Coastal areas are commonly defined as the interface or transition areas between land and sea, including large inland lakes. They are diverse in function and form, dynamic and do not lend themselves well to definition by strict spatial boundaries. Unlike watersheds, there are no exact natural boundaries that unambiguously delineate coastal areas (Iglesias-Campos et al, 2015). On land, the coastal area is increasingly used for intensive agriculture, industry, energy generation electric, mining, transport, development urban and, of course, tourist activities.

The economic development of the coastal area of Romania situated in Tulcea county region is highly influenced by the existence of the Danube Delta Natural Reserve in the immediate neighborhood. The agriculture sector is must comply with the environmental restrictions imposed by legislation in force regarding protected areas.

The agricultural activities across the region have gone through major changes in the last 30 years and this is reflected in the structure of vegetal species cultivated. The region is intensively exposed to climate change dynamics, such as drought and desertification processes, which contribute to the amplification of the vulnerability of rural livelihoods.

Inside the hinterland, the agriculture is the main one way of exploiting the land, being a source important income for the rural community. The agricultural activities in the coastal areas of Romania are subjected to regulatory framework law 202/2002. Rural areas occupy more than 50% of Europe's surface, housing more than 20% of the population. Rural areas play an important role in the national and European regional economy, looking for natural resources and offering jobs through agro-food, tourism, and processing industries. However, rural areas face many challenges such as global competition, automation, market dynamics and, last but not least, environmental challenges.

According to national regulatory framework rural areas from Romania occupy 87,1% of the country surface, with 43,7% of total population.

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Tulcea county and its coastal area is a representative region for studying the existing synergies between agriculture, rural development and demographic changes. The transition to a sustainable rural development can only lead to the achievement of economic, social and territorial cohesion for a balanced development throughout the whole region. The increase of resilience of rural areas by diversification of their economic activities, seems to be a viable solution for their socio-economic survival (Sima, 2016). Taking into account the above mentioned general context of economic activities, social changes and territorial development, the present study is an overview of the evolution of agricultural sector in the coastal area situated in Tulcea county, covering the last three decades.

## MATERIALS AND METHODS

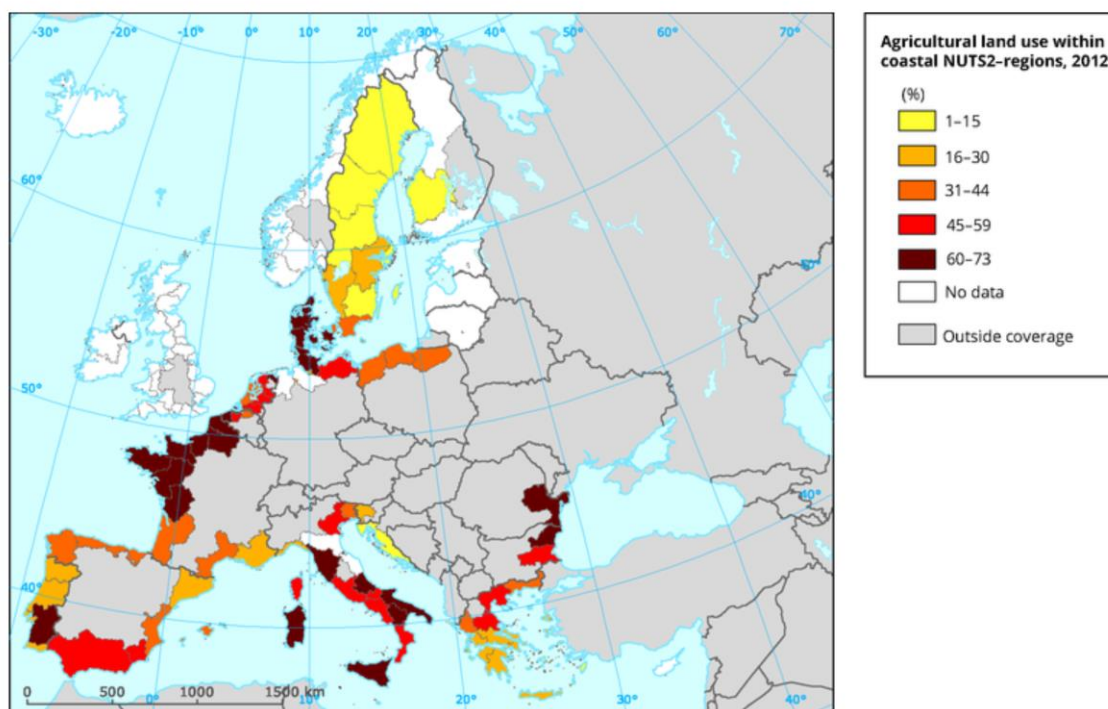
The present paper is a blueprint of Tulcea county agriculture as in the last three decades, from quantitative point of view. The historical data were extracted from official reports on National Institute of statistics and Eurostat and Ministry of Agriculture and Rural development.

## RESULTS AND DISSCUSIONS

Tulcea County economy is dominated by agriculture (both vegetal and animal sector) and fishing. Agriculture is the main economic activity of the South-East region, employing over 35% of the active population.

In the last three decades, the population of Tulcea county has decreased, reaching the lower density in the country. The vegetal sector is characterized by extensive production systems, dominated by cereal cultivation. Most of the producers are organized in subsistence and semi-subsistence farms. The agricultural sector is facing strong threats due to land degradation, much of it being salted and undergoing an acidification process. However, compared to European countries, the coastal area of Romania covers a high percent of agricultural land use.

Nowadays, the agricultural sector and the rural economy in general continue to have substantial growth potential, still under-exploited. For example, at national level, agriculture accounts for 6% of gross value added (GVA), representing 1.6% in the EU (CE, Informații statistice România, mai 2018).



**Figure 1. Agricultural land used in Coastal areas across Europe**

Source: [www.eea.europa.eu/data-and-maps/figures/agricultural-land-use-within-coastal](http://www.eea.europa.eu/data-and-maps/figures/agricultural-land-use-within-coastal)

In Romania, the cultivated area is decreasing, a tendency also manifested in the EU. During 1990-2017 the cultivated area decreased by 11.6%, from 9,4 mil Ha to 8.3 million Ha (Figure 2a).

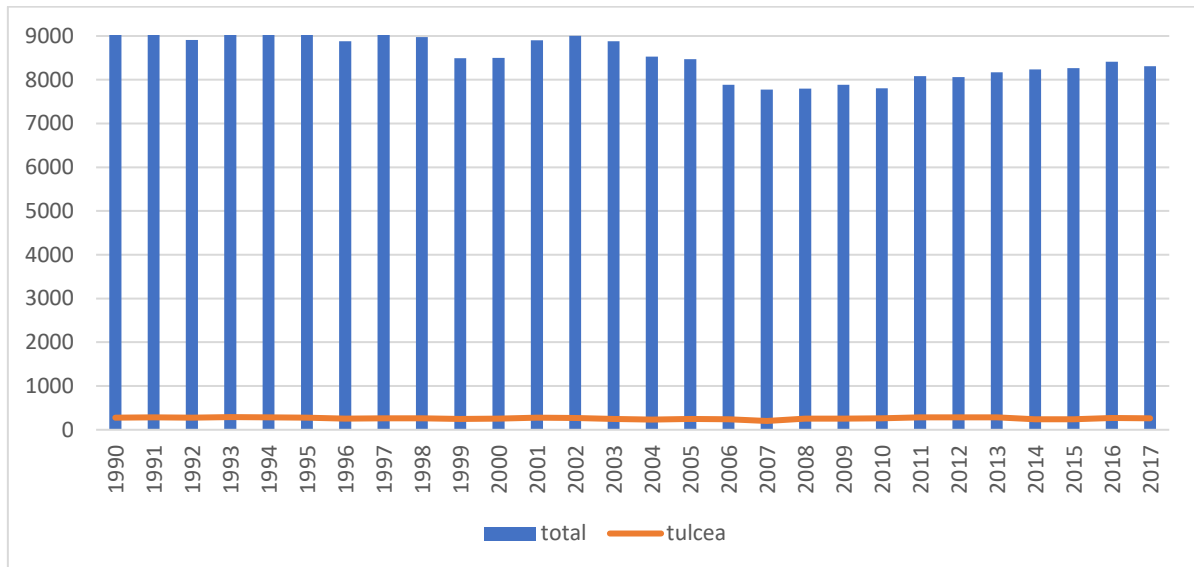


Figure 2 a). Evolution of cultivated area in Romania, 1990-2017

Traditionally, Romania is a large producer of cereals and oil plants, these two categories occupy the most significant areas (60% and 17% respectively) of the 8.3 million ha of agricultural land of the country.

In Tulcea county, the evolution of cultivated area in the last 3 decades has had an oscillating trend, with the lowest level in 2007 (2 million ha), and the highest in 2012 (2.85 million ha). In 2017 the cultivated area decreased by 6.4% compared to the level of 1990 (Figure 2b).

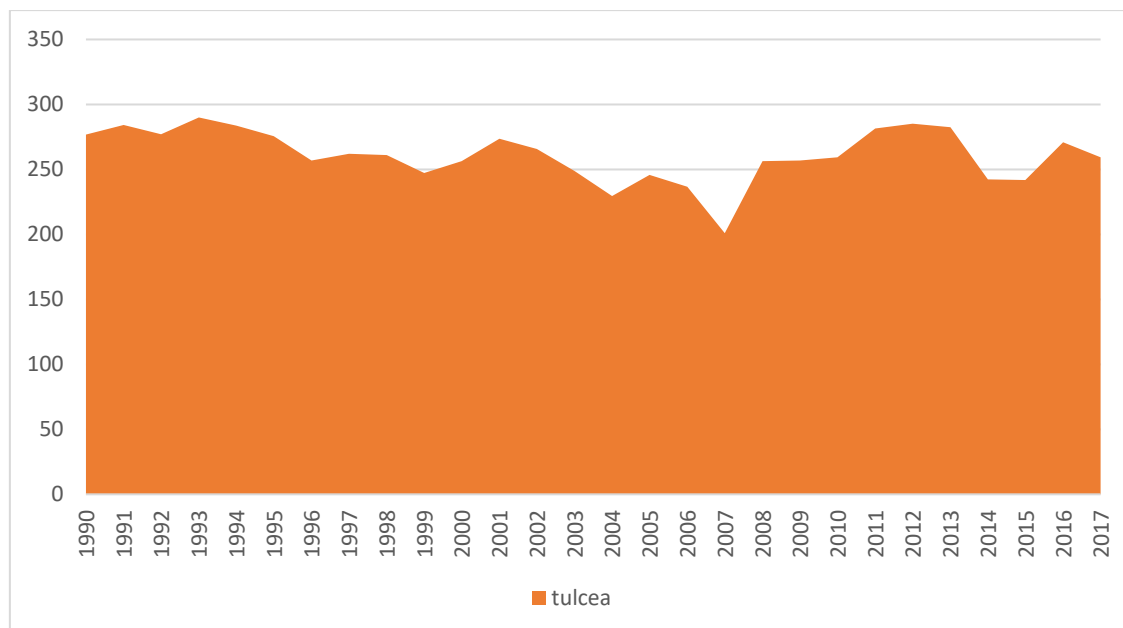


Figure 2b) Evolution of cultivated area, Tulcea county

In the structure of the surfaces cultivated the highest weight is held by the cereal crops, sunflower, wheat and rye (Figure 3).

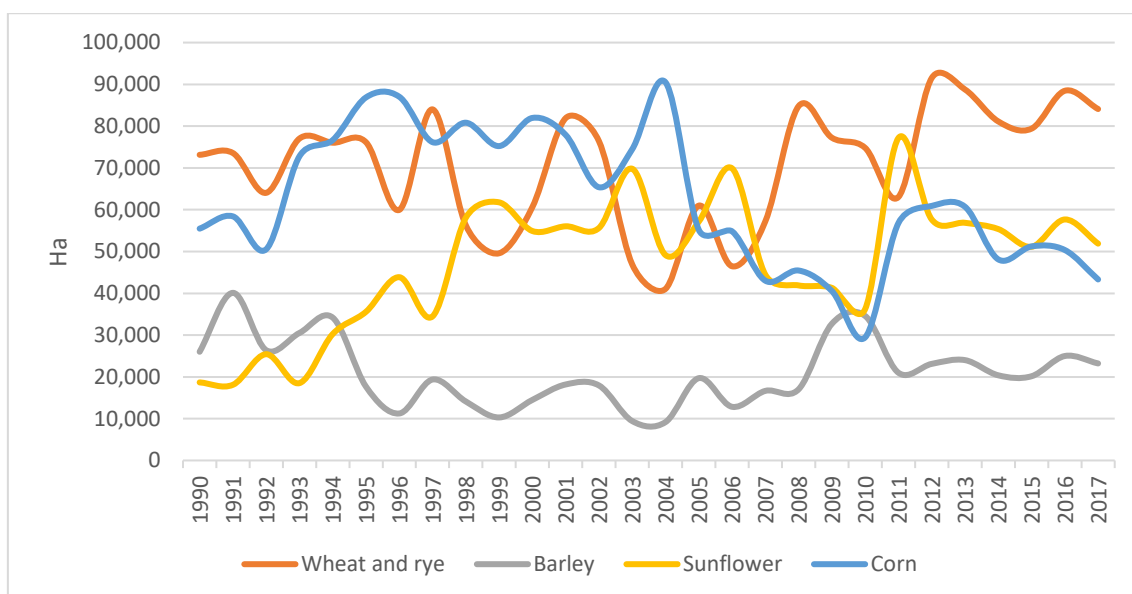


Figure 3. Main cultivated species

Between 2007 and 2010, there is an upward trend in the areas occupied with rape, followed by a sharp decrease and stabilization of the surfaces around 25 thousand hectares (Figure 4).

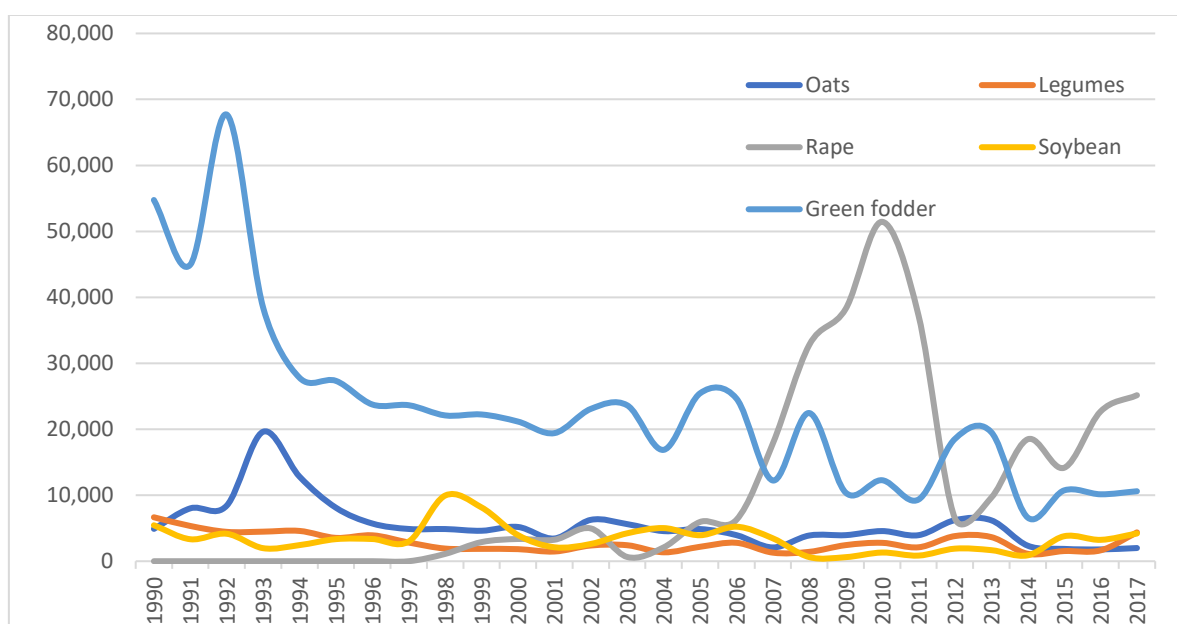


Figure 4. Other crops cultivated in Tulcea county 1990-2017

At the beginning of the 90s, there were surfaces cultivated with tobacco and sugar beet, but these crops were definitively abandoned, starting with 1996-1998 (Figure 5).

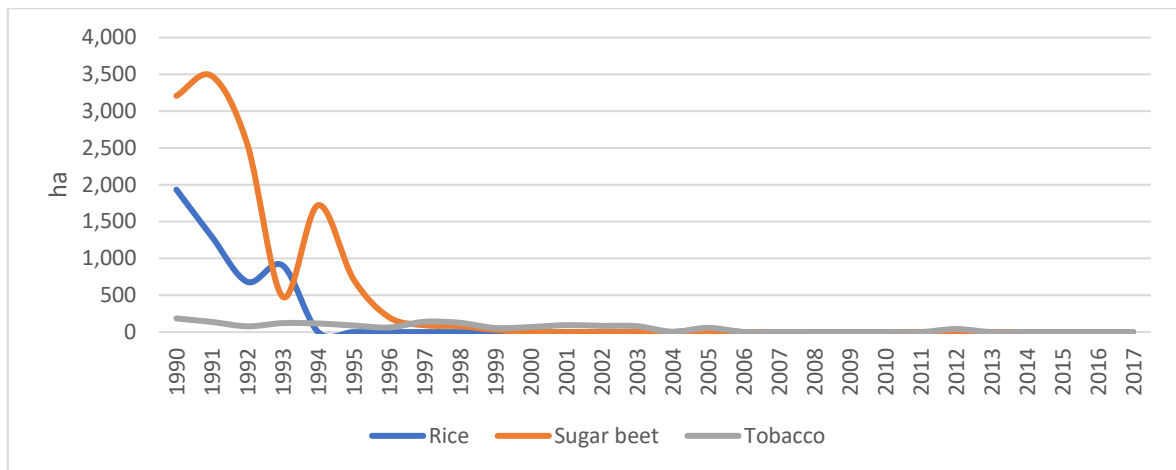


Figure 5. Crops that are no longer cultivated

The animal sector is well represented, first of all when speaking of number of chickens and sheep. Sheep herds have remained relatively constant over the past three decades (Figure 6a).

It can be observed an upward trend of goat herds in the last decade, after a period of decline recorded in the period 2000-2001 (Figure 6b).

Interesting to note is that starting from 2001-2002, at the county level the growth of rabbits became of interest.

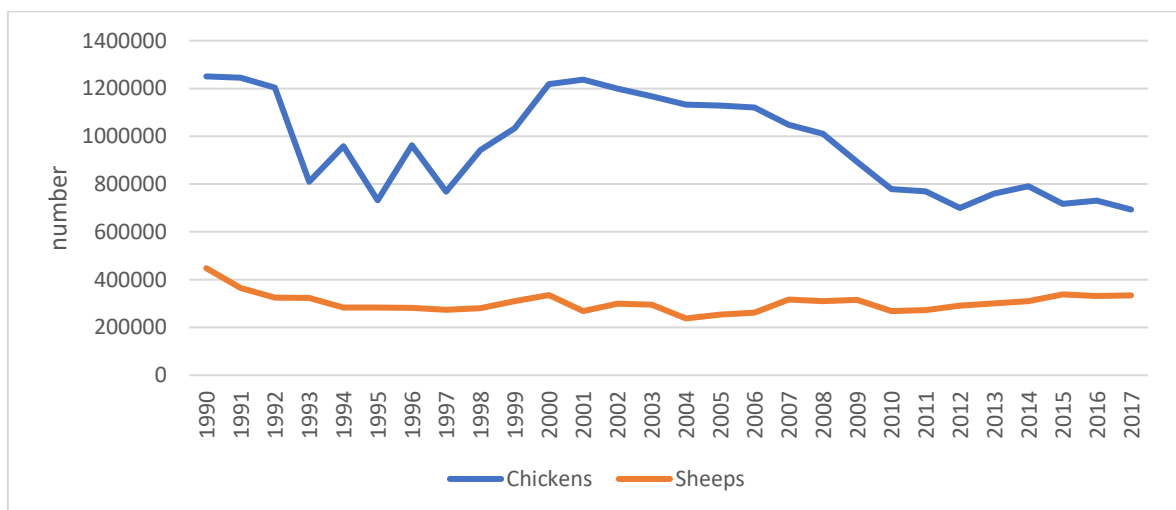


Figure 6a). Number of animals per county

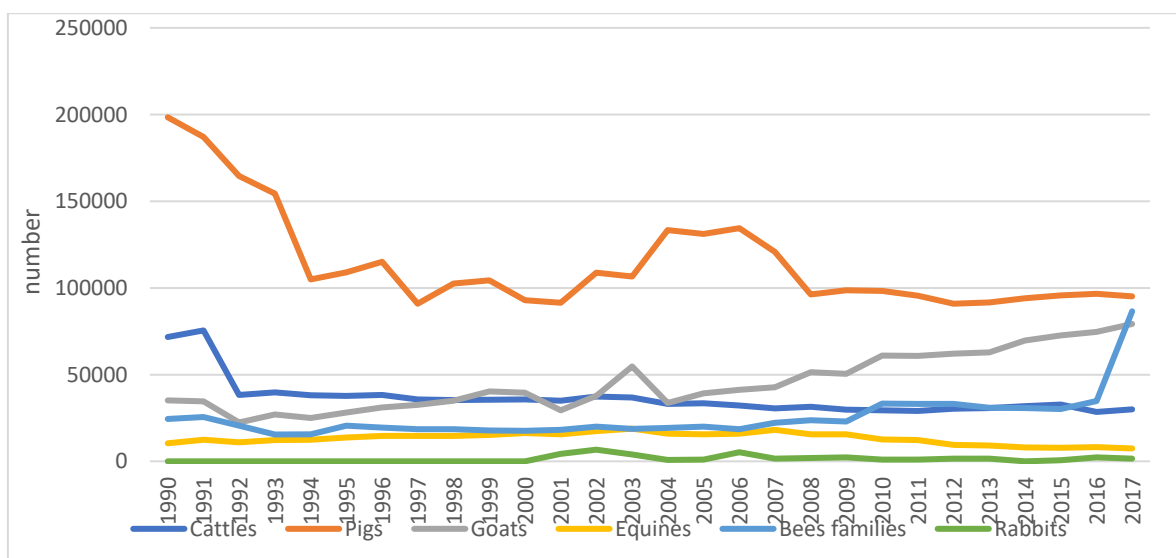


Figure 6b). Number of animals per county



Also, in 2016 there was a spectacular increase in the number of bee families, probably due to the increased demand for honey at national level and even for export, Romanian honey being appreciated as being of high quality at the big international fairs.

Goat herds have a constant upward trend, starting with 2004, until 2017.

Within the coastal area of Tulcea, agriculture is the main mode of exploitation of the land, being an important income for the rural community. The Romanian village, as it has evolved in the last 3 decades, can represent a sustainable development pole for our country, and specifically for the Tulcea region. As statistics show, the rural area is predominantly agricultural (Bohateret et al, 2018).

A leap in development can be achieved by exploiting niche sectors, and one of these can be organic farming. For example, Tulcea occupies the second place in the country with the number of bee families, and among the first places at the number of ecologically certified bee families (Bruma et al., 2018). Moreover, from the point of view of the areas cultivated in the ecological system, Tulcea County, at the level of 2018, holds the first place in our country, approximately 62 thousand hectares, out of a total of 305 thousand national hectares.

## CONCLUSIONS

The agricultural activities across the region have gone through major changes in the last 30 years and this is reflected in the structure of vegetal species cultivated. The region is intensively exposed to climate change dynamics, such as drought and desertification processes, which contribute to the amplification of the vulnerability of rural livelihoods.

For the future, the coastal area will probably follow the overall international trend to move from agricultural economy to a so called rural economy, including in its structure all forms of tourism and services. Agriculture will still be an important part of the rural activity, but it does no longer provide sufficient income for the rural population nor sufficient jobs. One promising direction of development could be orientation towards providing traditional, local products, as the demand for such products has an increasing trend, lately. This kind of products are expected to bring an added value to the economy of the region, alongside with the mass production of standardised products. This change will lead to job creation in agro-food value chains and the conservation of natural resources.

In the last three decades, the agricultural sector in Tulcea county has undergone important shifts in agricultural workforce, crop diversity and natural resource management. The productivity is rather low and major investments should be done in modern technologies to make a shift through a sustainable production system.

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# FORMATION OF THE BASIC BIOCHEMICAL INDICATORS OF WINTER WHEAT GRAIN QUALITY ON THE FERTILIZERS BACKGROUND AND PREDECESSORS

SVETLANA BURYKINA<sup>1</sup>, ANNA KRIVENKO<sup>2</sup>, VLADIMIR OREKHOVSKY<sup>3</sup>

**Abstract:** According to the many years of research results in a stationary field experiment on southern chernozems, it has been shown that the systematic use of fertilizers for black and green fallow provides the production of winter wheat grains with protein and gluten that meets the requirements of the first class (protein is not  $\leq 14.0\%$ , gluten is not  $\leq 28, 0\%$ ); for MBC corn, winter rapeseed and winter wheat - the requirements of the second class (protein content is not  $\leq 12.5\%$ , gluten is not  $\leq 23.0\%$ ). For the zone of the Black Sea steppe of Ukraine, the payback options of an active substance unit of organic, mineral and organo-mineral fertilizers are determined by the growth of protein and gluten content in winter wheat grain.

**Keywords:** agriculture, fertilizers, sustainable development, winter wheat.

**Classification JEL:** Q Agricultural and Natural Resource Economics; Environmental and Ecological Economics. Q010 Sustainable Development.

## INTRODUCTION

The Black Sea steppe is one of the main regions of Ukraine, supplying winter wheat grain with a high content of protein and gluten. This is mainly due to the peculiarities of the climate: the presence of frequent and prolonged droughts, especially during the period of grain filling. However, even under the same weather conditions and within the same enterprise, quality indicators are not stable, since they are the product of not only weather conditions, but also the level of fertility of a particular field, as well as all parts of the cultivation technology: compliance with crop rotation, tillage, sowing dates, the fertilizers use, plant protection systems, etc. [1, 5, 6].

Fertilizers have the most effective and powerful effect on the winter wheat quality of [2-4]. And since cereal crops remain the main source of vegetable protein, it is important to establish which doses and elements ratios in the winter wheat fertilizer system will ensure their greatest payback not only by yield increases, but and an increase in quality, especially increases in the content of raw protein and gluten proteins.

## MATERIALS AND METHODS

To achieve this research goal, the materials of a long-term stationary experiment with fertilizers, which was laid down in 1972 on the experimental field of the Odessa State Agricultural Experimental Station, were systematized and processed. Soil - southern low-humus chernozem clayey-loamy on the loess. Four rotations was fallow - grain - row-crop rotation took place, in which the predecessors of winter wheat were black fallow, peas and maize of milk-wax maturity, and two rotations of fallow - grain with predecessors were black fallow, winter rapeseed, green manure and winter wheat after green manure (i.e. stubble).

The experience scheme constantly includes 17 options. Of the first 4 rotations, 7 options (variants) are presented: 1- control without fertilizers, in which the nutrition background was formed due to crop rotation; 2 - the first organic (O1), where an average of 64 tons of manure per hectare of arable land was introduced; 3 - second organic (O2 - 80 t ha<sup>-1</sup>); 4 - mineral (M - an average of 4 rotations for wheat was N<sub>75</sub>P<sub>52.5</sub>K<sub>52.5</sub>; 5 - organo-mineral (O1 + M1 - O1 + N<sub>50</sub>P<sub>40</sub>K<sub>35</sub>); 6 - organo-mineral (O2 + M1); 7- organo-mineral (O1 + M2 - O1 + N<sub>75</sub>P<sub>52.5</sub>K<sub>52.5</sub>) and 8- organo-

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mineral (O2 + M2). The indicated norms of manure were introduced in two doses: for black fallow and for corn.

The passage of the following 2 rotations coincided with the period of reorganization of Ukraine as an independent state, which in the agricultural sector caused a sharp reduction in the number of livestock, and hence the yield of manure. Therefore, the introduction of manure was replaced by a green manure crop, the mass of which was planted into the soil during the budding phase - the beginning of flowering. Of the options for the 5-6th rotation, the following are presented: control; N<sub>60</sub>; N<sub>120</sub>; N<sub>180</sub>; N<sub>60</sub>P<sub>30</sub>K<sub>30</sub>; N<sub>120</sub>P<sub>30</sub>K<sub>30</sub>; N<sub>180</sub>P<sub>30</sub>K<sub>30</sub>; N<sub>60</sub>P<sub>60</sub>K<sub>60</sub>; N<sub>120</sub>P<sub>60</sub>K<sub>60</sub>; N<sub>180</sub>P<sub>60</sub>K<sub>60</sub>. As mineral fertilizers used ammonia nitrate, nitrogen-phosphate, superphosphate simple granular and potassium salt.

The experience is located in four permanent fields, entering the crop rotation is carried out in one field; 3-fold repetition in the experiment with the systematic placement of variants and repetitions. The total area of the plot is 240 m<sup>2</sup>, accounting 88 m<sup>2</sup>.

To protect winter wheat crops from diseases and pests, an integrated method of protection was used, combined soil cultivation generally accepted for the cultivation zone. Harvesting and harvesting were carried out using the Sampo-500 combine.

Grain sampling and determination of quality indicators were carried out by standard methods: the quantity and quality of gluten — Ukrainian national standardization system 13586.1-68 [7], the protein content — by infrared spectroscopy on a Spectran-119M instrument — Ukrainian national standardization system 4117: 2007 [8]. Mathematical processing of the results was carried out using the Excel and Statistic software package, using the methods of variance and correlation - regression analyzes [9].

## RESULTS AND DISCUSSIONS

A generalization of long-term data showed that the food properties of wheat grains are determined not only by fertilizers, but also by the quality of the precursor (Table 1).

Table1 – The influence of predecessors on grain quality

Predecessors	Years	Protein, %		Gluten, %		Gluten quality	
		K*	Y*	K	Y	K	Y
Black fallow	1973-2017	12.20	14.18	22.3	29.0	83.6	86.0
Green fallow	2011-2019	11.90	14.16	20.6	28.8	79.9	82.8
Peas	1976-2005	11.31	13.48	20.2	27.2	88.3	86.2
Corn	1978-2007	10.93	12.55	18.7	24.9	87.1	86.2
Winter rape	2009-2019	10.62	13.02	16.9	23.9	87.7	81.9
Winter wheat	2012-2016	11.97	13.82	19.9	25.8	80.5	78.4

\*K– control; \*Y – average for fertilizer options

In the control variant, the grain quality was ensured by the level of natural fertility, a background of nutrition due to crop rotation and a specific predecessor. Thus, the protein content in the dry matter of winter wheat grain during the transition from fallow to winter rapeseed naturally decreased from 12.20% to 10.62%, gluten content - from 22.3% to 16.9%. With the systematic use of fertilizers, these parameters are higher, but a similar trend persists: the protein content of the grain decreases from 14.18% to 13.02%, the gluten content - from 29.0% to 23.9%. The overall picture on the stubble predecessor is slightly disturbed, perhaps this is due, firstly, to a sample for a relatively small period (5 years) and, secondly, with the fact that almost all five years differed in extremely arid conditions during the period of grain filling. It is known that under such conditions a grain with a high protein content is formed [3, 10]. For the other predecessors, there were longer observation periods, in which there was still an alternation of favorable and varying degrees of arid conditions of the spring-summer vegetation of the culture.

The correlation and regression analysis showed a high degree of influence of the precursor on the process of protein and gluten formation in winter wheat grain: on unfertilized variants 98% and 96%, for fertilizer options, 75.7% and 92.2%, respectively (when calculating paired correlation coefficients). The influence of the precursor on the quality of gluten is much lower and amounts to only 13.0%. With an increase in the dose of fertilizer application, the protein content of wheat grain also increases, which is well illustrated by Figure 1 and 2. On average for 5-6 rotations, the protein content in the grain of the control variant was 11.68%, with N<sub>60</sub> - 12.76%; N<sub>120</sub> - 14.02% and N<sub>180</sub> - 14.84%. Despite significant fluctuations over the years, within each year, the protein content in fertilized variants is higher than the control.

Figure 1 - Protein content in the grain of winter wheat, depending on the dose of mineral nitrogen precursor black steam, % (5-6 rotation)

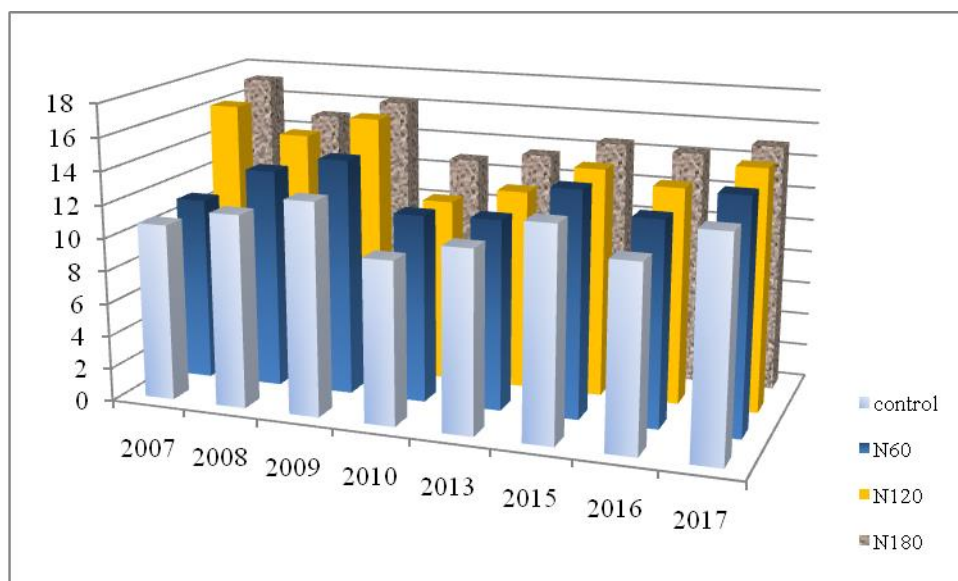
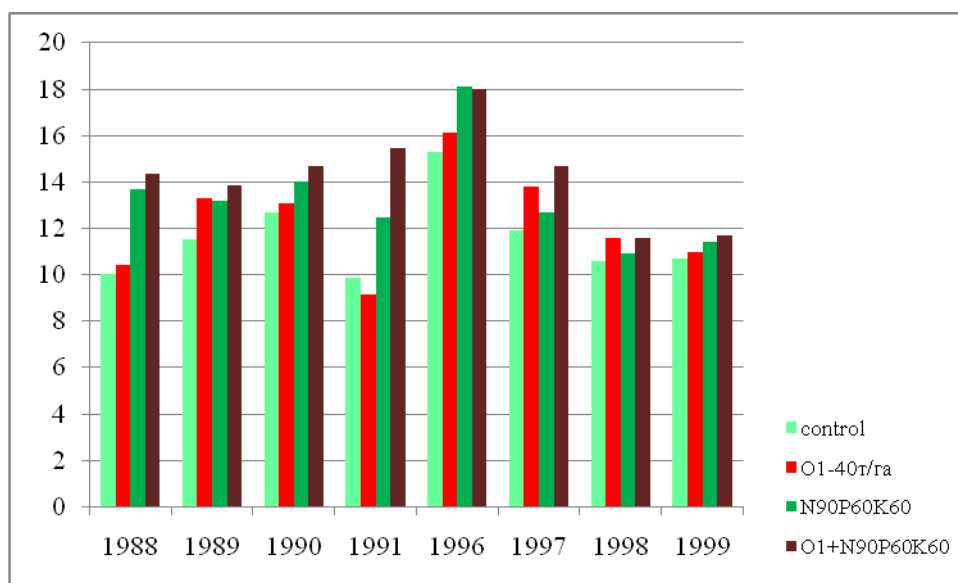


Figure 2 - The influence of fertilizer systems on the protein content in the grain of winter wheat on the precursor of corn, % (application doses are given in 2-3 rotations)



A similar situation is observed when growing winter wheat in maize for silage (Fig. 2). As an example, data are given for years of observations in the second and third rotations for four nutritional backgrounds: zero, where the average protein content in winter wheat was 11.58%, at the aftereffect of manure application at a rate of 40 t ha<sup>-1</sup> - 12.30%, for the mineral fertilizer system -

13.30% and the organo-mineral - 14.30%. Similar results were obtained, for example, on the typical chernozems by S.I. Popov et al. [11], Yu.I. Krivda and others in the conditions of the Right Bank of the Central Dnipro [12].

One of the important indicators of the effectiveness of fertilizers on winter wheat crops is their payback by the growth of grain and gluten. According to the precursor of maize (Figure 3, 4), the highest payback of fertilizers by increments in protein (14.2 and 19.2 mg) and gluten (48.0 and 62.2 mg) was observed when using organo-mineral fertilizer systems, where, on average, they were applied by background O1 and O2 N<sub>50</sub>P<sub>40</sub>K<sub>35</sub>.

Figure 3 - Payback of a fertilizer unit with protein growth, mg % per 1 kg (t)  
(average for 1973-2007)

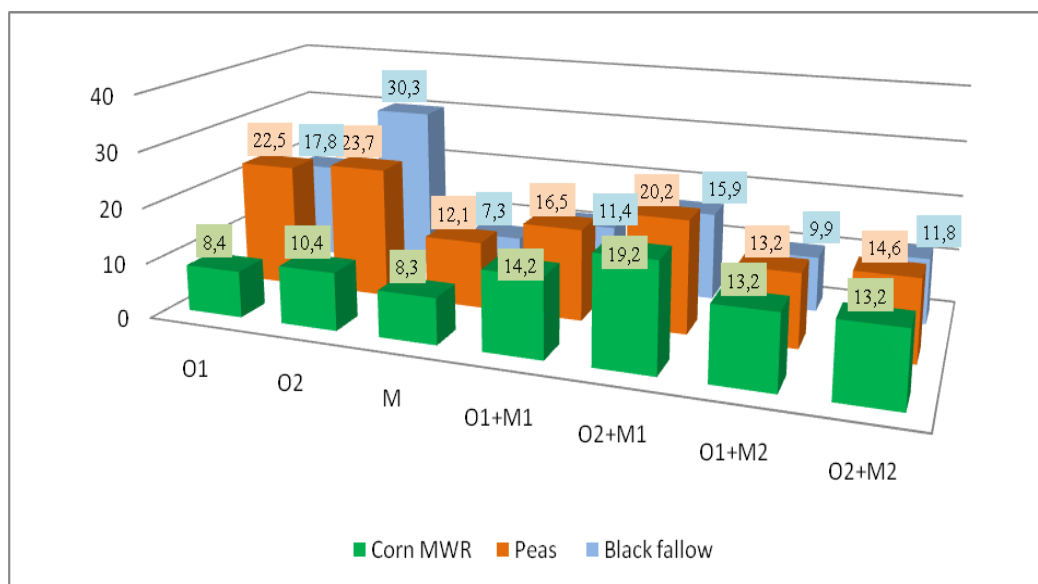
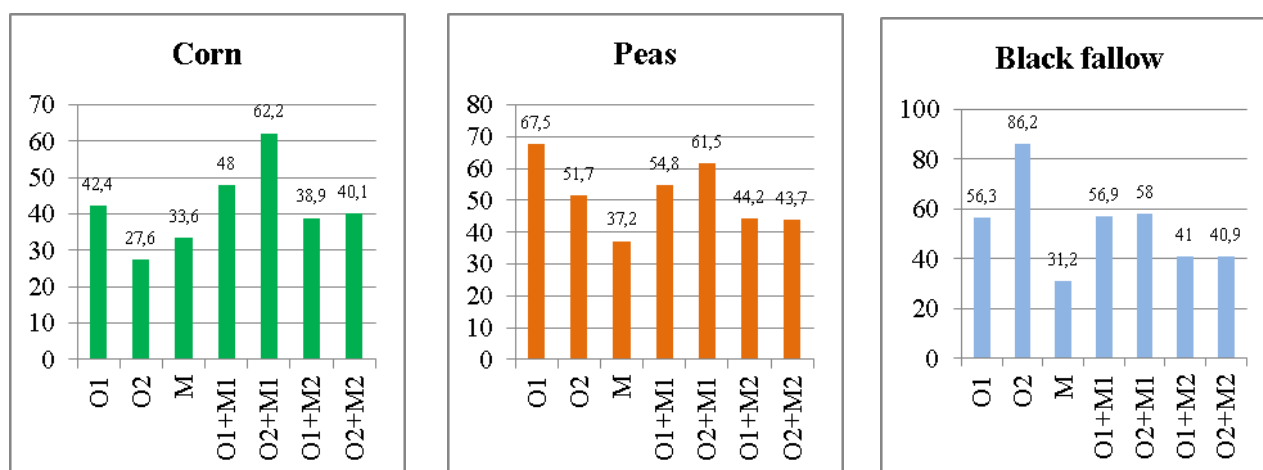


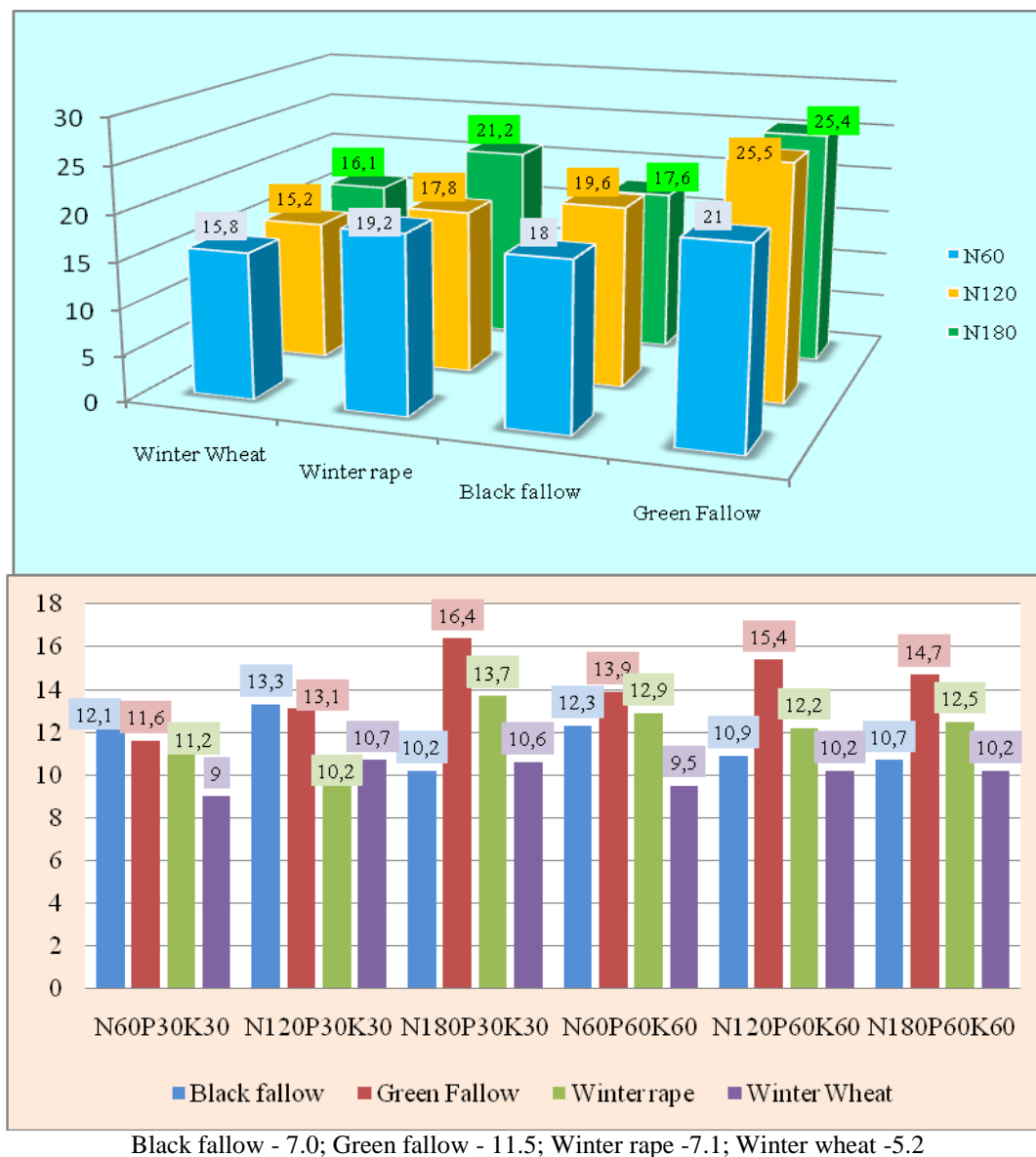
Figure 4 - Payback of a fertilizer unit with gluten growth, mg% per 1 kg (t)  
(average for 1973-2007)



When growing winter wheat with peas, the maximum payback with protein (22.5–23.7 mg) was due to the addition of organic matter (O1 and O2), and gluten (67.5 mg) was a consequence of adding 32.0 t ha<sup>-1</sup> of manure and when using background O2 mineral fertilizer N<sub>50</sub>P<sub>40</sub>K<sub>35</sub> (61.5 mg). According to the precursor, black fallow has the most effective effect on increasing the protein content (+30.3 mg) and gluten (+86.2 mg), an organic fertilizer system was allocated, where 40 t ha<sup>-1</sup> of manure was introduced under the precursor; organo-mineral systems also had a positive effect on gluten growth: O1 + M1 (+56.9 mg), O2 + M1 (+58.0 mg).

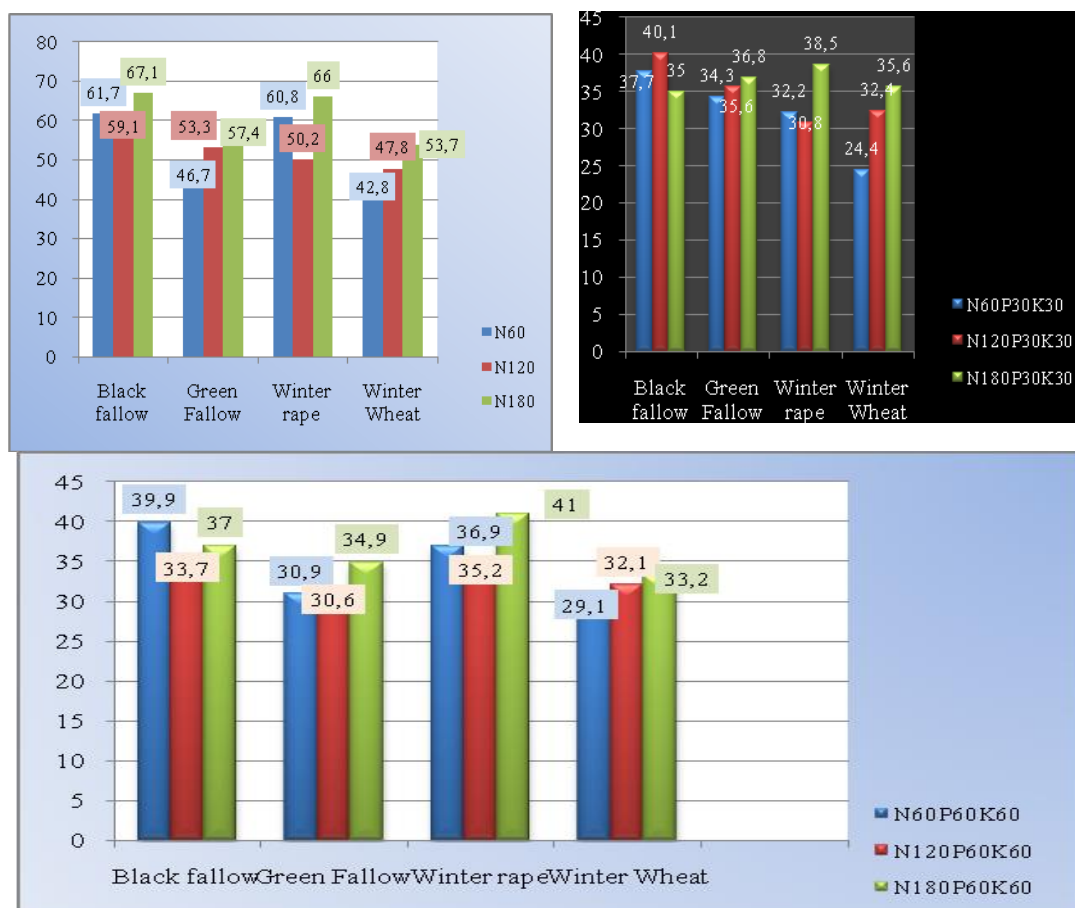
An analysis of the mineral fertilizer systems that were used during the fifth and sixth rotations according to the sideration background showed that for almost all doses of fertilizer application, their effectiveness was mathematically provable with respect to the zero variant and only when using  $N_{60}P_{30}K_{30}$  for the green manure fallow - at the confidence level (Fig. 5).

Figure 5 - Fluctuations in the growth of protein content in winter wheat grain depending on the doses of mineral fertilizers,  $mg\ kg^{-1}$  a.s. (average for 2002-2019)



With increasing doses, the application of mineral nitrogen from 60 to 180 kg, the payback of 1 kg of the active substance increased, but the values did not differ from each other, which is also natural for the use of these doses of nitrogen as part of a complete mineral fertilizer, although the differences were clearer within the precursor. So, according to the precursor,  $N_{120}P_{30}K_{30}$  -  $13.3\ mg\ kg^{-1}$ ; for green manure and winter rapeseed  $N_{180}P_{30}K_{30}$  -  $16.4\ mg\ kg^{-1}$  and  $13.3\ mg\ kg^{-1}$ , respectively; according to the stubble predecessor, they fluctuated in a rather narrow range: from  $9.0$  to  $10.7\ mg\ kg^{-1}$ , but nevertheless a large payback of  $10.6$  and  $10.7\ mg\ kg^{-1}$  was provided by the introduction of  $N_{120}$  and  $N_{180}$  according to the background of  $P_{30}K_{30}$ .

Figure 6 - Dependence of the payback of mineral fertilizers with gluten growth against the background of different doses and predecessors, mg kg<sup>-1</sup> (average for 2002-2019)



Minimum difference 095: black fallow - 27.2; sidereal fallow - 23.4; winter rapeseed -21.2; winter wheat -12.2

The supply of a unit of mineral nitrogen with gluten growth was the highest when N<sub>180</sub> was added and amounted to 67.1 mg for black fallow, 57.4 mg for sidereal fallow, 66.0 mg for winter rape and 53.7 mg for stubble (Fig. 6). The same nitrogen rate when applied both in the background of P<sub>30</sub>K<sub>30</sub> and in the background of P<sub>60</sub>K<sub>60</sub> showed greater efficiency with respect to lower doses of nitrogen in the composition of a complete mineral fertilizer for all precursors except black fallow. When growing wheat by black fallow, the maximum gluten gains per unit of active substance NPK were observed with the addition of N<sub>120</sub>P<sub>30</sub>K<sub>30</sub> (40.1 mg) and N<sub>60</sub>P<sub>60</sub>K<sub>60</sub> (39.9 mg). And although the differences in gluten growth by fertilizer options are not significant, it must be borne in mind that when applying N<sub>180</sub>, N<sub>180</sub>P<sub>30</sub>K<sub>30</sub>, N<sub>180</sub>P<sub>60</sub>K<sub>60</sub>, the concentration of protein and gluten in the grain meets the requirements of the first class, regardless of the predecessor and weather conditions of the growing season; with a decrease in the dose of nitrogen to 120 kg ha<sup>-1</sup>, the grain quality fluctuates between the first and second class, and at N<sub>60</sub> in different combinations, between the second and third class.

If we return to the results of the study on the first four rotations, it should be noted that in general, the mineral and organo-mineral fertilizer systems for protein and gluten content ensured the production of Grade 2 grain (the actual gluten content was 24.5% compared to the required 23.0%, and protein 13.47-13.97% versus the required 12.5%), organic systems - according to the gluten content - are of the 2nd class, and protein is of a lower class (12.24%).



## CONCLUSIONS

Based on the results of many years of field research, the following conclusions can be drawn:

- the systematic use of fertilizers for black and green manure fallow provides the production of winter wheat grains with protein and gluten content corresponding to the requirements of the first class (protein is not  $\leq 14.0\%$ , gluten is not  $\leq 28.0\%$ ); for corn, winter rapeseed and winter wheat - the requirements of the second class (protein content is not  $\leq 12.5\%$ , gluten is not  $\leq 23.0\%$ );

- for the zone of the Black Sea steppe of Ukraine, the parameters for the payback of a unit of active substance of organic, mineral and organo-mineral fertilizers are determined by increments in the content of protein and gluten in winter wheat grain;

- the payback of a purely mineral fertilizer system at  $N_{75}P_{52.5}K_{52.5}$  standards without the background introduction of manure and green manure below organic (64-80 tons of manure per 1 ha of arable land) and organo-mineral systems and, depending on the precursor, amounts to protein growth:  $8.3 \text{ mg kg}^{-1}$  a.s. (corn MVS),  $12.1 \text{ mg kg}^{-1}$  a.s. (peas),  $17.3 \text{ mg kg}^{-1}$  a.s. (black fallow); gluten growth - 33.6-37.2-31.2, respectively.

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# BIODIVERSITY PROTECTION IN ROMANIA - FINANCIAL RESOURCES

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**Abstract:** *This paper attempts to make an evaluation of the programs implemented or under implementation for the protection of biodiversity. Beyond the national interest, Romania must respect international agreements (Convention of Biological Diversity, Birds Directive, Habitats Directive, EU Biodiversity Strategy, EU Forest Strategy, CITIES) on the conservation and sustained exploitation of biodiversity and ensure a fair distribution of biodiversity costs and benefits. Both EU and international policies have as their main objectives to stop biodiversity loss by 2020, to strengthen the NATURA 2000 network and to compensate for the loss of biodiversity according to the NNL (No Net Loss) principle, in other words: "Stopping global degradation of the environment". By evaluating public data sources, national concerns, results obtained, sources of funding for this field are highlighted. Also, the support measures for the environment and climate, respectively for biodiversity conservation, provided in the NRDP during the two programming periods, are analysed on comparative basis, in order to mark the objectives, the categories of measures and the financial allocations for each type of area in which they were applied.*

**Keywords:** *environment, financial resources, biodiversity conservation*

**JEL Classification:** *O13, P18, P48, Q57*

## INTRODUCTION

Biodiversity represents the natural capital of the world, being an integral part of sustainable development. Conceptually, biodiversity describes the entire life on earth and the interactions that exist between its different components (soil, air, water, etc.). Due to its geographical position, Romania has a high biodiversity, expressed both at the level of ecosystems and at the level of species. The natural and semi-natural ecosystems account for about 47% of our country's area, 45% being agricultural ecosystems, while the remaining 8% are buildings and infrastructure.

Biodiversity protection and conservation *represent one of the priorities of sustainable global development*. The United Nations has proposed that this decade be dedicated to the protection of biodiversity and has established as a vision for 2050 "the assessment, conservation, restoration and sustainable use of biodiversity, maintaining ecosystem services to support a healthy planet and ensuring the well-being of the population".

As foreseen in Romania's Development Strategy for the Next 20 Years, 2016 - 2035, *biodiversity influences the economic development process*, a causal link existing between the two: when development does not respect the environment, biodiversity will undergo negative transformations.

At EU level, the European Commission (EC) aims to monitor the spending on biodiversity and to highlight all the expenditures of member states against the adverse effects on biodiversity, as well as to provide financial support for biodiversity.

Having in view the objectives established at European level – stop biodiversity loss and degradation of ecosystem services by the year 2020, restore them as much as possible, as well as increase the contribution to fight against biodiversity loss worldwide – for Romania, biodiversity conservation represents an objective of national interest, which should be transposed into consistent policies.

## MATERIALS AND METHODS

One of the methods used to prepare the raw material for analysis was the personalized query of available official databases. Highlighting the financial resources necessary to protect biodiversity was based on the results published by the National Institute of Statistics (NIS), in Environmental Statistics Series, and by the public database Tempo Online queries, followed by own processing. In

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the present paper, data were also used from the national reports on monitoring the results of NRDP (National Rural Development Program) 2007 – 2013 and NRDP 2014-2020.

Therefore, the information source is mainly represented by NIS databases and EUROSTAT databases.

For documentation purposes, the *national and international literature* (treatises, monographs, research projects, scientific papers from well-established journals), various *studies and analyses* of well-known national and international institutions represented important milestones. Information from unofficial analyses, reports and studies was also used, as well as information from regional development strategies.

Another method used in the study was complementary information filtering, collection and analysis (internet, various publications), based on complex documentation of BigData type.

## RESULTS AND DISCUSSIONS

In Romania there is a large number of bio-geographical regions and a great variety of natural habitats and wild species of community interest, most of them in a favourable state of conservation. stage. The results of studies conducted under the project CORINE Biotopes identified and catalogued in a database 783 habitats of different types, 3700 plant species and 33800 animal species, including species of community interest and/or included under world heritage protection. However, according to the National Strategy and Plan of Action for Biodiversity Conservation in the period 2010-2020, the indicator “*biodiversity conservation*” for Romania has the lowest value (3.88), compared to the other EU member states. One of the causes would be the way in which funding in this field has been treated so far. “Biodiversity conservation was based on disparate funding from external sources, with no special allocations from the state budget, without any efforts made to develop domestic financial instruments that complement the external ones”. Publicly available information is scarce and disparate. Data on expenditures and investments for environmental protection are provided by the National Institute of Statistics.

In the year 2017, the expenditures for environmental protection totalled 7194 thousand RON nationwide, accounting for 0.84% of GDP, while those for the protection of natural resources and biodiversity conservation totalled only 147 thousand RON, i.e. 0.02% of GDP. The latest data available (presented in the table below) reveal the decrease of expenditures for environmental protection by 36% in 2017, as against 2011 (when these accounted for 2.17% of GDP), while those for the protection of natural resources and biodiversity decreased by 13%.

As regards the investments for environmental protection, the data reveal their decrease by 54%, in the period 2011 - 2017, while the investments for the protection of natural resources and biodiversity decreased by 95%. Therefore, the very small amounts financial resources allocated to environmental protection and for natural resources and biodiversity have become increasingly small over time. In the year 2017, out of total expenditures for environmental protection, only 2% were used for the protection of natural resources and biodiversity conservation (the remainder being expenditures for other activities specific to environmental protection: pollution prevention and control – air and water protection, waste management, soil and groundwater protection, other activities, such as research& development, general environmental management, noise and vibration reduction, protection against radiations, education, training, information), as against 1.51% in 2011.

**Current domestic expenditures and investments for environmental protection, in the period 2011-2017**

Environmental areas	thou. RON current prices						
	2011	2012	2013	2014	2015	2016	2017
<b>Expenditures for environmental protection</b>	12095325	13142644	11561417	8176316	8695321	6018018	7194436
out of which for:	182419	120641	125889	128642	84750	169705	146587

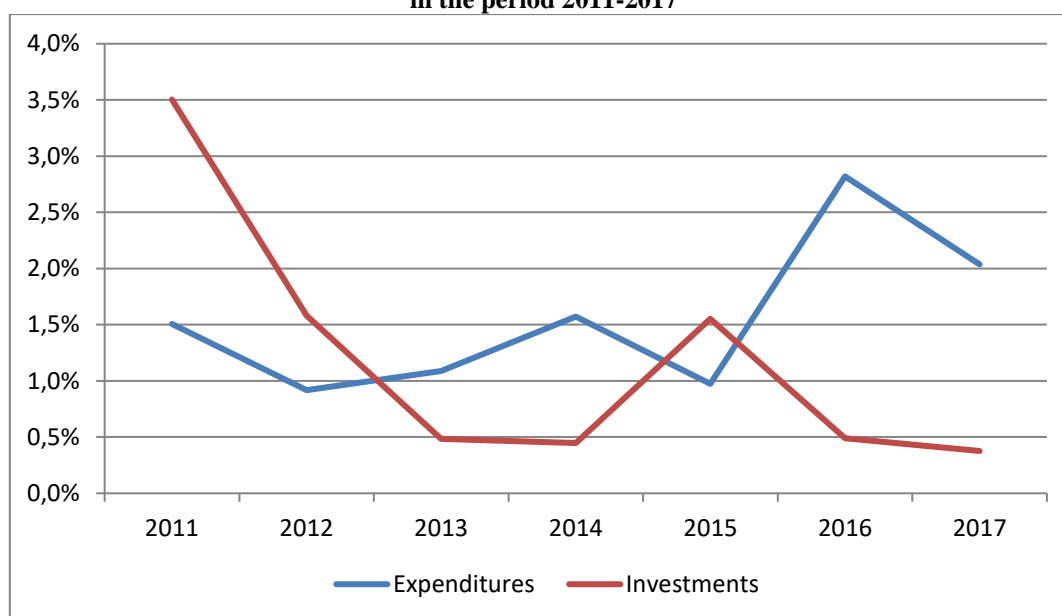
Natural resources and biodiversity <sup>2</sup>							
<b>Investments for environmental protection</b>	5414279	4116201	3920067	4254676	6745028	3004455	2306009
out of which for: Natural resources and biodiversity	189692	65078	19004	19033	104775	14736	8680

Source: NIS, Environmental Statistics series

As regards the investments for natural resources and biodiversity, these accounted for only 0.38% in total investments for environmental protection (as against 3.5% in the year 2011).

In the same period, the expenditures for environmental protection across the EU-28 increased by about 10%<sup>3</sup>. Compared to Romania, many EU member states allocate significant parts of their budgets for biodiversity conservation.

**Share of investments and current domestic expenditures for natural resources and biodiversity, in total investments and expenditures for environmental protection, in the period 2011-2017**



Source: NIS, Environmental Statistics Series, NIS, author's own calculations

One of the 9 general objectives of the future Common Agricultural Policy (CAP), which reflects the importance of policy in economic, social and environmental terms, for the period 2021-2027, is the contribution to biodiversity protection, improvement of ecosystem services and the conservation of habitats and landscapes. This objective is implemented in practice by different categories (and sources) of environmental and climate support measures, as follows:

- **agri-environment climate schemes** – compensatory payments for the actions implemented under the EU CAP. These have as objective to encourage the agricultural land users (farmers) do adopt agricultural practices on voluntary basis that should preserve the ecological value of areas where farming activities are performed (in order to maintain the habitats specific to agricultural land for priority wild species, to use natural resources in a sustainable manner and to preserve the natural landscapes);

<sup>2</sup> Includes activities targeting the protection of species, of natural protected areas, ecological reconstruction, restoration of the aquatic environment, ecological prevention of dangerous natural phenomena.

<sup>3</sup> Calculations obtained from EUROSTAT estimated data, for the years 2011, 2017.

- ***national grants, subsidies and investments through the National Rural Development Program (NRDP)***, which contribute to the improvement of farm economic efficiency or to local community development;
- ***legal protection through the EU Habitats and Birds Directive*** (92/43 / EEC and 2009/147 / EC) – areas included in Natura 2000 network and designated as SCI (site of Community importance), SAC (special areas of conservation) or SPA (special protection area);
- ***legal protection by national legislation*** for the protection of natural reserves;
- ***funding through projects under the Climate Policy Program*** (LIFE – of the European Environment Agency) ***and environmental*** (these projects need to be co-financed from other sources, such as EAFRD, ERDF or private).

Romania's agriculture has a huge potential that should be put into value according to the sustainable development principle, taking into account the application of biodiversity conservation measures. In this regard, we have the support measures provided in NRDP – Axis 2. Besides the expenditures with direct impact on biodiversity conservation, there are also expenditures related to the measures from Axes 1, 3 or 4 from NRDP, financing actions with indirect positive impact upon the environment.

Romania has one of the richest agricultural land resources that can be included in HNV category – 5.22 million hectares (about 39% of the utilized agricultural area), ranking 5<sup>th</sup> in EU-27. The concept of ***high natural value (HNV) of agricultural land*** has been relatively recently used in Romania, since the first post-accession NRDP (NRDP 2007-2013) and starts from one of the definitions provided by the European Environment Agency: “semi-natural vegetation, mainly semi-natural grassland, generally associated with a high level of biodiversity”, with great diversity of species and habitats.

Initially, in the year 2008, only the pastures were considered high natural value areas (which had a high biodiversity among other types of agricultural land); later on, since 2012, the high natural value land concept has been extended, to include other types of agricultural land as well (traditional orchards – permanent pastures, for mowing and/or grazing, mosaic landscapes – including meadows, trees and shrubs and small-sized agricultural land areas, extensively cultivated, in the proximity of forests, where biodiversity and wild fauna are present).

The next table presents the HNV agricultural land, on comparative basis, by each NRDP

**High natural value (HNV) agricultural land**

	<b>PNDR 2007-2013</b>	<b>PNDR 2014 - 2020</b>
<b>Number of administrative-territorial units (ATU) with HNV grasslands</b>	1038	958
<b>Area of eligible pastures (million hectares)</b>	2.4 <sup>4</sup>	2 <sup>5</sup>
<b>Land eligibility conditions</b>	- minimum 1 ha (parcel size minimum 0.3 ha) <sup>6</sup> - 449,000 holdings – excluded from any form of CAP support	- the same (except for ATUs partially or fully overlapping the most important Natura 2000 sites)

Source: Farm Structure Survey, 2013 and the Land Parcel Identification System (LPIS), 2013

#### **NRDP 2007 - 2013**

The implementation of measures from Axis 2 aimed at maintaining and improving the quality of the rural space, by promoting a sustainable management of agricultural and forest land.

<sup>4</sup> Farm Structure Survey - 2013

<sup>5</sup> Land Parcel Identification System (LPIS) - 2013

<sup>6</sup> Excludes a great number of small and medium-sized farms

The main **NRDP** 2007-2013 measures meant to restore and protect biodiversity on agricultural land are the following:

- **Measure 211** – Support for the less-favoured mountain area has as specific objective to support the continuous utilization of agricultural land in the less-favoured mountain area, thus maintaining the viability of the rural space and maintaining and supporting sustainable farming activities. The measure has been implemented since 2007.
- **Measure 212** – Support for less-favoured areas, other than mountain areas, implemented since 2008, together with Measure 214. Its specific objective is to support the continuous utilization of agricultural land in the less-favoured areas, thus maintaining the viability of the rural space and maintaining and supporting sustainable farming activities.
- **Measure 214** – Agro-environmental payments – has as specific objective to support the sustainable development of rural areas by encouraging the land users to introduce or to continue farming methods compatible with the protection and improvement of the natural environment, of biodiversity, water, soil and natural landscape inclusively. This *brings direct benefits for biodiversity conservation* by a proper pasture management, through traditional farming practices and maintaining the high natural value grassland.

**The total financial allocation of Axis 2** was 3.16 billion euros, i.e. about 23% of NRDP financial allocation (taking into consideration the total allocation), and about 25% respectively (in terms of allocations exclusively dedicated to NRDP measures), to reach 34% in the final version (version XVI, approved in November 2015). Under Axis 2, the main measure in terms of financial allocation was Measure 214 “Agro-environmental payments”, which was constantly allocated more than 40% of the total budget of this Axis.

In the period 2008 – 2015, payments worth 3.47 billion euros were effected under the commitments made within the 3 measures, which accounted for about 42% of the entire NRDP 2007-2013 allocation and 98% of the allocations under the measures of Axis 2 (Environment and rural area – sustainable management of agricultural and forest land and protection and improvement of natural resources) addressed to the plant sector.

**Financial support for the environment and climate measures**

Measure	Financial allocations (public expenditure) for the period 2007-2014 - mil. EUR -	Payments made - mil. EUR -	Beneficiaries	
			Number of holdings	Area - ha -
	NRDP 2007 – 2013			
Measure 211 Support for the less-favoured mountain area	769.6	771.2	360993	2112396
Measure 212 Support for the less-favoured areas (other than mountain areas)	435.6	431.4	151524	2057535
Measure 214 Agro-environmental payments	1428.4	1377.9	321544	2281383
Measure 215 Animal welfare	526.4	457.5	898	-
Measure 221 First afforestation of agricultural land	3.2	0.5	18	345
	NRDP 2014-2020			
Measure M10 Agro-environmental payments	1069	253.6	...	1381100
Measure M11	235.7	89.5	...	225950

Organic farming				
<b>Measure M13</b>				
Areas facing natural constraints	1317.6	965.9	...	470000

Source: Yearly Progress Report NRDP 2007-2013 and Implementation Stage of NRDP 2014 - 2020 – Situation of projects on 4.04.2019

### **NRDP 2014-2020**

The environmental protection objectives from NRDP 2007-2013 are continued under NRDP 2014-2020, the allocations for environmental and climate measures in the new programming period exceeding 30% of total EAFRD allocations.

The agro-environmental payment is the core element for environment protection, objective included in the Common Agricultural Policy. At the same time, these payments support the sustainable development of rural areas, biodiversity conservation (wild species and their habitats, local animal breeds), soil and water protection, diminution of greenhouse gas emissions, carbon sequestration in biomass, as well as the sustainable management of natural resources.

In order to strengthen the agricultural sector sustainability in ecological terms and to capitalize farmers' efforts, the European Commission, through CAP 2014-2020, has proposed that 30% of direct payments be granted for the adoption of practices that allow the optimum use of natural resources. These are ecologically effective practices, which can be implemented in a simple manner, such as: crop diversification, maintaining the permanent pastures, protection of ecological reserves and landscapes.

Thus, the following measures of **NRDP 2014-2020** were provided, implemented since 2015:

- **Measure 10** – *Agro-environmental and climate (M10)* – represents a key element necessary to integrate the environmental protection issues into the Common Agricultural Policy. In Romania, this measure must encourage farmers to adopt, on voluntary basis, agricultural practices, meant to maintain the environmental value of rural areas, to maintain the habitats specific to agricultural land that are important for the priority wildlife species, to use the natural resources in a sustainable manner and to preserve the traditional landscapes.
- **Measure 11** – *Organic farming (M11)* – organic farming promotes extensive agricultural practices, responding to the society's demand to use environment-friendly agricultural practices, as well as to consumers' increasing demand for organic products. The specific practices of organic farming contribute to biodiversity protection, to maintain soil fertility and functionality and to reduce water pollution.
- **Measure 13** – *Areas facing natural or other specific constraints (M13)* – the support provided under this measure is meant to compensate economically the disadvantages experienced by farmers in their farming activities, related to the low production capacity of agricultural land and the additional costs implied by maintaining the agricultural activities in these areas, thus lowering the abandonment risk of farmland (higher in these areas).

The allocations for these measures are consistent, farmers being able to access commitments in which amounts of about 2.623 billion euros are available (Measure 10 – 1069 million euros, Measure 11 – 235.72 million euros, Measure 13 – 1317.6 million euros).

### **Other financial allocations**

The most important funding sources for biodiversity conservation in the next period, too, will remain the EU funds, LIFE + and the (national) Environmental Fund.

**LIOP (Large Infrastructure Operational Program) 2014 - 2020** is the operational program benefitting from the greatest financial allocation, i.e. about 12 billion euros; the program is funded both from the European Regional Development Fund and from the Cohesion Fund.

*The financial allocation for biodiversity conservation*, through the Large Infrastructure Operational Program 2014 - 2020 /LIOP/ is 350 million euros, higher by about 130 million euros than in the previous programming period 2007-2013, according to the environmental organization World Wide Fund for Nature /WWF/, which specifies that the new program approved by the European

Commission /EC/ contains the WWF recommendations on integrating biodiversity as primordial objective.

Since 1992, the special EU instrument dedicated to funding the environmental activities is the program **LIFE+**, one of the most important financial instruments for the environment, and mainly for biodiversity conservation. Nature and biodiversity conservation have been included among the subprograms for the four stages already completed. The Commission manages the LIFE program, which provides support to projects in the member states and in third countries. The fifth stage of the LIFE program (introduced in the Regulation 1293/2013, which covers the period 2014-2020) consists of two sub-programs, one on the climate change and one for the environment. For nature and biodiversity, which are part of the environment sub-program, a total budget of *1155 million EUR was allocated*.

Another funding source is the **Environment Fund**. Yet at present, the value of the funding from this fund for projects for biodiversity conservation and management of natural protected areas is quite low. According to the Environment Fund Administration, 667 projects were approved in the period 2007-2011. The value of projects completed so far is 330.18 million RON (7 projects are still ongoing, with a financed value of 2.72 million RON). The beneficiaries of funding for this type of projects are the administrative-territorial units that can make eligible expenses consisting of: land and soil preparation for planting, purchase of seedlings and plants necessary to create green spaces, development of playgrounds; development of ecological alleys and borders; furniture necessary for the equipment of green spaces etc.

## CONCLUSIONS

Although many European states have allocated increasing financial resources each year for environmental protection, for biodiversity protection respectively, in Romania the expenditures in this area have diminished each year.

For the biodiversity protection projects, at present there are limited opportunities, as most applicants are state institutions or NGOs with limited financial possibilities.

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# STUDY REGARDING THE ANALYSIS OF THE AGRICULTURAL SUBSIDIES FROM ROMANIA COMPARED TO THE E.U. BETWEEN 2007-2017

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**Abstract:** *Every year the European Union grants a financial support to the agricultural sector of over 47 billion Euro, thus contributing to the completion of specific goals of the Common Agricultural Policy. The distribution of that EU funding towards the farmers from the member states is done according to the economical dimension of the exploitations, not according to the production level. In this study we intended to analyze the subsidies given to Romania after the admission to the EU compared to other member states. For a detailed analysis of the subsidies, quantitative as well as qualitative, we have taken account of the agricultural exploitations classification according to the economical dimension.*

**Key words:** *subsidies, economical dimension, PAC policies*

**JEL Categories:** *Q14, Q18*

## INTRODUCTION

E.U.'s Common Agricultural Policy is a dynamic policy which, through consecutive reforms has been adapted to the new challenges that the European agriculture is facing.

Since its foundation CAP has been through different stages, in its attempt to adapt.

In the beginning, the farmers have received subsidies according to production, thus reaching the goal of agricultural self-sufficiency, but major oversupply problems were created. The following reforms have reduced the production aid, by introducing concepts such as conditionality, through which the payments have been submitted to some agricultural good practices as well as through legal and management requirements. Ultimately, the reforms have created a multipurpose model in which the priorities are the environment and quality, aiding the farmers and the development of the rural areas.

CAP has two interconnected components through which they contribute to the completion of their goals, namely: revenue aid for farmers (direct payments) and rural development.

Currently, and mostly due to CAP, the European agriculture guarantees the security to over 500 million Europeans, insures a steady work for 22 million people (44 mil. if we take account of the whole agro-food chain) and Europe is the first agro-food exporter in the world.

## MATERIAL SI METHODS

The analysis in this study is based on statistical data given by RICA regarding the total subsidies in the European Union and Romania, by exploitations, by economical dimension classification, between 2007-2017.

Calculation formulas used to calculate the index numbers are the following<sup>4</sup>:

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### Annual growth rate

$$r_{2007-2017} = \sqrt[10]{\pi \left( \frac{p_1}{p_0} \right)} - 1;$$

Where:

$r_{2007-2017}$  = annual growth rate;

$\pi p_1/p_0$  = indexes with chain base

### Standard deviation

$$\sigma = \sqrt{\frac{\sum (\bar{x} - x_i)^2}{n-1}};$$

Where:

$\sigma$  = standard abbreviation

$\bar{x}$  = mean of a number of years

$n$  = the number of analyzed years

### Variation modulus

$$C = \frac{\sigma}{\bar{X}} \times 100,$$

Where:

C-variation modulus- stated as percent and who can be low (0-10%), medium (10,1-20%) or high (higher than 20,1%).

## RESULTS AND DISCUSSIONS

After analyzing the total of subsidies (without the ones for investments) given in the European Union between 2007-2017, it turns out that it has been registered a maximum of 11976 Euro in 2017 and a minimum of 9558 Euro in 2007, with a medium rate of 115,47%. The annual growth rate of total subsidies at European Union level has been of 2,28% and the variation modulus of 11,60%, which shows us that the period's average is significant and the data are homogenous.

In Bulgaria is registered an annual growth rate of 26,68%, having a variation modulus of 55,50%. In Croatia, the annual growth rate has been of 13,12%, in Spain of 6,17%, in Estonia 5,90% and in Cyprus 5,47%.

In Romania's case, we can see that between 2007-2017, it registers a minimum value of subsidies in 2015 of 1213 Euro and a maximum in 2016 of 2297 Euro, with an annual growth rate of 0,63% and the variation modulus of 19,46% shows us that the period's average is significant and the values are homogenous.

Within the analyzed period there are countries where the annual rate has had negative values like in Greece's case, with a rate of -0,22%, Belgium's with -1,0% and Malta's -11,12%. (according to Table nr.1)

Table nr. 1. Subsidies Total – without the ones for investemnts in E.U. between 2007-2017

Country	Min	Max	Medium rate	Average	Annual rate	Standard deviation	Variation modulus	Signif.
	Euro	Euro	%	Euro	%	Euro	%	
Belgium	20887	25900	104,12	24050,82	-1,00	1569,78	6,53	*
Bulgaria	1727	18376	465,41	8037,55	26,68	4461,13	55,50	***
Cyprus	3126	6331	153,54	4799,55	5,47	834,66	17,39	***
Czech Republic	61397	91141	130,15	79910,00	4,03	8415,87	10,53	**
Denmark	34488	38193	100,31	36554,73	0,43	3330,68	9,11	*
Germany	31844	36528	110,31	35128,36	1,38	1633,75	4,65	*

Greece	6117	7113	102,84	6665,36	-0,22	292,05	4,38	*
Spain	7081	12885	144,27	10215,64	6,17	1618,01	15,84	**
Estonia	16293	28906	142,26	23177,73	5,90	3696,19	15,95	**
France	28297	31621	99,79	30007,91	-0,46	1188,95	3,96	*
Croatia	4313	7061	127,16	5484,60	13,12	2937,66	53,56	***
Hungary	12644	17617	121,15	15705,27	2,70	1774,62	11,30	**
Ireland	17605	21176	95,61	19341,18	-1,26	1114,03	5,76	*
Italy	5265	8848	134,83	7098,82	5,22	1407,91	19,83	**
Lithuania	7108	11512	127,12	9035,91	4,12	1284,50	14,22	**
Luxembourg	39476	58300	118,63	47012,55	2,93	5938,60	12,63	**
Latvia	12513	16797	115,35	14434,18	2,47	1235,45	8,56	*
Malta	2524	9453	47,36	4137,27	-11,12	2495,45	60,32	***
Netherlands	16254	22524	108,66	18556,18	-0,49	1979,21	10,67	*
Austria	16251	20469	99,81	18402,55	0,87	1212,09	6,59	*
Poland	4028	5962	135,84	5471,64	3,89	558,78	10,21	*
Portugal	5691	9250	125,19	7124,36	3,55	1049,59	14,73	*
Romania	1213	2297	83,67	1772,91	0,63	344,95	19,46	*
Finland	45936	51559	108,05	49633,82	0,87	1759,64	3,55	*
Sweden	33448	41004	110,75	38159,45	1,61	2838,01	7,44	*
Slovakia	128575	169185	109,31	152684,00	0,90	10899,34	7,14	*
Slovenia	5873	8081	116,97	7080,18	2,44	715,19	10,10	**
UK	37455	45924	89,83	41252,82	-1,52	2330,53	5,65	*
Total Country	9558	11976	115,47	11036,64	2,28	679,72	6,16	*

Source: Calculations based on RICA's data base

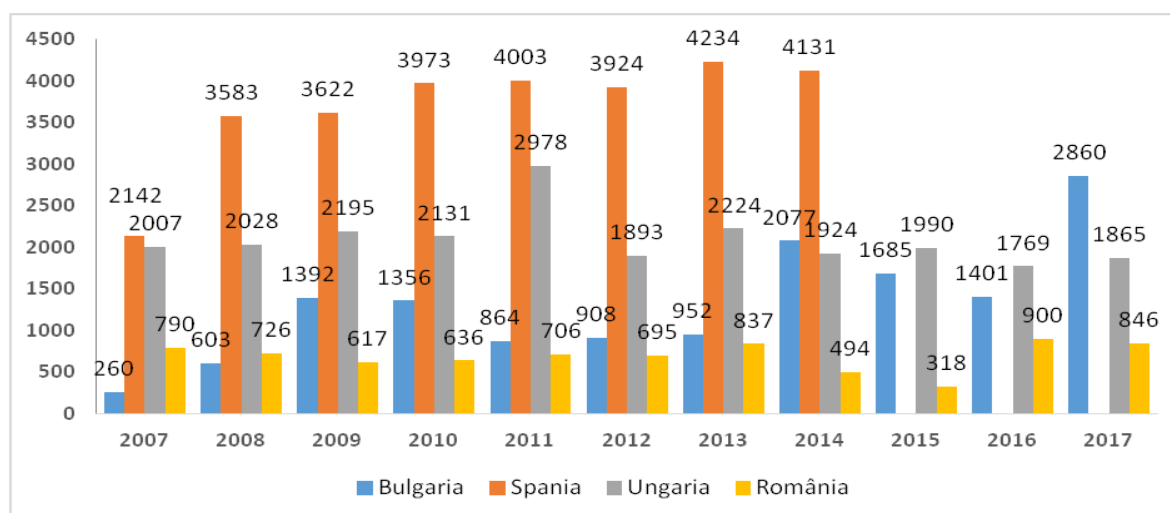
In order to fathom this analysis, six countries from the European Union have been taken under consideration: Romania, Bulgaria, Hungary, Spain, France and Germany.

By analyzing through comparison the total subsidies value (without the ones for investments) received by these countries between 2007-2017, ranked by sizes of economical dimension, we have detected that:

- in countries like France and Germany there are no **exploitations with economical dimensions between 2000–8000 Euro**, and in Spain's case, we can see that subsidies are given until 2014, and that after this year, there haven't been registered any semi-subsistence exploitations (Diagram nr.1);

- in Bulgaria we have detected an increase of those subsidies for the semi-subsistence farms, so that in 2007 they would receive 260 Euro and in 2017 the value reaches 2860 Euro, while in Hungary it dropped from 2978 Euro in 2011 to 1865 Euro in 2017.

Diagram nr.1. The evolution of subsidies total (without the ones for investments) in the E.U. by exploitations with an economical dimension between 2000-8000 Euro, between 2007-2017

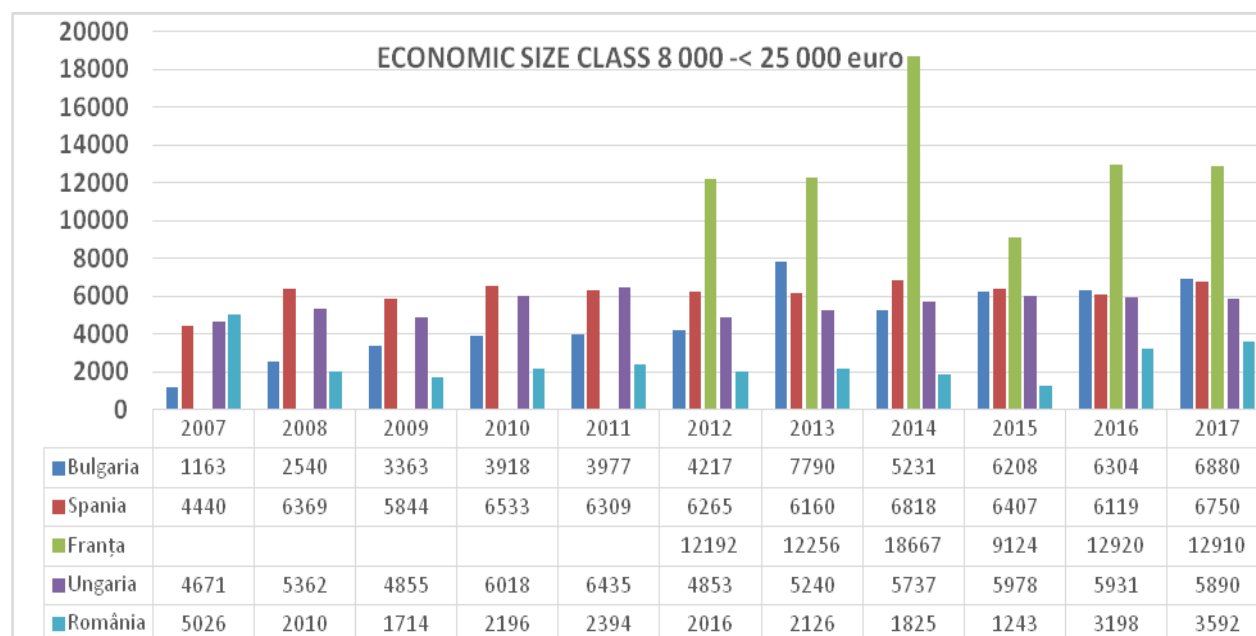


Source: RICA data base

In Romania, the subsidies total has dropped up until 2012 reaching 695 Euro from 790 Euro in 2007, but towards the end of the analyzed period, it grows up to 846 Euro.

Among the analyzed countries, our country receives the smallest amount for the semi-subsistence exploitations, in 2017, being by 54,6% smaller compared to the ones given in Hungary and by 70% smaller than the ones in Bulgaria.

Diagram nr.2. The evolution of subsidies total (without the ones for investments) in the E.U. by exploitations with an economical dimension between 8000 – 25000 Euro, between 2007- 2017



Source: RICA data base

Between 2007-2017 regarding the farms with **an economical dimension between 8000 – 25000 Euro**, among the analyzed countries, Bulgaria stands out by having the largest granted amount, with a maximum in 2013 of 7790 Euro, only to drop in 2017 to 6880 Euro.

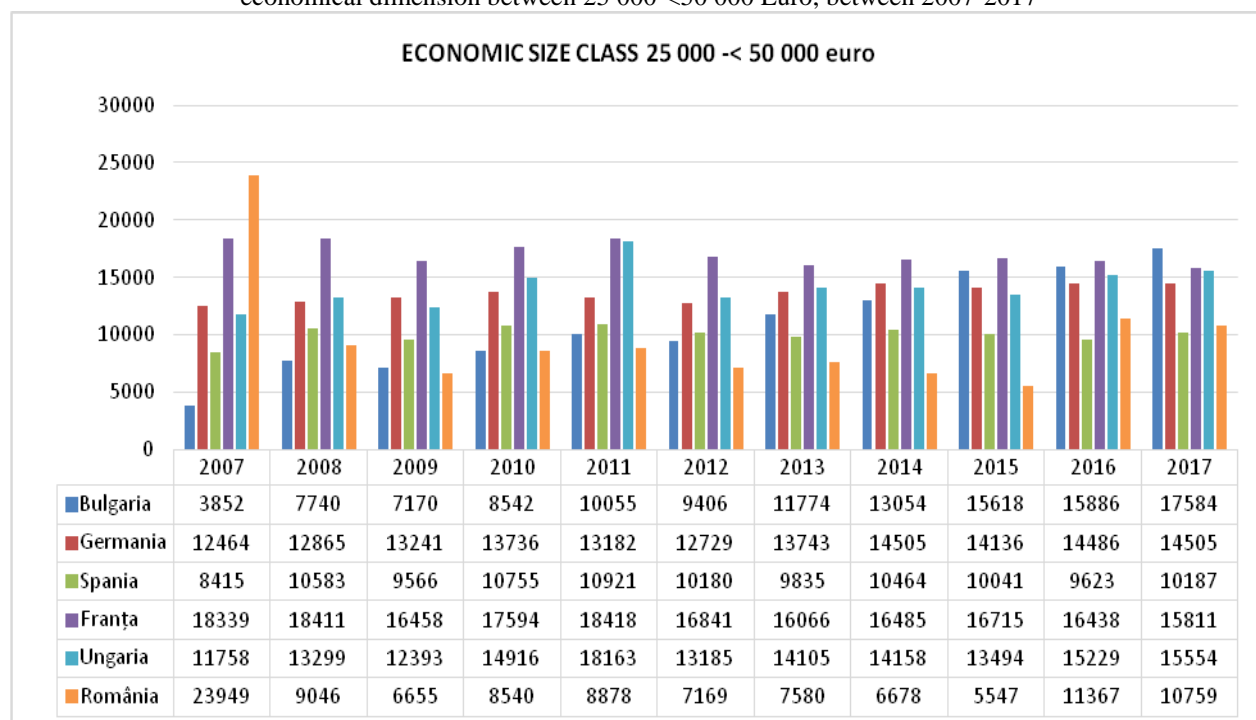
France, during 2012-2017 receives the largest amount so that it reaches in 2014 a maximum of 18667 Euro, but dropping up until 2017 to 12910 Euro.

Following the evolution of the subsidies total for the economical dimension between 8000-25000 Euro, we can see that Romania has received the smallest amount among the analyzed countries within this period, in 2017 the amount being smaller by 39% compared to the one given in Hungary and by approximately 47% compared to Spain and Bulgaria. Since 2013 in Romania the subsidies value has had a decreasing tendency up until 2015, followed by an increase in the next years of up to 3592 Euro in 2017 (Diagram nr.2).

- Within the analyzed period 2007-2017, regarding the farms with **an economical dimension between 25000-50 000 Euro**, Romania stands out with a subsidies value that is higher compared to the other states in 2007 of 23949 Euro, and in 2017 it drops to 10759 Euro (Diagram nr. 3).

The total subsidies value from Bulgaria has had an ascending trend throughout the analyzed period, growing from one year to another, reaching in 2017 a value of 17584 Euro.

Diagram nr. 3. The evolution of subsidies total (without the ones for investments) in the E.U. by exploitations with an economical dimension between 25 000-<50 000 Euro, between 2007-2017



Source: RICA data base

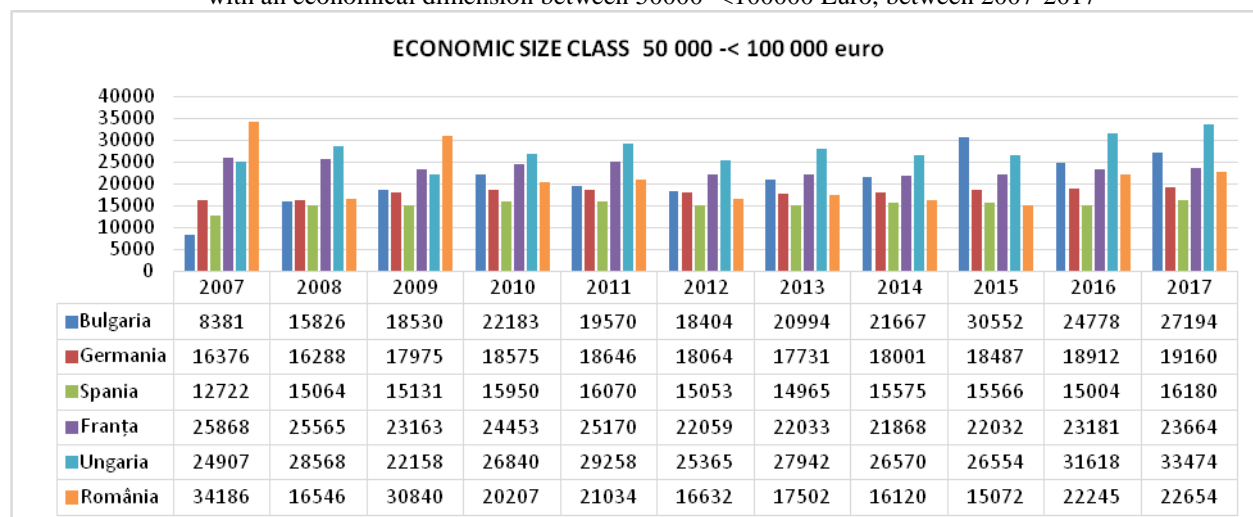
In România the total subsidies value received by farms with **an economical dimension between 25000-<50000 Euro** have a decreasing tendency up until 2015 reaching 5547 Euro, but increase in 2016 by 104% compared to last year. In 2017 the subsidies total value (without the ones for investments) has been of 10759 Euro, representing a drop of 44,9% compared to 2007.

The value of the subsidies given to Hungary reaches a maximum point in 2011 of 18163 Euro and in 2013 it has a decreasing trend with a value of 15554 Euro.

Out of all the analyzed countries, France ranks first with the highest values throughout the analyzed period.

- In 2017 the amount given to the farms with **economical dimension between 50000 - <100000 Euro** in Romania is of 22654 Euro, by 40% higher than the one received by Spain and by 18% compared to Germany, but, by 32% lower than Hungary and by 16,7% lower than Bulgaria (Diagram nr.4 ).

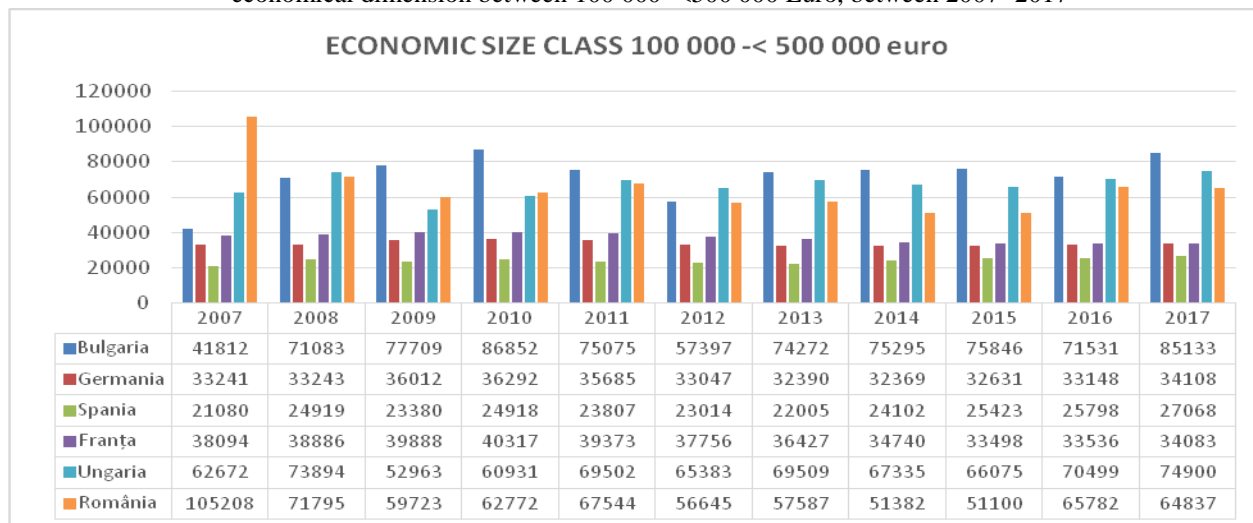
Diagram nr.4. The evolution of subsidies total (without the ones for investments) in the E.U. by exploitations with an economical dimension between 50000- <100000 Euro, between 2007-2017



Source: RICA data base

In the analyzed period 2007-2017 the highest value of subsidies total (without the ones for investments), for the exploitations with an economical dimension between 50 000-< 100 000 Euro, has been given to Romania, followed by France in 2007, Bulgaria in 2015 and Germany, Spain and Ungary in 2017.

Diagram nr.5. The evolution of subsidies total (without the ones for investments) in the E.U. by exploitations with an economical dimension between 100 000- <500 000 Euro, between 2007- 2017



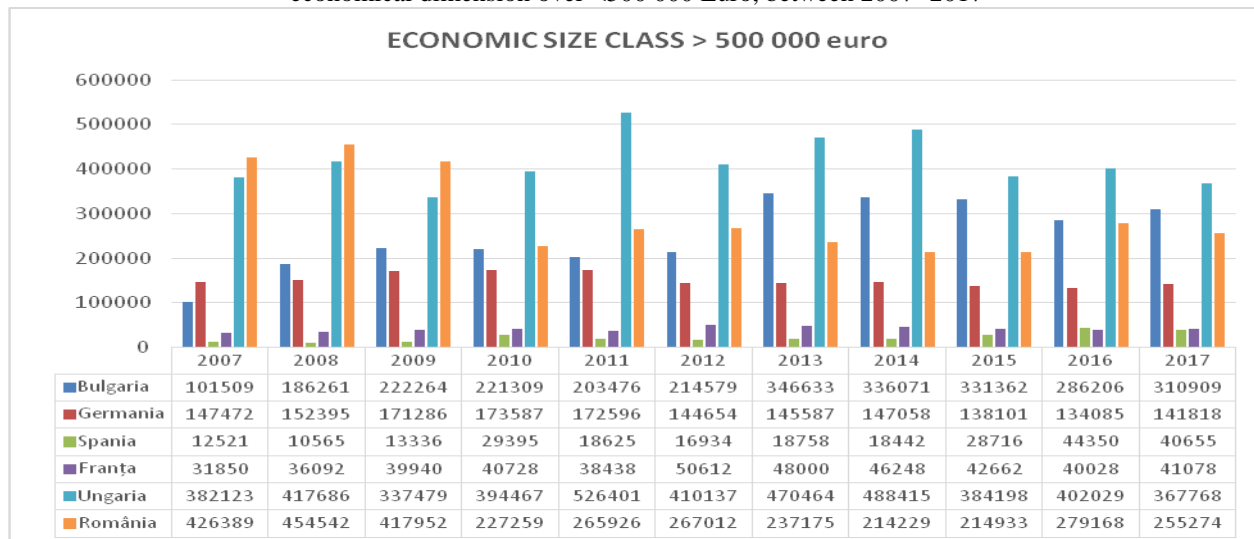
Source: RICA data base

Among the analyzed countries, regarding the exploitations with **an economical dimension between 100000 -< 500000 Euro**, Romania receives the highest value out of subsidies total, throughout the analyzed period 2007-2017 (Diagram nr.5). The value of the subsidies received by Bulgaria reaches a maximum point in 2010 with 86852 Euro, compared to 2013 with a value of 74,272 Euro. In Hungary and in Romania the subsidies value has been lower than Bulgaria's by 6,4 % respectively 22,5% in 2013, by 12,9% respectively 32,6% in 2015 and in 2017 these differences are of 12% and 23,8%.

In Germany the subsidies value is almost constant throughout the analyzed period, around the value of 32-33 thousand Euro, in 2017 being by 60% lower than Bulgaria's.

- Among the six analyzed countries from the E.U., Hungary ranks first for exploitations with **an economical dimension over 500000 Euro**, the value of the subventions being in 2011 of 526401 Euro, up until 2017 when it drops but it maintains at a higher level compared to others, with a value of 367768 Euro.

Diagram nr.6. The evolution of subsidies total (without the ones for investments) in the E.U. by exploitations with an economical dimension over <500 000 Euro, between 2007- 2017



Source : RICA data base

Bulgaria ranked second, reaching a value of 310909 Euro in 2017, with 35724 Euro lower than in 2013 (Diagram nr.6).

Romania ranks third among the analyzed countries having a representative value in 2016 of 279168 Euro, but it's reduced in the following year to 23894 Euro (by 8,5%). Germany, France and Spain follow the same oscillating trend throughout the analyzed period.

## CONCLUSIONS

- CAP assistance is necessary in order to promote and maintain a secure, sufficient and qualitative agro-food system, like the one that we have today and, at the same time, to guarantee an appropriate income for producers, to promote rural development and adaptation to new statuses (the impact on the environment, the climate changes, etc).

- The new reform is necessary in order to make CAP a more distributive, efficient and durable policy by prioritizing the vocational training of the farmers in order to achieve expertise and to support their effort by increasing competitiveness and by diversifying the agricultural activities within the farms that they manage, thus generating more jobs.

- The subsidies percentage out of total income varies from one year to another, depending on the final results of the exploitation and on the level of the subsidies given, playing an important part in the restructuring of the agricultural organizations and in achieving a certain level of economical performance.

- According to the data analyzed within the study, it has been noticed the fact that Romania, compared to the European countries, had the highest value of subsidies total when it comes to exploitations with an economical dimension of over < 500000 Euro in 2017.

- At the E.U. level the average of subsidies total that have been given between 2007-2017 has been of 11036,6 Euro, the registered annual rate being of de 2,3%, with a standard deviation from the standard average of 1280,5 Euro.

- The countries that have registered high annual rate within the analyzed period have been Bulgaria (26,68%), Croatia (13,2%), Spain (6,17%) and Estonia (5,9%).

- In order to improve the future support plans, the analysis in detail and methodical of the agricultural producer's needs is considered necessary in an approach with criteria such as: differentiation of support by crop zonation, area potential, so that the producers that get lower productions due to the fact that the crop area is inferior, can get a more substantial financial support; differential encouragement confronted with the existing surface.

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# THE STUDY ON THE MAIN ECONOMIC ACTIVITIES IN ROMANIA

ALEXANDRA MARINA MANOLACHE<sup>1</sup>

**Abstract:** *The present paper proposes the analysis of the sectors of the national economy from the point of view of production (Gross Domestic Product) but also from the point of view of consumption (average monthly labor costs). This paper is based on the analysis of the statistical data from a quantitative and qualitative point of view, in order to be able to raise awareness of the current level and the evolutions of the sectors and economic branches of Romania in the formation of GDP, but also in terms of labor productivity and labor cost. Finally, a comparison will be made between labor productivity (from a value point of view) and labor costs, and on the other hand it will analyze the value of the agricultural branch in order to determine the influence of this productivity / cost ratio on the value of production.*

**Keywords:** *agriculture, economic activities, evolution*

**JEL Classification:** *N 10, Q16*

## INTRODUCTION

Economic activities can not be substituted by any other activity, giving it world-wide importance, each nation wants to ensure food security by increasing the contribution that agriculture has in the general stages that contribute to both social development and economic growth, making this activity undertaken by man and supported by natural resources to play an important role in the economy and political strategies of the countries. Through agriculture, food products of plant and animal origin are provided at national, European and global level, as well as various raw materials destined to the processing / processing industry resulting in goods used on a large scale, so agriculture can be considered a basic branch of the national economy.

In order to focus our attention on the topic under analysis, namely, “The study on the main economic activities in Romania, it is necessary to know information regarding the branches and agricultural sectors as well as the description of the notion of GDP. The main branches of agriculture are:

- Vegetable agriculture divided by agricultural sectors such as - field crops, fruit growing, viticulture, etc.
- Zootechnical agriculture can be defined by the zootechnical sectors on different categories / breeds of animals and birds.

Gross domestic product is defined as a macroeconomic indicator that reflects the sum of the market value of all goods and services for final consumption, produced in all branches of the economy within a country within one year.

## MATERIALS AND METHODS

The present paper is subjected to the analysis of GDP formation on economic activities, the dynamics of agricultural production measured in GVA, the dynamics of gross domestic product but also the productivity of labor and labor, so this is the main objective of the paper, to show the evolution of the sectors and economic branches in Romania in the formation of GDP, but also in terms of labor productivity and labor cost with the data provided by the National Institute of Statistics (NIS), using the method of comparative, quantitative and qualitative analysis of data for the period analyzed 2013-2017 .

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## RESULTS AND DISCUSSIONS

If in 2005, the share of agriculture (including forestry and fisheries) was about 14.1% in GDP, it gradually decreased to around 6.0% in 2013. However, it is worth noting that the rest of the activities economic have increased their share in GDP formation, indicating that the trend of gross value added from agriculture, as absolute value remained in 2015 (30141.6 million lei current prices) relatively close to that of 2005 (31030.1 million lei) current prices), representing a slight fluctuation of 888.5 million lei current prices, while the relative value shows a tendency of significant reduction in GDP formation.

**Table 1-Economic activities in the formation of the gross domestic product**

Economic activities	2013		2015		2017	
	Million. lei current prices	%	Million. lei current prices	%	Million. lei current prices	%
Agriculture, forestry and fishing	33787,5	6,0	30141,6	4,83	36237,8	4,7
Industry	44746,1	28,6	171185,2	27,4	206726,1	26,7
Construction	44746,1	8,0	40451,3	6,5	49481,7	6,4
Trade	89322,1	16,0	120997,8	19,4	159170	20,6
Information and communications	32416,6	5,8	35963,9	5,8	43940,5	5,7
Financial intermediation and insurance	25158,4	4,5	23026,5	3,7	24001	3,1
Real estate transactions	50600,8	9,0	60472,3	9,7	65743,8	8,5
Professional activities	40613,6	7,3	49654,7	8,0	58894,3	7,6
Public Administration	67175	12,0	69698,7	11,2	102106,2	13,2
Other services	16174,6	2,9	22629,3	3,6	27499,3	3,6
<b>Gross value added</b>	<b>559829,1</b>	<b>100</b>	<b>624221,3</b>	<b>100</b>	<b>773800,7</b>	<b>100</b>

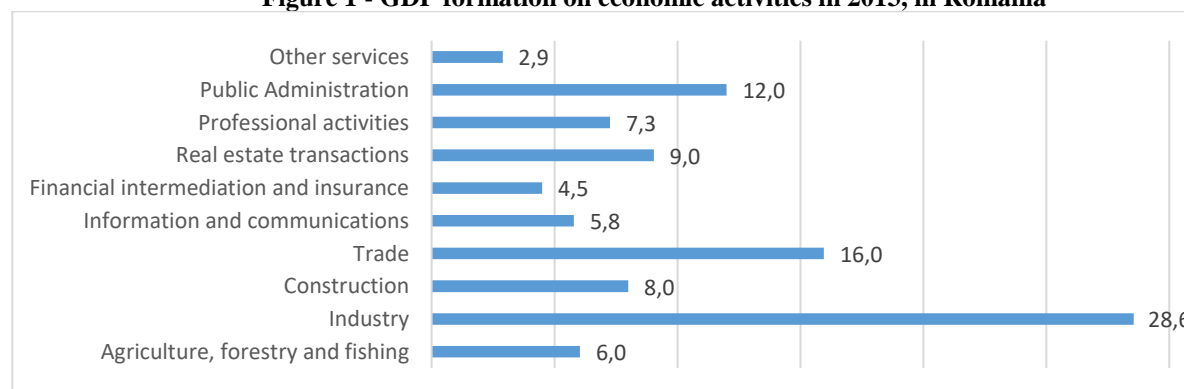
Source: National Institute of Statistics, own calculations

This trend was largely due to insufficiently developed economic conditions, a limited technical base, but also the influence of climatic factors.

Graphically representing the data presented in table 1, we can see that the economic activities that hold significant weights are - public administration, trade and industry for the five years analyzed.

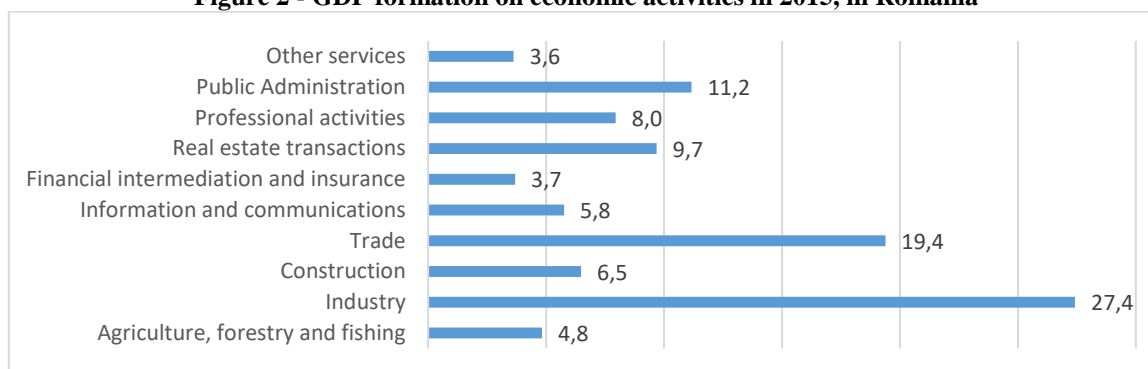
Another cause that may explain the decrease of the share of agriculture, forestry and fisheries in the gross domestic product may be the accelerated development of the other economic activities, which involved an increase of the total gross value added higher than the one of the agriculture (increase in 2017 compared to 2017). the year 2013 was 7.25% for agriculture, and the total gross added value increased by 38%)

**Figure 1 - GDP formation on economic activities in 2013, in Romania**



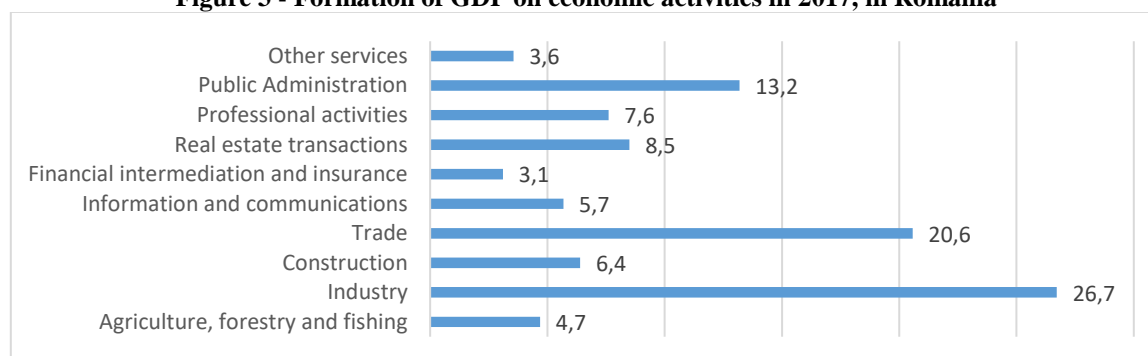
Source: National Institute of Statistics, own processing of statistical data

**Figure 2 - GDP formation on economic activities in 2015, in Romania**



Source: National Institute of Statistics, own processing of statistical data

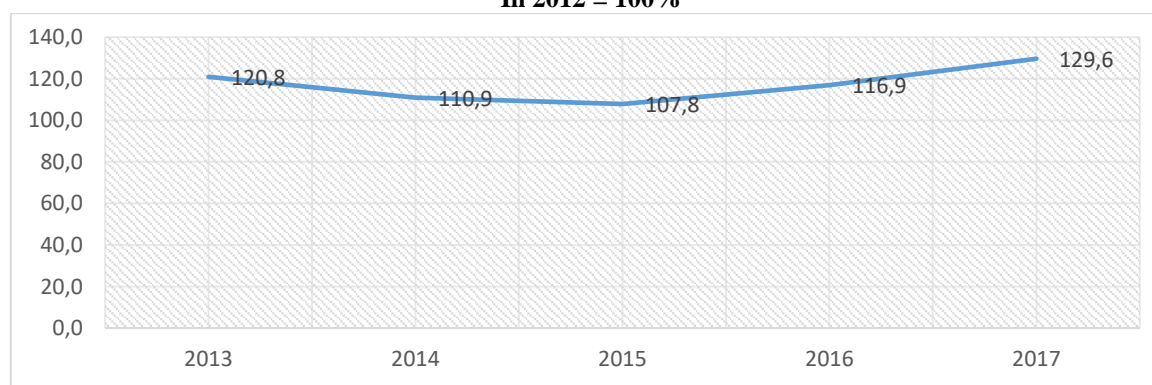
**Figure 3 - Formation of GDP on economic activities in 2017, in Romania**



Source: National Institute of Statistics, own processing of statistical data

The contribution of agriculture (including forestry and fisheries) to GDP formation was due to fluctuations in national agricultural production.

**Figure 4 - Dynamics of agricultural production measured in Romanian GVA in 2013-2017**  
In 2012 = 100%



Source: National Institute of Statistics, own processing of statistical data

The dynamics of agricultural production shows fluctuations from year to year due largely to the meteorological and climatic variations in Romania, as well as the impact of the common agricultural policies (CAP) with great influence on the granting of subsidies, but also the fact that the demand for agri-food products the market is one of an elastic nature in relation to other economic indicators (prices and revenues).

Also, agriculture plays a very important role in supporting the self-consumption of the rural population. It can be observed that from the analyzed period the share of consumption in GDP as well as that of the self-consumption has had an increasing tendency due to the big productions supported by the demand on the market of the agri-food products.

## Labor force in agriculture and labor productivity in this sector

According to the Institute of Statistics, labor productivity is defined as: The employed population comprising all persons - both employed and self-employed - engaged in production activities that fall within the limits of production from national accounts. Labor productivity per employed person was calculated as the ratio between gross value added and the number of employed persons.

**Table 2 - Labor productivity per employed person, by main activities of the national economy, between 2013-2016**  
lei / person / month

<b>Economic activities</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
Agriculture, forestry and fishing	1098,933	1040,433	1104,167	1288,783
Industry	7546,308	7695,517	8018,467	8352,333
Construction	5868,217	5481,467	5515,142	5719,258
Trade	4464,758	4891,575	5631,492	6153,267
Information and communications	18889,73	18348,26	17520,49	19584,49
Financial intermediation and insurance	18183,67	18156,96	18588,18	19956,88
Professional activities	10188,9	9788,542	11457,51	11651,78
Public Administration	5192,467	6111,633	5012,517	6280,558
Other services	6246,708	6724,158	8017,125	7578,442

Source: National Institute of Statistics

As can be seen in table 2, the labor productivity per employed person measured in lei per person within one month in the agriculture sector is the lowest of all economic activities, given that this activity is characterized by its zoning, thus there are months of the year when the employed person does not work.

However, analyzing the evolution of this indicator, we notice an increase in labor productivity in agriculture, reaching 2016 (1289 lei / person / month), being 17, 3% higher than the base year.

As can be seen, each economic activity has seen increases in labor productivity, the agricultural one being the fourth place. The main reason for the increase of the labor productivity both in the agricultural sector ((forestry and fisheries)) and in the rest of the economic activities is due to the increase of the gross added value.

**Table 3- The average monthly costs of the labor force per employed person, by main activities of the national economy, during the period 2013-2016**  
lei / person / month

<b>Economic activities</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
Agriculture, forestry and fishing	2095	2248	2375	2794
Industry	2932	3099	3214	3477
Construction	2112	2181	2435	2606
Trade	2237	2421	2650	2901
Information and communications	5294	5679	6267	7002
Financial intermediation and insurance	6568	6523	6903	6976
Professional activities	4125	4254	4648	5068
Public Administration	3501	3925	4033	4354
Other services	1733	2003	2213	2363

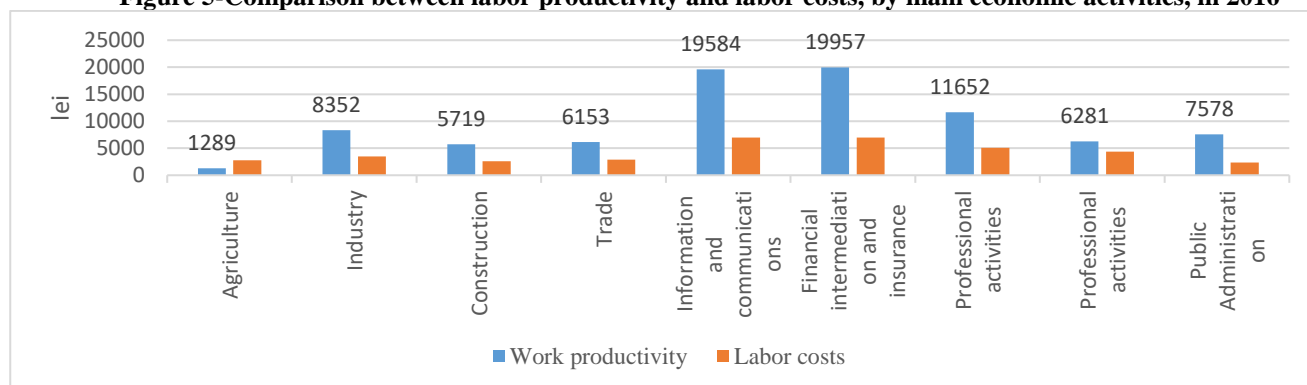
Source: National Institute of Statistics

According to table 3, the average monthly costs of the labor force measured in lei per person in the agricultural sector, are on the third place of all economic activities, given that this activity is characterized by the availability and the need of people according to the season, thus the costs per person are not recorded in all months of a current year.

Thus, analyzing the evolution of this indicator we notice an increase of costs per person in agriculture, reaching in 2016 to (2794 lei / person / month), being 33, 4% higher than the base year, representing an absolute value of about 700 lei / month / person.

As can be seen, each economic activity has registered increases in average monthly costs, the agricultural one being the third place, with relatively low costs compared to the other activities, where as you can see the highest costs per person during one month is registered for the economic activity (information and communications). The main reason for which the average monthly costs registered increases both in the main sector analyzed, namely agriculture, but also in the rest of the economic activities, is due to the increase of the minimum wage in the economy, so that the contributions of the employer to the state have undergone changes.

**Figure 5-Comparison between labor productivity and labor costs, by main economic activities, in 2016**



Source: National Institute of Statistics, own calculations

Drawing a comparison between labor productivity and labor costs, we note that in terms of labor productivity agriculture is below the average recorded for all economic activities, respectively 27356.13 lei / person / month, which is 95.3% smaller. While the average monthly cost for all the economic activities presented is 4074.1 lei / person / month, agriculture is below this average with 31.4%. It is worth noting that the labor costs in agriculture exceed 116.8% of labor productivity, being the only economic activity where this is observed.

According to the Institute of Statistics, the value of the production is defined as: value expression of the volume of all agricultural and animal products, (without losses) obtained in a calendar year, of the expenses for setting up and maintaining the plantations of trees and vines until their entry on the fruit. , of the agricultural services performed by specialized units against a tariff or on the basis of a contract as well as of the inseparable non-agricultural secondary activities.

**Table 4-The value of production on agricultural branches**

Agricultural branches	U.M	2013	2014	2015	2016	2017	2017/2013	2017/2016
Vegetable	THOUSAND LEI	53843812	49058330	43574128	45155180	53216739	-1,16	17,85
Animal		23876547	24481641	24315779	23293590	24331854	1,91	4,46
Agricultural services		744057	984483	859671	899844	945512	27,08	5,08
Total		78464416	74524454	68749578	69348614	78494105	0,04	13,19

Source: National Institute of Statistics

Calculating the value of the production on the agricultural branches from the analyzed period, it can be observed that the vegetable branch decreased by 1.16% in 2017 compared to the base year and the highest increase was registered in the agricultural services branch of 27.08 %, for the same period analyzed. The value of the production on the agricultural branches registered an increase in 2017 compared to the year of 2013 of only 0.04%, regarding the year 2017 compared to the previous year in terms of the value of the agricultural production it is observed the value of the production on the agricultural branches increased by 13.19%.

**Table 5 - Production value on agricultural branches  
- percentage representation-**

<b>Agricultural branches/year</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>
<b>Vegetable</b>	68,6	65,8	63,4	65,1	67,8
<b>Animal</b>	30,4	32,9	35,4	33,6	31,0
<b>Agricultural services</b>	0,9	1,3	1,3	1,3	1,2
<b>Total (%)</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

Source: National Institute of Statistics, own calculations

Calculating the weight of the value of the production on the agricultural branches, we find that the vegetable agricultural branch holds the highest weight for the whole period analyzed, ranging from 63.4% to 68.6%. According to table 5, the lowest weight is held by agricultural services with 0.9% and 1.3%.

## CONCLUSIONS

It is noted that agriculture plays a very important role in sustaining the self-consumption of the rural population. It can be observed that from the analyzed period the share of consumption in GDP as well as that of the self-consumption has had an increasing tendency due to the high productions supported by the demand on the market of agri-food products.

The tendency of reduction in the formation of the gross domestic product (GDP) was largely due to insufficiently developed economic conditions, to a limited technical base, but also to the influence of climatic factors. It is worth noting that among the economic activities that hold representative weights include: public administration, trade and industry.

At the same time, the decrease in the share of agriculture, forestry and fisheries in GDP is due to the much accelerated development of other economic activities. Regarding the labor force in agriculture, it is characterized by seasonality, but nevertheless there is an increase in labor productivity in agriculture.

Each economic activity has registered increases of the average monthly costs, these increases in agriculture are due to the increase of the minimum wage in the economy, since the contributions of the employer have undergone modifications according to the last laws in force.

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# RESEARCH ON THE WEEDS CONTROL IN MAIZE CROP

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**Abstract:** *The purpose of this paper is to evaluate the degree of dicotyledonous weed species of maize culture, the effectiveness of weed control products and the evaluation of maize yield. Experimental factors A-treatment variants: a<sub>1</sub>- pre-emergence herbicide with Tender 1.5 l/ha + Merlin Flex 0.4 l/ha (control); a<sub>2</sub>- pre-emergence herbicide with Tender 1.5 l/ha + Merlin Flex 0.4 l/ha and post-emergence with Titus Plus 300 g/ha; a<sub>3</sub>- pre-emergence herbicide with Tender 1.5 l/ha + Merlin Flex 0.4 l/ha and post-emergence with Arigo 320 g/ha; a<sub>4</sub>- pre-emergence herbicide with Tender 1.5 l/ha + Merlin Flex 0.4 l/ha and post-emergence with Principal Plus 420 g/ha; factor B - climatic conditions in the experimental years: b<sub>1</sub>-2016; b<sub>2</sub>-2017; b<sub>3</sub>-2018. In order to achieve the objectives during the period 2016-2018, determinations were carried out regarding the natural enrichment of maize crops by numerical determination of weed species before herbicide and after herbicide treatment at 14, 21 and 28 days, but also before harvesting the crop of maize when carried out and gravimetric determination of the weeds by drying at the oven. Following the determinations made during the growing period of the maize crop, the treatment variant applied to the herbicides Tender 1.5 l/ha + Merlin Flex 0.4 l/ha in pre-emergence and the herbicide Titus Plus 300 g/ha in post-emergence had the best result in combating the weed species existing at the time of the treatment but also the degree of weed reinfestation of the maize crop. Regarding the yield of grain maize determined in the four variants, the highest grain yield (over 6901 kg/ha) was obtained in the fourth treatment variant, with a very significant yield difference compared to the control variant at which only pre-emergence herbicide was performed.*

**Keywords:** *maize, weed control, yield, climatic conditions*

**JEL Classification:** *Q 01, Q15, Q16*

## INTRODUCTION

Maize is considered one of the most important crop plants, both in the agriculture of our country and worldwide, due to the large areas that are cultivated, the high yields that can be obtained and the possibilities of exploiting the production (Muntean et al., 2011).

With a slow growth in the first 4-6 weeks after emergence, maize is a plant of culture sensitive to weeding in the first phases of vegetation (Wilson, 1998) but also during the development, due to the small number of plants/m<sup>2</sup>.

Taking into account the fact that a maize crop where weeds are not controlled by any method can have production losses of up to 90% depending on the degree of soil tillage, it is necessary to use at least one method of eliminating the existing species.

Herbicide cultivation of maize is done by the use of selective herbicides depending on the category of weeds using a single product or more for weed control, and the use of applied herbicides is correlated with the degree of intoxication (Guş et al., 2004).

In maize cultivation, the methods of using weed control products differ from the pre-emergent stage, which is important in removing weeds from the early stages of development, being known that once they have reached an advanced stage, their control becomes a process of increasingly complex, at the post-emergent one which aims to eliminate the weeds that are in competition with the maize plants for light, water and nutrients.

The purpose of this paper is to evaluate the degree of intoxication with dicotyledonous species of maize crop, the efficiency of weed control products as well as the evaluation of maize production.

## MATERIALS AND METHODS

The researches were carried out during 2016-2018 at the Agricultural Research and Development Station Turda, located in the Transylvanian Plain.

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The experimental factors studied A-treatment variants: a<sub>1</sub>- pre-emergence herbicide with Tender 1.5 l/ha (*metolachlor* 960g/l) + Merlin Flexx 0.4 l/ha (*isoxaflutol* 240 g/l + *cyprosulfamide* 240g/l) ( control); a<sub>2</sub> - pre-emergence herbicide with Tender 1.5 l/ha (*metolachlor* 960g/l) + Merlin Flexx 0.4 l/ha (*isoxaflutol* 240 g/l + *cyprosulfamide* 240g/l) and post-emergence with Titus Plus 300 g/ha (3.26% *methyl rimsulfuron* + 60.87% *dicamba*); a<sub>3</sub> - pre-emergence herbicide with Tender 1.5 l/ha (*metolachlor* 960g/l) + Merlin Flexx 0.4 l/ha (*isoxaflutol* 240 g/l + *cyprosulfamide* 240g/l) and post-emergence with Arigo 320 g/ha (12% *nicosulfuron* + 3% *rimsulfuron* + 36% *mesotrione*) a<sub>4</sub>-pre-emergent herbicide with Tender 1.5 l/ha (*metolachlor* 960g/l) + Merlin Flexx 0.4 l/ha (*isoxaflutole* 240 g/l + *cyprosulfamide* 240g/l) and post-emergence with Principal Plus 420 g/ha (2.3% *methyl rimsulfuron* + 9.2% *nicosulfuron* + 55% *dicamba*); factor B - the climatic conditions of the experimental years: b<sub>1</sub>-2016; b<sub>2</sub>-2017; b<sub>3</sub>-2018.

In order to achieve the objectives for the period 2016-2018, determinations were made regarding the natural sprouting of the maize crop, by numerically determining the weed species before herbicide and after herbicide at 14, 21 and 28 days, but also before harvesting the maize crop, when the gravimetric determination of the weeds was carried out by drying in the oven.

The obtained results were statistically processed by the method of analysis of variance and the determination of the smallest significant difference - DL - (5%, 1% and 0.1%) (ANOVA, 2015).

Climatic data conditions are presented according to Turda Weather Station, located on the longitude coordinates: 23°47'; latitude: 46°35'; altitude: 427 m. Over the past 60 years, the average multiannual temperature recorded was 9.1°C and the precipitation amount was 531 mm.

The average temperatures recorded during the months of the vegetation period of the maize crop varied during the three years, but being higher than the 60 year average, with + 0.9°C in 2016, a year considered warm, with + 1.4°C in the year 2017, considered warm and with + 2.1°C in 2018, considered warm.

As can be seen from the data presented in Figure 1, the average monthly temperatures are constantly increasing, with values higher than the average of 60 years, especially during the vegetation period of the maize crop.

The precipitations dropped during the vegetation period and their distribution in the important phenophases of the crop are very important in the production, so from the data presented in figure 2, it can be observed that the monthly precipitation amount is variable, with periods in which significant quantities have fallen, but and periods when the amount of precipitation was well below the average of 60 years, affecting the maize crop by their non-uniformity or their lack in important phenophases.

Figure 1. Termic regime, Turda 2016-2018

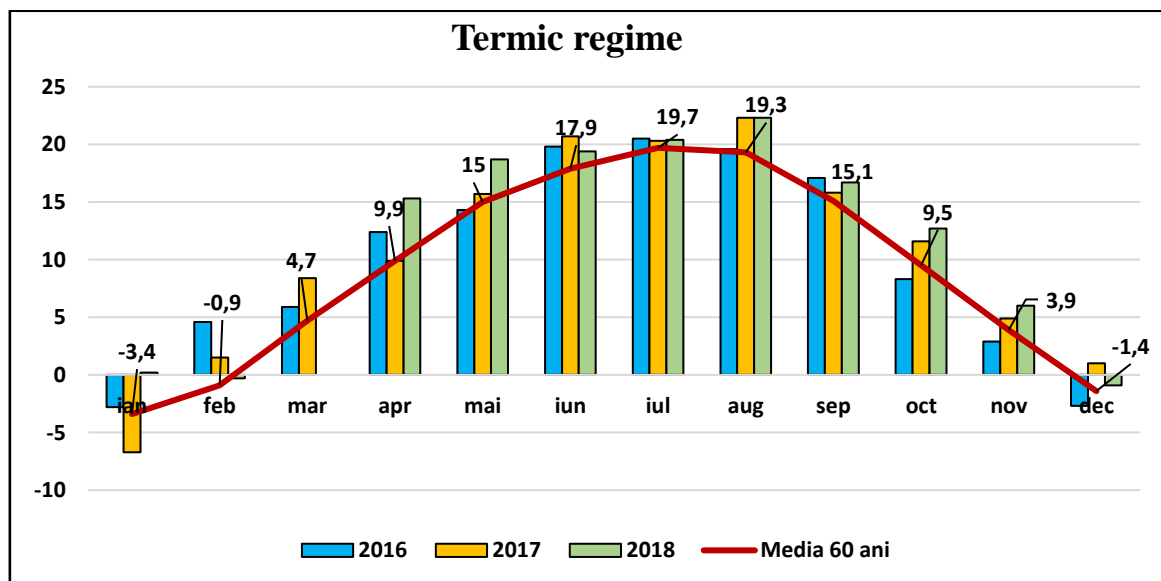
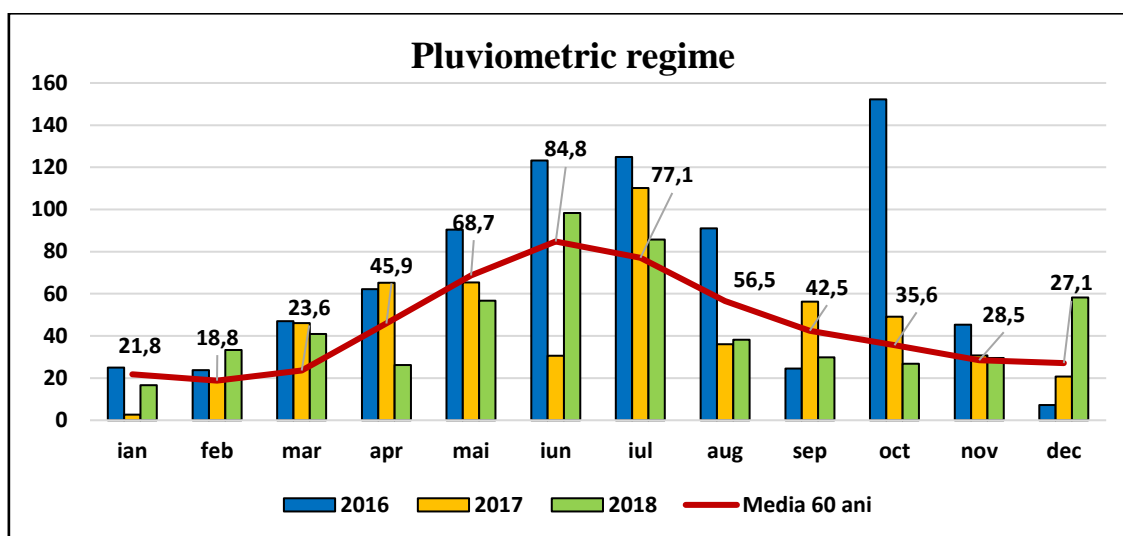




Figure 2. Pluviometric regime, Turda 2016-2018



## RESULTS AND DISCUSSIONS

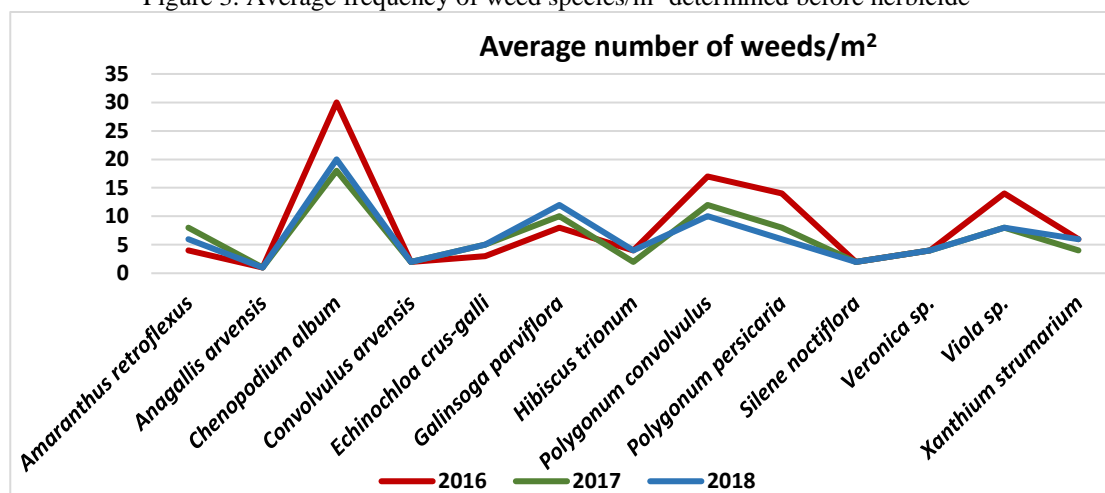
The climatic conditions of the area are favorable for the growth of the maize crop in the first part of the vegetation, in the majority with species of annual dicotyledonous weeds, some years being favorable and for the weeding with a significant share of annual monocotyledonous species.

The spectrum of weeds determined at the beginning of the research is quite diverse, comprising a number of 13 species, identified by frequency, depending on the climatic conditions of the year, their presence was higher or lower both monocotyledonous and dicotyledonous species. Of these species, about 5 are very high frequency species, 4 are low frequency species and the others are isolated species.

Of the species identified, those with a high frequency, with presence in all experimental variants and which require more attention in terms of control are the species: *Chenopodium album*, *Galinsoga parviflora* and *Polygonum convolvulus*. The average degree of corn cultivation is higher in 2016, reaching 109 weeds/m<sup>2</sup>.

During the studied period there was an increase in the frequency of drunkenness following the application of only a single control treatment, especially in the dry spring, when the weed emergence was delayed, because in the years when the climatic conditions are favorable to the culture, favorable conditions are created and weed development, the effectiveness of weed control products is generally better in the rainy spring years.

Figure 3. Average frequency of weed species/m<sup>2</sup> determined before herbicide





The effect of applying herbicides in post-emergence, in maize cultivation, has been observed from the first week of application, in which weeds have started to show changes in the development process depending on their development stage. Since the second week after treatment in all variants, the species *Setaria glauca* was reported, a species that later emerged and remained until the crop was harvested (Table 1).

Following the determinations made during the vegetation period of the maize crop, the treatment variant to which were applied the Tender herbicides 1.5 l/ha + Merlin Flexx 0.4 l/ha in pre-emergence and the herbicide Titus Plus 300 g/ha in post-emergence had the best result in the control of the weed species existing at the time of treatment but also of the degree of weed reinfestation of the maize crop.

Plowing tillage is still one of the most important methods of reducing the number and species of weeds in maize cultivation, but by using herbicides the number of both weed and the weed is being reduced. The importance of using post-emergent herbicides was also demonstrated by Cheung's research and published in 2013.

Table 1. The frequency of weed species/m<sup>2</sup> determined at 14, 21 and 28 days after the herbicide

Species	Number of weeds/m <sup>2</sup>											
	At 14 days				At 21 days				At 28 days			
	V1	V2	V3	V4	V1	V2	V3	V4	V1	V2	V3	V4
<i>Amaranthus retroflexus</i>	8	1	1	0	8	0	0	0	8	0	0	0
<i>Anagallis arvensis</i>	1	1	1	0	1	1	1	0	1	0	1	1
<i>Chenopodium album</i>	52	16	4	6	74	2	1	3	108	1	1	0
<i>Convolvulus arvensis</i>	2	2	2	2	2	2	0	0	2	0	0	2
<i>Echinochloa crus-galli</i>	4	1	2	1	6	1	1	0	8	1	1	0
<i>Galinsoga parviflora</i>	20	8	8	4	36	1	2	1	48	0	0	1
<i>Hibiscus trionum</i>	4	1	1	1	6	1	0	1	8	1	0	1
<i>Polygonum convolvulus</i>	4	4	4	4	7	2	1	1	8	1	1	0
<i>Polygonum persicaria</i>	6	4	4	2	7	1	0	1	9	1	0	1
<i>Setaria glauca</i>	8	2	4	1	12	1	4	0	16	1	4	0
<i>Silene noctiflora</i>	2	1	1	1	2	0	0	1	4	0	0	1
<i>Veronica</i> sp.	1	1	1	1	1	1	0	0	1	1	0	0
<i>Viola</i> sp.	2	1	1	1	4	0	1	0	4	0	1	0
<i>Xanthium strumarium</i>	2	1	2	1	2	0	1	1	2	0	1	1
Total	116	44	36	25	168	13	12	9	227	7	10	8

Although the second variant of herbicide had the best efficiency, nevertheless the most significant average production was registered in the fourth variant, with a very significant positive difference from the control of 4278 kg/ha, as shown in table 2. Success weed control is vital because it can reduce production by over 86%, as Týr, 2015 also states.

Table 2. The influence of post-emergent herbicide variants on maize yield

Variant	Yield (kg/ha)	Difference (kg/ha)	Significance
Untreated variant (control variant)	3306	-	cv.
Titus Plus	7389	4083	***
Arigo	7215	3909	***
Principal Plus	7584	4278	***
LSD (p 5%) 64	LSD (p 1%) 92	LSD (p 0.1%) 136	

The climatic conditions are the decisive factor in the production of a crop, thus, as it results from the data presented in table 3, 2016 was the year with the best climatic conditions for the maize crop, at the opposite pole being the year 2017, in which the production of maize decreased with very significant differences from the average of the three years studied, considered a control variant.

Table 3. The influence of experimental years on maize yield

<b>Variant</b>	<b>Yield (kg/ha)</b>	<b>Difference (kg/ha)</b>	<b>Significance</b>
Average years (control variant)	6374	-	cv.
2016	6814	440	***
2017	5635	-739	000
2018	6672	299	***
LSD (p 5%) 47	LSD (p 1%) 63	LSD (p 0.1%) 85	

From the interaction of the two factors (herbicide variants and climatic conditions) the best herbicide variant is the fourth variant with the highest yields obtained, over 6901 kg/ha registered in 2017, year in which the climatic conditions have were less favorable to the maize crop, due to the lack of precipitation during the important moments of the crop development, as seen in table 4.

Table 4. The influence of interaction of post-emergent herbicide variants and experimental years on maize yield

<b>Variant</b>	<b>Yield (kg/ha)</b>	<b>Difference (kg/ha)</b>	<b>Significance</b>
a <sub>1</sub> x b <sub>1</sub> (control variant)	3775	-	cv.
a <sub>2</sub> x b <sub>1</sub>	7758	3983	***
a <sub>3</sub> x b <sub>1</sub>	7721	3946	***
a <sub>4</sub> x b <sub>1</sub>	8001	4226	***
a <sub>1</sub> x b <sub>2</sub> (control variant)	2557	-	cv.
a <sub>2</sub> x b <sub>2</sub>	6831	4274	***
a <sub>3</sub> x b <sub>2</sub>	6250	3692	***
a <sub>4</sub> x b <sub>2</sub>	6901	4344	***
a <sub>1</sub> x b <sub>3</sub> (control variant)	3585	-	cv.
a <sub>2</sub> x b <sub>3</sub>	7578	3993	***
a <sub>3</sub> x b <sub>3</sub>	7675	4089	***
a <sub>4</sub> x b <sub>3</sub>	7851	4265	***
LSD (p 5%) 99	LSD (p 1%) 138	LSD (p 0.1%) 192	

From the economic point of view, the fourth treatment option is also the least expensive due to the price of the product/quantity per hectare, if we take into account that all other expenses are the same for each variant and the production obtained per hectare, as well as its efficiency.

## CONCLUSIONS

From the data presented in the paper it can be seen that the best studied variant with high production yields but also with effective control is the variant applied in the postemergence herbicide Principal Plus.

The development of a better weed control management can be achieved through a better understanding of the biology of the weeds and the factors that trigger the germination of the weed seeds, as well as by knowing the methods of prevention but also of the control of the species.

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# STUDY ON THE TENDENCY OF TECHNICAL-ECONOMIC EVOLUTION OF VEGETAL AGRICULTURAL PRODUCTS

ANA URSU<sup>1</sup>

**Summary:** *The aim of the paper is to investigate the evolution of agricultural production in rice, soybean and sugar beet crops, revealing their tendencies, as well as the main favorable or restrictive factors, the economic-social effects they generate and the formulation of possible solutions for production development. The study is based on the quantitative and qualitative analysis of the available statistical data series. The calculated indicators highlight the variability of the cultivated area, the yield per hectare, the prices, but also the trade balance. The place of each crop is examined from the point of view of the indicators studied and some conclusive remarks are made regarding the current state of economic development of the plant sector and of the studied plants.*

**Keywords:** *agricultural products, technical-economic indicators, economic-social effects*

**JEL classification:** *Q01, Q15, Q16.*

## INTRODUCTION

The contribution of agriculture to development differs from country to country, depending on how agriculture is a source of growth and a tool to reduce poverty. (1) Studies show that EU agriculture benefits from the liberalization of international trade, because of a comparative advantage over other parts of the world, not only because of climate and soil fertility, or because it has a large and rich internal market, but also that possesses knowledge, accumulated over time, in response to the demand for high quality agricultural products at a relatively low price. Thus, the most important factors of production in the EU have become capital and knowledge, as opposed to the cheap labor and land on which the traditional theory of comparative advantage was based (and which also underlies the cost advantage attributed to developing countries today). (1) However, there are concerns regarding the variation of agricultural production depending on climate change, the volatility of agricultural prices under the pressure of seeking alternative energy resources (Von Braun, 2008, quoted by A. Dachin in 2011) and speculative actions ( Zawojnska, 2010, quoted by A. Dachin in 2011). Also, within the European Union, the synchronization of the business cycle between the member countries is a necessary premise for the effective application of the common policies, but significant differences between the member countries, given the characteristics of the agriculture, reduce the degree of synchronization (Da-Rocha, 2006, quoted by A. Dachin in 2011).

## MATERIAL AND METHOD

The present paper aims to find an answer to the question: How did the 3 agricultural products in Romania evolve compared to the main EU countries? This is achieved by analyzing the evolution of the following technical and economic indicators: the cultivated area, the obtained production, the price of capitalization as well as the commercial balance of the products. The study is carried out during the period 2007-2018. The research method consists in the empirical analysis of the available data. The motivation of the research consists in: the need to analyze the products as important products for the Romanian economy; awareness of the maintenance and extension of cultivated areas; the usefulness of knowing the evolution of the production of rice, soy and sugar beet in relation to the countries of the EU.

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In order to determine the differences existing between Romania and the main (competitive) countries of the European Union, producing rice, soy and sugar beet, the following statistical indicators were determined: average, standard deviation and coefficient of variation (CV%).

## RESULTS AND DISCUSSIONS

In Romania, rice, soybean and sugar beet crops are supported by European funds (FEGA funding source) and Transitional National Aid (ANT) in order to achieve a high level of performance and stability. The purpose of this paper is to identify changes in the evolution of rice, soybean and sugar beet crops, compared with the main EU-27 cultivating countries, from the perspective of cultivated areas, yield per hectare, sales prices, imports and exports. For these crops, the agricultural policy measures in Romania aimed at expanding the cultivated areas and maintaining them in culture, as well as reducing imports. Starting with 2015, rice, soybean and sugar beet (SAPS + Redistributive Payment (PR) + Green payment (PI) + Transitional National Aid 1 (ANT 1 - for all crops) are among the crops that have benefited from coupled support. + Coupled Support (SC) + Transitional National Aid (ANT 6). According to Order no. 619/2015, art. no. 42, art. no. 47 and art. no. 50, coupled support was granted to rice, soybean and sugar beet growers - active farmers - who prove, based on a tax bill, the marketing of a minimum production of 4,500 kg / ha of rice, 1,300 kg of beans / ha on soy and 26,400 kg / ha for sugar beet, conditions that have been met.

In 2019, MADR decided to transfer money from coupled support for soybean to coupled support for alfalfa. The measures also envisage increasing the amounts allocated for the payment of support coupled to sugar beet and rice. For sugar beet the payment amount increases from 18,459,000 euros to 19,208,700 euros. Rice, from 4,800,600 euros to 5,117,765 euros.

**Area cultivated with rice:** In the EU, the main rice-growing countries are Italy, Spain, Greece, Portugal, France, Bulgaria, Romania, which ranks 6th, after Bulgaria, as the cultivated area. The coefficient of variability (15%) is lower than in France (17%), but is almost 4 times higher than in Italy (3.9%). The averages of the cultivated areas Italy (231 thousand ha) and Spain (111 thousand ha) are representative, the mentioned countries also registering the lowest values of the coefficient of variability, of 3.9% (Italy) and 7.4% (Spain). The situation is different for areas cultivated in Greece, Romania and France. This is explained by the fluctuations in the cultivation of rice fields. Table no. 1.

**Table no. 1: Area cultivated with rice 2007-2017 (1000 ha)**

Nr. crt	Specification	Average 2007-2017 (1000 ha)	Standard deviation (1000 ha)	The coefficient of variability (%)	Minimum 1000 ha (year)	Maximum 1000 ha (year)
0	1	2	3	4	5	6
1	Italy	231	8.9	3.9	216 (2013)	247 (2011)
2	Spain	111	8.2	7.4	96 (2008)	122 (2011)
3	Greece	31	3.5	11.3	26 (2008)	37 (2017)
4	France	19	3.3	17.0	16 (2008)	24 (2010)
5	Romania	11	1.7	15.4	8 (2007)	13 (2014)

**Source:** own processing according to EUROSTAT data

**Rice yield (tonne/ha):** The big rice-growing countries of the EU-27 are Spain (with an average of 7,551 to/ha), Greece (7,145 to/ha) and Italy (6,601 to/ha), followed by France (5,228 to/ha) and Romania (4,579 to/ha). The deviations fluctuate within limits limited to the average (0.30 Italy and 0.65 Romania), and the coefficient of variability indicates that there are no significant deviations, in the 11 years of production, compared to the average calculated in the case of Spain (4.9 %) and Italy (4.6%). Greece, even though it has a yield per hectare of 7,145 to/ha, (average for 2007-2017), the dispersion of data around the average (1.18) is the highest, compared to the analyzed countries, and the coefficient of variability the highest (16%).

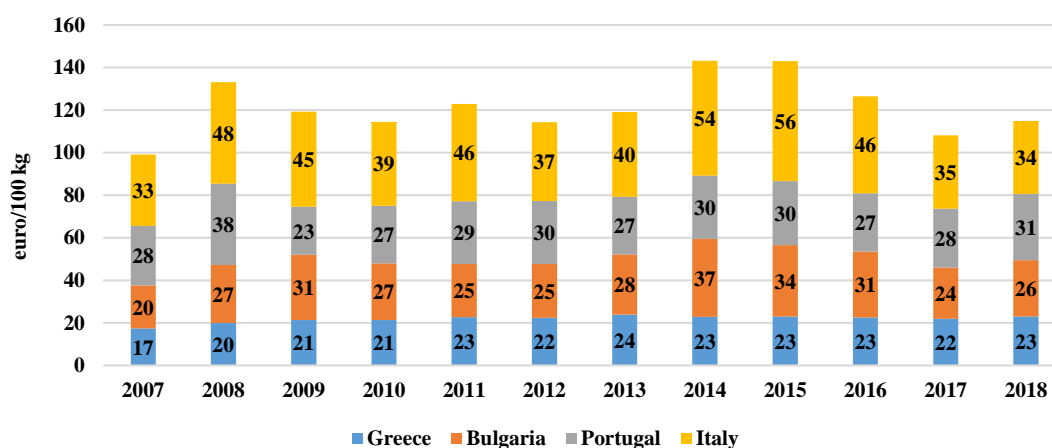
Table no. 2: Rice yield (tonne/ha) 2007-2017

Nr. crt	Specification	Average 2007-2017 (to/ha)	Standard deviation (to/ha)	The coefficient of variability (%)	Minimum to/ha (year)	Maximum to/ha (year)
0	1	2	3	4	5	6
1	Spain	7.551	0.37	4.9	6.657 (2008)	7.974 (2012)
2	Greece	7.145	1.18	16.5	4.888 (2016)	8.230 (2013)
3	Italy	6.601	0.30	4.6	6.072 (2011)	7.011 (2010)
4	France	5.228	0.64	12.2	3.904 (2013)	6.341 (2008)
5	Romania	4.579	0.65	14.2	3.265 (2007)	5.425 (2009)

Source: own processing according to EUROSTAT data

Romania ranks after France as a calculated average of yield and between France (12.2%) and Greece (16.5%) in terms of variability, from the perspective of production compared to the calculated average. The values of the coefficient of variability for the countries analyzed are below 20%, which means that the dispersion of the data around the average is relatively homogeneous, and the sample of the 11 years is statistically representative. Table no. 2.

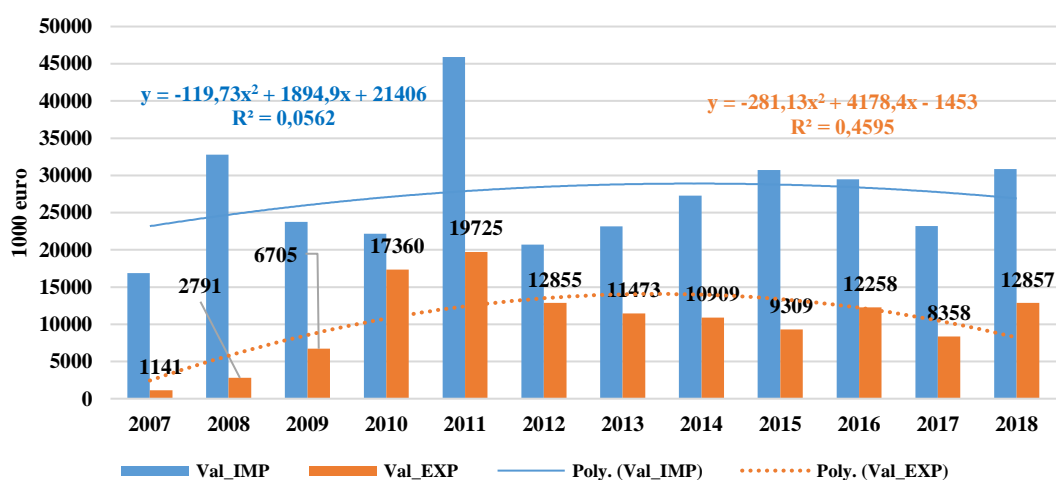
Chart no. 1: The dynamics of prices for rice (euro/100 kg)



Source: EUROSTAT data

Italy has the highest recovery prices for rice, with a minimum of 33 euros / 100 kg, in 2007, and a maximum of 56 euros/100 kg in 2015. Overall, the trend of recovery prices is in decrease. Chart no. 1.

Chart no. 2: The trade enters and outside the community of rice during 2007-2018 (1000 euro)



Source: processing after <https://www.madr.ro>

The contribution of the rice product, in the period 2007-2018, to the Romanian exports was increasing, both quantitatively (+11,016 to/year) and value (+4,178.4 thousand euros/year). Imports of rice, quantitative were, on average, (+2,623.7 to/year), and value (+1,894.9 thousand euros/year). Chart no. 2

**Area cultivated with soybean:** Italy has the largest area cultivated with soybeans (with an average for the period 2007-2017 of 199 thousand hectares), followed by Romania (with an average of 91 thousand ha), France (68 thousand ha) and Hungary (with an average of 46 thousand ha). The coefficient of variability, calculated as a ratio between the standard and average deviation, defines the threshold for the sample of the areas cultivated with soy in the 11 years of production, as heterogeneous (CV > 35%) heterogeneous (the cultivated areas differ from year to year), for all the countries studied. Table no. 3

**Table no. 3: Area cultivated with soybean 2007-2017**

Nr. crt	Specification	Average 2007-2017 (1000 ha)	Standard deviation (1000 ha)	The coefficient of variability (%)	Minimum (year)	Maximum (year)
0	1	2	3	4	5	6
1	Italy	199	76.5	38.5	108 (2008)	322 (2017)
2	Romania	91	36.7	40.3	49 (2009)	151 (2017)
3	France	68	44.4	65.5	22 (2008)	141 (2017)
4	Hungary	46	16.4	35.5	29 (2008)	77 (2017)

Source: own processing according to EUROSTAT data

**Soybean yield (tonne/ha):** Italy has the best yield per hectare (3,398 t / ha), followed by France (2,740 to/ha), Hungary (2,219 to/ha) and Romania (1,953 to/ha). In general, the standard deviation fluctuates within limits limited to the average (0.18 France and 0.46 Romania), and the coefficient of variability indicates that there are no significant variations in the 11 years of production, compared to the calculated average.

The determined values of the coefficient of variation, in the case of France, Italy and Hungary are below the value of 20%, thus concluding that the sample of the 11 years analyzed is a relatively homogeneous one from the point of view of the variability of soybean yield per hectare, (the average yields have small variations of from year to year) and at the same time it turns out that the average of the productions is also representative. Table no. 4.

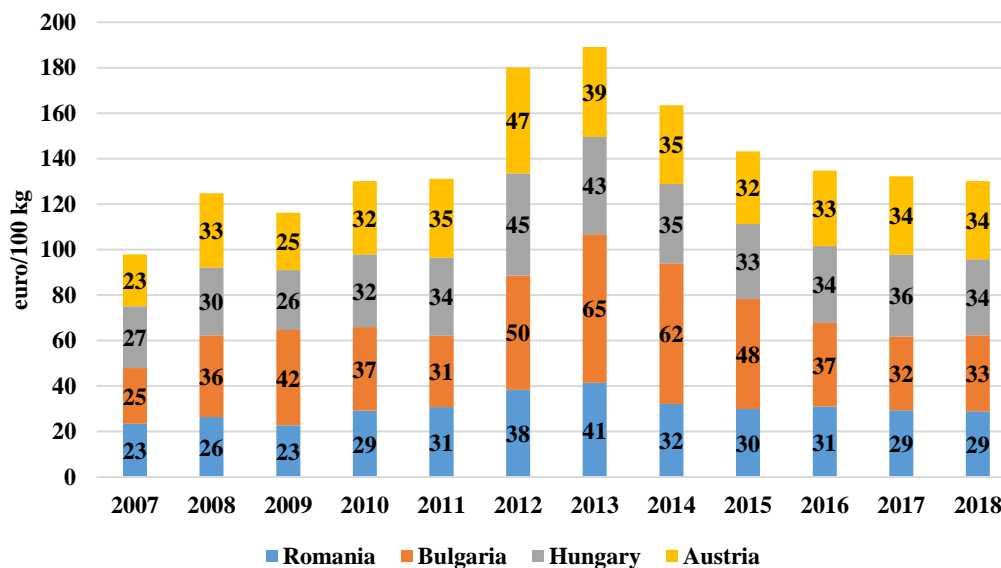
**Table no. 4: Soybean yield (tonne/ha) 2007-2017**

Nr. crt	Specification	Average 2007-2017 (to/ha)	Standard deviation (to/ha)	The coefficient of variability (%)	Minimum (year)	Maximum (year)
0	1	2	3	4	5	6
1	Italy	3.398	0.34	9.9	2.759 (2012)	4.007 (2014)
2	France	2.740	0.18	6.4	2.484 (2016)	2.947 (2011)
3	Hungary	2.219	0.43	19.3	1.641 (2007)	3.027 (2016)
4	Romania	1.953	0.46	23.8	1.021 (2007)	2.539 (2014)

Source: own processing according to EUROSTAT data

The exception is Romania, which has a coefficient of variability between 20% and 30%, which shows that the sample analyzed from the perspective of the average production variable is relatively heterogeneous.

Chart no. 3: The dynamics of sales prices for soybean (euro/100 kg)

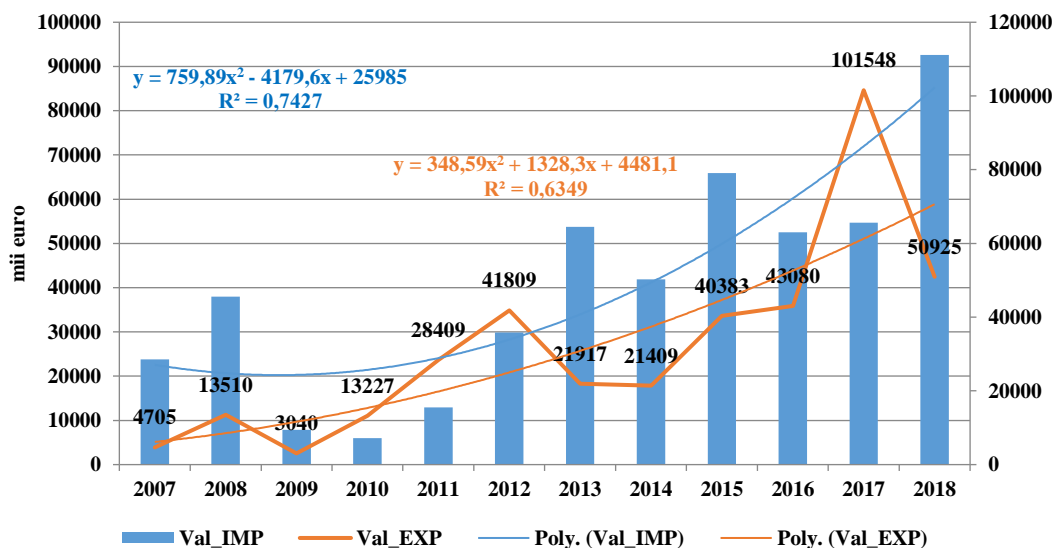


Source: EUROSTAT data

Bulgaria recorded the highest recovery prices for soybean crops, with a minimum of 25 euros/100 kg, in 2007, and a maximum of 65 euros/100 kg in 2013. Overall, the trend of recovery prices is in decline, and Romania sold soybeans at the lowest prices compared to the countries studied. Chart no. 3.

In Romania, soybean imports, on the period 2007-2018, decreased, on average, both quantitatively (-19,590 to/year) and in value (-4,179.6 thousand euros/year). Soybean exports decreased quantitatively by 7,445 tonnes/year and increased in value by an average of 1,328 thousand euros/year. Chart no. 4.

Chart no. 4: Soybean trade enters and outside the Community (1000 euro)



Source: processing after <https://www.madr.ro>

**Area cultivated with sugar beet:** France has the largest area cultivated with sugar beet (with an average, for the period 2007-2017, of 395 thousand hectares), followed by Germany (with an average of 373 thousand ha), Poland (205 thousand ha), Spain (with an average of 43 thousand ha) and Romania (with an average of 25 thousand ha). The coefficient of variability, calculated as a ratio



between standard and average deviation, defines the threshold for the sample of sugar beet surfaces during the 11 years of production, as being relatively homogeneous ( $CV < 20\%$ ) for all the studied countries, except for Spain which has a coefficient of variability of 24.3%, indicating the data series as relatively heterogeneous ( $20\% < CV < 30\%$ ).

**Table no. 5: Area cultivated with sugar beet 2007-2017**

Nr. crt	Specification	Average 2007-2017 (1000 ha)	Standard deviation (1000 ha)	The coefficient of variability (%)	Minimum area (year)	Maximum area (year)
0	1	2	3	4	5	6
1	France	395	34.0	8.6	349.3 (2008)	486.2 (2017)
2	Germany	373	30.1	8.1	312.8 (2015)	406.7 (2017)
3	Poland	205	18.2	8.9	187.5 (2008)	247.4 (2017)
4	Spain	43	10.5	24.3	32.1 (2007)	68.2 (2007)
5	Romania	25	4.0	15.8	20.5 (2008)	31.3 (2014)

Source: own processing according to EUROSTAT data

In Romania, the area allocated to sugar beet cultivation has reduced considerably, as a result of high production costs and low prices offered to producers. Table no. 5.

**Sugar beet yield per hectare:** Comparing the average production of sugar beet crop with the main cultivating countries, France has the best yield per hectare (88,909 t / ha), followed by Spain (87,109 t / ha), Germany (70,514 t / ha), Poland (56,695 t / ha) and Romania (36,383 t / ha). The determined values of the coefficient of variation, for all the countries analyzed, France (5.5%), Spain (9.5%), Germany (10.4%), Poland (12.5%), Romania (15.8 %) are found below the value of 20%, thus concluding that the sample of the 11 years analyzed is a relatively homogeneous one from the perspective of the variable sugar beet yield per hectare, (the average productions have small variations from one year to another) and at the same time it turns out that and the average of the productions is statistically representative.

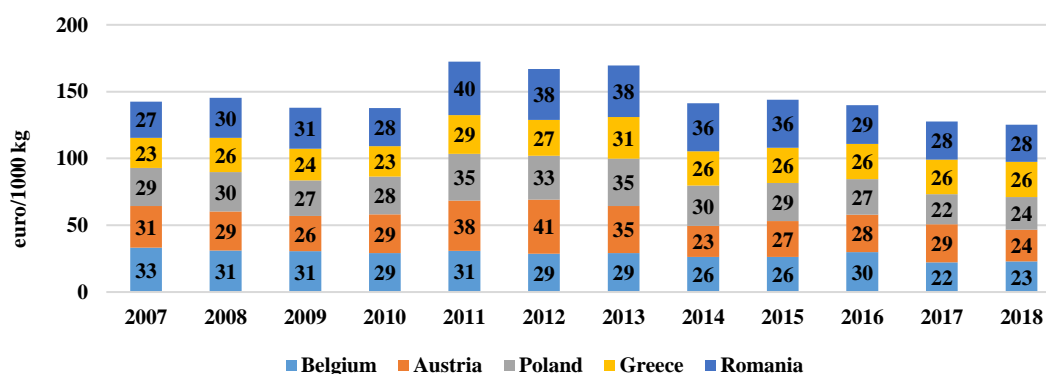
**Table no. 6: Sugar beet yield per hectare 2007-2017**

Nr. crt	Specification	Average 2007-2017 (to/ha)	Standard deviation (to/ha)	The coefficient of variability (%)	Minimum to/ha (year)	Maximum to/ha (year)
0	1	2	3	4	5	6
1	France	88.909	4.87	5.5	83.060 (2010)	96.999 (2011)
2	Spain	87.109	8.29	9.5	71.994 (2007)	96.936 (2014)
3	Germany	70.514	7.34	10.4	62.287 (2008)	83.747 (2017)
4	Poland	56.695	7.11	12.5	46.481 (2008)	68.250 (2014)
5	Romania	36.383	5.76	15.8	26.065 (2007)	44.711 (2014)

Source: own processing according to EUROSTAT data

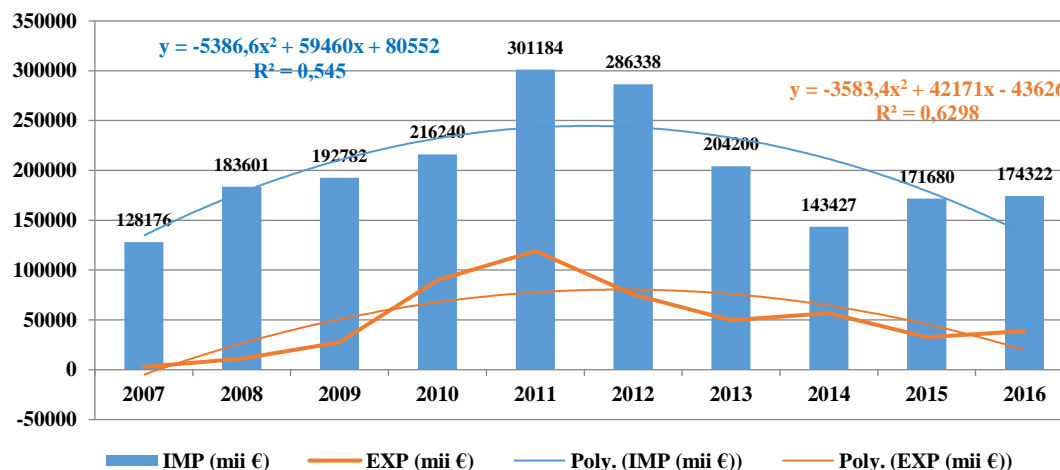
Although the dispersion of production yield (5.76 to/ha) compared to the average is low compared to Spain (8.29 to/ha), Germany (7.34 t / ha) and Poland (7.11 to/ha) , Romania records, after Poland (12.5%) the largest variability of average production, of 15.8%, compared to the countries analyzed. Table no. 6.

**Chart no. 5: The dynamics of sale prices for sugar beet (euro/1000 kg)**



Sales prices for sugar beet range from 22 euros/1000 kg to 41 euros/1000 kg. The maximum is reached in 2012 by Austria and the minimum in 2017 by Belgium and Poland. The disorganization of the sugar supply chain and the reduction of sugar beet production as a result of the advantageous import of raw sugar could not be offset by the increase in subsidies per hectare of cultivated beet. Chart no. 5.

Chart no. 6: Intra and extra-Community trade in cane sugar or sugar beet and pure sucrose



Source: processing after <https://www.madr.ro>

The foreign trade with sugar is characterized by the negative trade balance, as Romania is a net importer of raw sugar and white sugar. The agricultural policy measures have pursued and are aimed at expanding the areas cultivated with sugar beet, but it has not yet been possible to relaunch this crop. Between 2007 and 2016 Romania imports increased, on average, by 59,460 thousand euros/year and exports by about 42171 thousand euros /year. Chart no. 6.

## CONCLUSIONS

The instability of the products generates the instability of the offers for the analyzed products, being at the origin of the price volatility. The situation can be overcome by implementing culture technologies appropriate to the climatic zones and by using large-scale irrigation and inputs carrying the technical progress (selected seeds, pesticide fertilizers).

Oscillations of average yields per hectare create market distortions and insecure incomes for farmers, which usually lose: in the case of under-production due to lack of quantity, and in the case of overproduction due to the low prices offered by the buyers, which does not cover the costs.

The evolution of foreign trade with the analyzed products, rice, soy, sugar beet, expresses the level of development of agriculture and the food industry, as well as the insufficiencies of the support granted to the agri-food sector.

Data on the evolution of foreign trade in rice, soy and sugar beet reveals the export and import ratio in favor of import. Their import, under the conditions of subsidizing their production, affects domestic production.

The coupled support scheme, applied in Romania since 2015, contributed to the increase of the degree of assurance of the raw material of local origin for the processing industry (an average increase of the total sugar beet production of 39,174 thousand to/year, in 2007 -2016), the reduction of imports of vegetable proteins and the provision of quality feeds for the zootechnical sector (the reduction of imports to soybeans, on average 19,590 to/year, between 2007-2018), while maintaining the cultivated areas (an average increase of the cultivated area with rice of 1,5678 thousand ha, in the period 2007-2018) in the case of the mentioned crops, affected by certain difficulties and which are considered important for Romania, for economic, social and environmental reasons, etc.

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# ANALYSIS OF TECHNICAL AND ECONOMIC INDICATORS FOR MAIZE CULTURE IN THE PERIOD 2007-2017

DANIELA NICOLETA BĂDAN<sup>1</sup>

**Summary:** *Maize, original from America, ranks third in the top of cereal crops as importance and ranks second in the international top, after wheat cultivation, these positions being acquired due to a series of particularities I presume: high production capacity, wide area spreading, ecological elasticity and the fact that it is a good precursor for most crops. The present study analyzes, at national level, both the technical indicators (cultivated area, average production) and economic indicators (prices, subsidies granted per hectare, economic balance) for maize crop in the period 2007-2017. By using the methods of statistical analysis, we will follow the evolution of the statistical data series studied, the purpose of the paper being to highlight both the technical and economic aspects of the studied culture, the dynamics and the importance of the maize culture referring to the demand of the internal market.*

**Keywords:** *indicators, average production, price, economic balance*

**JEL classification:** *Q 10, Q 11, Q18*

## INTRODUCTION

Maize represents the third cereal crop, as important and is placed second after the wheat, in the top of international trade. This position can be motivated by the prism of some series of particularities that are held by this crop, phytotechnical and biological, such as: the production capacity greater than 50% than the other cereals, it has a high propagation coefficient, it adapts very well to the dry climatic conditions and in the heat, etc.

Regarding the use of maize, about 20% of the world production is used for human nutrition, with a substantial difference in the consumption of maize grains in food in developed countries compared to developing countries, 7% and 60% respectively. In the zootechnical sector, this category of cereals is used for animal feed, having a decisive role in its modernization and development.

In the specialized literature we find a lot of specialized works on maize crop research, being of national and international interest the development of maize hybrids resistant to climate change and with high yield, but also of the evolution of the prices of this cereal product.

## MATERIALS AND METHODS

The study aims to highlight the importance of maize culture by qualitatively analyzing the evolution of technical and economic indicators during 2007-2017.

The statistical data used in the study were provided from the specialized sites such as: National Institute of Statistics (INS), MADR, Trade Map and Eurostat and specialized documents.

The paper includes a study that goes on for a long period (10 years), taking into consideration the variable surfaces and total yields for the grain maize crop.

The processing of the chronological data series will be carried out with the help of absolute, relative and average indicators. The statistical analysis of some chronological series is based on a system of indicators that can characterize multiple quantitative relationships within the series and during the period to which the data taken in the study refer.

Absolute indicators indicate how much the level of an indicator has changed over a particular period over a long period as a basis of comparison. These are:  $y_i$  - the absolute levels of the series terms;  $\Delta_i / 0$  - absolute change calculated on a fixed basis;  $\Delta_i / i-1$  - absolute change calculated based on the chain.

The relative indicators indicate the dynamic index that shows how many times the variable increases / decreases from one unit of time to another. These are:  $I_i$  - the dynamic index calculated as a fixed basis;  $I_i / i-1$  - the dynamic index calculated based on the chain;  $R_i / 0$  - the rate of increase /

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decrease found in the specialized literature and under the name of index of the rate of increase, calculated on a fixed basis;  $R_{I/I-1}$  - the rate of increase / decrease calculated based on the chain;  $A_{I/0}$  - the absolute value of an increase / decrease percentage with a fixed base;  $A_{I/I-1}$  - the absolute value of a percentage increase / decrease based on the chain. [1]

Average indicators will indicate the average level and absolute changes.

- The average dynamic index:  $I = \sqrt[n]{\prod_{t=1}^n I_t} = \sqrt[n]{y_n/y_1}$ .
- The average growth rate shows how much the respective phenomenon has increased in relative sizes, over the analyzed period, on average from one interval unit to another.  $R = I * 100 - 100$ .

## RESULTS AND DISCUSSIONS

In 2017, Romania was in the first place among the member states of the European Union regarding the cultivated areas and the production obtained with corn kernels and sunflower, according to the NIS data.

In 2017, the area cultivated with corn represented 47% of the area cultivated with cereals for grains, and that of wheat by 39.7%. According to the data in table no. 1, it was found that the evolution of the areas cultivated with maize followed an increasing trend in the period 2007-2015 (2.5 million ha, respectively 2.6 million ha). During the period analyzed 2007-2017, the area cultivated with maize registered an annual rate of decrease of 0.50%.

Table 1. Evolution of grain corn surfaces and yields

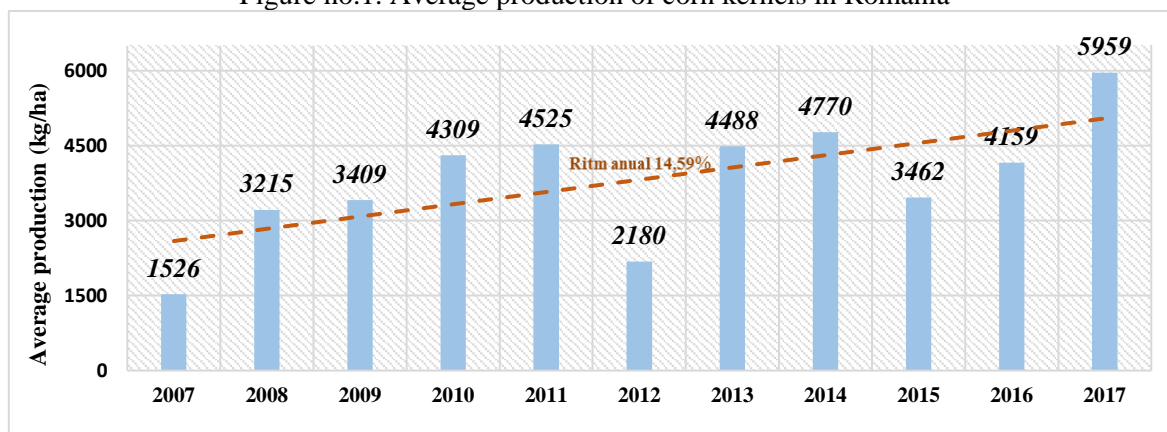
Specifications	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Annual ritm
Area (thousands ha)	2525	2445	2339	2098	2590	2730	2518	2513	2605	2581	2402	-0.50
Total production (thousand tons)	3854	7849	7973	9042	11718	5953	11305	11989	9021	10746	14326	14.03

Source: INSSE

In terms of grain maize production, it followed an increasing trend throughout the study period, registering an annual rate of 14.03%.

The average production of maize registered an annual rate of 14.59% for the period 2007-2017. The maximum value of this was 5.95 tonnes / ha in 2017, and the minimum value was registered in 2007, with an average production of 1.5 tonnes / ha.

Figure no.1. Average production of corn kernels in Romania



Source: INS data processing

With the help of the data from table no.1, the calculation methods mentioned above can be applied. In the tables no.2 and 3 can be observed changes of the surface as well as of the production for the maize crop both from one year to another but also compared to the base year, in this case, the year 2007.

Table no.2 Absolute changes in the area of maize

Year	Area (ha)	Absolute changes (ha)	
		With a fixed base $\Delta t/t-1=y_t-y_1$	Chain based $\Delta t/t-1=y_t-y_{t-1}$
2007	2524706		
2008	2441461	83245	-83245
2009	2338766	185940	-102695
2010	2098394	426312	-240372
2011	2589667	-64961	491273
2012	2730157	-205451	140490
2013	2518268	6438	-211889
2014	2512809	11897	-5459
2015	2605165	-80459	92356
2016	2580975	-56269	-24190
2017	2402082	122624	-178893

Source: processing based on statistical data

Table no.3 Absolute changes in the production of maize

Year	Production (tonns)	Absolute changes( tonns)	
		With a fixed base $\Delta t/t-1=y_t-y_1$	Chain based $\Delta t/t-1=y_t-y_{t-1}$
2007	3853918		
2008	7849083	-3995165	3995165
2009	7973258	-4119340	124175
2010	9042032	-5188114	1068774
2011	11717591	-7863673	2675559
2012	5953352	-2099434	-5764239
2013	11305095	-7451177	5351743
2014	11988553	-8134635	683458
2015	9021403	-5167485	-2967150
2016	10746387	-6892469	1724984
2017	14326097	-10472179	3579710

Source: processing based on statistical data

Analyzing the average rhythm of dynamics, which can be found in table no. 4, we can observe a significant change in the area cultivated with maize corn, registering a decrease in the chain from 2013 to 2014. The absolute value of 1% of the dynamics of the grain maize surface compared to 2007 is equal with an absolute increase of 25247.06 hectares, and the absolute value of 1% of the rate with a mobile base is an increasing quantity.

Table no.4 Relative changes in the area of maize (ha)

Year	Area (ha)	Dynamics index		Dynamic rhythm (%)		The absolute value of a percentage of the dynamic rate (hectares)	
		With a fixed base $It/1=y_t/1$	Chain based $It/t-1=y_t/y_{t-1}$	With a fixed base $Rt=It1*100-100$	Chain based $Rt/t-1=It/t-1*100-100$	With a fixed base $At/1=y_1/100$	Chain based $At/t-1=y_t-1/100$
2007	2524706					<b>25247.06</b>	25247.06
2008	2441461	0.97	0.97	-3.30	-3.30		24414.61
2009	2338766	0.93	0.96	-7.36	-4.21		23387.66
2010	2098394	0.83	0.90	-16.89	-10.28		20983.94
2011	2589667	1.03	1.23	2.57	23.41		25896.67
2012	2730157	1.08	1.05	8.14	5.43		27301.57
2013	2518268	1.00	0.92	-0.25	-7.76		25182.68
2014	2512809	1.00	1.00	-0.47	-0.22		25128.09
2015	2605165	1.03	1.04	3.19	3.68		26051.65
2016	2580975	1.02	0.99	2.23	-0.93		25809.75
2017	2402082	0.95	0.93	-4.86	-6.93		24020.82

Source: processing based on statistical data

Analyzing the average rate of dynamics for maize corn production, we can see in table no.5 a significant increase (74%) of the value of production in 2007 compared to 2017.

In the case of the absolute value of 1% of the dynamics rate, it shows us that by analyzing with fixed base the size of a percentage of the maize production of any year compared to the base year is equal to an absolute increase that has the value of 38539.18 tons, and the absolute value of 1% of the dynamic rate with the chain base is a size that has successively different values.

Table no.5 Relative changes in the production of maize (to)

Year	Production (tons)	Dynamics index		Dynamic rhythm (%)		The absolute value of a percentage of the dynamic rate (hectares)	
		With a fixed base $It/1=yt1/y1$	Chain based $It/t-1=yt1/yt-1$	With a fixed base $Rt=It1*100-100$	With a fixed base $It/1=yt1/y1$	Chain based $It/t-1=yt1/yt-1$	With a fixed base $Rt=It1*100-100$
2007	3853918					<b>38539.18</b>	38539.18
2008	7849083	2.04	2.04	103.67	103.67		78490.83
2009	7973258	2.07	1.02	106.89	1.58		79732.58
2010	9042032	2.35	1.13	134.62	13.40		90420.32
2011	11717591	3.04	1.30	204.04	29.59		117175.91
2012	5953352	1.54	0.51	54.48	-49.19		59533.52
2013	11305095	2.93	1.90	193.34	89.89		113050.95
2014	11988553	3.11	1.06	211.07	6.05		119885.53
2015	9021403	2.34	0.75	134.08	-24.75		90214.03
2016	10746387	2.79	1.19	178.84	19.12		107463.87
2017	14326097	3.72	1.33	271.73	33.31		143260.97

Source: processing based on statistical data

For the period 2007-2017, the average area of the area was 10810.1 hectares and the area of maize increased yearly for the analysis period by 12.34 thousand hectares.

On average, the surfaces decreased during the period 2007-2017 by 0.95 times, the average dynamic rate indicating that the surfaces changed on average by 1.7% annually.

The average level of grain maize production for the period considered was 9434.25 thousand tons and maize production increased by 1323.71 thousand tons annually. On average, production increased by 3% annually.

Table 6. Economic indicators of maize culture

Specification	Average production	Average purchase price	Income / ha without subsidies	Income / ha + subsidies	Cost of production / ha	Profit without subsidy	Profit + subsidies	Profit rate without subsidies	Profit rate + subsidies	Subsidies
	Kg/ha	lei/kg	lei/ha	lei/ha	lei/ha	lei/ha	lei/ha	%	%	lei
<b>2007</b>	1526	0.55	839.3	1165.50	833	6.3	332.50	0.76	39.92	326.20
<b>2008</b>	3215	0.72	2314.8	2716.84	2300	14.8	416.84	0.64	18.12	402.04
<b>2009</b>	3409	0.48	1636.32	2124.60	1645	-8.68	479.60	-0.53	29.16	488.28
<b>2010</b>	4309	0.57	2456.13	3015.74	2400	56.13	615.74	2.34	25.66	559.61
<b>2011</b>	4525	0.79	3574.75	4154.60	3520	54.75	634.60	1.56	18.03	579.85
<b>2012</b>	2180	0.87	1896.6	2598.49	1910	-13.4	688.49	-0.70	36.05	701.89
<b>2013</b>	4488	0.74	3321.12	4035.80	3300	21.12	735.80	0.64	22.30	714.68
<b>2014</b>	4770	0.61	2909.7	3688.98	2885	24.7	803.98	0.86	27.87	779.28
<b>2015</b>	3462	0.6	2077.2	2797.47	2200	-122.8	597.47	-5.58	27.16	720.27
<b>2016</b>	4159	0.62	2578.58	3348.94	2590	-11.42	758.94	-0.44	29.30	770.36
<b>2017</b>	5959	0.6	3575.4	4382.24	3626	-50.6	756.24	-1.40	20.86	806.84

Source: calculations performed within ICEADR

Regarding the economic indicators of the corn crop, according to the studies carried out by ICEADR, the average purchase prices varied between 0.55 lei / kg and 0.87 lei / kg, an influence on these variations being the cultivated area as well as the production obtained.

The highest price was noted in 2012, of 0.87 lei / kg, higher by 37% compared to the reference year 2007, while the average purchase price recorded in 2017 is 12% higher than in 2007.



The financial aid (Subsidies) granted for the grain maize crop per hectare increased from year to year, so that in 2017 the value of the subsidy granted was 806.84 lei / ha, being 2.47 times higher than the the year 2007 when the subsidy was only 326.2 lei / ha.

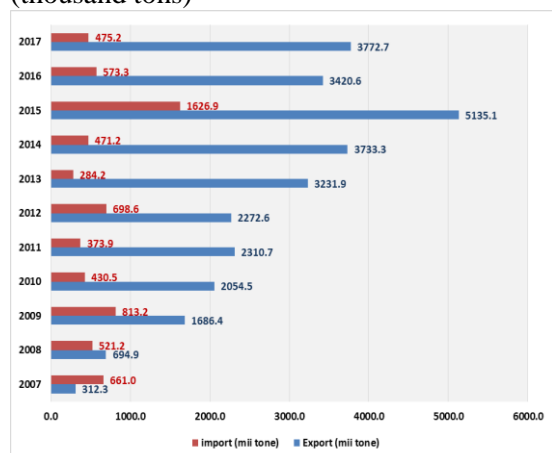
It can be seen from table no. 6, that by capitalizing on the maize grain production at the farm price, farmers without the aid of the subsidies granted do not make a profit.

The value of the profit with subsidies increases with the value of the support granted, from 336.5 lei / ha to 756.24 lei / ha, the rate of profit in 2017 being kept at 20.86%.

In the period 2007-2017, observing the profit without subsidy, we can say that without the aid of the supports, the very low profit, in 2007 registering a profit of 6.3 lei / ha or even negative, in 2017 reaching -50.6 lei / ha, considering that this culture is a non-profit, registering a profit rate of -1.4% in the last year taken into study (2017). Exports of maize from a value point of view were more than 3 times higher than the imports, so that at the level of 2015, the value of corn maize exports was over 961 million euros, reaching the maximum value of the period analyzed (figure no.3)

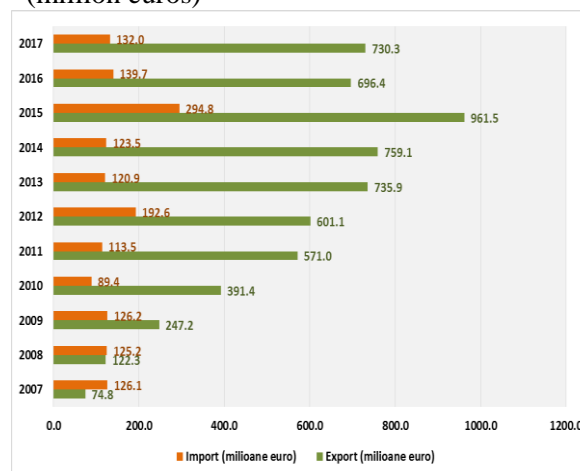
Spain (10.3 million euros), Italy (9.5 million euros), as well as Turkey (6.2 million), exports growing in the year, are among the top importing countries of Romanian corn in Romania. 2017, reported in 2007.

Figure no. 2. Import and export of corn maize to Romania between 2012-2017 (thousand tons)



Source: Trade statistics for international business development –Trade map

Figure no.3.Import and export of grain maize to Romania in the period 2012-2017 (million euros)



Source: Trade statistics for international business development –Trade map

From a quantitative point of view, grain maize imports are very low compared to exports, so that in 2017, the total quantity of maize imported was 475.2 thousand tons, compared to 3.75 million tons of maize exported. Among the corn exporting countries in Romania are Hungary, Slovakia and Bulgaria.

Analyzing from the point of view of the commercial corn grain balance, it is noted that it has an upward trend, but Romania exports double quantitatively, especially raw materials, and the deficit appears as a result of the import of value-added products.

Following the analysis of the import and export of grain maize, we can say that this crop is of great importance at national level, due to the quantities exported annually.

## CONCLUSIONS

Within the study carried out, the technical indicators of the grain maize culture, the surfaces and the productions obtained at national level were highlighted, thus indicating their evolution during the analyzed period 2007-2017 with the help of absolute, relative and average statistical indicators.

With the help of the average dynamics indicators, it was observed that the maize corn surfaces underwent annual changes on average of 1.7%, and the total maize yields increased year by



year at a rate of 14%. All these evolving trends can be due both to the funds allocated from the U.E. as well as the resurgence of the agricultural sector through investments in the mechanization of the sector but also of the development of research in the field.

Taking into consideration the economic indicators such as: the average purchase price, the production cost, the subsidies, the income obtained per hectare with subsidies and without, the profit of the crop, it could be shown that the grain corn crop is a profitable one only if the farmers benefit from the subsidies granted.

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# NEW VARIANTS OF SOYBEAN CULTIVATION UNDER THE CURRENT CLIMATE CHANGES

FELICIA CHEȚAN<sup>1</sup>, CORNEL CHEȚAN<sup>2</sup>

**Abstract:** *The yield dates recorded in the period 2016-2018 indicate that soybean is less demanding at the soil cultivation system, so that in the three years of experimentation, the average yield achieved in the classical soil cultivation system had a close value of that obtained in the minimum system (chisel and disk), the differences being between 29-245 kg/ha. By marketing the production, it obtains the highest profit in the minimum soil cultivation system - the chisel variant of 1174 lei/ha followed by the classical system with 967 lei/ha and the disk variant 829 lei/ha. During these three experimental years there were very rapid changes in the weather, at hot to cold and vice versa, the torrential rains abundance of followed by long droughts. Higher values of available water reserve in the soil ( $R_a$  m<sup>3</sup>/ha) were determined in the classical system in the rainy years, but at the same time there is a faster loss than the minimum system where the accumulation of water in the soil is made more difficult but it's slower.*

**Keywords:** *tillage system, climate, water reserve, yield, soybean*

**JEL Classification:** *Q 01, Q 15, Q 16*

## INTRODUCTION

By excessive work of the soil with mechanical machinery and primarily the basic work, the appearance, which has negative effects through a greater water loss, a weaker mineralization of the vegetal remains, the hardpan creation, breaking the continuity of the capillarity, and if the plowing is made after the highest slope line, favors erosion (Bogdan et al., 2007, Cociu, 2011, Ibanez et al., 2008, Moraru and Rusu, 2010, Pop et al., 2013; Berca, 2006). Obsolete, energy-efficient technologies are an initial factor for soil degradation, 35% of the degradation is due to human activity worldwide and 28% to other forms of improper land management (Brown, 2002). In the last few years the climate of the area has changed, due to the increase of the temperature and the unevenness of the precipitations distribution, and we have to look new variants of the soil cultivation (Rusu et al., 2014; Chețan et al., 2011, 2016, 2017).

The minimum work system involves the basic work without plow with the furrow return, using: disk harrow, chisel, rotary harrow, mills, complex aggregates and the keep vegetal debris 15-30% or superficial incorporation the mulch. The crop rotation also aims at keeping the water in the soil at cultivating the plants with low water consumption after the plants with high water consumption and including rotation of roots alternating the culture plants with the depth rooting with plants with the shallow rooting (Chețan, 2015). Soybean is currently one of the most important crops for human consume, animal feed, and is of agro-technics importance (soil fertility) by fixing the atmospheric nitrogen (symbiosis between the roots and *Bradyrhizobium japonicum*), Dencescu et al., 1982; Guş et al., 2004; Vidican et al., 2013; Chețan and Chețan, 2013). Minimal work has been aimed at accumulating - storage the water in the soil in as large a quantity as possible in the soil horizons, accessible to crops.

## MATERIALS AND METHODS

The researches was realized between 2016-2018, at the Agricultural Research Development Station Turda (ARDS), physically-geographically located in the Transylvanian Plain. The experience was placed on a haplic chernozem (SRTS, 2012): 56.07% clay; coarse sand 0.73%; porosity 58%; density 1.13 g/m<sup>3</sup>; SIC texture; with the following indices (MESP, 1987): pH 7.8; humus 3.49%; total nitrogen 0.207%; 65 ppm phosphorus; potassium 400 ppm; carbonate 0.7%, values determined at a

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depth of 0-28 cm (OSPA Cluj). The experimental field was included in a three-year crop rotation: soybean - winter wheat - maize. The biological material was represented by soybean Felix variety (maturity group 00, created at ARDS Turda).

Experimental factors:

**A - Soil system:** a<sub>1</sub> classic (SC), plow with Kuhn Huard Multi Master 125T at 28 cm depth + the seedbed preparation in spring with rotary harrow HRB 403 D + sowing + fertilized, with Gaspardo Directa 400 seed drill; a<sub>2</sub> conservative, minimal works (MC), scarified in autumn with the Gaspardo Pinocchio chisel at 28 cm depth; the seedbed preparation in spring with Kuhn HRB 403 D rotary harrow and sowing + fertilized, with the Gaspardo Directa 400 seed drill; a<sub>3</sub> conservative, minimal work, processed the soil in autumn with the Discovery hard disk at 12 cm depth (MD); the seedbed preparation in spring with Kuhn HRB 403 D rotary harrow and sowing + fertilized, with the Gaspardo Directa 400 seed drill; **B - year** (climatic conditions): b<sub>1</sub>-2016, b<sub>2</sub>-2017, b<sub>3</sub>-2018.

The sowing was done at a density of 65 gg/m<sup>2</sup>, 18 cm the distance between the rows and the seed incorporation on 5 cm depth. The basic (mineral) fertilization was carried with N<sub>32</sub>P<sub>32</sub>K<sub>32</sub> a.s./ha, at the same time with the sowing and the additional fertilization before the soybean flowering was made with 2.0 l/ha of foliar fertilizer NPK type + microelements (8:32:4 + Fe, Mn, Zn, humic acids). The weed control was realized in two phases: pre-emergence with 0.35 l/ha Sencor (*metribuzin* 600 g/l) + 1.5 l/ha Tender (960 g/l *S-metolachlor*) and post-emergence with 1.0 l/ha Pulsar 40 (40 g/l *imazamox*) + after 4 days with 1.5 l/ha of Agil 100 EC (100 g/l *propaquizafop*). For the control of *Tetranychus urticae* pests (red spider), used an acaricide Omite 570 EW (570 g/l *propargite*) at a dose of 0.8 l/ha and 0.2 l/ha Biscaya 240 OD (240 g/l *thiacloprid*) for *Cynthia cardui* (thistle caterpillar). The disease control, *Peronospora manshurica* and *Pseudomonas glycine*, was achieved by treatment with 2.5 kg/ha of Ridomil Gold MZ 68 WG (4% *mefenoxam* 64% *mancozeb*).

The reserve of accessible humidity (Ra m<sup>3</sup>/ha) was determined on the depth of 0-50 cm (for soybeans most of the root system is in the first 40 cm deep in the soil):  $Ra_{50} = Ra_{50} \text{ (mm)} \times 10 \Rightarrow Ra_{50} \text{ (m}^3\text{/ha)}$ . Soil harvesting was carried out in all three soil cultivation systems, with CASE combine harvester, the difference that in the minimum system the stalks were chopped and evenly dispersed on the soil surface as the mulch and in the classical system after harvest the land was released by plant debris (strains were bundled and transported off the field).

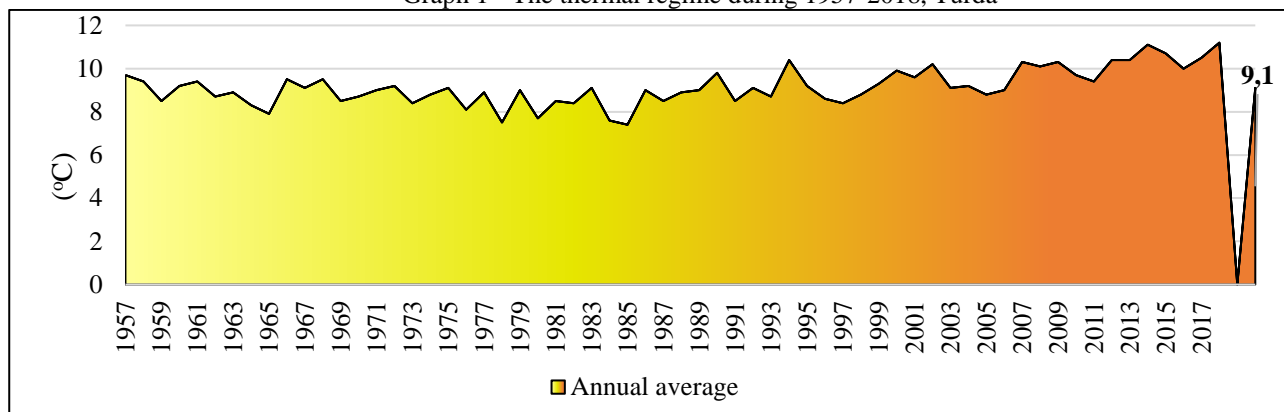
The economic efficiency of the investigated variants was determined by the number of technological works applied, fuel consumption (on the basis of the characteristics of agricultural machinery, equipment used, on land with 1.19% slope coefficient) and materials used, per hectare. The yield data obtained were statistically processed by variance analysis (PoliFact, 2015) and limiting differences (LSD, 5%, 1%, 0.1%). The climatic conditions during 1957-2018 (Turda Meteorological Station, longitude 23°47', latitude 46°35', altitude 427 meters) are presented in Graph 1 and 2.

## RESULTS AND DISCUSSIONS

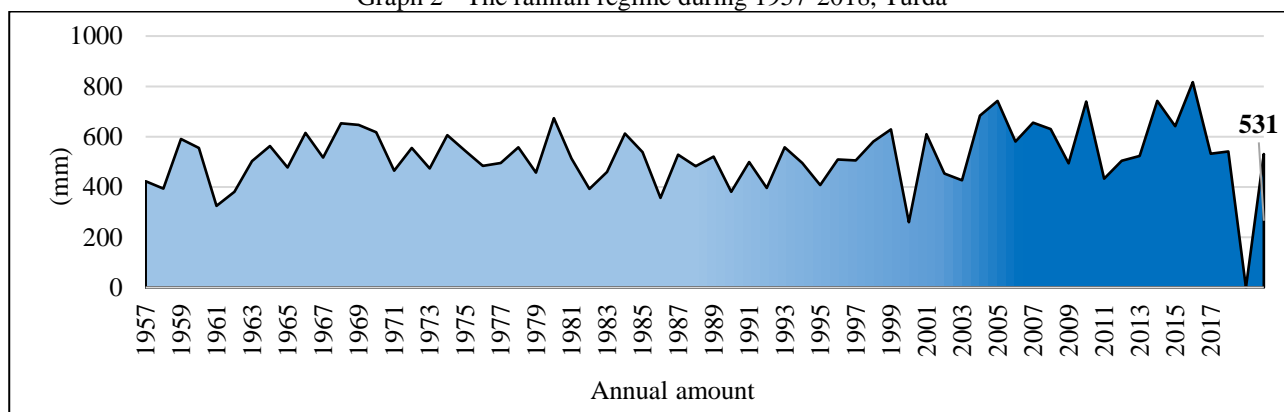
In the 62- years since the evolution of the climatic conditions in Turda was monitored, the data collected at the Turda Meteorological Station (1957-present) regarding their evolution in dynamics, it can be noticed that the weather in Turda is in a heating process and that felt more intense after 2007, which is part of the global warming phenomenon (Ignea, 2017). The 62-year multiannual average was 9.1°C, the number of years in which the annual mean temperature was below 9°C was 25- year, 25- year at 9°C and above 9°C, and 12- year with annual mean values temperatures above 10°C, especially in the last seven years (2012-2018). The highest average annual temperatures are attributed to 2014 (11.1°C) and 2018 (11.2°C).

The evolution of the rainfall regime was uneven and no dominant trend was observed, the 62-year multiannual amount was 531 mm, the number of years in which precipitation had values below 500 mm was 24- years-, over 500 mm in 21- years, over 600 mm were recorded in 13- year and in four years the precipitations had values over 700 mm. The highest rainfall over the period, 816.8 mm, was recorded in 2016.

Graph 1 - The thermal regime during 1957-2018, Turda



Graph 2 - The rainfall regime during 1957-2018, Turda

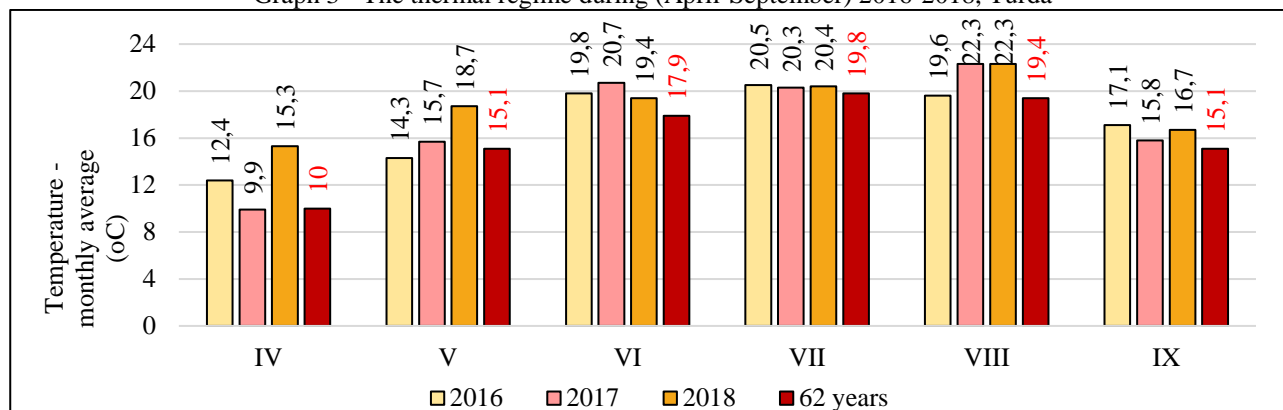


Soybean has high and different temperature requirements depending on the vegetation phases: for sowing-emergence requires at least 7-10°C (optimum 20-22°C); emergence-beginning bloom, minimum 16-18°C (optimum 21-25°C); pods formation, 13-14°C (optimum 21-23°C) and beginning maturity at minimum 8-9°C (optimum 19-20°C), (Bâlțeanu, 1998; Ștefan, 2011). In the Turda area, these periods coincide with the second decade of April and the May; the second decade of June and the second decade of August and September. From the data presented in Chart 3, it can be noticed that during April - September the temperatures recorded during all three experimental years exceeded the average monthly multiannual temperatures for 62 years. In 2016 April with average temperature of 12°C was close to normal (10°C); with 14.3°C the May month was cooler than the monthly average multiannual (15.1°C) with deviation - 0.8°C, June had a hot character with deviation + 1.9°C; July with deviation + 0.8°C; August with + 0.3°C and September with + 2°C. In 2017 the April spring month with 9.9°C was close to the multiannual average monthly, deviation + 0.1°C; May 15.7°C with + 0.6°C deviation; the summer had two hot months, June with + 2.8°C deviation, August + 3°C and a normal July month with a + 0.6°C deviation; August with + 2.9°C deviation and in September recorded average temperature exceeded by + 0.7°C monthly average for 62-year. Atypical climatic conditions marked the agricultural year 2018, throughout the April - September period. Monthly average temperatures were above the multiannual monthly values, with deviations of + 5.3°C in April; + 3.6°C in May; + 1.5°C in June + 0.6°C in July; + 2.9°C in August and in September with + 1.6°C.

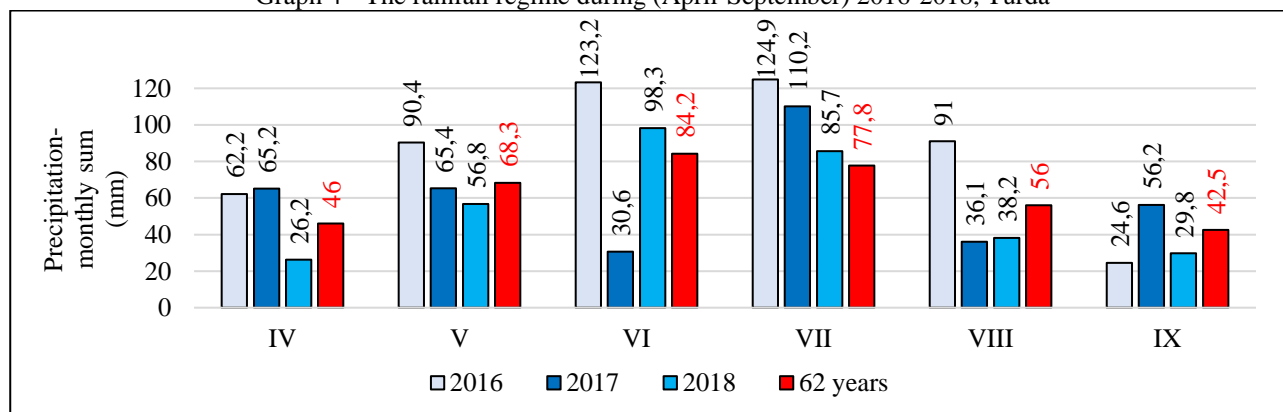
From the rainfall point of view (Graph 4), compared with the monthly multiannual sum (April 46 mm, May 68.3 mm, June 84.2 mm, July 77.8 mm, August 56.0 mm, September 42.5 mm), the year 2016 has the month April and May very rainy (April 62.2 mm with deviation + 16.2 mm, May 90.4 mm with deviation + 21.8 mm), very rainy June (123.2 mm, deviation + 38.4 mm), excessive rainy July (124.9 mm, deviation + 48.7 mm) and excessive rainy August (91 mm with deviation + 34.5 mm). Year 2016 with an annual sum of 816.8 mm, was the rainiest of the past 62-year (531 mm multi-annual amount). In April and May 2017 the precipitations had very close values (65.2 mm with deviation + 16.2 in April and 65.4 mm in May with deviation of -2.9 mm) compared to the monthly

multiannual sum, followed by a very dry June (30.6 mm with deviation - 53.6 mm versus multiannual value of 84.2 mm); July very rainy with 110.2 mm (deviation + 32.4 mm); followed by two months very dry: August, which recorded a deficit of - 19.9 mm versus 56 mm, representing the multiannual average for this month and in the September it was 56.2 mm with a deviation + 13.7 mm.

Graph 3 - The thermal regime during (April-September) 2016-2018, Turda



Graph 4 - The rainfall regime during (April-September) 2016-2018, Turda



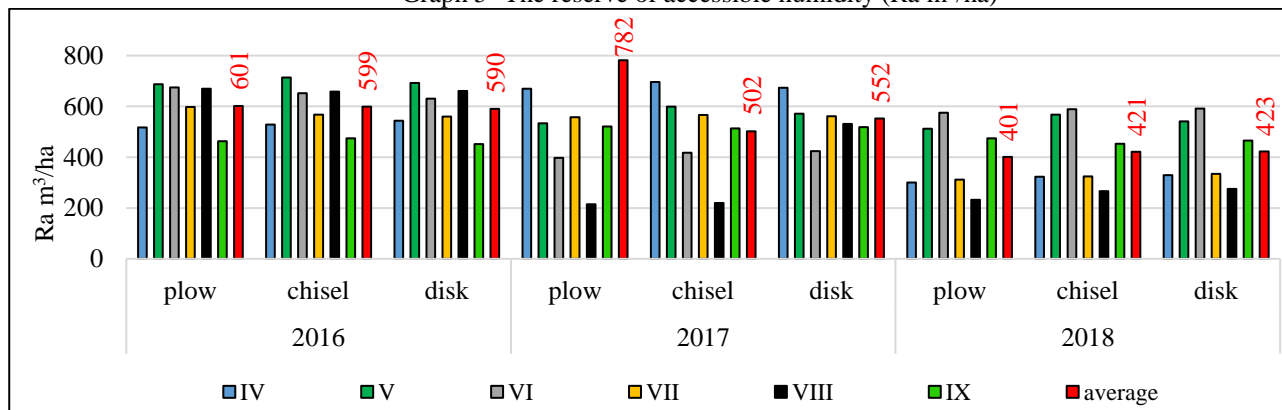
During these three years there were very rapid changes in the weather, warmth to cold and vice versa, as well as the abundance of torrential rains followed by long droughts. Graph 5, shows the average values of the accessible humidity reserve ( $R_a$  m<sup>3</sup>/ha) recorded in the period 2016-2018, starting from April to September, compared to the three soil cultivation variants (classic-plow, minim-chisel; minim-disk). The classic system with recorded  $R_a$  values proved to be superior in the six months (average 601 m<sup>3</sup>/ha) at which the  $R_a$  determinations were made on the 0-50 cm depth in the rainy year 2016, the infiltration of water being made easier compared to the minimum system in which only part of the precipitation (short-torrential rains) infiltrated into the soil but the leakage on the slopes was higher than the infiltrations (chisel 599 m<sup>3</sup>/ha, 590 m<sup>3</sup>/ha of disk), the difference being between 2- 11 m<sup>3</sup>/ha in favor of the plowing system. Even though the total value of the average 782 m<sup>3</sup>/ha is attributed to the classic plug- in the whole period of April-September in 2017, this variant also recorded the lowest value of the whole research period in August, only 215 m<sup>3</sup>/ha, close to the minimum-chisel system (220 m<sup>3</sup>/ha).

The storage and preservation of a larger quantity of water in the soil active horizons was achieved in the minimum-disk system, which had a  $R_a$  value of 531 m<sup>3</sup>/ha. In the dry year 2018, the accumulation and preservation of water in the soil for a longer period of time we believe it is easier to achieve in the minimum system due to the fact that, in the absence of plowing, the capillary water circuit in the ground is not interrupted, the rains have not had a torrential character in this so that they infiltrated more easily into the soil, plus the intake of vegetal mulch from the soil surface that provides a somewhat constant moisture, fades in the cultivation of the soybean the growth and competition of weeds for water. The loss of moisture in the 0-50 cm layer in the summer months, of June to August

when recorded prolonged drought periods correlated with temperatures higher than the multiannual average for this period, determined the lowest values of Ra in the classic- plow 575 m<sup>3</sup>/ha in June, 312 m<sup>3</sup>/ha in July and 232 m<sup>3</sup>/ha in August, and in the minimum-chisel the values were 589 m<sup>3</sup>/ha in June, 325 m<sup>3</sup>/ha in July and 267 m<sup>3</sup>/ha in August. The minimum-disk version had Ra values of 592 in June, 334 in July, 275 in August.

Conservation of water in the soil through the application of minimum systems (chisel and disk) is noticeably higher in drought years, when in these systems the Ra values recorded during the critical periods for soybean culture exceeded the Ra values in the classical soil working system with the plow with the return of the furrow). It seems that in the rainy years the water builds up faster in this system, but it is easier to lose from the horizon of 0-50 cm.

Graph 5- The reserve of accessible humidity (Ra m<sup>3</sup>/ha)



Applied technologies should be better suited to the pedo-climatic conditions of the area of interest and cultivar requirements so as to improve their stability to some extent. The increase in yields on the surface unit is based on the use of modern technologies, varietal performance and the application of scientific research results and the use of innovations in agricultural production activity (Ion, 2010).

From the data presented in Table 1, one can notice the significant negative influence of a minimal-disk soil working system in soybean crop production. The difference between the three classic, minimal-chicken and minim-disc systems suggests that soybeans are not preference to the soil operating factor and are suitable for the minimal works variant where the difference from the control was only 29 kg/ha. It appears that in the Turda area, soybean produces the lowest yields in the soil-processing variant with the disc with a difference of 245 kg ha compared to the control and shows distinct significantly negative assurance statistics. These production differences are believed to be due primarily to the soil type with a high content of clay (over 50%).

Soybean crop is influenced more by the year factor (climatic conditions), it can be noticed the negative influence of the years 2017 and 2018 (significantly negative) in expressing the soybean production potential. In 2017, although rain was rainy in April, very low precipitation occurred during May-June, which led to a lower production of 2882 kg/ha (insignificant influence) and a minimum disc of 2731 kg/ha (distinct significant positive influence), with differences from the control between 34-185 kg / ha. Compared with 2016, which was favorable in terms of temperatures and precipitation for soybean culture with a positive impact on production (3296 kg/ha in the classic-plow variant, 3390 kg/ha in minim-chisel and 3240 kg/ha in minim-disk), in 2018 the lack of water in the spring led to the achievement of small productions in all three variants of soil work: classic-plow 2394 kg/ha; minim- chisel 2362 kg/ha; minim-disk 2220 kg/ha. Referring to the classic version - plow taken as a control, the lowest production was made in the minim-disk version with a difference of 173 kg/ha (Table 1).

The technological differences of the minimum tillage system reduce the soil degradation process caused by the compacting phenomenon at repeated crossings with heavy machinery on the soil surface.

The cost of mechanical, manual and material works (seed, fertilizers, pesticides, etc.) in the minim- chisel variant is 2592 lei/ha and 2581 lei/ha in the disk version and 2761 lei/ha in the classic system. By selling the production at an average price of 1.3 lei kg, there is a profit of 967 lei/ha in the classic system, 1174 lei/ha in the minim- chisel variant and 829 in the disk variant (Table 2).

Table 1- The influence of experimental factors on the soybeans yield, 2016-2018

Variants system/year	Yield (kg)	%	Difference	Significance
a <sub>1</sub> classic- plow	2868	100	0	Mt.
a <sub>2</sub> minim - chisel	2897	101	29	-
a <sub>3</sub> minim - disk	2623	91	-245	00
LSD 5% = 60 kg/ha; LSD 1% = 248 kg/ha; LSD 0.1% = 440 kg/ha.				
b <sub>1</sub> 2016	3309	100	0	Mt.
b <sub>2</sub> 2017	2843	86	-466	000
b <sub>3</sub> 2018	2325	70	-984	000
LSD 5% = 59 kg/ha; LSD 1% = 90 kg/ha; LSD 0.1% = 144 kg/ha.				
a <sub>1</sub> x b <sub>1</sub>	3296	100	0	Mt.
a <sub>2</sub> x b <sub>1</sub>	3390	103	95	-
a <sub>3</sub> x b <sub>1</sub>	3240	98	-56	-
a <sub>1</sub> x b <sub>2</sub>	2916	100	0	Mt
a <sub>2</sub> x b <sub>2</sub>	2882	99	-34	-
a <sub>3</sub> x b <sub>2</sub>	2731	94	-185	00
a <sub>1</sub> x b <sub>3</sub>	2394	100	0	Mt
a <sub>2</sub> x b <sub>3</sub>	2362	99	-32	-
a <sub>3</sub> x b <sub>3</sub>	2220	93	-173	00
LSD5% = 100 kg/ha; LSD 1% = 170 kg/ha; LSD 0.1% = 354 kg/ha.				

Table 2- The technological expenses for 1 ha of soybean, 2016-2018

No.	Elements of expenditure	Tillage system		
		classic-plow	minim-chisel	minim-disk
1.	Mechanical works, lei/ha	546	512	501
2.	Materials, lei/ha	2099	1964	1964
3.	Hand works, lei/ha	116	116	116
Total expenses, lei/ha		2761	2592	2581
Average yield kg/ha (2016-2018)		2868	2897	2623
Yield sale price (1.3 lei/kg)		3728	3766	3410
Profit (lei/ha)		+ 967	+ 1174	+ 829

## CONCLUSIONS

The soil cultivation system, climate conditions and technology specific to each system influence the productivity potential of the soybean.

Soybean is less demanding than the soil cultivation system, so that in the three years of experimentation, the average production achieved in the classical soil working system had a value close to that obtained in the minimum system (chisel and disc), the differences being between 29-245 kg / ha.

In the yield formation the major role is played by climate conditions, the reduced precipitation from May to August, combined with high temperatures that have persisted for a long time, had a negative impact on the soybean crop in the years 2017 and 2018.

Higher water reserves ( $Ra\ m^3/ha$ ) were determined in the classical system during the rainy years, but at the same time a faster loss is recorded than in the minimum system where the water accumulation in the soil it is harder to do but it is slower.

By selling the average yield obtained in the three experimental years, the highest profit is achieved in the minimum system - the chisel variant of 1174 lei/ha followed by the classic system with 967 lei/ha and the disk variant with 829 lei/ha.

The application of conservative technology is aimed not only at ensuring harvests close to or equal to those obtained in classical technology, but also in reducing soil degradation by erosion, organic matter growth, soil structure rebuilding, the accumulation and storage the water in the soil (increase of plant availability), the economy of the fuel and labor.

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# STUDY ON THE POTATO MARKET AT THE LEVEL OF ROMANIA IN THE PERIOD 2012-2017

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**Abstract:** *Potato is a basic food for the Romanian consumer, and not because of the special nutritional qualities, but rather the consistency it has. Given the low level of living, in Romania it is an extremely consumed food, both in the urban environment, but especially in the rural area. Exceptional storage qualities cannot be left aside, offering the possibility of consumption even in the cold season. In 2017 (28 million euros), there was an increase of 80.3% compared to the value of imports registered in 2012 (16 million euros).*

**Keywords:** *potatoes, vegetable sector, vegetables*

**JEL Classification:** *Q13, Q17*

## INTRODUCTION

Considering that the population of our country is in a sharp and continuous decrease, the need for vegetables is on an upward trajectory due to the increase of the standard of living, in conjunction with the disappearance of the family households, which represented an important source of assurance of the need for products. farm.

Romania has benefited from a whole series of financial aids, including those for the vegetable sector, both by granting direct payments and by the possibility of accessing European funds for investments at sector level. However, the investments were not sufficient to ensure the internal needs of fresh vegetables at country level, Romania being dependent on imports from countries such as the Netherlands, Turkey or Italy.

The problems that the vegetable producers claim, refer in particular to the fact that they do not have a safe market, there being periods when they failed to market part of the production, resulting in significant losses. The surfaces cultivated with vegetables register a marked decrease from year to year, being replaced by the surfaces cultivated in protected spaces, which have special advantages over the modality of cultivation in the field (Table no. 1.).

**Table no.1-The evolution of the area cultivated with potatoes at the level of Europe in the period 2012 - 2017 (1000 ha)**

Country	2012	2013	2014	2015	2016	2017	2017/2012 (%)
Poland	373,00	337,00	267,12	292,50	300,70	321,26	-13,9
Germany	238,30	242,80	244,80	236,70	242,50	250,50	5,1
France	154,10	160,96	168,02	167,26	179,00	192,22	24,7
Romania	229,27	207,61	202,67	196,07	186,24	171,92	-25,0
Netherlands	150,00	156,00	156,00	155,66	155,59	160,79	7,2

Source: Basic data Eurostat.eu, accessed 24.09.2018

Poland cultivated the largest area with potatoes in 2017, over 320 thousand hectares, but down from 2012 when it cultivated over 370 thousand hectares. Only France presents an upward evolution of the cultivated area, so that if in 2012 it was 154 thousand hectares, in 2017 it was over 192 thousand hectares, increasing by about 25% (Table no. 1). ). In Romania, the trend is a downward one, due to the massive imports from countries like Poland, at a lower price, which led to the reorientation of farmers to other agricultural crops, because due to the low selling price imposed by competition they made this culture to be unprofitable for some of the farmers. It should be noted that the area cultivated in 2012 was 229 thousand hectares, while in 2017 it was only 171 thousand hectares, decreasing by 25% (Table no. 1).

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## MATERIALS AND METHODS

The research is based on the statistical data provided by the National Institute of Statistics, Eurostat and by TradeMap, which will determine the evolutions recorded by the surfaces, the productions, the average productions, the prices, the imports and the exports using the quantitative and qualitative research methods such as, and the method of comparison.

## RESULTS AND DISCUSSIONS

In 2017, the largest potato production was registered by Germany of 11.72 million tonnes, up 9.9% from the production obtained in 2012, when it was 10.66 million tonnes , and an average production of 46.8 t / ha (Table no. 2.).

**Table no.2-Evolution of potato production in Europe between 2012 and 2017 (1000 t)**

Country	2012	2013	2014	2015	2016	2017	2017/2012	Average annual production / ha (t / ha)
Germany	10.665,60	9.669,70	11.607,30	10.370,20	10.772,10	11.720,00	9,9	46,8
Poland	9.041,30	7.110,90	7.424,11	6.151,80	8.624,00	8.956,04	-0,9	27,9
France	6.376,06	6.953,28	8.054,52	7.114,49	6.959,61	8.529,36	33,8	44,4
Netherlands	6.766,00	6.577,00	7.100,00	6.651,69	6.534,34	7.391,90	9,3	46,0
UK	4.553,00	5.685,00	5.921,00	5.598,00	5.373,00	5.555,00	22,0	-
Turkey	4.822,00	3.955,00	4.175,00	4.763,00	4.751,00	4.801,00	-0,4	-
Belgium	2.811,50	3.428,00	4.121,45	3.665,46	3.404,64	4.290,74	52,6	-
Romania	2.465,15	3.289,72	3.519,33	2.699,68	2.689,73	3.127,52	26,9	19,5

Source: Basic data Eurostat.eu, accessed 24.09.2018

Although the cultivated area has decreased, the potato production in Romania increased by approximately 27%, so that if in 2012 it was 2.46 million tonnes, in 2017 it registered no less than 3, 12 million tonnes, due to higher average yields due to investments made in the last period (Table no. 2). We note that in Belgium the lowest price of potatoes was recorded, of only 6.47 euros / 100 kg, decreasing by 61% compared to 2012. Also, during the analyzed period, the average selling price of potatoes was only 11 , 4 euros / 100 kg, the lowest of all the countries analyzed (Table no. 3.)

**Table no.3-The evolution of the price for potatoes in the period 2012-2017 (euro / 100kg)**

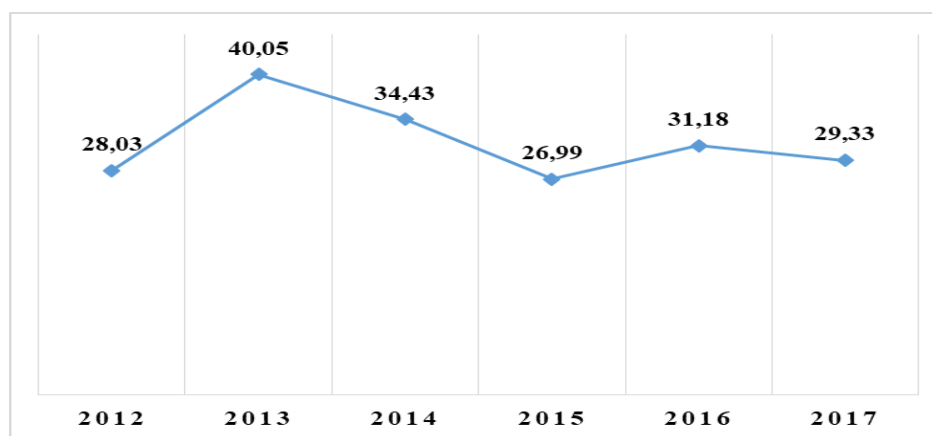
Country	2012	2013	2014	2015	2016	2017	2017/2012	Average annual production / ha (t / ha)
Cyprus	34,50	39,50	31,60	35,90	35,50	52,00	50,7	38,2
Greece	42,54	53,75	44,83	47,89	48,98	43,74	2,8	47,0
Italy	36,69	47,26	37,06	36,34	41,39	40,58	10,6	39,9
Malta	32,14	36,45	28,25	32,71	39,34	30,08	-6,4	33,2
Romania	28,03	40,05	34,43	26,99	31,18	29,33	4,6	31,7
Sweden	25,52	32,49	26,62	27,22	29,73	25,60	0,3	27,9
Denmark	16,29	23	24,13	25,58	24,92	25,00	53,5	23,2
Luxembourg	38,01	38,08	20,81	31,20	30,03	24,28	-36,1	30,4
Slovakia	21,03	26,06	26,77	24,72	25,73	23,18	10,2	24,6
Portugal	18,79	34,13	15,78	19,56	33,07	22,95	22,1	24,0
Austria	16,91	25,63	12,25	18,85	14,83	22,35	32,2	18,5
Hungary	15,88	27,11	19,26	21,60	22,94	20,89	31,5	21,3
UK	20,29	24,96	17,75	19,60	22,89	20,30	0,0	21,0
Bulgaria	19,02	23,91	20,37	19,76	19,40	19,74	3,8	20,4
Slovenia	15,52	32,67	16,45	13,11	16,43	18,10	16,6	18,7
Finland	16,03	23,81	14,61	17,74	20,02	17,97	12,1	18,4
Czech Republic	11,25	22,36	17,69	16,57	19,12	16,41	45,9	17,2
Croatia	15,82	22,43	15,54	14,39	16,53	16,03	1,3	16,8
Netherlands	14,6	19,62	10,19	11,50	17,13	15,83	8,4	14,8
Lithuania	11,39	17,24	15,43	11,52	14,09	15,45	35,6	14,2
Latvia	13,26	15,81	15,85	13,62	14,14	14,06	6,0	14,5
Poland	10,75	15,35	12,43	12,22	11,98	12,32	14,6	12,5
Belgium	16,81	14,79	2,73	9,96	17,36	6,47	-61,5	11,4

Source: Basic data Eurostat.eu, accessed 24.09.2018

Also, Poland recorded a low price of potatoes, occupying the second position, with a price of 12.32 euros / 100 kg, increasing compared to 2012 (Table no. 3).

We can see that Romania ranks among the countries with the most expensive potatoes in Europe, being 29.33 euros / 100kg. This can also be attributed to their quality at the expense of potatoes produced by other states (Table 3).

Figure no. 1.



Source: INSE basic data, accessed 24.09.2018;

Price evolution for potatoes grown in Romania (euro / 100kg)

The price of potatoes has an oscillating evolution, with significant variations, ranging from 26.99 euros / 100 kg to 40.05 euros / kg. This is due in large part to the total production obtained, but also to the decrease in potato consumption in Romania (Table no. 1).

Vegetables play an extremely important role in human nutrition, so they should not be lacking, as it is necessary that at least 70% of the composition of a meal, be made of vegetable food to maintain a healthy lifestyle.

Table no.4-Evolution of annual average consumption per capita (kg) between 2012 and 2017

Product	2012	2013	2014	2015	2016	2017	2017/2012
Potatoes (kg)	41,8	39,8	39,8	38,4	36,7	36,9	-11,7
Vegetables and canned vegetables (kg)	90,9	91,4	92,7	90,6	92,7	95,8	5,4
Cabbage is cooping	8,9	9,6	10,0	9,4	9,7	10,3	15,8
Tomatoes (red tomatoes)	12,0	12,1	12,1	12,6	13,1	13,1	8,8
Carrots and other edible roots	9,5	9,7	10,3	9,7	9,9	10,5	10,6
Dried onions	10,0	10,2	10,2	10,4	10,4	10,8	8,3

Source: INS data processing

The average annual potato consumption shows a decreasing trend, so that if in 2012 it was 41.8 kg / capita, in 2017 it registered a decrease with 11.7%, reaching 36.9 kg / capita . This decrease can be accounted for by several factors, such as the decrease of the population, the increase of the standard of living (the minimum wage on the economy increased from 700 lei in 2012 to 1450 lei in 2017), so that the consumer turned to other products considered more nutritionally rich (Table 4). The need for consumption of vegetable products is influenced on the one hand by the annual average consumption, and on the other hand it is influenced by the evolution of the population.

Table no.5-Need for consumption of vegetable products in the period 2012 -2017

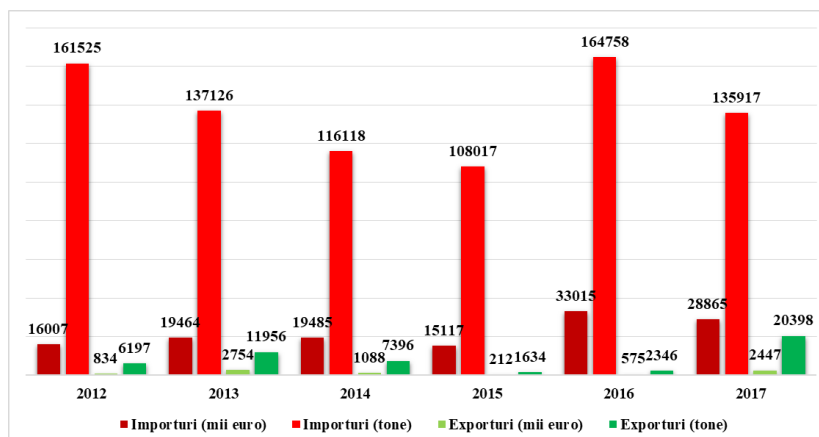
Product	2012	2013	2014	2015	2016	2017	2017/2012
	thousands of tons						%
Potatoes (kg)	839,2	796,2	793,5	762,3	726,1	724,4	-13,7
Vegetables and canned vegetables (kg)	1826,7	1829,9	1849,9	1801,4	1832,0	1881,9	3,0
Cabbage is cooping	178,5	191,7	198,7	186,3	191,4	202,0	13,2
Tomatoes (red tomatoes)	241,4	242,9	241,1	250,4	259,2	256,7	6,3
Peppers and lentils	101,3	94,9	97,0	100,4	103,2	103,7	2,4
Carrots and other edible roots	190,8	193,6	205,2	193,0	195,2	206,3	8,1
Dried onion	201,1	203,5	204,2	206,8	205,4	212,9	5,8

Source: own calculations

According to the table above we can see that in 2017, the consumption of potatoes has a value of 724 thousand tons (down 13.7% compared to 2012), vegetables and canned 1.9 million tons (in increase by 3% compared to 2012) or cabbage and cauliflower in quantities of 202 thousand tons (up 13.2% compared to 2012) (Table no. 5).

Regarding the import from the point of value of the potatoes, we observe an oscillating evolution during the analyzed period. However, it is noted that in 2017 (28, million euros), there was an increase of 80.3% compared to the value of imports registered in 2012 (16 million euros) (Figure no. 2.).

**Figure no. 2.**



Source: TradeMap basic data, accessed 03.10.2018

**Potato import and export in Romania between 2012-2017**

In the case of potato value export, there is an upward trend, with minimum values reached in 2015 of 212 thousand euros and a maximum reached in 2013 of 2.7 million euros (Figure no. 5.9.).

Romania imported potatoes in 2017 (in terms of value) from countries such as: Poland (7.5 million euros), Greece (5.7 million euros) and Germany (3.5 million euros) and exported to countries such as: Republic of Moldova (1.8 million euros), Poland (392 thousand euros) and Greece (109 thousand euros) (Figure no. 2.).

**Table no.6-Comparative prices on potato import and export**

Import	2012	2017	2017/2012	Export	2012	2017	2017/2012
	Euro / tonne	Euro / tonne	%		Euro / tonne	Euro / tonne	%
Total	99,1	212,4	114,3	Total	134,6	120,0	-10,9
Poland	51,5	137,2	166,4	Republic of Moldova	116,7	104,6	-10,4
Greece	146,5	312,3	113,1	Poland	166,7	212,9	27,8
Germany	120,9	235,7	94,9	Greece	-	224,3	-

\*Grand total

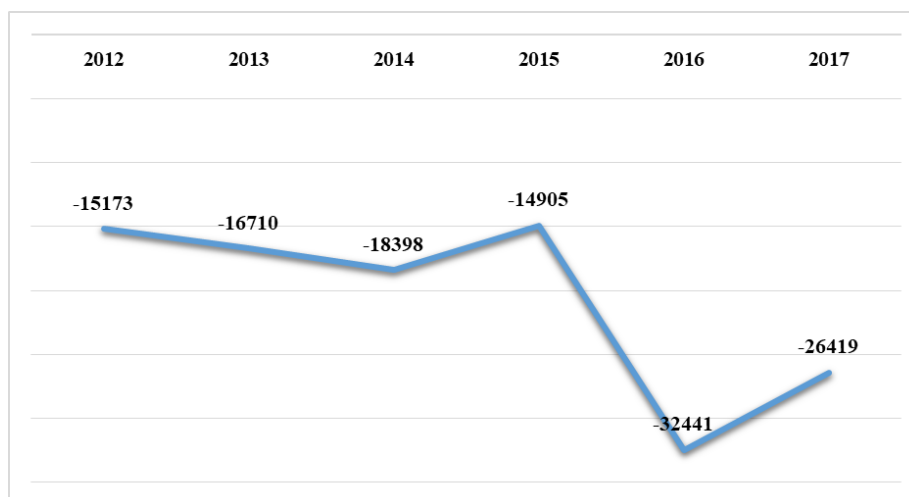
\*\* the first 3 importing / exporting countries

Source: TRADE MAP data processing;

According to the table above it is noted that the import price of potatoes increased by 114%, so that if in 2012 it was 99.1 euro / tonne, in 2017 it exceeded 200 euro / tonne, which due to the increased demand for this product (Table no. 6).

Also in the case of the export price of potatoes, a decrease of approximately 11% compared to 2012, with a price of 134.6 euros / tonne (Table no. 6).

Figure no. 3.



Source: Trade Map data processing;

**The evolution of the trade balance with potatoes in the period 2012-2017 (thousands of euros)**

It is noted that the highest deficit was registered in 2016, being 32.4 million euros. Due to higher production in 2017, the trade deficit registered a decrease reaching 26.4 million euros, down 18.6% (Figure no. 3).

## CONCLUSIONS AND RECOMMENDATIONS

The fluctuations recorded in the vegetable crops, are directly influenced by the surfaces on which they are cultivated, on the one hand, and on the other hand, these fluctuations are determined by the weather conditions that condition the satisfactory production of vegetables.

Although we cultivate significant areas (ranking in the first countries in terms of cultivated areas), when it comes to yields, they are low compared to other countries in Europe. Two of the main causes are: weather conditions, and the degree of technology available to Romanian vegetables, so that facilitating bank loans under favorable conditions, but also facilitating access to European funds can be two measures that help to remedy this problem by acquiring high performance equipment.

In Romania, the trend is a downward one, due to the massive imports from countries like Poland, at a lower price, which led to the reorientation of farmers to other agricultural crops, because due to the low selling price imposed by competition they made this culture to be unprofitable for some of the farmers. It should be noted that the area cultivated in 2012 was 229 thousand hectares, while in 2017 it was only 171 thousand hectares, decreasing by 25%.

Although the cultivated area has decreased, the potato production in Romania increased by approximately 27%, so that if in 2012 it was 2.46 million tonnes, in 2017 it registered no less than 3, 12 million tonnes, due to higher average yields due to investments made in the last period.

Also, Poland recorded a low price of potatoes, occupying the second position, with a price of 12.32 euros / 100 kg, increasing compared to 2012.

We can see that Romania ranks among the countries with the most expensive potatoes in Europe, being 29.33 euros / 100kg. This can also be attributed to their quality at the expense of potatoes produced by other states.

The average annual potato consumption shows a decreasing trend, so that if in 2012 it was 41.8 kg / capita, in 2017 it registered a decrease with 11.7%, reaching 36.9 kg / capita . This decrease can be accounted for by several factors, such as the decrease of the population, the increase of the standard of living (the minimum wage on the economy increased from 700 lei in 2012 to 1450 lei in 2017), so that the consumer turned to other products considered more nutritionally rich.

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# STUDY ON FRUIT MARKET IN ROMANIA IN 2014-2018

DIANA CREȚU<sup>1</sup>

**Abstract:** *The paper presents the fruits market in 2014-2018 in Romania, highlighting aspects such as fruit specifics, production, price dynamics, annual average consumption, internal and external trade. Fruits have a special role in maintaining physiological balance, due to the high content of minerals and vitamins. The research method used in the study is the statistical processing and economic analysis of the existing data for 2014-2018 on specialized sites such as the National Institute of Statistic (NIS)s, Eurostat, FAO, the Ministry of Agriculture and Rural Development(MARD), as well as other specialized materials.*

**Keywords:** *fruit market, consumption, price dynamics*

**JEL Classification:** *Q11;Q13;L11*

## INTRODUCTION

Romania is a country with an agricultural tradition, a country that benefits from climatic conditions and soil as few countries have in the world, on this background, developing centuries ago a strong agriculture, able to provide not only the consumption needs of the inhabitants of the country, as well as to export the surplus of resulting food. In the present paper I proposed to analyze, as the title says, a study on the fruit market for a period of 5 years, namely 2014-2018, analyzing some specific features of the fruit sector and the vegetables, fruit / tree production, price dynamics (pears, apricots, cherries, plums), average annual consumption, import and export.

The fruit market is of major importance for both agriculture and human health, with a high content of minerals and vitamins. In this article I will present some specificities specific to the fruit sector, namely that fruits as opposed to vegetables are seasonal products, the offer being completed in the off-season by imports from Turkey, Greece, Spain, Italy etc.

The fruits are perishable products, their storage assuming the existence of special microclimate conditions. Fruit consumption is flexible, due to the local conditions that allow the cultivation of highly diversified species, local traditions, the position of producers as compared to the consumption centers, etc. The fruits are grown in all households and provide a high level of self-consumption.

## MATERIAL AND METHODS

The research method used in the study is statistical processing and economic analysis of data. In the present paper, the fruit market was analyzed during 2014-2018, highlighting the particularities of this sector, productions, price dynamics, consumption, but also the respective import, exporting through specialized sites, namely National Institute of Statistics (NIS) and Ministry of Agriculture and Rural Development ( MARD) but also books, magazines, scientific papers.

## RESULTS AND DISCUSSIONS

As I said in the introduction I will also mention some specific features of the fruit and vegetable sector, namely that vegetables and fruits play a special role in maintaining the physiological balance due to the high content of minerals and vitamins.

Fruits as opposed to vegetables are seasonal products, the offer being completed in the off-season by imports from Turkey, Greece, Spain, Italy etc; Fruits and vegetables are perishable products, their storage assuming the existence of special microclimate conditions. Vegetables and

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fruits are obtained in all regions of the country, in a great assortment diversity

The consumption of fruits and vegetables is flexible, due to the local conditions that allow the cultivation of highly diversified species, the local traditions, the position of the producers vis-à-vis the consumption centers, etc.

Fruits and vegetables are grown in all households and provide a high level of self-consumption. On the vegetable and fruit sector, European producers are grouped into producer organizations, thus strengthening their market position and integrating more advantageously into the product industry with the processing industry and trade.

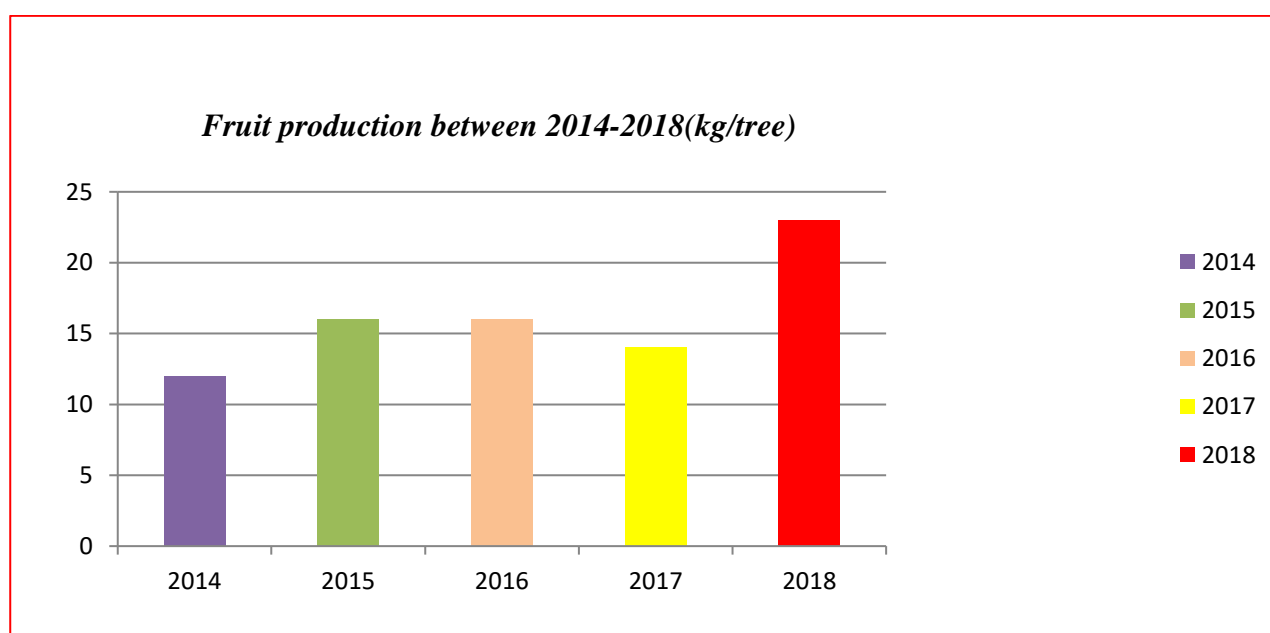
In Romania according to the NIS data (table 1) regarding the average fruit production per tree in the period 2014-2018 we observe that it increased in 2018 compared to 2014, namely in 2014 we had a production of 12 kg / tree and in 2018 we have a production of 23 kg / tree.

Table 1. Fruit production registered in Romania between 2014-2018 (kg/tree)

Period	2014	2015	2016	2017	2018
<i>Fruit production</i>	12	16	16	14	23

Source:NIS

Fig. no.1 Fruit production between 2014-2018



Source:NIS

As for the dynamics of fruit prices, I chose to analyze four of the most important fruits, namely pears, apricots, cherries and plums. Analyzing the data provided by the National Institute of Statistics (NIS) we observe the following:

The highest pear price was recorded in 2017 with a value of 5.21 lei / kg and the lowest value was in 2015 with a value of 4.53 lei / kg.

In apricots the highest price was registered in 2018 with a value of 5.10 lei / kg and the lowest value was registered in 2017, namely 4 lei / kg.

Regarding the price of cherries, the highest value was registered in 2017 with a value of 7.40 lei / kg and the lowest price is in 2015 with a value of 6.26 lei / kg.

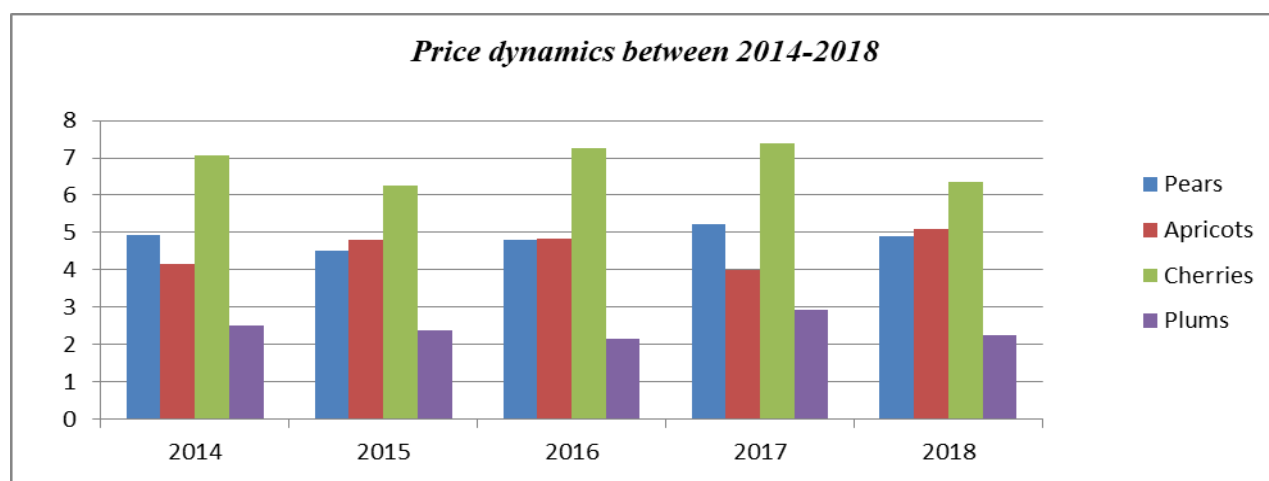
At plums the highest price was registered in 2017 with a value of 2.93 lei / kg and the lowest price has a value of 2.15 lei / kg.

Table no. 2 Price dynamics recorded in Romania in period 2014-2018 (RON/kg)

THE NOMENCLATURE OF AGRICULTURAL PRODUCTS	UNIT	PERIOD				
		2014	2015	2016	2017	2018
<i>Pears</i>	Ron / kg	4.92	<b>4.53</b>	4.79	<b>5.21</b>	4.91
<i>Apricots</i>	Ron / kg	4.15	4.81	4.83	<b>4</b>	<b>5.1</b>
<i>Cherries</i>	Ron / kg	7.06	<b>6.26</b>	7.26	<b>7.4</b>	6.37
<i>Plums</i>	Ron / kg	2.5	2.37	<b>2.15</b>	<b>2.93</b>	2.27

Source:NIS

Fig. no.2 Price dynamics between 2014-2018 (pears, apricots, cherries, plums)



Source:NIS

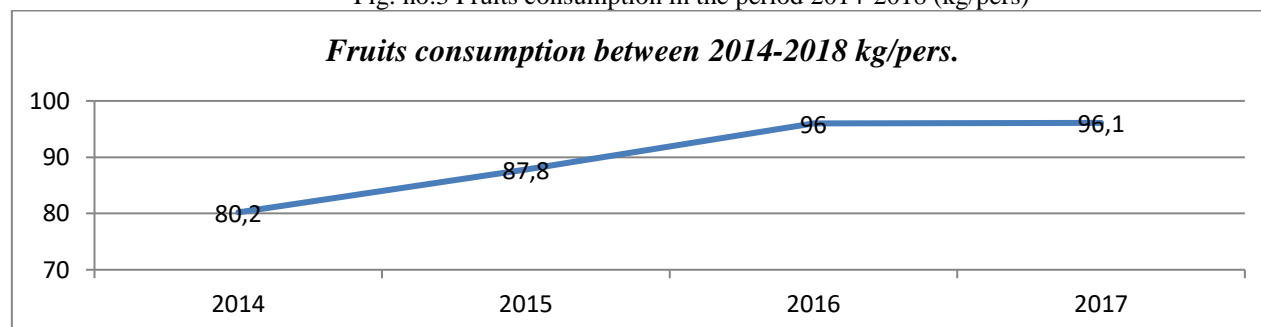
Regarding the fruit consumption between 2014-2017 we observe from the statistical data provided by the NIS that in 2017 compared to 2014 the fruit consumption has increased considerably, namely in 2017 we have a consumption of 96.1 kg / consumer and in 2014 there has been a consumption of 80.2 kg / consumer which we can deduct from the fact that the consumer is heading towards a healthy lifestyle.

Table no. 3 Fruits consumption in Romania between 2014-2018 (kg/pers.)

THE MAIN FOODS AND BEVERAGES	UNIT	PERIOD			
		2014	2015	2016	2017
<i>Fruits and fruit products in fresh fruit equivalent</i>	kg/consumer	80.2	87.8	96	96.1

Source:NIS

Fig. no.3 Fruits consumption in the period 2014-2018 (kg/pers.)



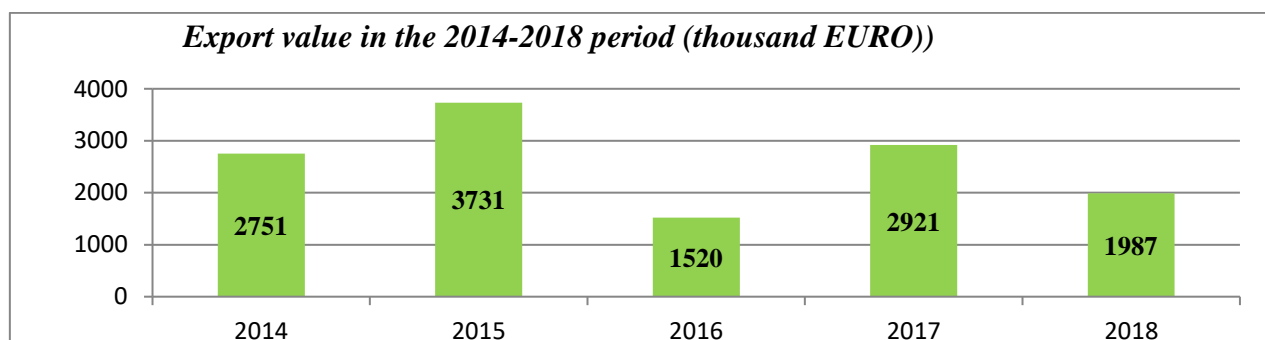
Source:NIS

Table no.4 Export value during 2014-2018(thousands of euros)

<b>EXPORT VALUE BY GROUPS OF GOODS FROM THE COMBINED NOMENCLATOR</b>						
<b>GROUPS ACCORDING TO THE COMBINED NOMENCLATURE</b>	<b>MU (MONETARY UNITS)</b>	<b>PERIOD</b>				
		2014	2015	2016	2017	2018
Apples, pears and cloves, fresh	THOUSAND EURO	2751	<b>3731</b>	1520	<b>2921</b>	1987
Apricots, cherries, cherries, peaches (including peaches and nectarines), plums and pigeons	THOUSAND EURO	1850	<b>2198</b>	1260	<b>1752</b>	1048

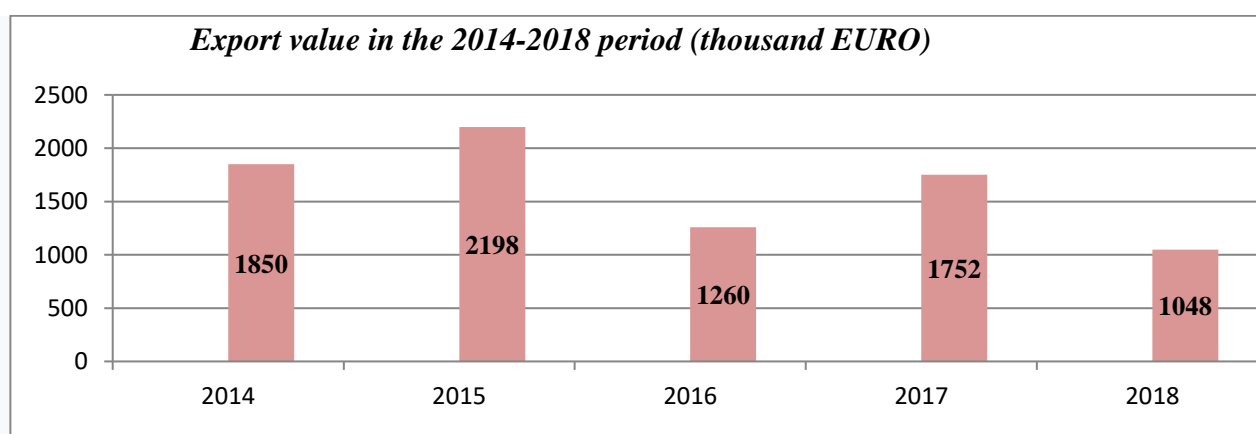
Source:NIS

Fig no.4 The value of the export (apples, pears, fresh quince) in the period 2014-2018



Source:NIS

Fig. no.5 The value of the export (apricots, cherries, cherries, peaches without fluff, nectarines, plums and blackthorn) during 2014-2018



Source:NIS

If we analyze the value of the export regarding the statistical data registered by the NIS during the period 2014-2018 we observe (chart no.4) that in 2018 compared to 2015 the export decreased considerably, namely in the year we have a value of 1987 thousand euros and in 2015 we have a value of 3731 thousand euros the highest value of the analyzed period.

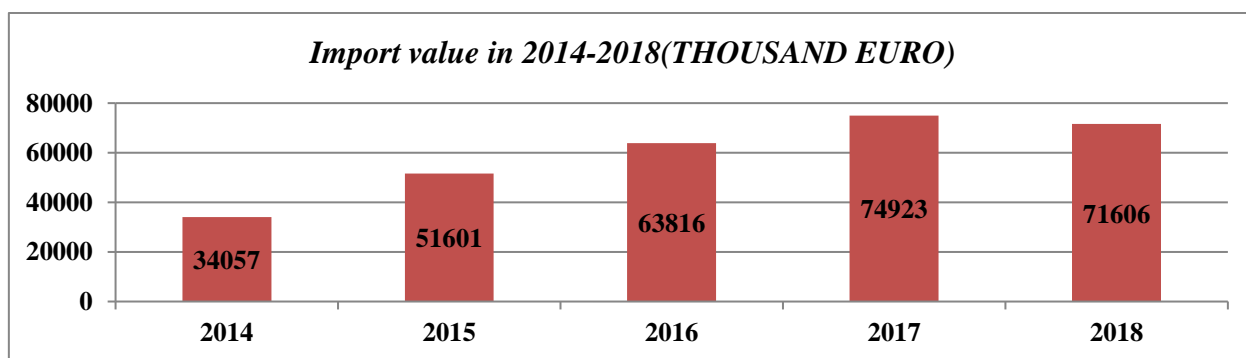
In fig. no.5, the value of the export in the period 2014-2018 is decreasing, namely in 2018 we have a value of 1048 thousand euros in 2015 we have a value of 2158 thousand euros being the highest value of the analyzed period.

Table no. 5 The value of the import for the period 2014-2018 (thousands of euros).

VALUE OF IMPORT BY GROUPS OF GOODS FROM THE COMBINED NOMENCLATOR						
GROUPS ACCORDING TO THE COMBINED NOMENCLATURE	MU (MONETARY UNITS)	PERIOD				
		2014	2015	2016	2017	2018
Apples, pears and cloves, fresh	THOUSAND EURO	34057	51601	63816	74923	71606
Apricots, cherries, cherries, peaches (including peaches and nectarines), plums and pigeons	THOUSAND EURO	20482	32494	39264	49443	45636

Source:NIS

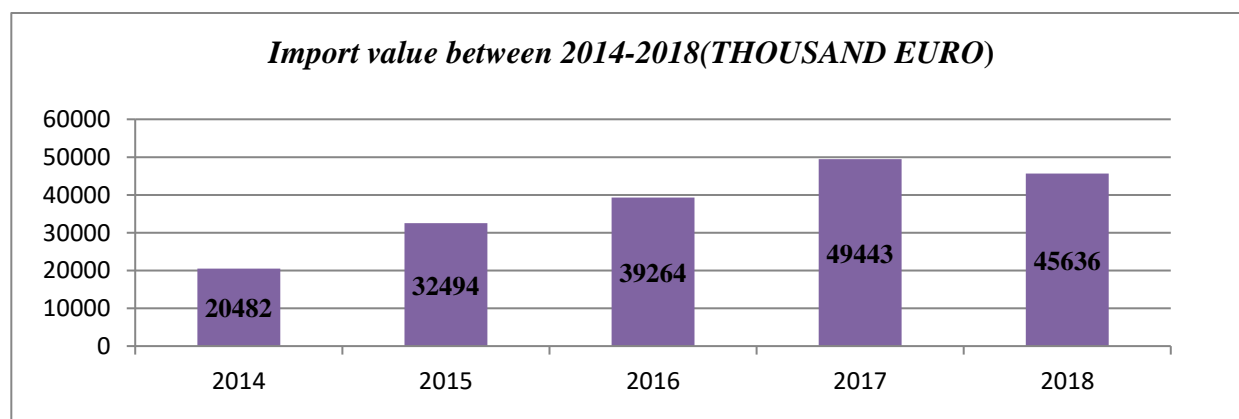
Figure no.6 Import value (apples, pears, fresh quince) between 2014-2018



Source:NIS

From the statistical data recorded by INS (Fig. no. 6) it is noted that the highest import was registered in 2017 with a value of 74923 thousand euros and the smallest value was in 2014 with a value of 34057 thousand euros.

Figure no.7 Import value (apricots, cherries,sour cherries, nectarine, plums, blackthorn) between 2014-2018



Source:NIS

In figure no.7 the highest value of the import was registered in 2017 with a value of 49443 thousand euros and the smallest value was in 2014 with 20482 thousand euros.

## **CONCLUSIONS**

The fruit market is one of the most important sectors of the world economy. It has always been an area of interest for the health of the population.

Fruits are important foods in the daily diet, which is why the consumption of fruits is constantly increasing according to the statistical data registered on NIS. If in 2014 we had an consumption of 80.2 kg / consumer in 2017 we have a consumption of 96.1 kg / consumer which shows that we are on the right path to a healthy life.

Regarding the price of the analyzed fruits, the highest price for pears was registered in 2017 with a value of 5.21 lei / kg and the lowest value was in 2015 with a value of 4.53 lei.

For apricots, the highest price was registered in 2018 with a value of 5.10 lei / kg and the lowest value was registered in 2017, namely 4 lei / kg.

For cherries the highest value was registered in 2017 with a value of 7.40 lei / kg and the lowest price is in 2015 with a value of 6.26 lei / kg, and at plums the highest price is registered in 2017 with a value of 2.93 lei / kg and the lowest price has a value of 2.27 lei / kg.

In Romania, according to the NIS data on the average fruit production per tree in the period 2014-2018, we note that it increased in 2018 compared to 2014, namely in 2014 we have a production of 12 kg / tree and in 2018 we have a production of 23 kg / tree.

From the statistical data recorded by the NIS regarding the value of the import (apples, pears, fresh kernels) in 2014-2018 the highest value was registered in 2017 with a value of 74923 thousand euros and the lowest value was in the year 2014 with a value of 34057 thousand euros.

Regarding the value of the import to (apricots, cherries, cherries, peaches without fluff, nectarines, plums and pigeons) during 2014-2018 the highest value was registered in 2017 with a value of 49443 thousand euros and the lowest value was in 2014 with 20482 thousand euros.

The value of the export to (apples, pears, fresh kernels) regarding the statistical data registered by the NIS during the period 2014-2018 we observe that in 2018 compared to 2015 the export decreased considerably, ie in the year we have a value of 1987 thousand euros and in 2015 we have a value of 3731 thousand euros the highest value of the analyzed period.

For apricots, cherries, cherries, peaches without fluff, nectarines, plums and pigeons the value of the export during 2014-2018 is decreasing, namely in 2018 we have a value of 1048 thousand euros in 2015 we have a value of 2158 thousand euros being higher value in the analyzed period.

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# ANALYSIS OF THE EVOLUTION OF ROMANIA'S FOREIGN TRADE IN NATURAL HONEY

AURELIAN BULIGA-ȘTEFĂNESCU<sup>1</sup>

**Abstract:** *Romanian honey, a food product of higher quality compared to that obtained in other European countries, is exported extensively (50-60% of the total production). Currently, the Romanian beekeepers are facing the tough competition of the low prices of the honey imported from Ukraine, Poland and the Republic of Moldova. Germany is the largest importer of honey (26%) from Romania. In 2018, Romania exported honey amounting to a total of 41.7 million euros. The Romanian market still sells products at low prices, to the detriment of quality, which is why, in the same year, about 9.7 million euros' worth of honey was imported. In the whole period analyzed (1991-2018) the value of honey exports was significantly higher than the value of imports, thus generating a positive balance of trade.*

**Keywords:** *honey production, honey import, honey export*

**JEL Classification:** *Q10, Q13, Q17, O13*

## INTRODUCTION

Although Romania ranks first in terms of honey production, most of it is destined for export. For example, in 2017, Romania exported 37% of its domestic production of natural honey, at an average price of 3.7 euros per kilogram. On the other hand, in order to meet its domestic consumption needs, Romania imported cheaper honey from countries such as Moldova, Poland or Hungary, at 2.6 euros per kilogram (7). Although it exports a large part of its domestic honey production, in terms of intra-Community trade, Romania is not among the top EU countries like Hungary or Bulgaria, where the conditions are less favorable for the beekeeping sector. (4). The good quality of Romanian honey was certified by a series of complex tests carried out in Germany, in order to detect genetically modified organisms or residues, for the whole quantity that is exported (9). The beekeeping sector is largely influenced by the climatic conditions and the temperature. Consequently, in unfavorable years, the honey production in Romania decreased and the exports were negatively affected as well.

## MATERIALS AND METHODS OF WORK

The present research is based on the analysis of the evolution of Romania's export and import of natural honey before and after its accession to the European Union. For this purpose, the statistical data provided by the National Institute of Statistics and International Trade Center (ITC) for the period 1990-2018 were collected and processed using the Excel program. Descriptive statistics was used to interpret them, and the Student t test was used to compare the periods.

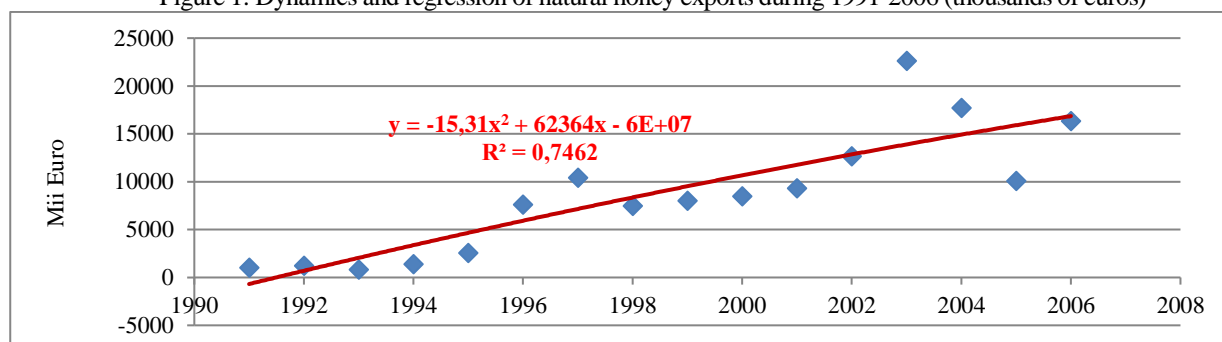
## RESULTS AND DISCUSSIONS

The evolution of the Romanian exports of natural honey can be drawn as a sinusoidal curve (figure 1). Between 1991 and 2006 there was an increase of 1,462.58% in the value of honey exports. Thus, from 1,045 thousand euros' worth of honey in 1991, Romanian exports reached 16,329 thousand euros in 2006, with 15,284 thousand euros more. The increases were not constant, as there were years that saw lower values, compared to the previous ones. For example, in 1993 there was a minimum value of exports, of only 824 thousand euros. The best year from 1991-2006 was 2003, when 22,633 thousand euros' worth of Romanian honey was exported (figure 1).

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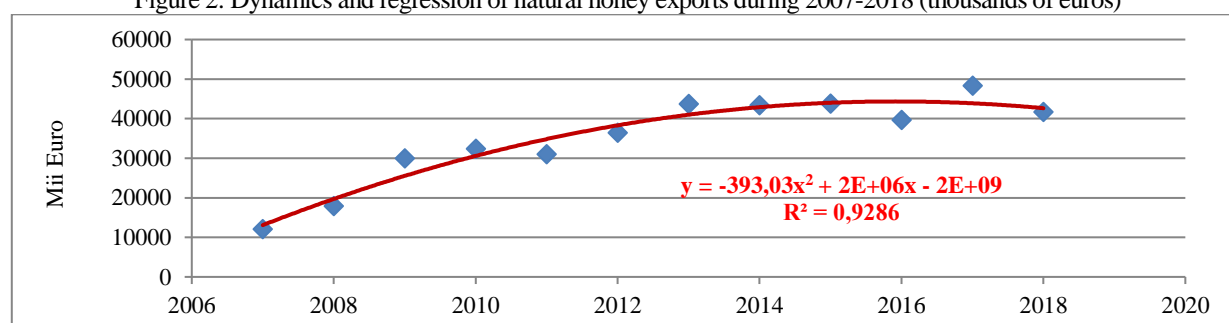
Figure 1: Dynamics and regression of natural honey exports during 1991-2006 (thousands of euros)



Source: Own design based on the data provided by National Institute of Statistics (12)

The post-accession period was prolific for Romanian beekeeping, with its honey production following an upward trend. The value of exports increased from 12,141 thousand euros in 2007, to 41,720 thousand euros, in 2018. The percentage increase was 243.63%. The maximum of exports was registered in 2017, when 48,352 thousand euros' worth of honey was exported. The European funds allocated to the beekeeping sector contributed to the increase in the number of bee families and, implicitly, in the production of honey. Compared to the previous year, in 2008, exports increased by 47.88%, while in 2009 the growth was 66.97%.

Figure 2: Dynamics and regression of natural honey exports during 2007-2018 (thousands of euros)



Source: Own design based on the data provided by National Institute of Statistics (12)

The training of farmers and their access to European funds led to a significant increase in the production of honey, and, consequently, in the value of the exports of this food. According to the statistical data provided by INS (figure 1 and figure 2), the increase of the value of exports between 1991 and 2018 was 3,992.34%. In total, this evolution brought to Romania revenues of 40,675 thousand euros.

Table 1: Comparative presentation of the descriptive statistics of the export of natural honey during the periods 1991-2006 and 2007-2018

Indicators	1991-2006	2007-2018
Mean	8620,938	35069,42
Standard Error	1613,63	3179,672
Median	8262	38087
Standard Deviation	6454,519	11014,71
Coefficient of variation	74,87026	31,4083
Annual growth rate	20,11287	8,130628
Minimum	824	12141
Maximum	22633	48352
Sum	137935	420833
Count	16	12

Source: Own calculation based on the data provided by National Institute of Statistics (12)

Analyzing the periods 1991-2006 and 2007-2018, it appears, according to table 1, that in the first period the value of exports was, on average, 8,262 thousand euros, respectively, 38,087 thousand euros. From year to year the increases were quite significant, the statistical data registering values of exports that fluctuate annually, with big differences between them. The coefficient calculated for both

periods indicates a large variation in the value of exports during the analyzed periods. For the period 1991-2006 this coefficient is 74.87%. The annual rate was positive and the export value increases are significant. Between 1991 and 2006 the rate was 21.11, while between 2007-2018 it was 8.13. It follows that the growth rate was more pronounced in the first period studied.

Therefore, the total value of the Romanian honey exports for the period 1991-2006 amounted to 137.9 million euros. The 12 post-accession years brought total revenues of 420.8 million euros from honey export.

Table 2: Student's t-test for comparing Romanian exports of natural honey during the periods 1990-2006 and 2007-2018

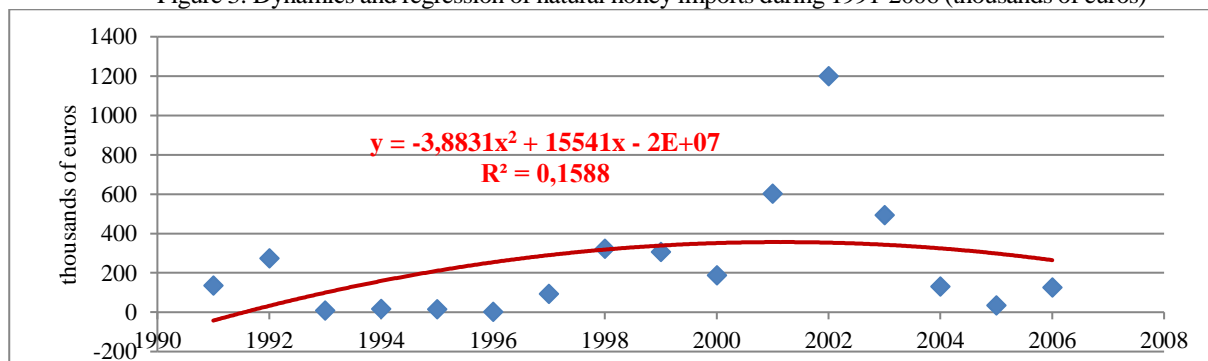
	2007-2018	1991-2006
Mean	35069,417	8620,9375
Variance	121323791	41660810
Observations	12	16
Hypothesized Mean Difference	0	
df	17	
t Stat	7,4175009	
P(T<=t) one-tail	5,029E-07	
t Critical one-tail	1,7396067	

Sursa: t-Test: Two-Sample Assuming Unequal Variances

Analyzing the data presented in the table no. 2, we can conclude that the calculated values of the statistical test t are high in relation to the theoretical values ( $7.4175009 > 1.7396067$ ), and the probabilities are small with respect to the significance threshold ( $p < 0.05$ ) and, therefore, we can say that there is a statistically significant difference between the two periods.

The evolution of the value of honey imports during the period 1991-2006 is represented in figure 3. The absolute difference between 1991 and 2006 was 10,000 euros. A decrease of 7.35% between these two years was calculated.

Figure 3: Dynamics and regression of natural honey imports during 1991-2006 (thousands of euros)

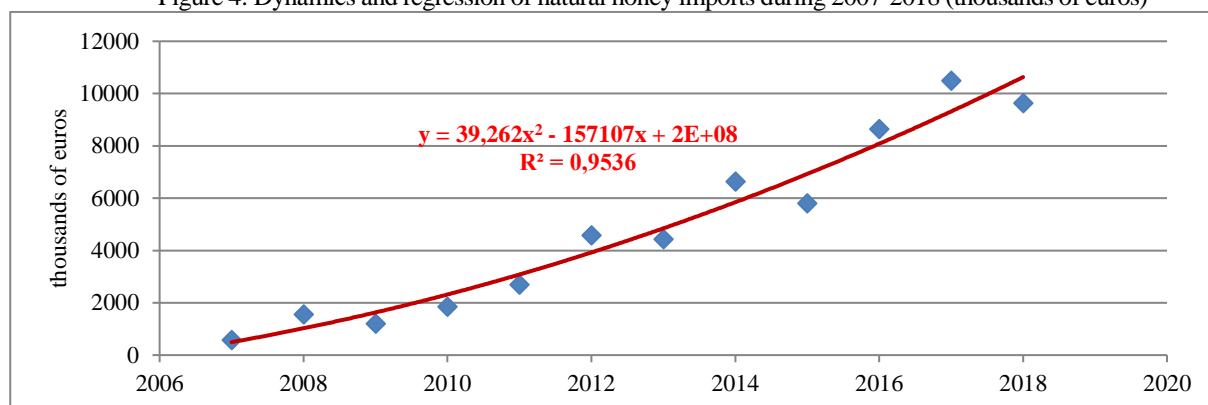


Source: Own design based on the data provided by National Institute of Statistics (12)

Between 2007 and 2018, honey imports saw an upward trend (Figure 4). According to the data provided by the NIS, in 2017, the value of honey imports was 580 thousand euros, increasing by 1,661.72%, to 9,058 thousand euros. The lowest value of imported honey, of 580 thousand euros, was attained in 2007, while a maximum of 10,497 thousand euros was reached in 2017.



Figure 4: Dynamics and regression of natural honey imports during 2007-2018 (thousands of euros)



Source: Own design based on the data provided by National Institute of Statistics (12)

The annual average for the period 1991-2006, according to the data processed in table 3, was 133.5 thousand euros. For the period 2007-2018 the annual average was 4,502.5 thousand euros. Therefore, the variation in the annual values of honey imports was considerable. For the first period analyzed, which included 16 years, the rate was negative, the value of imports decreasing slightly (-0.5). The increase in the value of imports was significant in the 12 post-accession years, the calculated rate being (+43,53).

Table 3: Comparative presentation of the descriptive statistics of the import of natural honey during the periods 1991-2006 and 2007-2018

Indicators	1991-2006	2007-2018
Mean	246,875	4842,833333
Standard Error	77,4388401	990,383495
Median	133,5	4502,5
Standard Deviation	309,75536	3430,789065
Coefficient of variation	125,470526	70,84260036
Annual growth rate	-0,5078592	43,53837703
Minimum	3	580
Maximum	1199	10497
Sum	3950	58114
Count	16	12

Source: Own calculation based on the data provided by National Institute of Statistics (12)

Table 3 shows that honey imports amounted to 3,950 thousand euros, during the period 1991-2006, while between 2007 and 2018 they amounted to 58,114 thousand euros. Although the domestic production exceeds the demand for honey, this food was imported. The big chains of shops in Romania prefer to stock up with the cheapest (import) merchandise to which they can add a mark-up as high as possible and then sell it at even lower prices than the local beekeepers. In 2018, Romania reported a production of 29,162 tonnes of honey (12), out of which a large part, 11,326 tonnes, were directed to export. At the same time, imports reached 3,275 tonnes of honey, according to MADR.

Table 4: Student's t-test for comparing natural honey imports averages during the periods 1990-2006 and 2007-2018

	2007-2018	1991-2006
Mean	4842,833	246,875
Variance	11770314	95948,38
Observations	12	16
Hypothesized Mean Difference	0	
df	11	
t Stat	4,626463	
P(T<=t) one-tail	0,000366	
t Critical one-tail	1,795885	

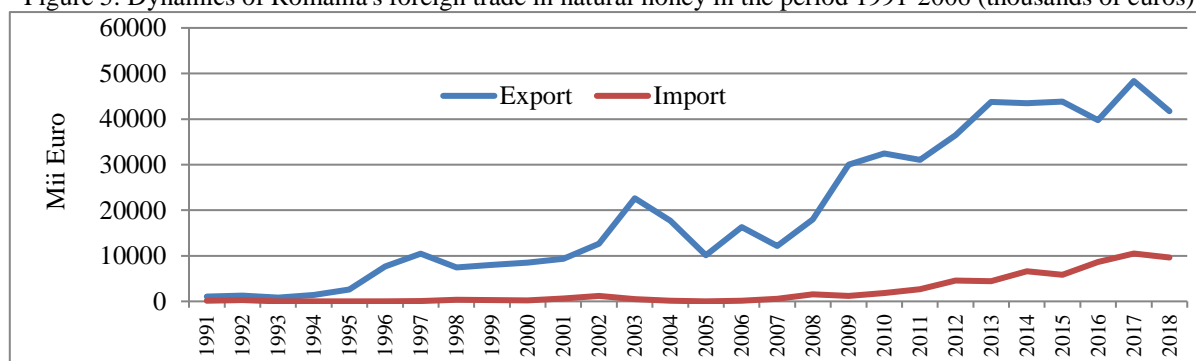
Sursa: t-Test: Two-Sample Assuming Unequal Variances

Analyzing the data presented in the table no. 4 we can conclude that the calculated values of the statistical test t are high in relation to the theoretical values ( $4.626463 > 1.795885$ ), and the

probabilities are small with respect to the significance limit ( $p = 0.000366 < 0.05$ ). In conclusion, we can say that there is a significant difference, statistically, between the two periods.

According to figure 5, Romania's trade balance, in terms of honey trade, is active (in surplus), because the value of exports is significantly higher than the imports for this food product. There is an increasing trend for both trading years. Between 1991-2018, Romania saw a steady growth in the foreign trade in natural honey. According to the statistical data, during the entire period analysed, the results indicated a commercial surplus (12). Romania's trade balance regarding natural honey ranged from 909 thousand euros in 1991, to 11,561 thousand euros in 2007 and 20,521 thousand euros in 2018 (12).

Figure 5: Dynamics of Romania's foreign trade in natural honey in the period 1991-2006 (thousands of euros)



Source: Own design based on the data provided by National Institute of Statistics [12].

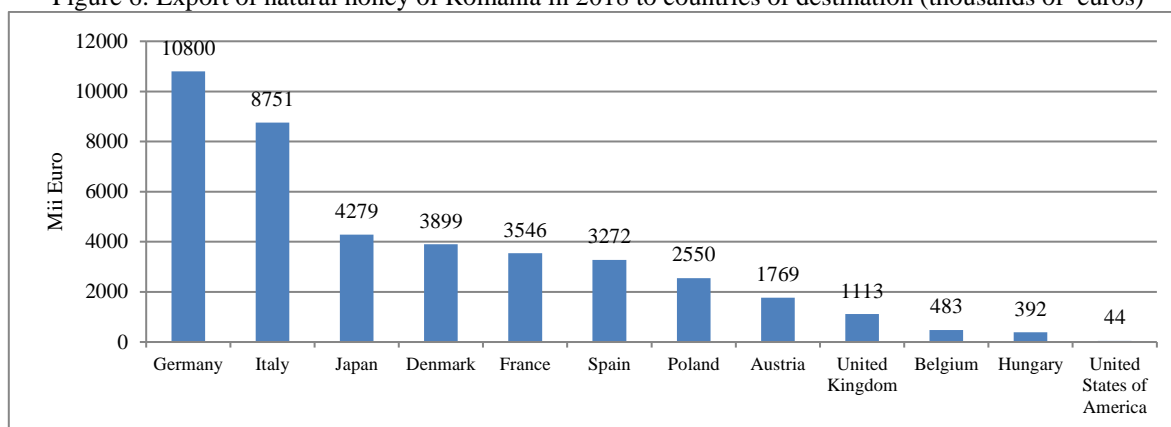
Table 5: Evolution of Romania's natural honey export to countries of destination between 2001-2018

Export	2001		2007		2018		2018-2007	2018-2001	2018/2007	2018/2001
	thousands of euros	%	thousands of euros	%	thousands of euros	%	thousands of euros	thousands of euros	%	%
Germany	6178	66,42	7818	65,66	10800	25,82	2982	4622	138,14	174,81
Italy	828	8,90	616	5,17	8751	20,92	8135	7923	1420,62	1056,88
Japan	183	1,97	129	1,08	4279	10,23	4150	4096	3317,05	2338,25
Denmark					3899	9,32	3899	3899		
France	79	0,85	20	0,17	3546	8,48	3526	3467	17730,00	4488,61
Spain	254	2,73	172	1,44	3272	7,82	3100	3018	1902,33	1288,19
Poland	0	0,00	49	0,41	2550	6,10	2501	2550	5204,08	
Austria	23	0,25	0	0,00	1769	4,23	1769	1746		7691,30
United Kingdom	502	5,40	1882	15,81	1113	2,66	-769	611	59,14	221,71
Belgium	272	2,92	378	3,17	483	1,15	105	211	127,78	177,57
Hungary	423	4,55	539	4,53	392	0,94	-147	-31	72,73	92,67
United States of America	41	0,44	0	0,00	44	0,11	44	3		107,32
<b>Total</b>	<b>9301</b>	<b>100%</b>	<b>11907</b>	<b>100%</b>	<b>41833</b>	<b>100%</b>	<b>29926</b>	<b>32532</b>	<b>351,33%</b>	<b>449,77%</b>

Source: Own calculation based on the data provided by International Trade Centre (ITC), <https://www.trademap.org/Index.aspx>, (11)

The main market for Romanian honey is represented by Germany. In 2018 Romania sold 10.8 billion euros' worth of honey to this country (25.82%). Table 5 shows that honey exports to Germany amounted to 6,178 thousand euros (66.42%) in 2001, and to 7,818 thousand (65.66%) in 2007. There was a 74.81% increase in exports in 2018, compared to the figures in 2001. Italy is the second country that prefers Romanian honey, buying 8,751 thousand euros' worth of honey in 2018 (20.92%). From 2001 to 2018, the value of exports to this country increased by 1,056.88%. Also, Romania sold 4,279 thousand euros' worth of honey (10.23%) to Japan in 2018.

Figure 6: Export of natural honey of Romania in 2018 to countries of destination (thousands of euros)



Source: Own calculation based on the data provided by International Trade Centre (ITC), <https://www.trademap.org/Index.aspx>, (11)

Since 2016, Romania has sold large quantities of honey to Denmark, obtaining significant monetary gains. In 2018, the exports to this country reached 3,899 thousand euros (9.32%). Romania's accession to the EU greatly facilitated the activity of foreign trade in honey. According to the data in table 5, there is a substantial increase of 17730% in the value of exports to France in 2018, compared to the year of EU accession. Spain, Poland and Austria also top the chart of the countries where Romanian honey is mainly exported (12).

The trend in the value of exports for countries such as the UK and Hungary was a downward trend. Exports to these countries declined in 2018, compared to 2007. The value of exports to the United States has changed considerably over the years. There were years when the value of honey exports exceeded 1 million euros (2002, 2003, 2004), but there was also a year, 2007, when honey was not exported at all.

As it can be seen from figure 4, honey imports increased exponentially after Romania joined the EU. Before 2007, Romania imported small quantities of honey from certain countries. The main source of imports was the Republic of Moldova (table 6).

Table 6: Romania's import of natural honey by country of origin (thousands of euros)

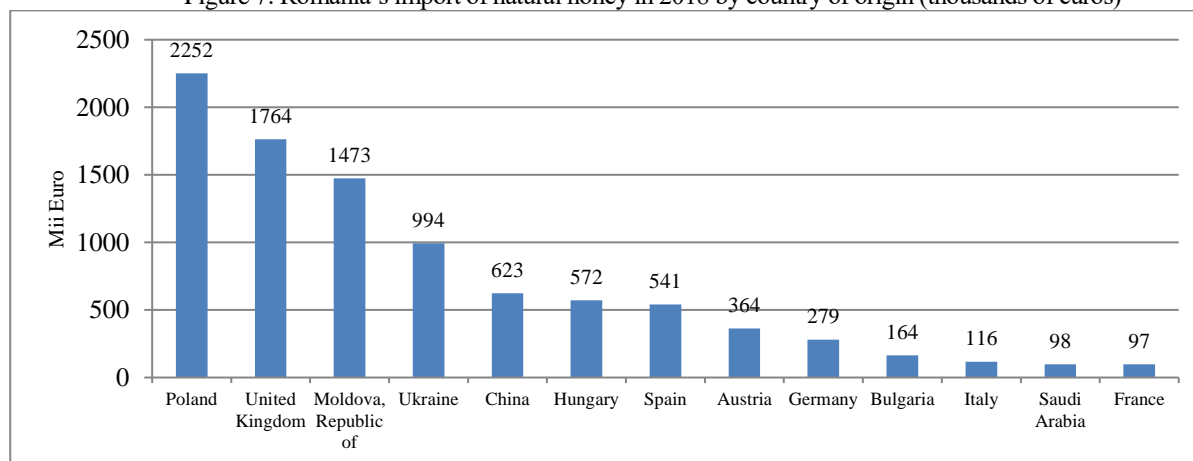
Exporters	2001		2007		2018		2018-2007	2018-2001	2018/2007	2018/2001
	thousands of euros	%	thousands of euros	%	thousands of euros	%	thousands of euros	thousands of euros	%	%
Poland	0		0		2252	23,32	2252	2252		
United Kingdom	0		0		1764	18,27	1764	1764		
Moldova, Republic of	308	51,08	17	3,01	1473	15,25	1456	1165	8664,71	478,25
Ukraine	0		0		994	10,29	994	994		
China	0		0		623	6,45	623	623		
Hungary	1	0,17	4	0,71	572	5,92	568	571	14300,00	57200,00
Spain	0		55	9,73	541	5,60	486	541	983,64	
Austria	0		12	2,12	364	3,77	352	364	3033,33	
Germany	16	2,65	0	0,00	279	2,89	279	263		1743,75
Bulgaria	0		5	0,88	164	1,70	159	164	3280,00	
Italy	0		7	1,24	116	1,20	109	116	1657,14	
Saudi Arabia	0		0		98	1,01	98	98		
France	17	2,82	0		97	1,00	97	80		570,59
<b>Total</b>	<b>603</b>	<b>100</b>	<b>565</b>	<b>100</b>	<b>9656</b>	<b>100</b>	<b>9091</b>	<b>9053</b>	<b>1709,03</b>	<b>1601,33</b>

Source: Own calculation based on the data provided by International Trade Centre (ITC), <https://www.trademap.org/Index.aspx>, (11)

The value of imports from this country was on a downward curve. Thus, if 308 thousand euros' worth of honey was imported in 2001, this amount was reduced to 17 thousand euros in 2007. Small quantities of honey were imported before 2007 from countries such as Austria, France and Italy. The first three countries for Romania's import of honey are Poland (2,252 thousand euros in

2018), the United Kingdom (1,764 thousand euros in 2018) and the Republic of Moldova (1,473 thousand euros in 2018) (table 6).

Figure 7: Romania's import of natural honey in 2018 by country of origin (thousands of euros)



Source: Own calculation based on the data provided by International Trade Centre (ITC), <https://www.trademap.org/Index.aspx>, (11)

From Ukraine, Romania has been importing honey since 2014. The value of imports amounted to 994 thousand euros in 2018. Our country started importing honey from China, the largest global producer, in 2008, with imports which reached 623 thousand euro last year. From Germany, the country where Romania sells the most significant quantity of honey, Romania imported honey worth 279 thousand euros in 2018. According to table 6, in 2018, Romania imported honey worth 98 thousand euros from Saudi Arabia, for the first time (11).

## CONCLUSIONS

Romania's natural honey production increased significantly, from 16,766 tonnes in 2007 to 29,162 tonnes in 2018 (+ 74%) (12). Due to the low purchasing power of the population, the internal consumption of honey is 500-600 grams per year (1). For this reason, most of the production of excellent quality honey is exported to developed countries. Thus, we supply natural honey to more developed countries such as Germany, Japan, Italy, France, etc. Although Romania produces more and more honey every year, there is a significant increase in honey imports at a very low price (6 lei/kg), from countries such as Poland, Moldova, Ukraine, China, even Saudi Arabia. While the beekeeping associations and organizations claim that in 2018 the cost of obtaining a kilogram of polyphorous honey was 12 lei, the wholesale companies dealing with the collecting and exporting of Romanian honey offer farmers a price of 8-9 lei/kg.

Following the analysis of the Romanian honey market we can draw several conclusions:

1. Romanian honey is appreciated on foreign markets, but it is not rendered profitable because it is sold wholesale.
2. If we refer only to 2018, when Romania exported 11,326 tonnes of honey, the farmers' total loss amounted to about 339 million lei (-3 lei/kg) .
3. The export of honey brings foreign currency and profit only to wholesalers.
4. The Romanian beekeepers can turn to good account the honey which could not be exported (~ 50%) with extreme difficulty, through all the channels they have at hand: on the roadside, in the food markets, at food fairs, in supermarkets, by online advertising (web pages, Facebook, etc.), etc. Romanian honey is hard to sell because the asking price is high for the the Romanians' purchasing power and varies between 20 and 40 lei depending on the type of honey (polyfloral, acacia, linden, etc.).
5. So far, the profile associations have been interested only in their own profit obtained by collecting membership fees, collecting honey and selling inputs for beekeeping.

6. The retail networks take advantage of the legal conditions in Romania and offer EU and non EU honey at affordable prices (14-18 lei/kg) to Romanian consumers, obtaining considerable profit margins, while Romanian beekeepers conserve honey on stock.

7. The labeling of honey, under the current conditions, is not informative enough for Romanian consumers, on the basis of which to decide. Even if the EU has certain regulations in this regard, the authorities must find a solution to providing on each label the correct and legible information on the provenance (honey produced in China, Ukraine, etc.) and quality (honey, sugar molasses or industrial glucose).

8. Over the 12 years since Romania's accession to the European Union, Romanian farmers in the beekeeping field have failed to understand that profit can be obtained only through investments in processing / packaging and short sales channels through local brands.

Over the whole period analyzed (1991-2018), the value of honey exports is significantly higher than the value of imports, thus generating a positive balance of trade.

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# MARKET RESEARCH CONCERNING THE CONSUMPTION OF FISH AND FISHERY PRODUCTS

ANCUȚA MARIN<sup>1</sup>

**Abstract:** *Summary: In order to be healthy, people need essential amino acids, carbohydrates, essential fatty acids and not less than 28 vitamins and minerals. The fish is a healthy protein source with a special nutritional value, rich in essential nutrients: proteins, amino acids, vitamins A, B6, B12, D, and Omega-3. Fish, especially fish from the sea, also contain phosphorus, potassium, sodium. Nutritional needs differ from one stage of life to another, so specialists recommend dietary intake specific to different stages of life. Fats in fish are highly perishable being subjected to oxidation, therefore fresh fish is considered proper for consumption just 1 or 2 days. Fish and fish products must therefore be kept at low temperatures, being known the fact that the nutritional value of the frozen fish is almost the same as that of the fresh fish. Research methods used in this paper are "bibliography analysis" and "survey based on questionnaire". The purpose of the paper is to find out what consumer preferences are, in order to form an image of the requirements of the fish market and fish products. Given the components of fish and its importance in human nutrition, it is not without interest to form a picture of the profile of the urban consumer in Romania. The energy given to humans by eating fish and fish products is very small. The conclusion is that we do not consume fish for the caloric intake it provides but for vitamins (especially B), minerals, but especially Omega-3 it contains.*

**Keywords:** fish, essential nutrients, consumption, profile of fish consumer

**JEL classification:** O13, M31, Q13

## INTRODUCTION

Compared to meat, be it white or red, fish is a source of healthy protein, having a high nutritional value. Rich in iodine and zinc, chemical elements known as "youth elements", fish and seafood are consumed especially in coastal areas around the world or along the rivers that cross the relief. Fish is rich in essential nutrients: proteins, amino acids, Vitamins A, B6, B12, D, Omega-3, minerals, increasing muscle and psychic tone, ensuring a good balance of the consumer's weight. Consumption of fish or fish oil improves the health of the heart and blood vessels, protecting them from cardiovascular disease. Omega 3 fatty acids in fish, are those "good" fats that lower blood pressure, triglycerides and cholesterol, fluidize the blood circulation preventing blood clots and thrombosis.

Research has shown that regular and constant consumption of Omega-3 decreases the risk of death from cardiovascular causes by over 33%. In the first years of life, children receive fish oil for the good development of the brain and nervous system, for increasing the learning and memory capacity, for increasing immunity. Regardless of age, it has been found that polyunsaturated omega-3 fatty acids contribute to the growth of good disposition being considered the "elixir of happiness".

The fish contains protein L-ichtulin, as well as albumin, which are complete proteins. The protein represents 8.95-18.14% of the edible part of the fish, balanced in amino acids (Table 1). The protein has a fairly high content of methionine, lysine, tryptophan, which makes fish necessary in baby foods. The fish contains 6 times less connective tissue than meat, which ensures fast cooking.

The amount of lipids varies greatly depending on the species of fish. Depending on the percentage of fat content, the fish can be classified into several groups:

- fish with low fat (up to 3%): carp, cod;
- fish with moderate fat (3-8%): sleep, carp, splash;
- fatty fish (8-20%): catfish, sturgeon, halibut;
- very fatty fish: (more than 30%): eel fish.

Fish, especially those fished in the sea, also contain phosphorus, potassium, sodium. In order to more easily calculate the caloric content of prepared foods we will take into account the non-edible part of the product (bones, head, skin) and the need of fish meat to obtain 100 gr. edible product. We

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will also take into account the protein, lipid and carbohydrate content of each product analyzed (Table 1).

Fish fats are extremely perishable and are subject to oxidation. Therefore, fish and fish products should be kept at low temperatures, the nutritional value of frozen fish being almost the same as that of fresh fish.

**Table 1 – Nutrient content of the most consumed fish species**

	NECESSARY FOR 100 GR EDIBLE PRODUCT	WEIGHT OF NONEDIBLE PRODUCT	THE EDIBLE QUANTITY OF PRODUCT	PROTEINS		LIPIDS		Kcal
				Gr.	%	Gr.	%	
Bream	222	55	167	16,9	10,12%	3	1,80%	78
Pike	182	45	137	19,1	13,94%	0,4	0,29%	82
Zander	167	40	127	19,4	15,28%	0,9	0,71%	83
Turbot	250	60	190	17	8,95%	2	1,05%	88
Carp	222	55	167	18,9	11,32%	2,8	1,68%	104
Beluga sturgeon	114	12	102	17,5	17,16%	4,7	4,61%	115
Russian sturgeon	114	12	102	18,5	18,14%	17,3	16,96%	237
Mackerel	286	65	221	22	9,95%	10	4,52%	183
Catfish	114	12	102	16,8	16,47%	18	17,65%	244
Herring	182	45	137	17,7	12,92%	18,5	13,50%	245
Pontic shad	182	45	137	14,2	10,36%	25,9	18,91%	299
Sardines	182	45	137	21,1	15,40%	27	19,71%	331

Source: <http://www.cevabun.ro/continutul-in-proteine-lipide-glucide-al-alimentelor-de-baza/>

## MATERIAL AND METHOD

In this paper I will present aspects related to determining the need for fish consumption and fish products. The purpose is to find out what are the preferences of the consumers in order to form an image on the requirements of the market and of the selling prices.

The first research method used in this paper is "bibliographic analysis". It aims to extract the official data existing in the field of research of the paper. Data collection was done by accessing the database from the National Institute of Statistics.

The second research method used in this paper is the "questionnaire-based survey", a method that has been used more and more frequently in the last 50 years. The general or specific objectives and assumptions that make sense for the survey were formulated and the sampling was given which gives to the inquiry a survey character, depending on the homogeneity/heterogeneity of the population. The objectives set are:

- identification of the number of consumers of canned fish
- identifying the average frequency of consumption of the fish
- identification of average fish consumption
- identifying the place of purchase of the fish
- identifying consumer preferences regarding the origin of the consumed fish
- identifying the source of the fish
- identifying the average budget allocated for the purchase of fish and fish products
- hierarchy of the fish selection criteria

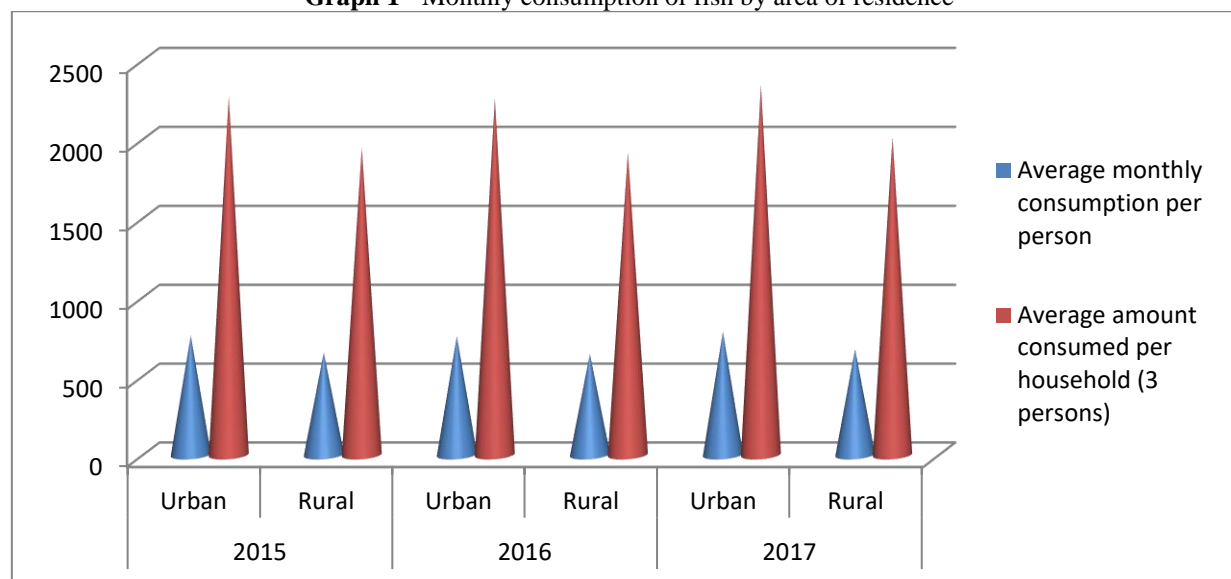
The basic problem of the operation is related to the representativeness of the chosen sample, and can be determined statistically, depending on the sampling technique used. The essential conditions for drafting and applying a questionnaire are validity and fidelity. Validity is the ability to provide information according to the objectives pursued, and validity is the production of results that vary within predictable limits. Another important part of the survey is the coding of the answers and the content analysis of the questions, in order to establish the coding criteria, which allows them to be drawn up and processed (manual for small batches, electronic for large batches). Regardless of whether or not the starting hypotheses are confirmed, the results should be presented objectively, using tables, graphs, posters, slides, etc.

## RESULTS AND DISCUSSIONS

To be healthy, people need essential amino acids, carbohydrates, essential fatty acids and *no less than 28 vitamins and minerals*. However, nutritional needs differ from one life stage to another. Specialists recommend a dietary intake specific to different stages of life. These nutritional recommendations are not intended for people who suffer from chronic diseases or who have an increased risk of developing diseases due to age, genetics or as a result of life factors (eg, smoking, alcohol use, physical exertion).

Fresh fish is only good for 1-2 days and should be kept on the lowest shelf in the refrigerator. After cleaning the fish, we can keep the fillets for 6-8 weeks in the freezer. Smoked fish is kept at a temperature of 5-6°C, in a closed container, so that its characteristic odor does not penetrate other products. Canned fish can be stored for 2-3 days after being opened, provided they are transferred from the box to a closed container.

**Graph 1 - Monthly consumption of fish by area of residence**



Source: <http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table>, 23 mai 2019

Analyzing the data taken from the National Institute of Statistics the following results:

- the average monthly quantity per person varied between 640 g and 782 g unconditional by the environment of residence;
- in urban versus rural the average consumption per inhabitant was about 110 g higher in all the studied years;
- in the urban area, the lowest amount of fish was 754 g/person in 2016, and the highest of 782 g/person in 2017;
- in the rural area, the largest amount of fish consumed by one person was 672 g in 2016, and the lowest of 640 g in 2017.

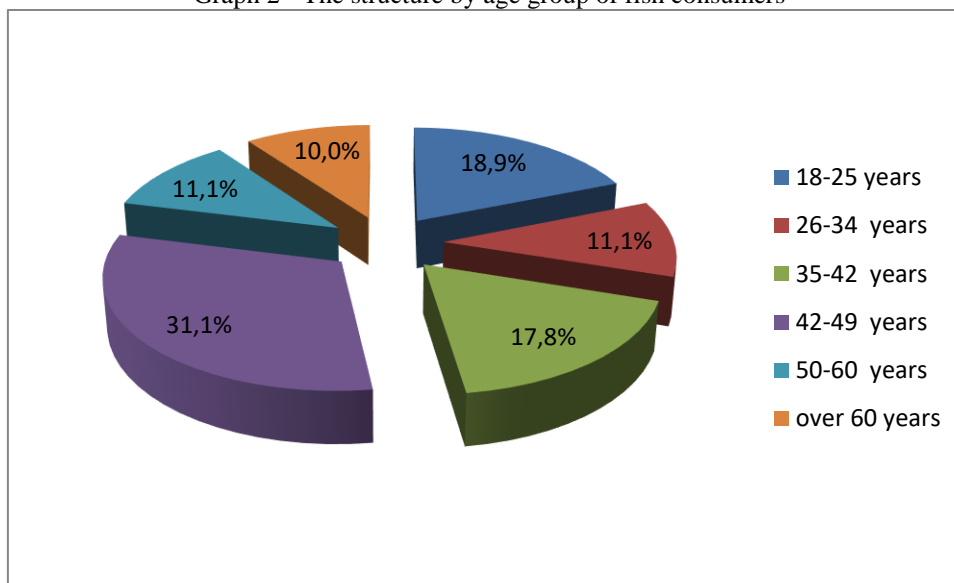


For the purpose of conducting a market study we conducted an opinion poll in June 2019. The questionnaires were applied to a number of 90 people, resulting the profile of fish consumers in Bucharest:

- 98.9% of those surveyed consume fish frequently;
- the share of women is twice as high (66.7%) than that of men (33.3%);
- 85.60% of the respondents consider that the reason they eat fish is healthy eating.

As shown in Graph 2, the questionnaire is addressed to adults of all age categories: 30% of those interviewed are young people under 35 years of age, the rest of 70% being second and third age persons.

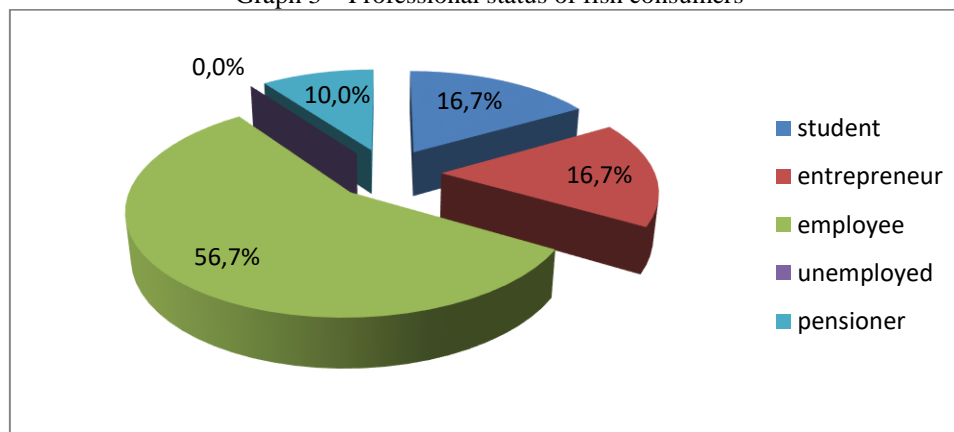
Graph 2 - The structure by age group of fish consumers



*Source: survey data processing*

Regardless of age, most of the interviewees have their own incomes (56.70% employees, 16.70% entrepreneurs, 16.70% pensioners) (Graph 3).

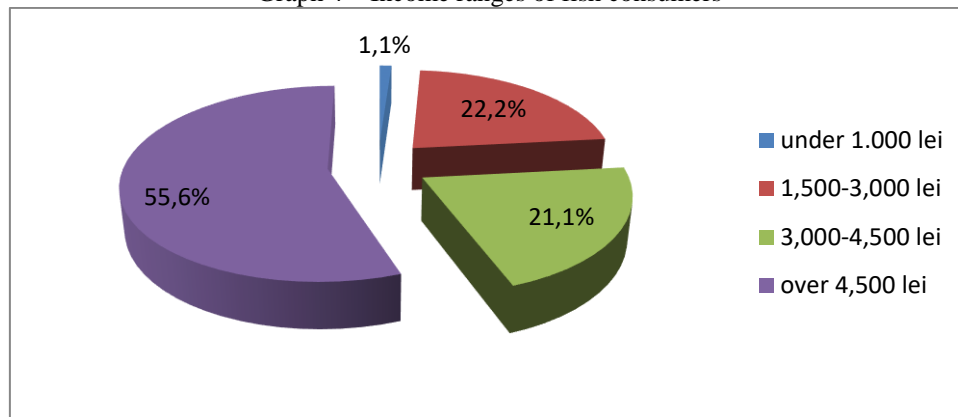
Graph 3 – Professional status of fish consumers



*Source: survey data processing*

It is clear from the answers received that over three quarters of those surveyed have above average incomes (Graph 4).

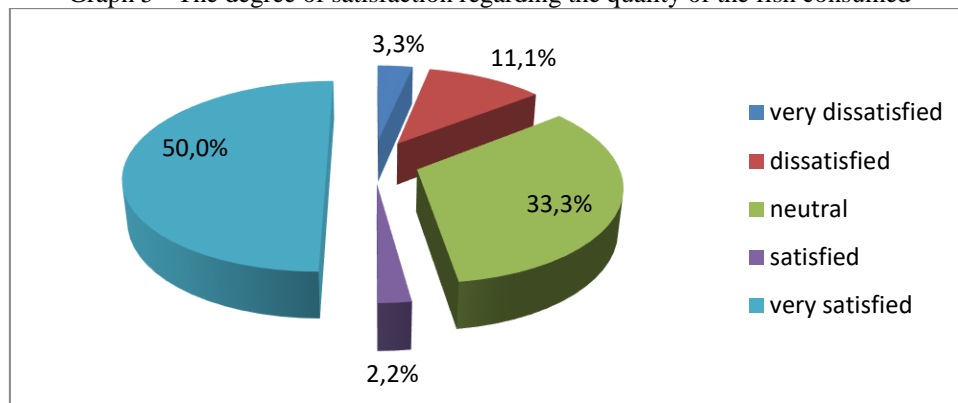
Graph 4 – Income ranges of fish consumers



Source: survey data processing

Regarding the satisfaction of the buyers / consumers of fish, it is observed that 53.3% are satisfied and very satisfied with the fish and fish products they find on the market, but there are also dissatisfied and very dissatisfied (13.3 %). A total of 30 people (33.3%) did not vote for any of the variances (satisfied / dissatisfied) (Graph 5).

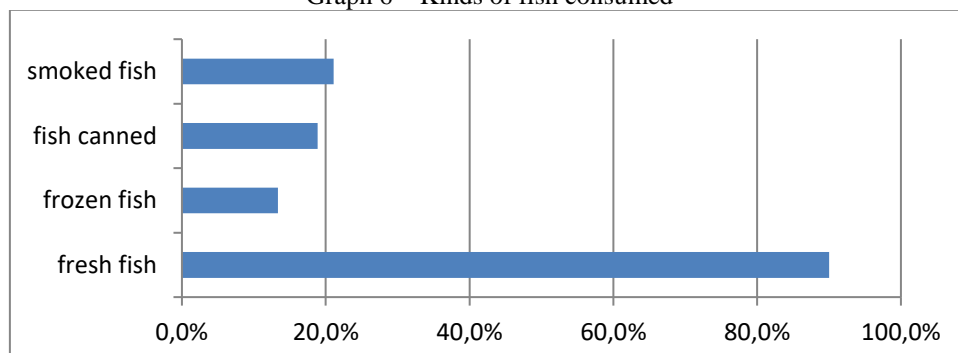
Graph 5 - The degree of satisfaction regarding the quality of the fish consumed



Source: survey data processing

The overwhelming majority of those interviewed prefer fresh fish (90%), but consume largely canned fish (18.9%), smoked fish (21.1%) and even frozen fish (13.3%) (Graph 6).

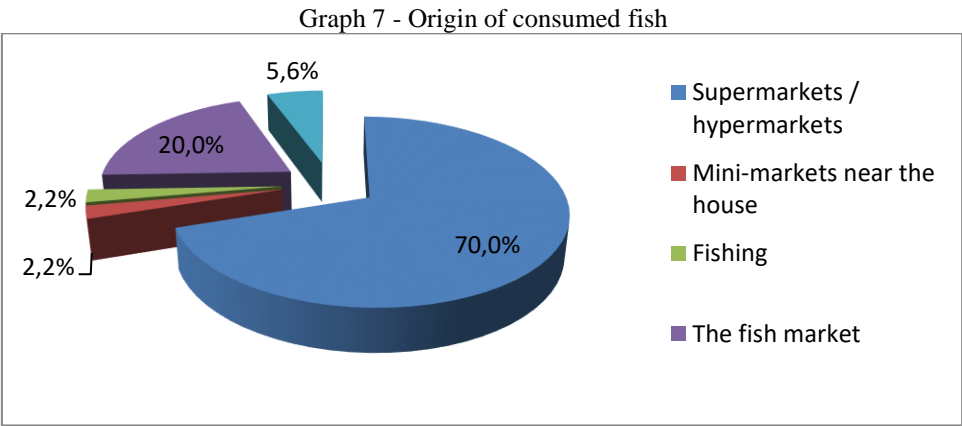
Graph 6 – Kinds of fish consumed



Source: survey data processing

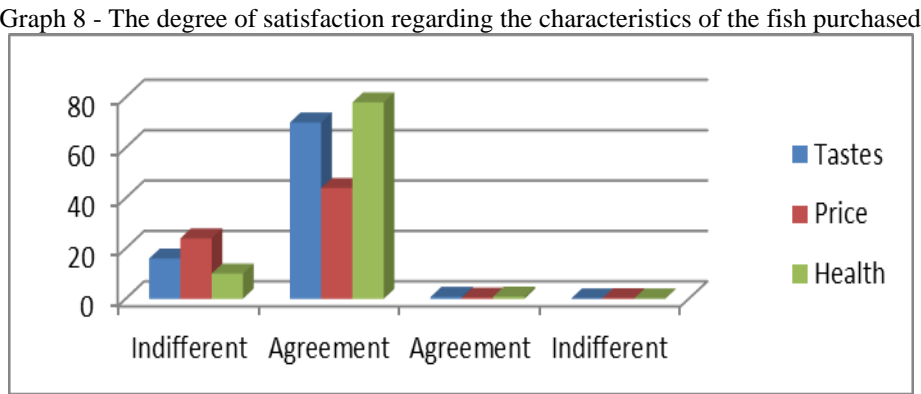
As shown in Graph 7, 63 people (70%) buy fish from supermarkets or hypermarkets, considering that in these locations there is a greater degree of product control, knowing that fish is an extremely perishable and highly allergenic food. 20% of those surveyed buy fish from the fish market,

but there are also 2 people who fish and 2 others who prefer ready-made fish at the restaurant (Graph 7).



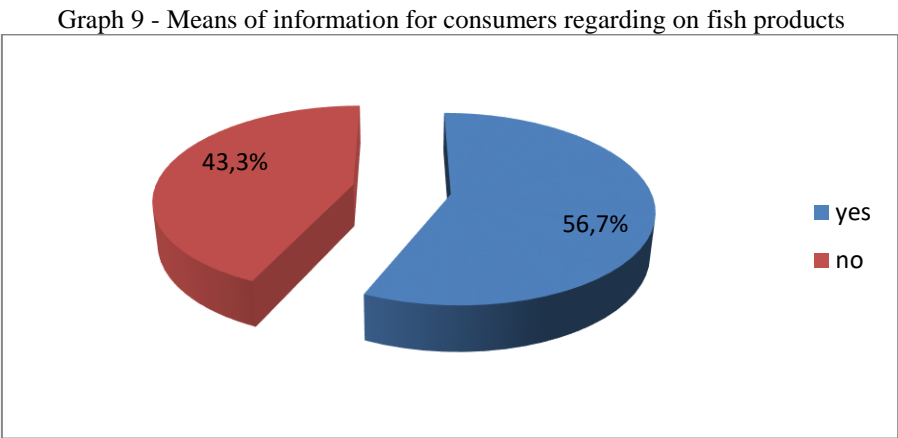
Source: survey data processing

Consumers interviewed appreciated that the fish is preferred because it is very good for health (78 people) and because it tastes good (70 people). Only 45 of those surveyed appreciated that the fish has an acceptable price (Graph 8).



Source: survey data processing

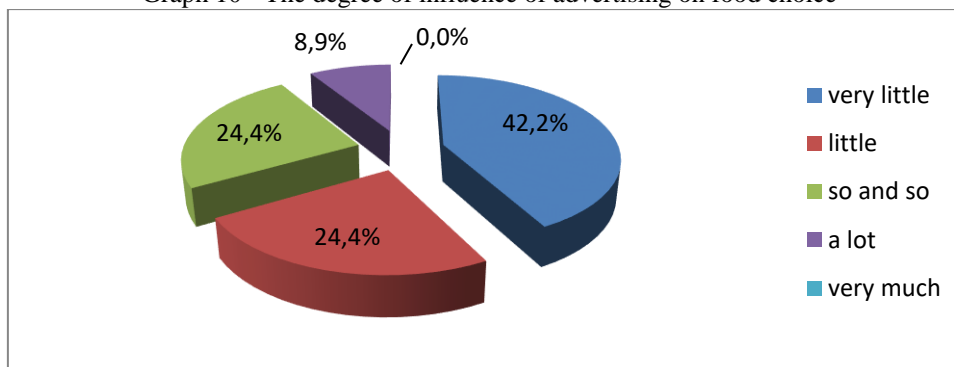
Interviewed consumers do not watch commercials on fish consumption and fish products (51 people) (Graph 9).



Source: survey data processing

Regarding the degree of influence of advertising on the choices of different food products, only 9% of those questioned are left influenced by advertising, the rest of 91% (82 people) do not (Graph 10).

Graph 10 - The degree of influence of advertising on food choice



*Source: survey data processing*

## CONCLUSIONS

From the questionnaire applied to the 90 consumers in Bucharest, it was found that women consume more fish than men either for health reasons, for aesthetic reasons or because they appreciate its special taste. Most of those who consume fish and fish products are people over 35 years of age, with above average incomes, who consider that fish is still an expensive product.

Only slightly more than half of those surveyed are satisfied with the fish and fish products they generally buy from supermarkets or hypermarkets. Eighty-one of the respondents prefer fresh fish, but among those surveyed are consumers of smoked fish (17 people) and even frozen (12 people).

Romanian consumers of fish and fish products are not influenced by advertising, as they have already formed opinions. In Romania the consumption of fish is influenced by the awareness of its importance as well as by the eating habits and traditions. Therefore, better consumer information and changing eating habits at an early age should be a priority.

The energy offered by marine products is very low. The bottom line is that we do not consume fish for its caloric intake but for vitamins (especially B), minerals, but especially Omega-3's.

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# ANIMAL PRODUCTS MARKET STUDY - BETWEEN SCIENTIFIC RIGOR AND REALITY

ANCUȚA MARIN<sup>1</sup>, RODICA CHETROIU<sup>2</sup>, LIDIA IURCHEVICI<sup>3</sup>

**Abstract:** *The paper represents the result of the efforts made to develop a market study within the first subsystem of the marketing - the entries on the market, meaning the production sector, by applying a questionnaire addressed to the producers of cow's milk, sheep meat, pork, broiler. Even though the number of the questionnaires fulfilled (from 69 animal farms) is insufficient for the information contained to be statistically validated as a representative sample, given the data and information received from the producers who were opened to participate in this study and who deserves our appreciation, we felt that they must be known. The results of the opinion poll show that the respondents do not, in general, conclude contracts for the sale of the products, and the valorisation of the production takes place on the local and county market, only the larger farms delivering on the national market. The production sold is generally unprocessed, in a proportion of about 65%. The sources of financing of the activity are own sources in the proportion of 40-60%, loans 30-50%, subsidies 10-65% and access of European funds 10-15%. The questionnaire also reveals the problems that the breeders encounter during the production. Many of them invoke the low selling price of production, the fact that the takeover of the production has an irregular frequency, and the payment is made late.*

**Keywords:** *market, milk, meat, producer, questionnaire*

**JEL Classification:** *O12, O13*

## INTRODUCTION

The marketing is a system that, under structural aspect, comprises three subsystems: inputs, represented by domestic production (excluding self-consumption), imports, national reserves and foreign aid; the market itself, represented by the confrontation of the supply with the consumer demand; outputs, represented by the consumption of the indigenous population, the raw material for the processing industries, the availability for export, the national reserves and the international obligations. Considered as a mechanism, the market for animal products comprises competition, demand and supply, prices, promotion, etc.

## MATERIAL AND METHODS

The paper represents the result of the efforts made to develop a market study within the first subsystem of the market - the market entry, meaning production sector, by applying a questionnaire addressed to the producers of cow's milk, sheep meat, pork, poultry. After sending the questionnaires to a significant number of producers and their various associations, only 61 completed questionnaires were received. Subsequently, the questionnaires were also sent to the agricultural departments and only 8 completed questionnaires were returned.

From a statistical point of view, their number is insufficient for the information contained to be validated as a representative sample. However, given the data and information received from the producers who were open to participate in this study and which deserves our appreciation, we considered that they should be known. The paper presents, in summary, the most important aspects regarding the sale of animal products from the farms that participated in this study.

The processing of the answers from the received questionnaires was done using the applications available in the Excel program.

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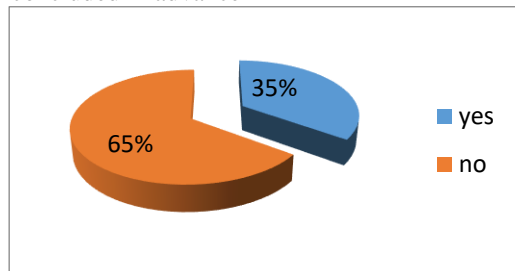
<sup>3</sup> Eng. Iurchevici Lidia, Scientific researcher III – Research Institute for Agriculture Economy and Rural Development, e-mail: lidia.iurchevici@iceadr.ro

## RESULTS AND DISCUSSIONS

### Milking cows

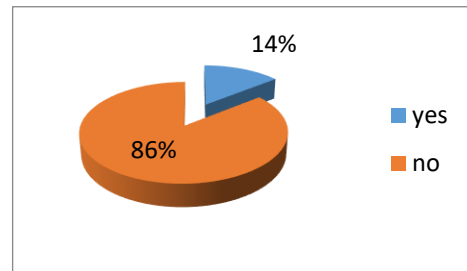
The farms analyzed have a variable size, between 11 and 466 cows. Most fall in the size class below 50 heads, the others being large and very large. From Chart 1, it appears that 65% of the interviewees do not plan their activity, do not conclude contracts in advance for the sale of the production obtained, nor consult materials or market studies for a better information on the marketing of the production (Chart 2).

Chart 1 – Planning activity based on contracts concluded in advance



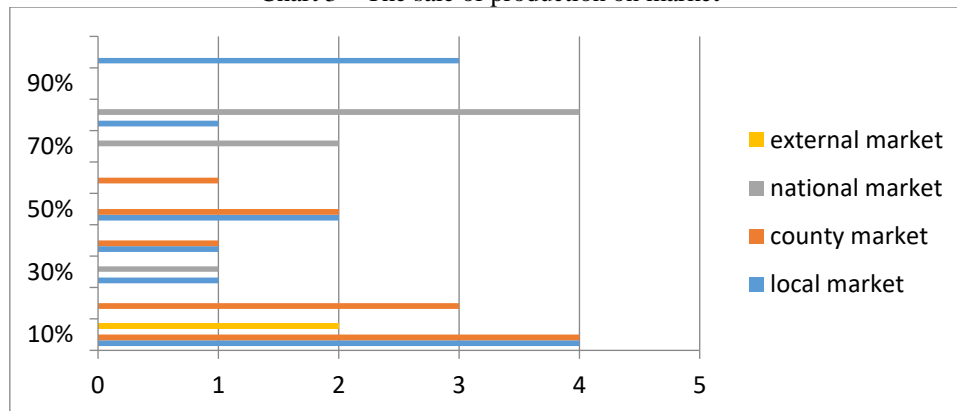
Source: own calculations, following questionnaire

Chart 2 – Studying marketing materials



Almost three quarters of those surveyed obtain incomes of over 10,000 lei annually, while the rest have incomes below 10,000 lei annually, the activity of raising dairy cows proving to be profitable. Most of the producers sell their milk production on the county market, respectively national, very few (2 farms among those questioned) being those who export (Chart 3).

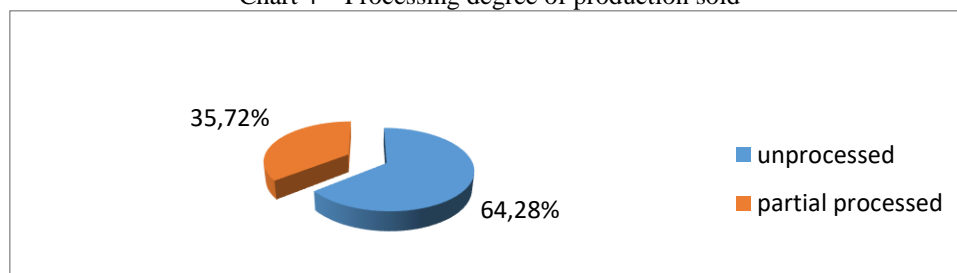
Chart 3 – The sale of production on market



Source: own calculations, following questionnaire

As for the destination of milk production, most farms sale their production directly (at the farm gate), which is 64.28% unprocessed, respectively 35.72% partially processed (Chart 4).

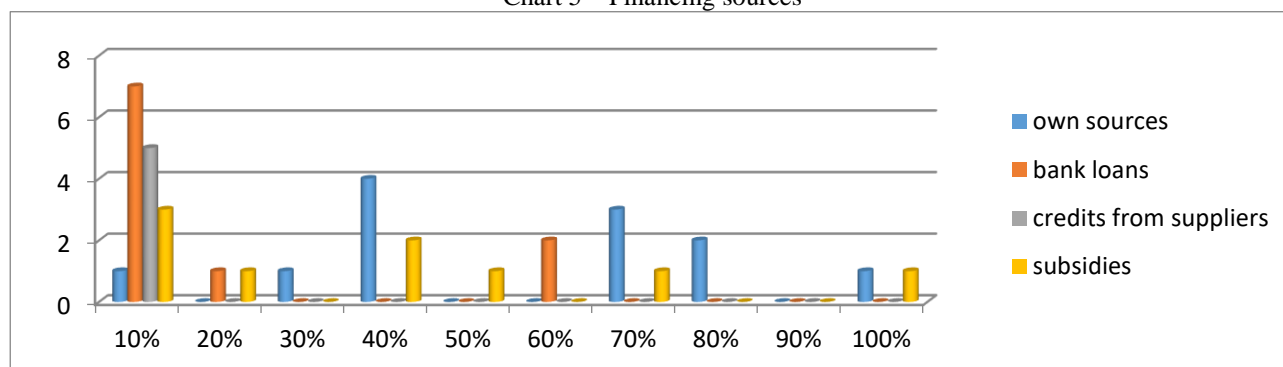
Chart 4 – Processing degree of production sold



Source: own calculations, following questionnaire

As shown in Chart 5, 71% of those surveyed are based on their own sources of funding in proportion of over 40%. In addition to financing sources, half of those surveyed take bank loans and 35% credits from supplier. 64% of the respondents applied for subsidies, for 4 of them representing less than 20%.

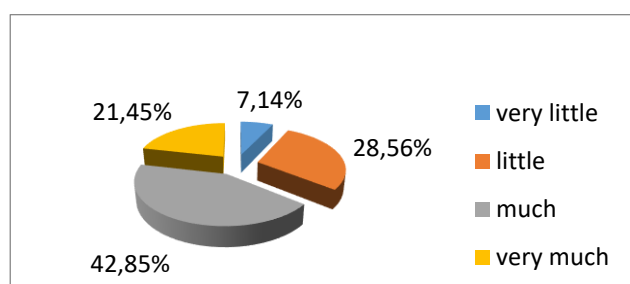
Chart 5 – Financing sources



Source: own calculations, following questionnaire

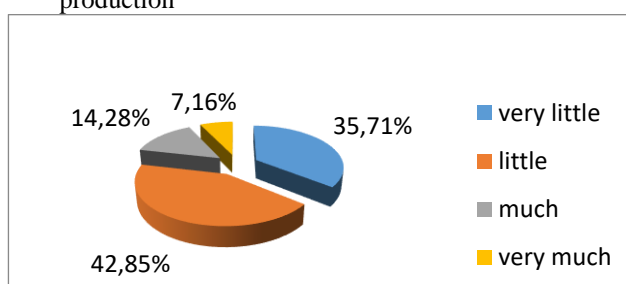
The questionnaire highlights the problems that dairy farmers have encountered during the production process. Many of them have complained about the low price of milk production, and the payment is late. Other farmers reported lack of work force and too many intermediaries, which leads to far too high prices for shelf products (from 0.9-1.2 lei / liter at the farm gate, at a price around the value of 5 lei at shelf). According to the respondents, the influence of competition on the output of the production is large or very large (64.30%). Only one third of those surveyed considered this influence to be small and very small (Chart 6).

Chart 6 – Influence of competition on the market



Source: own calculations, following questionnaire

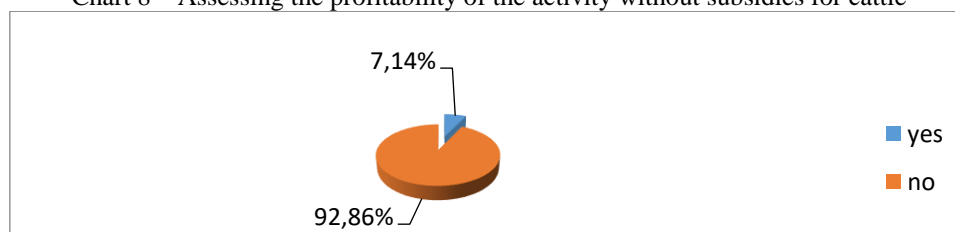
Chart 7 – Degree of covering demand by domestic production



From the answers received, it turns out that 21.44% of the interviewed farmers appreciate that the demand for milk is covered by the domestic production, the rest of 78.56% considering that this cannot be done 100% of the Romanian farms (Chart 7).

A very large number of respondents consider that their activity could not be profitable without the subsidy for the bovine species (Chart 8).

Chart 8 – Assessing the profitability of the activity without subsidies for cattle



Source: own calculations, following questionnaire

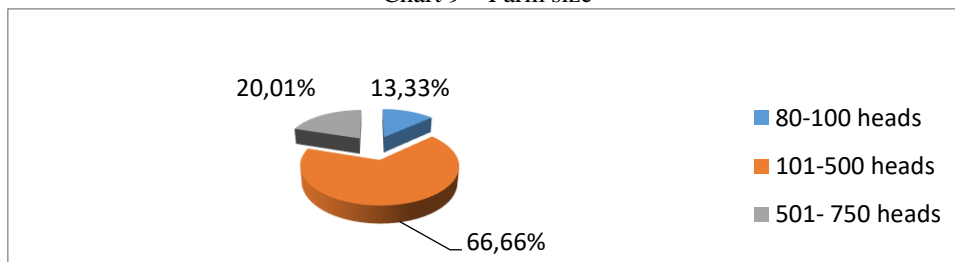
Even if 64.28% of the respondents consider that accessing European funds is a solution for the development of the production activity, they will not resort to this solution for the development

of their activity, as they consider "too big a headache". A high percentage (78.57%) of farmers do not want to go to banks for loans, because they consider that interest and commissions are too high and unsafe. At the same time, half of those surveyed see a solution in association / cooperation.

## Sheep

The farms analyzed have a variable size, between 80 and 750 heads. Most are in the size class 100-500 heads (66.66%), followed by those with large holdings, over 500 heads, respectively 20% of the respondents (Chart 9). One of the biggest problems identified by the questionnaire is that no respondent plans his activity based on previously concluded contracts.

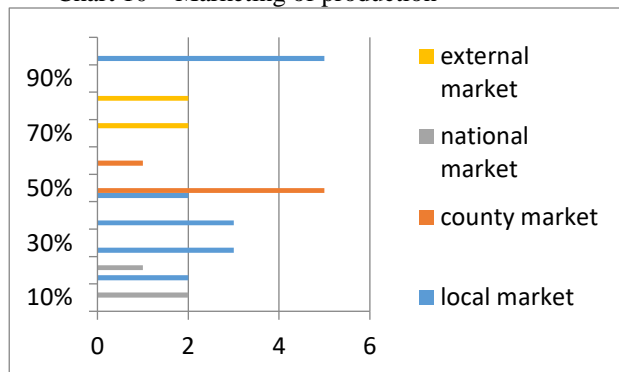
Chart 9 – Farm size



Source: own calculations, following questionnaire

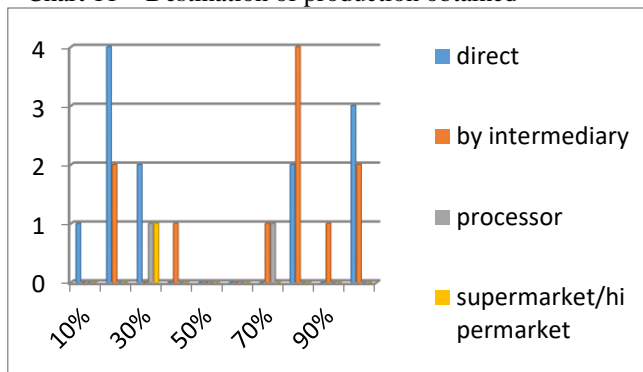
As shown in Chart 10, marketing of production is generally done on local market, for export delivering only 4 of the respondents. We observe in Chart 11 that the destination of production is generally for sale at the farm gate and through the intermediary. Very few products reach the processor and almost none in supermarkets or hypermarkets, a possible explanation being that related to the eating habits of Romanians who consume less sheep / lamb meat, except for the Easter holidays.

Chart 10 – Marketing of production



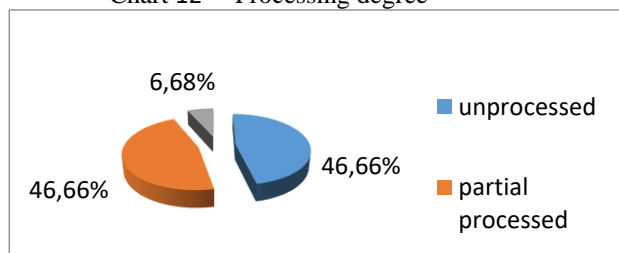
Source: own calculations, following questionnaire

Chart 11 – Destination of production obtained



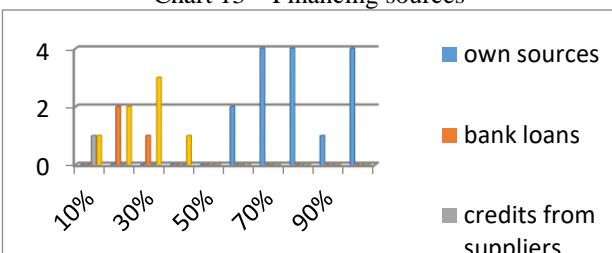
Production is sold in proportion of over 93% unprocessed or partially processed (Chart 12). Sheep breeders, from father to son, are accustomed to doing their business using their own money. Only 3 respondents took bank loans, which accounted for 20-30% of the total funding sources used (Chart 13).

Chart 12 – Processing degree



Source: own calculations, following questionnaire

Chart 13 – Financing sources





Two farmers from the respondents have accessed European funds, respectively Sub-measure 4.1 - Farms. As for future access, 60% of subjects do not want to access European funds, the reason being too bureaucratic.

## Swine

The farms analyzed have a variable size, between 100 and 100,000 heads. Most (over 82%) are under 30,000 heads. One of the major problems identified by the questionnaire is that about 71% of the interviewees do not plan their activity and do not conclude contracts in advance for the delivery of the obtained production.

More than half of those surveyed (64.72%) obtain incomes over 50,000 lei per year, while 17.64% of them have incomes between 10,000-50,000 lei per year, pig raising activity proving to be profitable.

Most pig farmers sell their produce on the county and national markets. Of those surveyed, none has export sales (Chart 14). Most of the respondents sell their production directly (at the gate of the farm), in proportion of over 80%. However, there are no respondents to produce for supermarkets or hypermarkets (Chart 15).

Chart 14 – Marketing of production

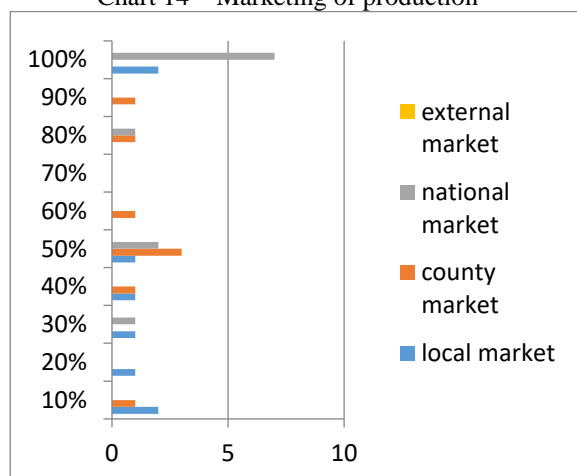
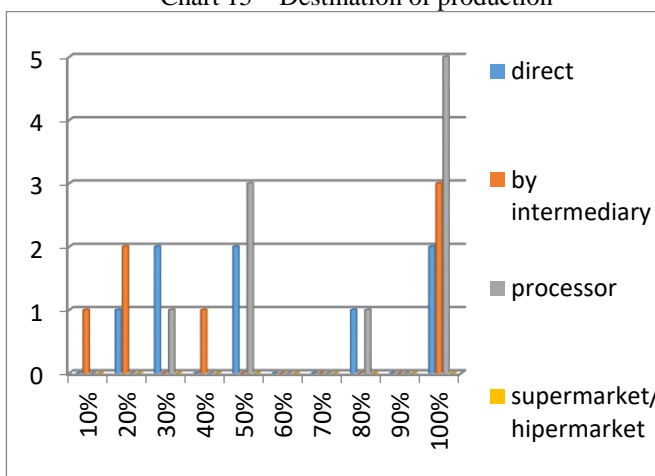


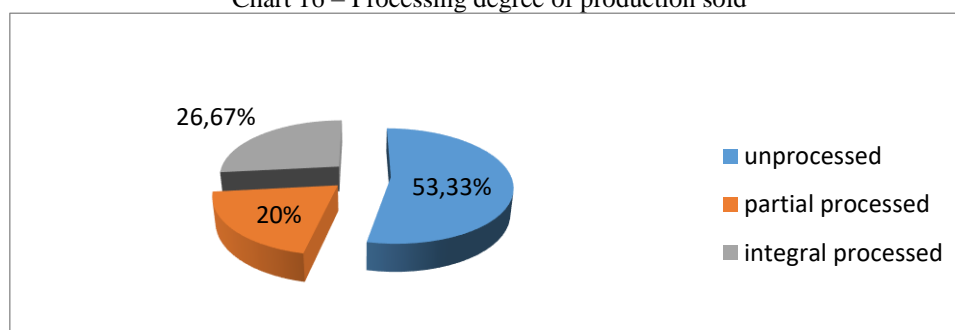
Chart 15 – Destination of production



Source: own calculations, following questionnaire

The production delivery is made of 73.33% unprocessed or partially processed (Chart 16).

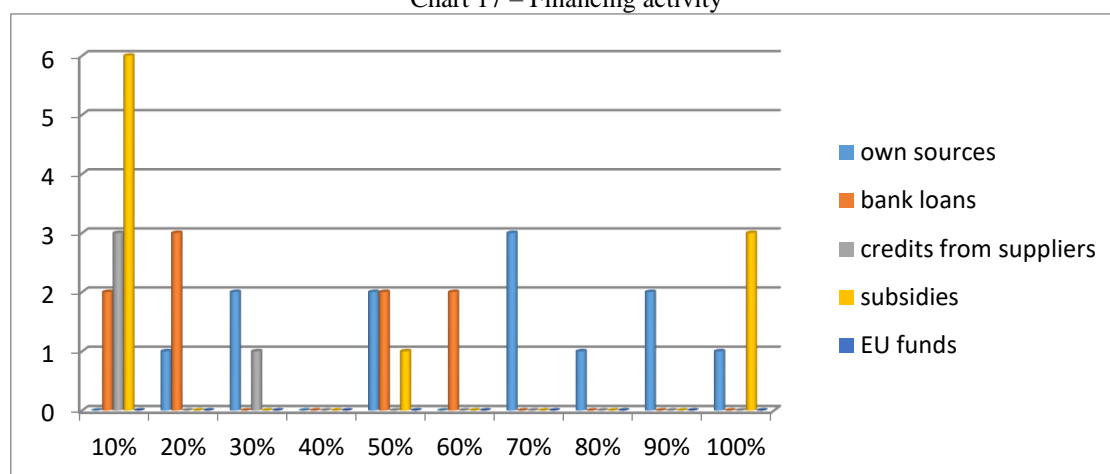
Chart 16 – Processing degree of production sold



Source: own calculations, following questionnaire

Over 50% of those surveyed finance their activities from their own sources and less than half resort to bank loans, supplier credits, subsidies. None of the respondents have accessed European funds. (Chart 17).

Chart 17 – Financing activity



Source: own calculations, following questionnaire

Another question regarding the sale concerned the problems encountered by them. Respondents noted the followings: restrictions following the evolution of outbreaks of African swine fever; low demand; low prices; massive imports at non-competitive prices; too many intermediaries; late payments. From the answers, it turns out that 60% of the interviewed farmers appreciate that the demand for pork is covered by the domestic production, the rest 40% considering that this cannot be done 100% of the Romanian farms.

Only one farmer said he had accessed European funds, applying for "Measure 14 - Pig welfare". Due to the conditions to be met, even in the future pig farmers do not want to access European funds.

## Poultry

The farms analyzed have a variable size, between 15 and 1,025,100 heads per series. Most are in the size class over 100,000 heads per series, but we also have very small holdings, below 100 heads per series. One of the major problems identified by the questionnaire is that 53% of the interviewees do not plan their activity and do not conclude contracts in advance for the delivery of the obtained production. Most of the poultry farmers sell their production on the county and national markets, very few being those who export (Chart 18).

Chart 18 – Marketing of production

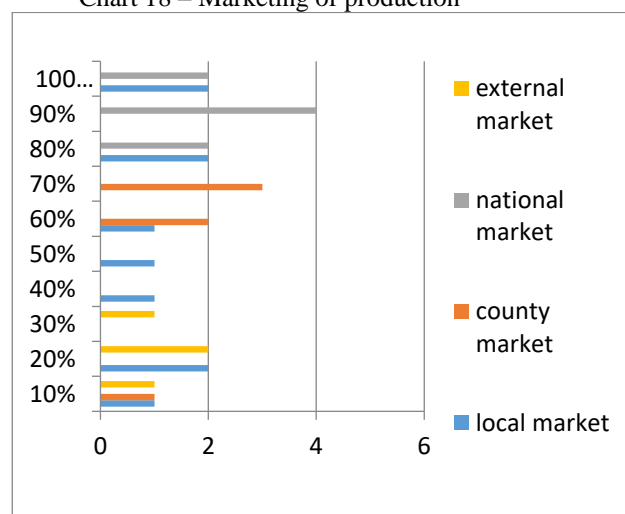
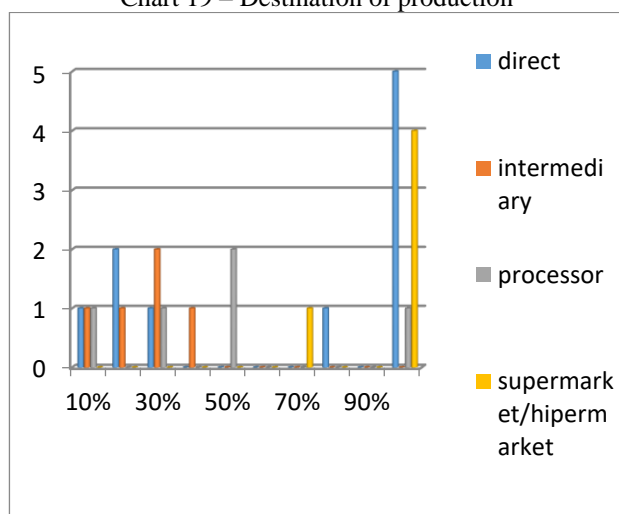


Chart 19 – Destination of production



Source: own calculations, following questionnaire

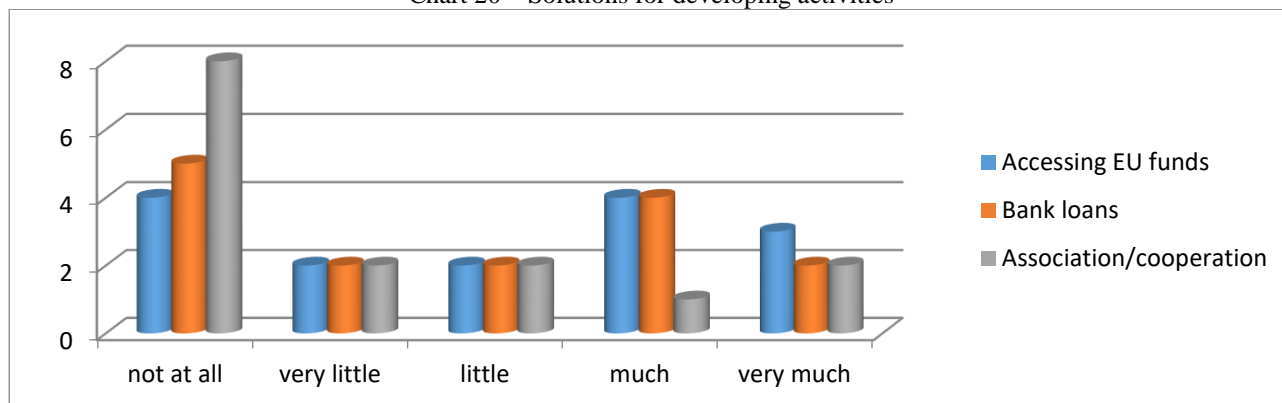
Most of the respondents sale more than 80% of their production direct. Four of the respondents stated that they are using intermediaries and five are delivering directly to the processors.

However, there are 4 respondents who produce exclusively for supermarkets or hypermarkets (Chart 19).

Taking into account the specificity of the activity, the production delivery is generally quarterly and 73.33% unprocessed, or partially processed. 60% of those surveyed finance their activities from their own sources and less than half resort to bank loans, subsidies or European funds.

Another question regarding the sale concerned the problems encountered by them. The respondents pointed out the followings: Romanian products hardly find their place on the shelf; intermediaries in the production chain - the final consumer - there are many and insistent; a jumping market; low prices. 46.66% of the respondents consider that accessing European funds represents a solution for the development of the production activity. 40% believe that by using bank loans, they can develop their business. Unfortunately, only 20% of those surveyed think that the association represents a way of developing / expanding the activity (Chart 20).

Chart 20 – Solutions for developing activities



Source: own calculations, following questionnaire

## CONCLUSIONS

In conclusion, we present some of the opinions of the farmers who answered the questions from the questionnaires:

- low price of marketing production;
- the takeover of the production has an irregular frequency;
- payment of the delivered production is made late;
- lack of workforce;
- the large number of intermediaries, which leads to much higher prices for the shelf products;
- massive imports at non-competitive prices;
- the influence of competition is big;
- the activity could not be profitable without the subsidies granted;
- the procedures for accessing European funds are too cumbersome and the files too heavy.

The proposals that farmers have for the smooth running of the activity:

- protecting the business environment, protecting and encouraging Romanian producers and domestic production in Romania;
- subsidizing the Romanian producers; establishing minimum state guaranteed prices for the Romanian producer;
- removing the ticks from the short supply chain;
- encouraging the unification of producers in cooperatives, for the bargaining power;
- support for bank loans; subsidizing part of the interest on bank loans.

Finally, we quote the opinion of a producer: "*Competition is the only thing that makes us stronger, which motivates us to be better, not to be careless, to listen to messages in the market, from the customer, to be close to their needs and to market needs; competition is healthy, but lately it has gone too far from the truth, from the need of the final consumer (low price, good quality)*".

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# DIMENSIONAL STRUCTURE OF DAIRY FARMS IN 2018

DIANA CREȚU<sup>1</sup>

**Abstract:** *Romania's agriculture is of great diversity in terms of farm structure of production methods and technologies used. In this article, will be presented the dimensional structure of dairy farms in 2018, highlighting issues such as the number of farms, the number of cattle, the number of farms and the number of cows depending on the type of farm, and the average size of cows' farms.*

**Keywords:** *dimensional structure, milking cows, weight.*

**JEL Classification:** *Q11;Q13;L11*

## INTRODUCTION

The breeding of animals as a science was born in 1946, with the establishment of the first specialized department within the National Agricultural Institute of Versailles. In 1884 the term zootechnics was introduced by GASPRN, which comes from the Greek language from the combination of the words: zoon = animal and technos = technique.

In the current acceptance, zootechnics is the science that deals with studying and establishing the principles and methods underlying the technologies of production, breeding of domestic animals, in order to obtain high quality, high quality products at the lowest prices.

The main purpose of animal husbandry is to obtain food products of high biological and nutritional value, such as: milk, meat, eggs, honey, bees, products consumed as such or are raw materials for the food industry.

Cattle farming is a traditional activity of the population in the rural area and especially in the mountain area. The dimensional structure of dairy farms is of major importance for Romania's agriculture.

Due to the diversity and value of the producers and the products that result from this activity, namely the breeding of cattle, it is a branch of primary importance. The diversity of the productions they make, the low energy consumption and the nature of the feeds they use, give the cattle breeding and exploitation the character of a sustainable and prospective activity. In 2018, in Romania there were 531.851 farms, with a total of 1,46 million cows. Most farms and the largest number of cows are in small farms, 1-2 heads.

The average size of the cattle farm in the whole country is 2,74 cows. The highest share of the number of cows is found in the category 3-5 heads (81,58%), followed by the category 3-5 heads, (12,97 %), and the smallest share belongs to the category "over 100 heads" with a percentage of only 0,09 % of the total number.

## MATERIAL AND METHODS

The research method used in the study is the statistical processing and the economic analysis of the data. In this paper, the dimensional structure of the dairy farms from April 30, 2018 was analyzed, namely the number of dairy farms and the number of cows depending on the type of farm but also average size of cattle farms using data provided by MADR (Ministry of Agriculture and Rural Development).

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## RESULTS AND DISCUSSIONS

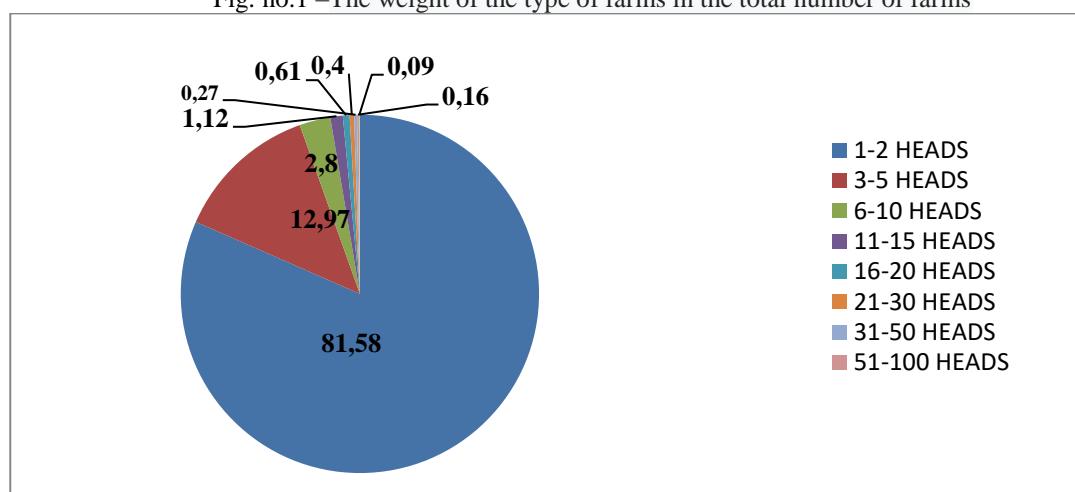
In Romania, according to the data provided by MADR (table 1), we observe the size classes, the number of farms, the number of cows, their weight, but also the average number of cows per farm. As of April 30, 2018, in Romania there were **531,851** farms, with a total of approximately **1.46** million cows. Most farms and the largest number of cows are in small farms of **1-2** heads. The average size of the cows farm in the country is **2.74** cows.

Table no.1 Dimensional structure of dairy farms

Size class	TOTAL SECTORS				
	Number of holdings	% of total	Heads	% of total	Average size (heads)
<b>TOTAL</b>	<b>531851</b>	<b>100.00</b>	<b>1459540</b>	<b>100.00</b>	<b>2.74</b>
1-2 heads	433893	81.58	661852	45.35	1.53
3-5 heads	68994	12.97	269906	18.49	3.91
6-10 heads	14868	2.80	114427	7.84	7.70
11-15 heads	5973	1.12	76965	5.27	12.89
16-20 heads	3245	0.61	56861	3.90	17.52
21-30 heads	2121	0.40	52848	3.62	24.92
31-50 heads	1438	0.27	544902	3.73	37.89
51-100 heads	860	0.16	58123	3.98	67.58
over 100 heads	459	0.09	114068	7.82	248.51

Source:MADR

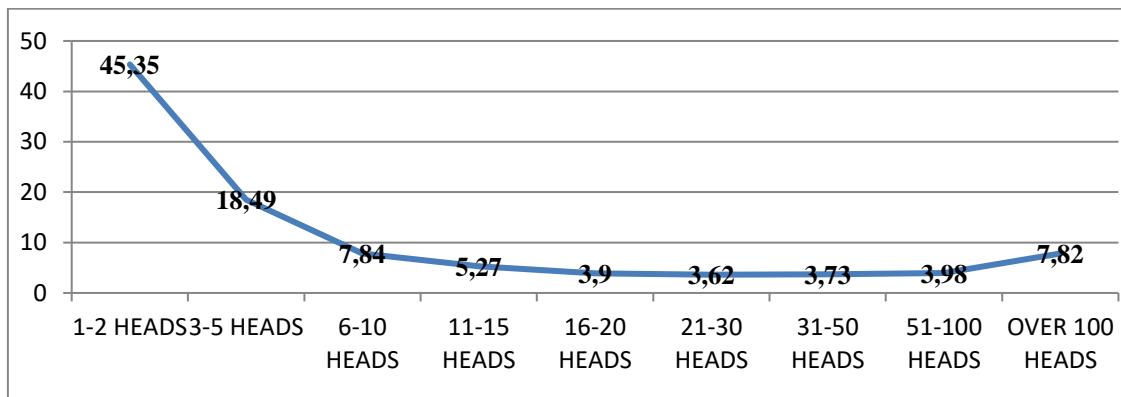
Fig. no.1 –The weight of the type of farms in the total number of farms



Source:MADR

In Fig. no. 1 it is observed that the highest weight is found in holdings in the category 1-2 heads (81.58%), followed by the category 3-5 heads, (12.97%), and the smallest weight belongs to the category " over 100 heads "with only 0.09% of the total number.

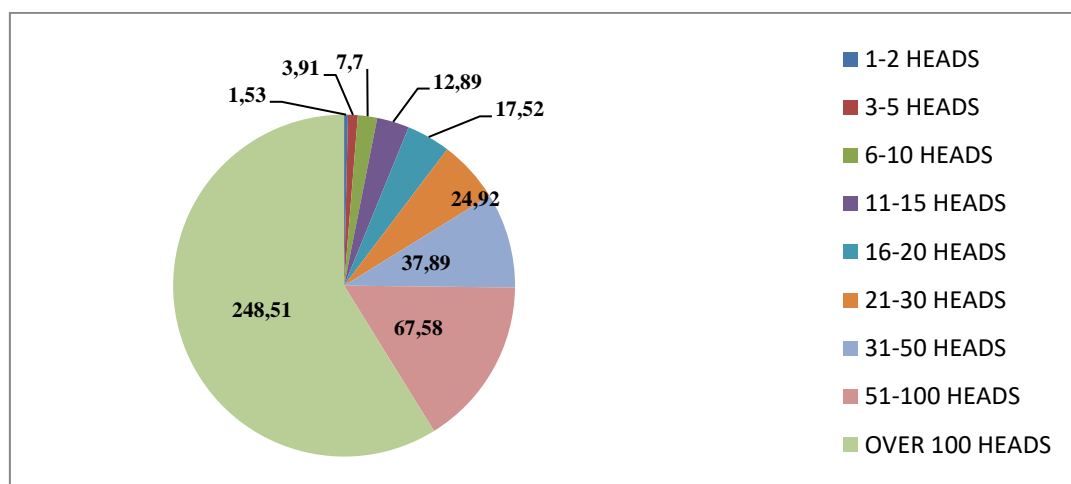
Fig. no. 2 – Share of cows according to the type of farm



In chart no.2 the highest weight in terms of number of cows is found in the category 1-2 heads (45.35%), followed by the category 3-5 heads (18.49%) and the lowest weight is found in the category 31-50 heads.

In large farms, with over 100 heads, it is 7.82% of the total cows in Romania.

Fig. no. 3 – Distribution of the number of cows by farm type



In the chart no.3 the smallest cattle farms in Romania have an average size of 1.53 heads, and at the opposite pole are the large farms (category over 100 heads), which have an average size of 248.51 heads.

## CONCLUSIONS

The agriculture of Romania is of great diversity in terms of the structure of the farms, the production methods and the technologies used. This diversity reflects the climatic conditions, the topography and the evolution of the socio-economic environment.

On April 30, 2018, in Romania there were 531,851 farms, with a total of 1.46 million cows. Most farms and the largest number of cows are located in small holding, with 1-2 heads.

The average size of the cattle farm in the country is 2,74 cows.

The highest weight of the number of cows is found in the category 1-2 heads (81.58%), followed by the category 3-5 heads, (12.97%), and the smallest share belongs to the category " over 100 heads "with only 0.09% of the total number.

The highest weight in terms of the number of cows is found in the category 1-2 heads (45.35%), followed by the category 3-5 heads (18.49%) and the lowest weight is found in category 31 -50 heads.

In large farms with over 100 heads, are found 7,82% from the total number of cows from Romania.

The smallest cattle farms in Romania have an average size of 1.53 heads, and at the opposite pole are the large farms (over 100 heads category), which have an average size of 248.51 heads.

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# RESEARCH REGARDING OF THE UTILIZATION AND PROMOTION OF SOME INNOVATIVE TECHNOLOGIES IN THE AGRO-ZOO-VETERINARY FIELD (BIOFERTILIZERS, PROBIOTICS, IMUNOMODULATORS)

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**Summary:** *The paper has the role to promote certain sustainable production systems, diversified and balanced, in order to prevent pollution of agricultural crops, the environment, the conversion of agri-food waste (whey) into veterinary medical products as well as the implementation of green, non-polluting technologies in the agricultural sector, zootechnics and veterinary medicine. The purpose of this work is to present and use the newest innovative technologies into these fields and replace the traditional polluting products, so that the farmers can reaches a much greater potential over the recorded productions. The interest in green products and technologies and the achievement of high yields in the field of agro-zoo-veterinary has an upward trend in Romania. In order to support farmers in these fields, new organic products have appeared on the Romanian market meant to be used in the agro-zoo-veterinary field: biofertilizers, silage agents, probiotics and immunomodulators.*

**Keywords:** *biofertilizer, silage agent, probiotic, immunomodulator, Romvac Company S.A.*

**JEL classification:** *Q01, Q16, Q57.*

## INTRODUCTION

Food safety, a normal objective for any man, farm and enterprise, is aimed to producing sufficient, varied and cheap food, corresponding to the physiological requirements and purchasing power of any person. In the developed countries, this objective has been achieved and often exceeded substantially by promoting intensive systems for both land cultivation, animal husbandry and veterinary medicine, as well as modern methods of processing and marketing agricultural products. Mechanization, chemization, animal husbandry technologies, technologies for applying treatments, growing plants and raising more and more productive animals, and modernizing processing and marketing systems have contributed, first and foremost, to improving human living conditions, as much as volume. and diversity of agri-food products, as well as accessible to buyers.

## MATERIAL AND METHOD

The development and diversification of both green and environmentally friendly, innovative systems and technologies in the agro-zoo-veterinary field have become a landmark for both farmers and for the communities and companies involved in the projects for obtaining agro-food products of high biological value, technologies that have the role of minimizing the negative impact on the environment. The population growth and the increasing demand for food has led to the use of non-

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agricultural, polluting technologies for the environment and for the agro-zoo-veterinary sectors. Thus, in order to ensure organic products, unpolluted as well as agri-food safety, some companies in Romania have developed a series of ecological technologies, a series of innovative technologies that have the role of recycling certain wastes from the agri-food industry in order to obtain organic products. , biological products successfully used in the agro-zoo-veterinary sector (FAO, 2015).

In order to protect the environment and the agri-food health and safety of humans and animals, the company Romvac Company S.A has developed a series of innovative technologies with the help of the farmer have obtained certain ecological products for their use in the agro-zoo-veterinary field. The first products obtained by green technologies were those intended for the agricultural field: biofertilizer (Rom-Agrobiofertil NP) and silage agent (Bioromsil) based on bacterial culture. Rom-Agrobiofertil NP is an ecological fertilizer based on bacterial cultures (Figure 1). It occurs as a set of three bacterial strains: *Azospirillum lipoferum*, *Azotobacter croococcum*, *Bacillus megaterium* (Levandovschi et.al, 2017).

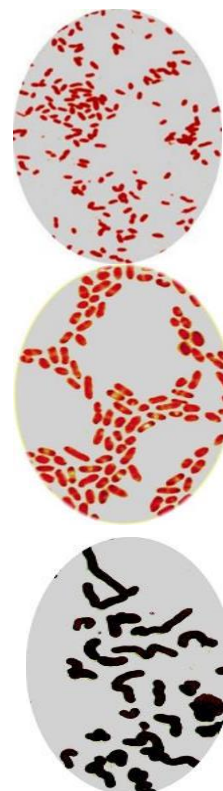
**Figure 1 - Rom-Agrobiofertil NP  
biofertilizer bacterial strain set**



*Azospirillum lipoferum* - Beijerinck strain 1925 - has the role of metabolizing organic materials from the soil (cellulose, hemicellulose, lignin, xylose). This bacterium multiplies and colonizes the plant roots by associating atmospheric nitrogen in the soil (Atilla, H.I, 2010) (Figure 2).

*Azotobacter croococcum* - Beijerinck strain 1901 - has the role of metabolizing free nitrogen from the atmosphere based on the energy resources existing in the soil. At the same time, the bacteria metabolize phosphates, assimilate and harvest the root exudates, counteracting the pathogenic microorganisms in the soil (Toader, George et al.) (Figure 3).

*Bacillus megaterium* - strain NCIMB 8508 - has the role of decomposing the detritus (complex compounds - chelations) in the soil. It converts insoluble phosphates from the soil into soluble, easily assimilated forms of plants, provides phosphorus and organic acids (lactic, glutamic, succinic, propionic) and enzymes, with biostimulatory action on plants (Chima, Ngumah, 2013) (Figure 4).



Bioromsil is a silage agent obtained by an ecological technology, a green technology by recycling an agro-food waste, namely whey. Bioromsil is composed of live strains - in equal parts - of *Lactobacillus plantarum* and *Enterococcus faecium*.

Bioromsil silage agent based on bacterial cultures is used for: rapidly lowering the pH (below 4.5) of the silo by increasing acidolactic fermentation of sugars and increasing lactic acid content, inhibits the growth of rot, mold and stops butyric fermentation, reducing fodder degradation, accelerates silo maturation by reducing fermentation period, ensures increased organoleptic quality of silo, improves animal production by increasing the conversion of animal feed, ensures probiotic flora in the entire apatogenic, non-polluting, non-polluting Romvac Company SA Prospect Bioromsil).

**Figure 5 -  
BioRomSil silage agent**



### **Romvac and the new series of bio products: zoo-veterinary domain**

Whey is a major pollutant. The traditional milk processing technology does not allow the use of all milk components in finished dairy products, such as butter, cheese, casein, etc. Secondary products in the form of skimmed milk, whey and whey are inevitably obtained in the production process. In fact, whey and whey are an additional source of raw materials, which are part of secondary material resources and can be conventionally combined under the term - low fat dairy raw materials. Whey is a good basis for creating functional products of a new generation with a higher biological and nutritional value. From the perspective, in the creation of new food products with modified properties and compositions, the direction in the combination of dairy and vegetable raw materials is considered (Melescco, Sofia, 2018).

Going on the idea of obtaining BIO products by using waste from other fields of industry (whey in milk, molasses in sugar industry), Romvac specialists have created, in recent years, several natural products based on beneficial bacterial cultures and proteins whey bioactive, with probiotic and immunomodulatory role.

#### **1. Bioenterom**

All animal species are born with the sterile digestive tract. Probiotics are recommended for the first 3 days of life for intestinal colonization. BioEnteRom is a probiotic dietary supplement for stabilizing intestinal flora that contains live germs of *Enterococcus faecium* strain NCIMB 11181. The probiotic Bioenterom (figure 6) has the role of: stabilizing the digestion, increasing the conversion of food and nutrient absorption, increasing the weight gain in animals, reducing the level of toxins in the intestine, preventing

the proliferation of pathogenic germs *E. coli*, *Salmonella*, *Clostridium*, *Pseudomonas*.



Bioenterom is recommended in the following situations: administration before stress periods, sanitary-veterinary actions, in all gastrointestinal disorders associated with diarrhea for digestive tract digestion, during antibiotic therapy, oral administration in drinking water, colostrum or milk (Romvac Company SA - Prospectus Bioenterom).

## 1. Biolactorom

Biolactorom is a probiotic dietary supplement for stabilizing intestinal flora that contains live germs of *Lactobacillus plantarum* strain NCIMB 11974. The probiotic Biolactorom (figure 7) has the role of: stabilizing the digestion, increasing the conversion of food and nutrient absorption, increasing the weight gain in animals, reducing the level of toxins in the intestine, preventing the multiplication of pathogenic germs *E. coli*, *Salmonella*, *Clostridium*, *Pseudomonas* (Romvac Company SA - Prospect BioLactorom).



Biolactorom is recommended in the following situations: administration before stressful periods, sanitary-veterinary actions, in all gastrointestinal disorders associated with diarrhea for digestive tract digestion, during antibiotic therapy, oral administration in drinking water, colostrum or milk.

## Romimunoactiv - immunomodulatory food supplement

The immunomodulatory Romimunoactiv (figure 8) is obtained from whey from mature immunological cows. It contains active substances such as: bioactive whey proteins > 10mg / l, lactoglobulin  $\alpha$ , lactoglobulin  $\beta$ , immunoglobulins (IgA, IgG, IgE, IgM), lactoferin, lactoperoxidase, lysosyme, lymphokine. At the same time, its contents also identify the following excipients: lactose serum, mineral salts, vitamins, etc. The immunomodulator has significant antimicrobial action, acting as an antibiotic (Romvac Company S.A - Prospect Romimunoactiv).



## RESULTS AND DISCUSSIONS

Following the testing of two innovative products from the portfolio of Romvac Company SA (Rom-Agrobiofertil NP and Bioenterom), both within certain research and development stations in agriculture, and within certain farms, both high yields per hectare were registered per hectare. certain agricultural crops, as well as a significant increase in the production increase in birds.

Thus, following the testing of the innovative products from the Romvac company both within the Research and Development Station in Buzau Vegetable (tomato culture „Florina 44”) and the testing of the probiotic Bioenterom within the Medgidia farm the following results were registered:

**Table 1 - The total production registered in the “Florina 44” tomatoes in 2018 / ha in the field - Variant treated with Rom-Agrobiofertil NP**

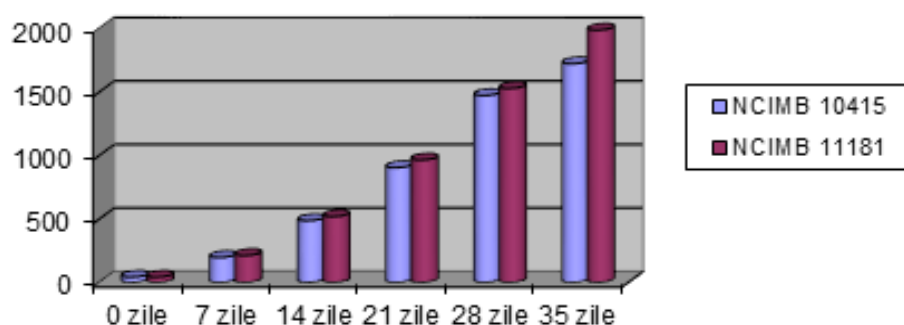
Nr. V/R	Nr. Ripe fruits / pl	Ripe fruit weight / pl (kg)	No. of green fruits / pl	Weight of green fruits / pl (kg)	Total fruit / plant production (kg)	Nr. total fruit / plant	Total production t / ha
Media V1	11,2	0,802	14,2	1,06	1,862	25,4	78,3
Media V2	13,3	1,251	22,25	2,1	3,351	35,55	132,6
Growth (%)	15,78 %	35,89 %	36,17 %	49,52 %	79,97 %	39,96 %	69,27 %

Source: Biometric data obtained at the Research-Development Station in Buzau Vegetables

Following the testing of the second product obtained by innovative total whey recycling technology (agro-industrial component considered a polluting waste) - Bioenterom strain *Enterococcus faecium* NCIMB 11181 - within Medgidia farm, applied to 230,000 bird heads.

**Table 2 - Weight gain rate of birds (BioEnterom test)**

Strain	0 days	7 days	14 days	21 days	28 days	35 days
NCIMB 10415 Period 03-05.2015 ~230.000 heads	42	197,4	487,1	904,6	1473,1	1723
NCIMB 1181(Bioenterom) Period 05-07.2016 ~230.000 heads	42	213,2	519,8	965,1	1528,8	1988,5
Growth (%)	0,0	8,0 %	6,7 %	6,7 %	3,8 %	15,4 %
Growth/ g at 35 days				265,5		
Growth g/ lot				61,065,00		



**Figure 8 - Trend of increasing bird weight**

**Table 3 - Bird mortality rate**

Strain	7 days	14 days	21 days	28 days	35 days
NCIMB 10415 Period 03-05.2015	0.92%	1.25%	1.69%	2.12%	2.58
NCIMB 11181 Bioenterom Period 05-07.2016	0.41%	0.74%	1.15%	1.45%	1.81
Decreased mortality (%)	-55.43	-40.80	-31.95	-31.60	-29.84

Source: Biometric data obtained during product testing at Avicola Medgidia



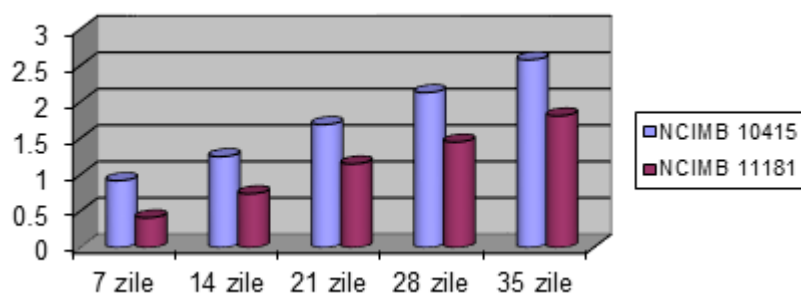


Figure 9 - Trend of decreasing bird mortality

## CONCLUSIONS

Following the application of the biofertilizer Rom-Agrobiofertil NP on the tomato crop, there were significant increases both on the plant's physiognomy (fruit increases, plant height, number of ripe fruits per plant, weight of ripe / raw fruits, number of fruits per plant) but especially on increasing the total fruit production per plant.

Following the administration of the probiotic Bioenterom in the Avgola Medgidia on the 230,000 thousands of birds, there was a significant increase in the production increase (meat) as well as a major decrease in the mortality rate of the birds. Thus, following the administration of this product, the farm obtained a production surplus of up to 61 t.

These innovative technologies applied in the agro-zoo-veterinary sector have the role of both greening the environment, ensuring an agri-food production (vegetables, fruits, meat, etc.) safe for the final consumer (man) but above all a safety over the use of these products. obtained in the environment. Biofertilizers have the role of ecologizing the soil, the soil being the basis of agriculture and, implicitly, of the zoo-veterinary sector.

Once applied to the soil surface, the bacteria in their contents have the role of capturing nitrogen from the atmosphere, fixing it in the soil. The other bacteria have the role of ecologizing the soil by destroying the complex compounds identified in the soil texture, solubilizing them so that the plants have all the necessary elements for their growth and development but especially to ensure an ecological production.

The application of probiotics and immunomodulators to farm animals has the role of balancing the animals' immune system, protecting them from possible diseases or ensuring a significant increase in the production increase in poultry and beyond. The fact that probiotics can lower mortality in animals and ensure a substantial increase in weight gain and, by implication of the production itself, is an innovation in the zoo-veterinary sector, which will represent a greater profit for the farmer.

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# PRO AND CONS OPINIONS ON USE OF PESTICIDES IN MODERN AGRICULTURE –CRITICAL REVIEW

FLORENTINA HADDAD<sup>1</sup>, IOANA TOMA<sup>2</sup>, MIRELA DANIELA NICOLA<sup>3</sup>,  
CRISTINA GARLEA<sup>4</sup>

**Abstract:** *With a growing population there is an increasing challenge for agriculture to produce more and more food. Use of herbicides, insecticides and fungicides in agriculture reduces the loss of crops, and increases the yield, however regarding the benefits and impact of the use, opinions are divided. Some scientists suggest that the use of these chemicals involve risks for human and animal health and is not sustainable for the environment. Other groups claim that the use of pesticides in agriculture is safe and sound and is very beneficial for human kind. Real life, nevertheless, shows today that we are facing a lot of challenges, such as: import of banned pesticides from one country to another, poisoning of people by accident, residues in food and environment, disruption of ecosystems, human and animal dangerous exposure etc. So, the aim of this paper is to review the pro and cons of the use of pesticides in agriculture and to enrich the knowledge concerning the possible impact of these chemicals on future generations and the dimension of correlated environmental damages.*

**Keywords:** pesticides, agriculture crisis management, economy, trade.

**Classification JEL:** Q16

## INTRODUCTION

This article is looking to review **the Pro and Cons opinions** concerning the use of pesticides in agriculture and to enrich the current knowledge concerning the benefits and the possible negative impact of these chemicals on future generations and the dimension of correlated environmental damages.

Literature shows that there are many benefits consequently the use of the pesticides in agriculture, nevertheless there are also assessments carried out over the use of pesticides in agriculture which shows the negative impact on human and animal health, and on environment or bad experiences.

Therefore the article is questioning if the benefits of using pesticides are worthing the negative impact on the human, animal health and environment, or not?

In addition, we are also looking to identify a more realistic management approach for decisions making system in case of the use of pesticides, in order to reduce the negative impact of pesticides on the human and animal health, and the environment.

## MATERIALS AND METHODS

In order to assess the Pro and Cons opinions concerning the use of pesticides in agriculture we proceeded to collect and review bibliographic data, legislative, reports, scientific materials available, worldwide, from all the stakeholders involved.

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## RESULTS AND DISCUSSIONS

### WHAT ARE THE CONS?

#### WHY TO BREAK DOWN THE VICIOUS CIRCLE OF PESTICIDE USE?

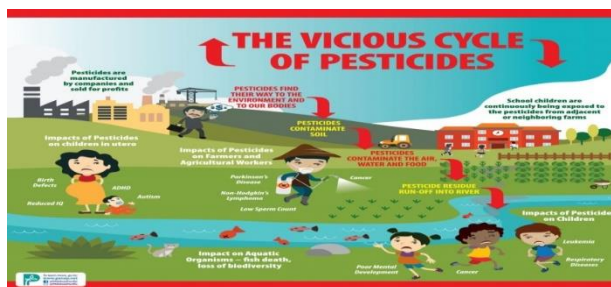
Pesticide residues resulting from the use of plant-protection products in agriculture presents risks. Today when we are talking about pesticides we linkage with routine use, significant quantities, exposure, spreading, remnants, polluting, poisoning, toxicity diseases, deaths, economical impact. Unfortunately in our days for most farmers and many other people, the treatment with pesticides of different agricultural crops **has now become rather a routine** than a last solution in rare cases of very harmful infestations. This means that on an agricultural crop, during growth season time's chemicals are applied too many times.

Some statistics data concerning the use of pesticides are showed in the tables below (6)

	Number of people using PPP in agriculture	People using PPP occupationally for public health programs	People using PPP for lawn and garden applications and in and around the home
worldwide	1.8 billion	No data found	No data found
		Quantity of PPP used/year	
United States		1 billion pounds	
worldwide		5.6 billion pounds	

In addition besides the **significant quantity** used, in some countries **the control exposure is limited or non-existent** (6). An example is that in our days in some countries (EU, USA) you can't sell pesticides without a licence in other yes. Worst since marketing through internet has established some pesticides can be bought on Internet ( again India, China).

**Moreover some of the pesticides** have proprieties such as high volatility, solubility etc that facilitate the spread far away from the crop it is intended. In this way **they are polluting** air, water soil and consequently all the environments.



The literature cites that as many as 25 million agricultural workers worldwide experience **unintentional pesticide poisonings** each year. In United States, in the Agricultural Health Study, it was estimated that 16% of the cohort had at least one pesticide poisoning or an unusually **high pesticide exposure** episode in their lifetime Although attempts to reduce pesticide use through **organic agricultural practices** and the use of other technologies to control pests continue, exposure to pesticides occupationally, through home and garden use, through termite control or indirectly through spray drifts and through residues in household dust, and in food and water are common (6). The US Department of Agriculture has estimated that 50 million people in the United States obtain their **drinking water** from groundwater that is potentially contaminated by pesticides and other agricultural chemicals (7, 8). Children from 3-6 years old received most of their dermal and non-dietary oral doses from playing with toys and while playing on carpets which contributed the largest portion of their exposure (9-12).

In USA the **costs estimated for harm** because the use of pesticides is around **9.6 billion dollars/year**.

Harm	Annual US cost
Public health	\$1.1 billion
Pesticide resistance in pest	\$1.5 billion
Crop losses caused by pesticides	\$1.4 billion
Bird losses due to pesticides	\$2.2 billion
Groundwater contamination	\$2.0 billion
Other costs	\$1.4 billion
<b>Total costs</b>	<b>\$9.6 billion</b>

The WHO classification of pesticides by hazards is described below. The classification is based primarily on the acute oral and dermal toxicity to the rat since these determinations are standard procedures in toxicology.

WHO Class		LD <sub>50</sub> for the rat (mg/kg body weight)	
		Oral	Dermal
Ia	Extremely hazardous	< 5	< 50
Ib	Highly hazardous	5–50	50–200
II	Moderately hazardous	50–2000	200–2000
III	Slightly hazardous	Over 2000	Over 2000
U	Unlikely to present acute hazard	5000 or higher	

## Pesticides impact

### Organophosphates & Carbamates:

Literature mention that organophosphates have been used worldwide **for more than 50 years**, as insecticides. The use declined in last 20 years.

These pesticides are like nerve gas; they attack the brain and the nervous system, interfering with nerve signal transmission. Symptoms include headaches, nausea, dizziness, vomiting, chest pain, diarrhea, muscle pain and confusion. In severe poisoning incidents, symptoms can include convulsions, difficulty breathing, involuntary urination, coma and death. Acute poisoning of the nervous system by these pesticides affects hundreds of thousands of people around the world each year.

**3,000,000 people** were exposed in USA to organophosphate or carbamate yearly, with up to **300,000 fatalities**

**Figure 1**

Route of entry:

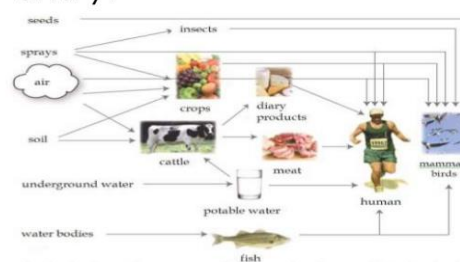


Fig. 1. Routes of exposure to OPs (adapted from WHO, 2001)

Literature indicate that **Mortality rates are from 3-25% worldwide**.

**Fumigants:** Fumigants like methyl bromide and metam sodium can severely injure any tissue they touch. Effects from even minor exposures can include burning and itching of the eyes and skin,

respiratory tract irritation as well as coughing and nose bleeds. Fumigants can severely injure the lungs.

Today there are regulatory restrictions on the use of soil fumigants. They have negative impact over the environment. Without control, can be emitted into the atmosphere due to its highly volatile nature. Many pesticide active and inert ingredients are also identified as volatile organic compounds (Segawa, 2008). Methyl iodide does not contribute to ozone formation. VOCs are compounds which are defined such that upon release to the atmosphere they can react with nitrogen oxides under sunlight to form harmful ground level ozone:

**Organochlorines:** Organochlorines are central nervous system stimulants that can cause tremors, hyperexcitability and seizures. Although these pesticides are generally less acutely (immediately) toxic than organophosphates or carbamates, since they persist in the environment and tend to accumulate in tissue as they pass up the food chain, they are extremely hazardous.

**Pyrethroids:** These organic compounds, similar to the natural pyrethrins produced by chrysanthemum flowers, are promoted by their manufacturers as harmless to humans, and are in increasingly wide use. In fact, pyrethroids are a synthetic copy of a natural poison. While pyrethroids are among the least toxic pesticides to humans, they are an excitatory nerve poison and known carcinogen. They are also highly toxic to insects, fish and birds, even in very small doses. While natural pyrethrum breaks down in as little as twelve hours, the synthetic forms have been engineered to be more stable, and persist in the environment for weeks.

The "Europe's pesticide breakdown: How it harms our environment" makes reviews of the use of synthetic pesticides in Europe, the serious and widely effects they have on the environment, including how they degrade some essential ecosystems and also the urgency to strengthen regulations aimed at controlling their use.

## HOW THE USE OF PESTICIDES IS IMPACTING OUR FOOD SECURITY?

"Food does not know borders." With a growing global population, food security is increasingly threatened and there is a growing challenge for agriculture to produce more food, safe and sustainable.

Therefore a huge number of synthetic chemicals are produced and used in agriculture, to prevent and combat animal and vegetal disease and pests of cultivated plants. These substances are characterized by high toxicity to diseases and harmful organisms, some duration of action, persistence and simple application (1).

As a result of our pesticide dependence, and because of their persistent and ubiquitous reality, almost every ecosystem of the world has already been adversely affected by these harmful chemical compounds.

## CONTAMINATION OF THE FOOD

Literature cites three categories of food contamination: physical, chemical, biological.

### Chemical contamination

Many groups of chemicals contaminants may enter accidentally into foodstuffs at various stages of production or during transport, becoming the chemical contaminants of the food concerned.

Contaminants may be organic and inorganic. A special group of chemical contaminants is represented **by pesticides**.

For example in USA, more than 900 synthetic pesticides are used in more than 60,000 commercial products. In Romania approximately 3000 commercial preparations are approved for use as pesticides in agriculture.

Sometimes, small amount of pesticides used in these ways, remains in food. They are known as pesticide residues. Pesticide residues are a public health concern and have been linked to a range of diseases and disorders. To avoid the contamination of food with pesticides, farmers should use alternative methods like integrated pest management (IPM), crop rotation or organic farming.

Consumers should also consume organic food products to escape from the harmful effects of pesticides. The pesticides originated in feedingstuffs administered to animals, in water etc. Even low concentrations of pesticides in their feedingstuffs/water may result in contamination of milk because of their liposolubility. They accumulate in the livestock body.

### **BEEES AND HONEY**

Bee-toxic pesticides in dozens of widely used products, on top of many other stresses are killing our bees and threatening our livelihoods.- Steve Ellis, MN & CA beekeeper. New 'safe' pesticides to replace banned chemicals still hurt bees, scientists say.

Therefore a recent example of re-thought decisions on pesticides in the EU is on some systemic insecticides.

On 1 December 2013, E. Tyamethoxam (Syngenta product), imidacloprid and cloreanide (Bayer's products) have been forbidden in the EU due to an increasing number of scientific evidence which contest the initial positive evaluation of these systemic insecticides, demonstrating serious negative effects on bees and other pollinators.

Researchers in Switzerland asked around the world to provide locally sourced honey in order to get an idea of the extent of the threat to pollinators from pesticides. They found **neonicotinoids most frequently in samples from North America**, where 86% had one or more neonicotinoid, and least often in South America, where they occurred in 57% of samples.

### **IMPACT OF PESTICIDES ON THE ENVIROMENT – PESTICIDES FAILING IN TOUCHING THEIR OWN TARGET**

Chemicals and pesticide compounds affects the environment and they have potentially serious consequences. In environment pesticides undergo oxidation, hydrolysis reactions which generally produce non-toxic products or reduced toxicity.

We can talk about quick decomposition in case of some pesticides, (for example, of organ phosphorus pesticides) to others decomposition is slow, so the toxicity is reduce. However, the toxicity of pesticide residues in foodstuffs is influenced, in addition to the decomposition speed, by the nature of the decomposition products, and the volatility of these pesticides, namely, is inversely proportional to them. The residual part of the product and therefore their toxicity is still influenced by others factors such as: the applied dose, the time of application, the temperature and the precipitation.

In general, a toxic action of a substance can be divided in two

- immediate and short-term effects, namely acute toxicity
- long-term effects, chronic toxicity.

The acute toxicity of a substance as such and of pesticides is expressed by lethal dose 50 (LD50) which represents the quantity of substance, expressed in mg of the substance at kilocorp causing the death of 50 % of the test organisms.

The literature indicates that the chronic toxicity is prevented by maintaining concentrations below the daily intake (ADI) for each pesticide. The maximum permitted levels of pesticides shall be determined from these dose levels by products or groups of foodstuffs, expressed in mg per pesticide/kg a food product, which is regulated.

The use of agri-chemical products is well known that pose a risk to fauna and natural environments. In particular, pesticides have a major impact on loss of biodiversity - almost one of four species (24.5 %) among vulnerable are threatened in the EU by pesticides and chemical fertilizers, such as nitrates and phosphates.

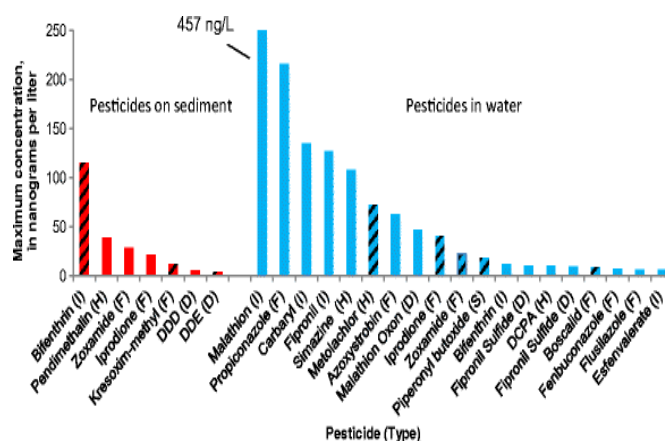
The data also shows a large-scale decline in the diversity of fauna in all groups of bodies studied. For example, 27 % of european mammalian populations are declining; although alarmingly this value could mask a much more serious tendency, as the situation of 33 % of mammalian species is not known. despite the growing evidence of serious problems produced by chemical pesticides, still :

1. no substantial policy-change or measures were taken to reduce their negative environmental effects and this may be considered a European failure,
2. children are more vulnerable to pesticide exposure

Children are more vulnerable to pesticides exposure because their organs, nervous systems and immune systems are still developing; their higher rates of cell division and lower body weight also increase children's susceptibility to pesticide exposure and risks. Most pesticide exposure occurs through the skin and children have more skin surface for their size than adults. Children have a higher respiratory rate and so inhale airborne pesticides at a faster rate than adults. With their increased contact with floors, lawns and playgrounds, children's behavior also increases their exposure to pesticides.

## WATER CONTAMINATION

Rainwater usually is safe to drink. However lately has become increasingly **contaminated** due to air **pollution** in various places of the world. Then the toxic storm water runoff pollutes rivers, streams and lakes. Much of the **contamination has been demonstrated that comes from** agriculture and industry, one source being the pesticides



Maximum concentrations of pesticides in stormwater runoff. Sampling included 15 streams and 5 outfall sites, each sampled once. Bar cross hatches indicate pesticides with maximum concentrations in stormwater outfalls. Pesticide types: F, fungicide; H, herbicide; I, insecticide; S, synergist; D, degradate

## WHAT ARE THE PRO? - WHY WE SHOULD NOT GIVE UP TO THE USE OF PESTICIDE?

Chemicals which inhibit or destroy harmful biological agents are defined as pesticides.

These substances are now indispensable for intensive agriculture. The world necessity has led to the increase and diversification of the levels of pesticides used and of very efficient substances. In terms of both - composition and destination. Therefore pesticides are much diversified. The use of herbicides, insecticides and fungicides **reduces crop loss**, before and after harvesting, increasing crop yield. Farmers use pesticides **to control** the growth of weeds, prevent crop damage by insects, rodents and molds. After harvest, pesticides are used to **increase the storage life** and **prevent spoilage**. Pesticides may also be used on **animal farms** to control insect-pests.

**More precisely**, based on **their use** each type of pesticides control a specific pests, such as:

**Algaecides** - kill / slow the growth of algae.

**Antimicrobials** - control germs and microbes such as bacteria and viruses.

**Disinfectants** - control germs and microbes ( bacteria, viruses)

**Fungicides** - control fungals ( molds, mildew, and rust)

**Herbicides** kill / inhibit growth of unwanted plants (weeds)

**Insecticides** control insects

**Insect Growth Regulators** - disrupt growth reproduction of insects.



**Rodenticides** kills rodents ( mice, rats, and gophers)

**Wood Preservatives** make wood resistant (insects, fungus, pests)

**Other advantages**

**In Asthma and Allergies** they help us to control indoor household pests (**cockroaches**). So, they have a say in controlling asthma and allergies.

**Bacillus anthracis spores** are a threat to public health. Pesticides can be used in anthrax spore decontamination

**Various microorganisms (bacteria, protozoans)** can contaminate hospitals, clinics, food processing facilities. etc There are many antimicrobial products registered out there intended to control microorganisms and help prevent the spread of numerous diseases.

**For Avian flu and viruses in general** there are antimicrobial pesticide products (sanitizers or disinfectants) that may be used to kill viruses on inanimate surfaces and to help prevent the spread of avian flu viruses (poultry industry).

### **IN ORDER TO PROTECT US GOVERNMENTS HAVE CREATED A REGULATORY SYSTEM FOR CONTROL THEIR USE**

The establishment of the presence or absence of pollution factors in foodstuffs is a major concern of governments in order to protect consumers. Per se, the competent authorities all over the world and international bodies pursue food contaminants in food. These constitute an important task of them, including those related to international trade.

Their control must identify the presence or absence of polluting substances in the product undergoing investigation, and in the event of their presence their concentration must be determined in order to establish whether the contents are within established limits, **according to the world current knowledge**.

Having regarded the toxic nature of pesticides, consumption of products treated with such substances **pose a risk** (the products contain the substances in question or any toxic products resulting from their degradation at concentrations beyond permissible limits).

Therefore, the legal framework for the pursuit of hygiene and the safety of foodstuffs, and in particular of pesticide contents, is established by public health legislation, food production legislation, environmental legislation, legislation on the use of plant protection products, the regime of toxic and dangerous substances and on plant protection, hygiene rules for foodstuffs, hygiene standards and public health, relevant standards.

In 2013, the European Union and a few non EU countries restricted the use of certain neonicotinoids; In 2018, the EU banned the three main neonicotinoids clothianidin, imidacloprid and thiamethoxam for all outdoor uses.

Austria becomes the first Member State in the European Union to outlaw this controversial herbicide. The Vienna Parliament approved the amendment of the law by which the use of glyphosate in Austria is completely forbidden.

Determination of pesticide residues requires preliminary processing of samples:

- The extraction consists of passing the pollutant from the sample feed into a suitable solvent, which will be analyzed when it has been further processed pesticides of an organic nature are generally soluble in fats (are propellants) and organic solvents. Extraction is therefore done with organic solvents (ethyl ether, light petroleum, benzene, etc.). The hydrosoluble pesticides are extracted with polar solvents such as acetonitrile. Extraction is carried out by passing the appropriate solvent over the product with agitation and heating. An example of an extraction apparatus is the Soxhlet apparatus.
- Purification of the extracts is carried out in order to remove from the extract substances which might disturb the analysis. Purification can be carried out by repeated washing of extract with distilled water and retention by absorption of pesticides in suitable filling columns followed by desorption with appropriate selective solvents.

- The concentration is intended to reduce the volume of the samples obtained from extraction and the solvent is distilled under vacuum.
- The methods of analysis of the residual levels of pesticides are the methods of physicochemical, high-performance, which are currently widely applied in analytical chemistry in general and the analytical chemistry of particular food.

The following give a summary statement of the principles of methods:

- ✓ colorimetric and spectrophotometric methods are based on measuring the dimming of the radiation light through a layer solution of a colored compound. The decrease in intensity is proportional to the concentration of the solution. Previously, pesticides are converted by appropriate chemical reactions into soluble color compounds.
- ✓ the chromatographic methods are based on the differential absorption of the components of a mixture on the surface of the porous absorber material which they pass. there are a large number of chromatographic methods which may be grouped according to the nature of the medium to which the absorption takes place.

The main chromatographic methods are:

- ✓ Thin-layer chromatography using a layer of silica gel deposited on a glass plate subjected to a known quantity of the prepared sample and then the mobile phase (light petroleum) which produces a differentiated migration of the test components as a stationary phase;
- ✓ Gas chromatography, using a porous material saturated with a suitable substance selected and introduced into a column as the stationary phase. The stationary At this stage is driven by an inert gas (argon) which carries the sample in very small quantities. The sample components move at different speeds due to different affinity from the absorbent substance. At the end of the column, the separate components are highlighted by a detector measuring their physical properties (thermal conductivity, ultraviolet radiation absorption).
- ✓ Liquid chromatography works on a similar basis - in the gas phase but that the mobile phase is a liquid and the detector is of a construction corresponding to those conditions. A more modern and rapidly expanding version of a great degree of accuracy is that created at high pressure (HPLC - high pressure LIQUID).

## CONCLUSIONS

Pesticides are the agrochemicals used in agricultural lands, public health programs, and urban green areas in order to protect plants and humans from various diseases.

However, due to their known ability to cause a large number of negative health and environmental effects, their side effects can be an important environmental health risk factor.

The urgent need for a more sustainable and ecological approach has produced many innovative ideas, among them agriculture reforms and food production.

Agriculture must be radically reoriented in the direction of viable, chemical-free methods,

- organic farming
- full use of ultrasound services,
- natural methods against vermin.
- development and selection of certain plant varieties, disease resistant, helping to reduce and even eliminate insects and harmful fungus
- crop rotation, closely planned,
- as well as diversification of agricultural systems
- the use of biculturists or multii culturists may increase significantly and reduce infestation by Pests.
- Protection of soil and reinforcement of its organic matter,

For now on it is advisable for all countries to practice large-scale ecological agriculture.

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# COMPARATIVE ANALYSIS OF TECHNICAL INDICATORS FOR CONVENTIONAL AND ECOLOGICAL AGRICULTURE

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**Abstract:** *Conventional agriculture is characterized by intensive mechanization and chemization, making products competitive on the market of agricultural products, while organic farming is a "modern" process of growing plants, fattening animals and producing food, which stands out. fundamental of conventional agriculture. In this paper, the technical indicators for the two types of conventional and ecological agricultural systems will be analyzed. The analysis of the surfaces, the average productions as well as the total ones from the quantitative point of view will be carried out, with the help of the data provided by the National Institute of Statistics (INSSE) and the Institute of Research - Ecological Agriculture (FIBL). This analysis highlights the evolution or involution, retrospective and current situation for the two types of agricultural systems at national level, using the method of comparative analysis, in order to determine the direction of these agricultural systems.*

**Keywords:** *evolution, conventional, ecological*

**JEL Classification:** *Q 14, Q57*

## INTRODUCTION

Agriculture is the basic branch of the national economy through which food products and raw materials are provided for the consumer goods industry, it is a branch of material production, where, with the help of green plants and under human influence, the kinetic energy of to the sun, in potential energy organic matter, the only form of energy accessible to the human and animal organism. As an independent occupation, agriculture has required the emergence of agricultural producers who, in addition to the process of obtaining the products, also deal with the transformation of plant agricultural products into animal or industrial products, which are then used in human nutrition.

Agriculture facilitates the creation and development of new branches of production. Conventional agriculture is characterized by intensive mechanization and chemization, making competitive products on the agricultural products market; this system of agriculture is based in particular on the concentration and specialization of production.

Organic farming (term similar to organic or organic farming) is a "modern" process of growing plants, fattening animals and producing food, which is fundamentally different from conventional farming. Organic farming contributes to the growth of economic activities with an important added value and has a major contribution to increasing the interest for the rural area.

## MATERIALS AND METHODS

The present work is subject to the analysis of the land fund, the surfaces, the average and total productions for agricultural crops, but also total productions for crops in ecological system at national level, so this is the main objective of the work, to show the positive or negative evolution with data provided by the National Institute of Statistics (INS) and the Ministry of Agriculture and Rural Development (MADR), Research Institute of Organic Agriculture (FIBL) using the method of quantitative and qualitative comparative analysis of data for the period analyzed 2013-2017.

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## RESULTS AND DISCUSSION

The territory of Romania totals an area of 23.8 million hectares, where the agricultural area used in the agricultural units was about 14.5 million hectares, representing 61.37% of which about 9.2 million hectares represent arable land at the end of 2014.

**Table 1.1 Land fund, according to the mode of use**

Use categories of the land fund	2009	2010	2011	2012	2013	2014	2014/2009	2014/2013
<b>Total</b>	23839071	23839071	23839071	23839071	23839071	23839071	0	0
Agricola	14684963	14634436	14621427	14615057	14611883	14630072	-0,374	0,124
Arable	9422529	9404008	9379489	9392262	9389254	9395303	-0,289	0,064
Pastures	3313785	3288725	3279251	3270610	3273961	3272165	-1,256	-0,055
Rough	1528046	1529561	1554680	1544957	1541854	1556246	1,845	0,933
Live nurseries	215382	213571	211347	210475	210270	209417	-2,769	-0,406
Orchards and nurseries	205221	198571	196660	196753	196544	196941	-4,035	0,202
Non-agricultural land	9154108	9204635	9217644	9224014	9227188	9208999	0,600	-0,197
Forests and other vegetation	6752998	6758097	6759140	6746906	6742056	6734003	-0,281	-0,119
Busy with water	833226	833949	822202	836856	835997	831495	-0,208	-0,539

Source: National Institute of Statistics

Reporting on 2014, in 2009 (base year) we see that the agricultural area decreased by 0.37% while in the same year compared to the previous year it increased by 0.12%. Regarding the arable area, it can also be observed changes, decreasing in 2014 compared to the base year by about 0.29% but increasing in the same year compared to the previous year by 0.064%.

Agriculture can be evaluated in terms of surface area, average and total production so we can see that the arable area at national level is mainly occupied by cereal, oil and vegetable crops so that for the period 2013-2017 the areas occupied by these crops have varied. For a wider and varied perspective, cereal, oilseed crops and vegetables were taken into consideration.

**Table 1.2 Surfaces with the main agricultural crops**

The main cultures	2013	2014	2015	2016	2017	2017/2013	2017/2016
	<i>ha</i>					<i>%</i>	
Wheat - total	2103985	2112866	2106591	2137731	2052917	-2.43	-3.97
Barley is barley	495685	515996	469859	481605	455457	-8.12	-5.43
Corn beans	2518268	2512809	2605165	2580975	2402082	-4.61	-6.93
Pea grains	31765	27364	31702	43218	106562	235.47	146.57
Sunflower	1074583	1001020	1011527	1039823	998415	-7.09	-3.98
Rape	276596	406705	367885	455953	597967	116.19	31.15
Soy beans	67672	79910	128156	127266	165143	144.03	29.76

Source: National Institute of Statistics

From the above table, respectively table 1.2, it is observed that the areas cultivated with wheat in 2017 decreased by 2.43% compared to 2013 and by 3.97% compared to 2016.

The most significant decrease of the surface is registered in 2017 compared to 2013 in barley and barley culture, which shows a decrease of 8.12%.

At the opposite pole with the highest growth of the surface is recorded the pea crop, the area cultivated with this plant increasing by 235.47% in 2017 compared to the base year and by 14.57% compared to the previous year. There are also positive developments for the areas where rape and soybeans were grown.

**Table 1.3 Average productions for the main agricultural crops**

The main cultures	2013	2014	2015	2016	2017	2017/2013	2017/2016
	<i>Kg/ha</i>					<i>%</i>	
Wheat - total	3468	3590	3780	3944	4888	40.95	23.94
Barley is barley	3111	3319	3461	3773	4186	34.55	10.95
Corn beans	4488	4770	3462	4159	5959	32.78	43.28
Pea grains	1719	1864	1744	1823	2649	54.10	45.31
Sunflower	1993	2187	1765	1955	2917	46.36	49.21
Rape	2408	2604	2499	2835	2798	16.20	-1.31
Soy beans	2216	2539	2045	2070	2383	7.54	15.12

Source: National Institute of Statistics

Analyzing the year 2017, at the base year 2013 we can see that the yield obtained per hectare increased for all crops, the highest growth being registered at the pea crop of 54.1%, at the opposite pole with the smallest growth being soybean culture with 7.54%.

Significant increases are observed in the same year, 2017, but compared to the previous year where the crops of corn, peas and flower are in the leading positions in terms of changes with the production obtained per hectare. The highest yield per hectare is recorded in the corn crop, while at the opposite pole is the pea crop.

**Table 1.4 Total productions for the main agricultural crops**

The main cultures	2013	2014	2015	2016	2017	2017/2013	2017/2016
	<i>tons</i>	<i>%</i>					
Wheat - total	7296373	7584814	7962421	8431131	10034955	37.53	19.02
Barley is barley	1542247	1712509	1626330	1817269	1906703	23.63	4.92
Corn beans	11305095	11988553	9021403	10746387	14326097	26.72	33.31
Pea grains	54590	51017	55302	78808	282245	417.03	258.14
Sunflower	2142087	2189309	1785771	2032340	2912743	35.98	43.32
Rape	666097	1059121	919473	1292779	1673327	151.21	29.44
Soy beans	149931	202892	262061	263380	393495	162.45	49.40

Source: National Institute of Statistics

It is worth noting that the total yields obtained for the seven crops increased significantly in 2017 compared to 2013 respectively 2016 although, according to the data presented previously, the areas covered by these crops decreased for the reference period. These increases in production can be accounted for by the average yields obtained per hectare using the technologies applied, on favorable weather conditions during this period but also on the quality or variety of the seed used. The grain production for grains increased in 2017 compared to the previous year, as follows: maize grain - 33.3%, barley and barley 4.92%, wheat 19.2%.

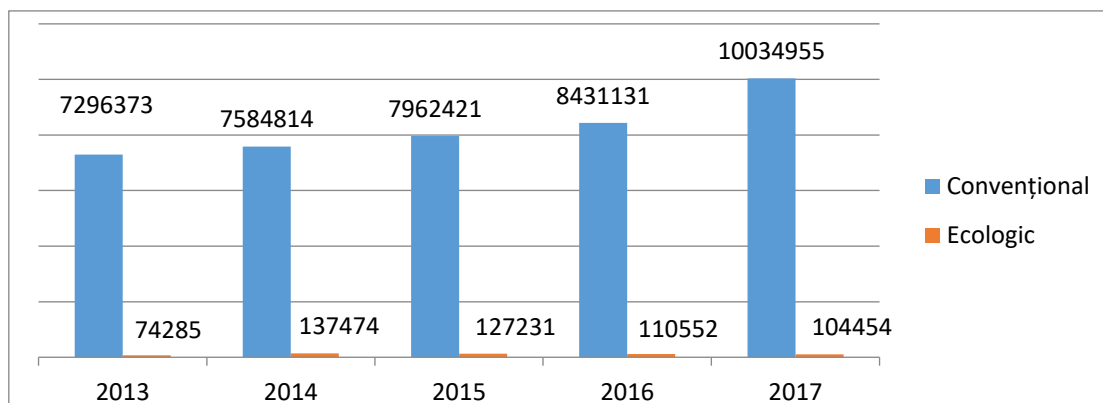
**Table 1.5 Total productions for the main agricultural crops in ecological system, national level**

The main cultures	2013	2014	2015	2016	2017	2017/2013	2017/2016
	<i>tons</i>					<i>%</i>	
Wheat - total	74285	137474	127231	110552	104454	40.6	-5.5
Pea grains	-	35715	39985	40055	52093	45.9	30.1
Sunflower	-	38731	37262	36290	47707	23.2	31.5
Rape	-	28031	20401	20772	24667	-12.0	18.8
Soy beans	-	17164	22036	19376	18924	10.3	-2.3

Source: National Institute of Statistics

From the table above, respectively (tab.1.5), we observe that wheat production increased by 40.6% in 2017 compared to 2013. The highest growth recorded in 2017 compared to 2013 is registered in the its peas production increased by 45.9%. At the opposite pole with the smallest increase of the total production is registered the soybean crop, the total production increasing by only 10.3%.

**Graph 1. Production of wheat in conventional and organic system between 2013-2017**



From the graph above (graph no. 1) it can be observed that the wheat production encountered in the two analyzed systems are very quantitatively different, but the quality of the organic products is higher compared to the quality of the products found in the conventional agricultural system.

## CONCLUSIONS

Organic farming, relatively new in European law, is practiced in 2018 in the EU member states and beyond, being practiced in approximately 170 countries. According to the statistical data provided by the German Institute of Organic Agriculture Research in 2017, organic farming was practiced on an area of approximately 12 million hectares, 78.7% more than in 2007. In Romania, on 28/05/2019, there are 13 inspection and certification bodies validated by OFIS (Organic Farming Information System).

The inspection and certification bodies in the territory of Romania issued in 2014, about 12 thousand certificates for organic farming, of which about 3 thousand were released in the plant sector, at a difference of three years, respectively 2017 (according to the website of FiBL), a number of 7,908 organic producers in the plant system have been identified and their number is expected to increase.

Organic farming is gaining increasing importance and is constantly expanding. This development is supported by the growing consumer demands for organic agricultural products, which are becoming more aware and interested in ensuring health through the consumption of products, to which are added the society's demands for sustainable agricultural development, as well as the multitude of favorable effects at the level of agricultural farm and environment.

Conventional as well as organic agriculture is a sector of great prospects for Romania, our country benefiting from appropriate conditions for the development of the two agricultural systems, such as fertile soil and the reduced level of pollution of the natural space, in comparison with economically developed countries, in which super intensive agricultural technologies, largely based on chemical fertilizers and synthetic pesticides, are widely used.

The knowledge of the two aspects can support the agricultural producer, the technical-economic support provided can provide the necessary information in evaluating the activity undertaken and taking a technical or economic decision in order to increase the profitability in conventional and / or organic farms.

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# THE FARM STEPA, COUNTY CONSTANZA ROMANIA A PIONEER OF ORGANIC AGRICULTURE

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**Abstract:** *The paper describes the ecology farm STEPA Constanta which practice an original system in the driest zone of Romania, Northern plateau of Dobrogea. The main innovations of this system are associated crops and medicinal plants. The soils are medium fertile. On it grows cereals, pulses, oilseeds as pure culture or associated. The seeds are exported and farm activity is profitable.*

**Keywords:** *Agriculture, ecological, technological system, profitability.*

**Classification JEL:** *Q55, Q57*

## INTRODUCTION

Essences of organic farming in vegetal production in version without chemically synthesized fertilizers as source of food for Plant and pesticides to fight a weeds, pests and diseases they were replaced with organic fertilizers and cultural techniques. The declared purpose is obtaining healthier consumer products, a soil fertility restoration clean version of sustainability conditions.

Organic agriculture/farming, until recently a niche version, tends to become if not now dominant, at least competitive, the historical circumstances that have led to this phase are numerous. They come from two directions – the consumer is increasingly unhappy with what is given to him as food, starting from vegetables that have not seen the soil, with cheese that have not see the milk. The consumer is concerned not only with the quality lack of taste, appearance) but also with the fact that the intensive, productive agriculture uses a lot of toxic substances that endanger his health. On the other hand, the farmer perceiving the “demand” is increasing the “offer” of ecological/organic products, taking care to raise the price, the additional costs and to earn more as the market economy is prone to maximizing the profit.

This material present an original system of ecologic agriculture practiced by Agricultural Society, “STEPA” located in North Dobrogea Plateau, without irrigation. It cultivates cereals pulses, oil and medicinal species in pure culture or associated in particular sequence.

## MATERIALS AND METHODS

The material presents the ecological farm of STEPA from Constanta County, one of the first of its kind in Romania. The farm is not just a pioneer in the field in the ecological regard. The assortments of plants, the culture system, the equipment used are original, some even unique and can build a model of organic farming. The method is descriptive, the authors are proposing themselves to present the original case to the specialists and the interested public.

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## RESULTS AND DISCUSSIONS

### *The method of construction and management of the STEPA farm*

The farm is located in the middle of the most arid province of Romania, Dobrogea, which belongs to agro climatic zone I warm-arid, characterized by two sub-continental accented with a high variability amplitude in thermal values and precipitation during growing season.

The average annual temperature range is between 11.0-11.2 °C with a brightness period 2180-2260 sun hours/year, amount a sum of positive temperatures (over 0°) of 4100-4200°C and an active temperature over 10°C, about 1600°C.

Rainfalls are the lowest in the county around 400 mm annually unevenly distributed especially in the growing season. In the late spring and early summer they are too complicated pair of averse causing land erosion and surface slop version.

High degree of aridity of the are motivated irrigation on more than 90% of arable land, Constanta County.

Greater heights pumping water and the light costs expelled from irrigation rehabilitation and is believed that it is unlikely that the area will continue to be irrigated.

STEPA farm was built in 1991, on the basis of the Law no.36 /1991, by associating a number of former cooperative families, which were appropriated according to the Law no.18 /1991.

As an organic farm, the unit operates an area of 300 ha of arable land.. Agricultural Society “STEPA”, a version of the Organic Agriculture system adopted during 1998-2000, found one of the top holdings of this kind in Romania. He is a member of the Romanian Association for Sustainable Agriculture – ARAD.

In 2000 it obtained necessary certification. Top Organic Products obtained in 2000 Former OA version was wheat, coriander, mustard, exported in Netherlands, witch carried out a certification as to that data in Romania there are not specialized companies authorized to provide such services. Since 2003, LACON company, BMD in Germany, Management is provided by the Board of Directors, led by a technician (Nicolae Alexe) with a ling activity in an agricultural research station.

**Technological system.** Constanta County is specialized in drought control through irrigation. Is characterized by succession of species in pure culture, or not, followed by successive crops as green manure.

Winter wheat. Regularly is sown after vetch. In wheat stubble is sown a leguminous plant (Lucerne, for example) which is incorporated into soil as green manure with winter plowing.

Mustard and Lucerne, culture combined. Sow is with the same girl, but on separate rows of straw with drill SUP 29, adapted. A total of 15 tubes distribute the seed from the main crop, alfalfa seed is distributed by 14 tubes from a box second further adapted, Sowing distance is 25 cm for both species (fig. 2).



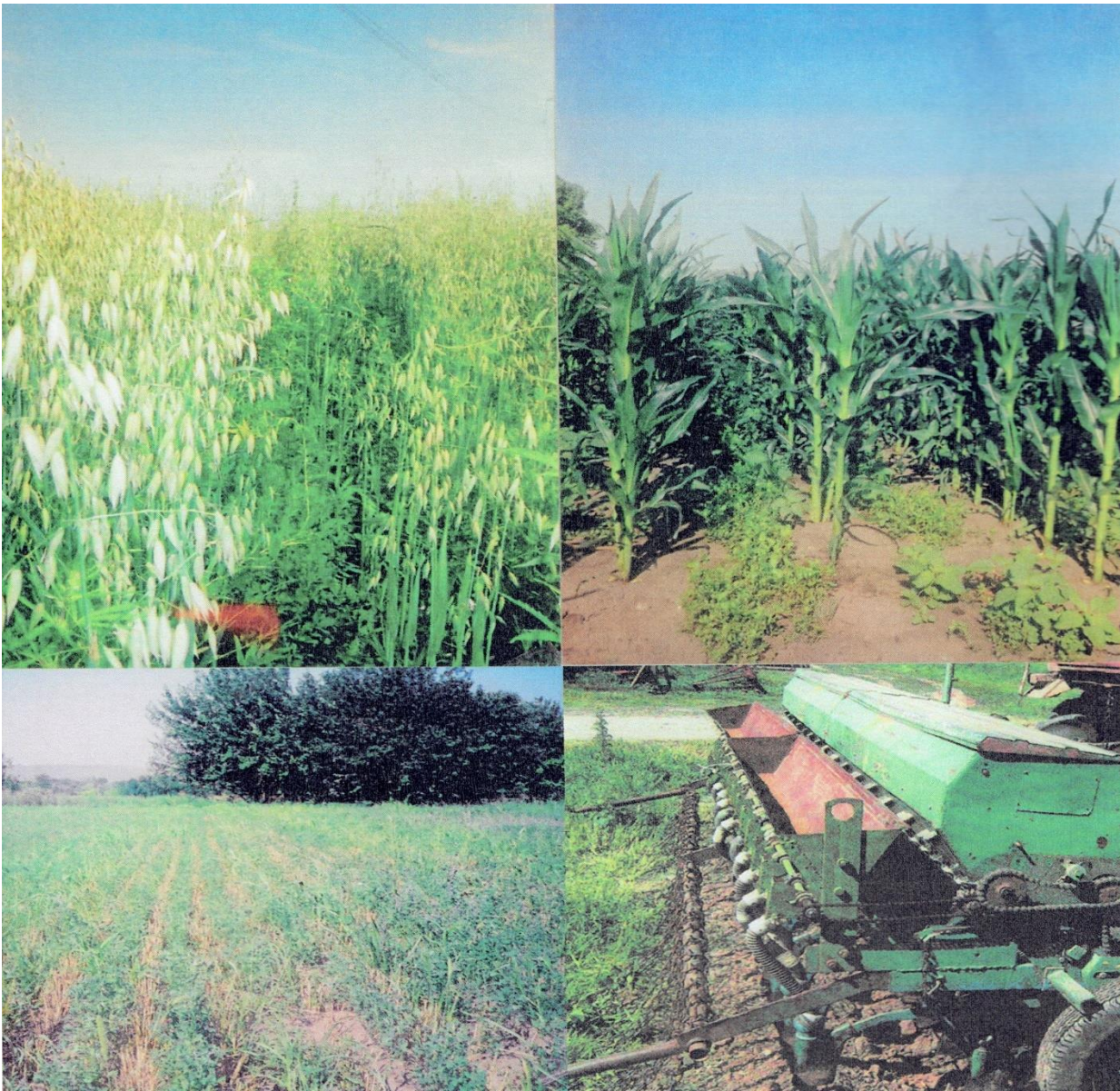


Fig.1 Associated crops oath + Alexandria clover (above left), maïse + Alexandria clover (above right), Lucerne in wheat stubble (below left) and the cereal drill adapted for sowing associated crops (below right).(Source 4).

The two plants are not impeded whereas Lucerne is the first part of vegetation growth rate is much lower than is harvested during the month of June without the performance drop significantly.

Lucerne is mown once or twice, depending on rainfall. Lack of them, Lucerne is incorporated into soil in autumn as grass manure. In terms of non irrigated agriculture is preferably that. Lucerne is maintained in a second year when it accumulates more nitrogen obtaining at the same time a seed crop as raw material required in version pharmaceutical industry.

Lucerne cultivated in combination with spring rape, mustard or other spring crop some years cross the entire area, enriching the soil in nitrogen while being a good precursory.



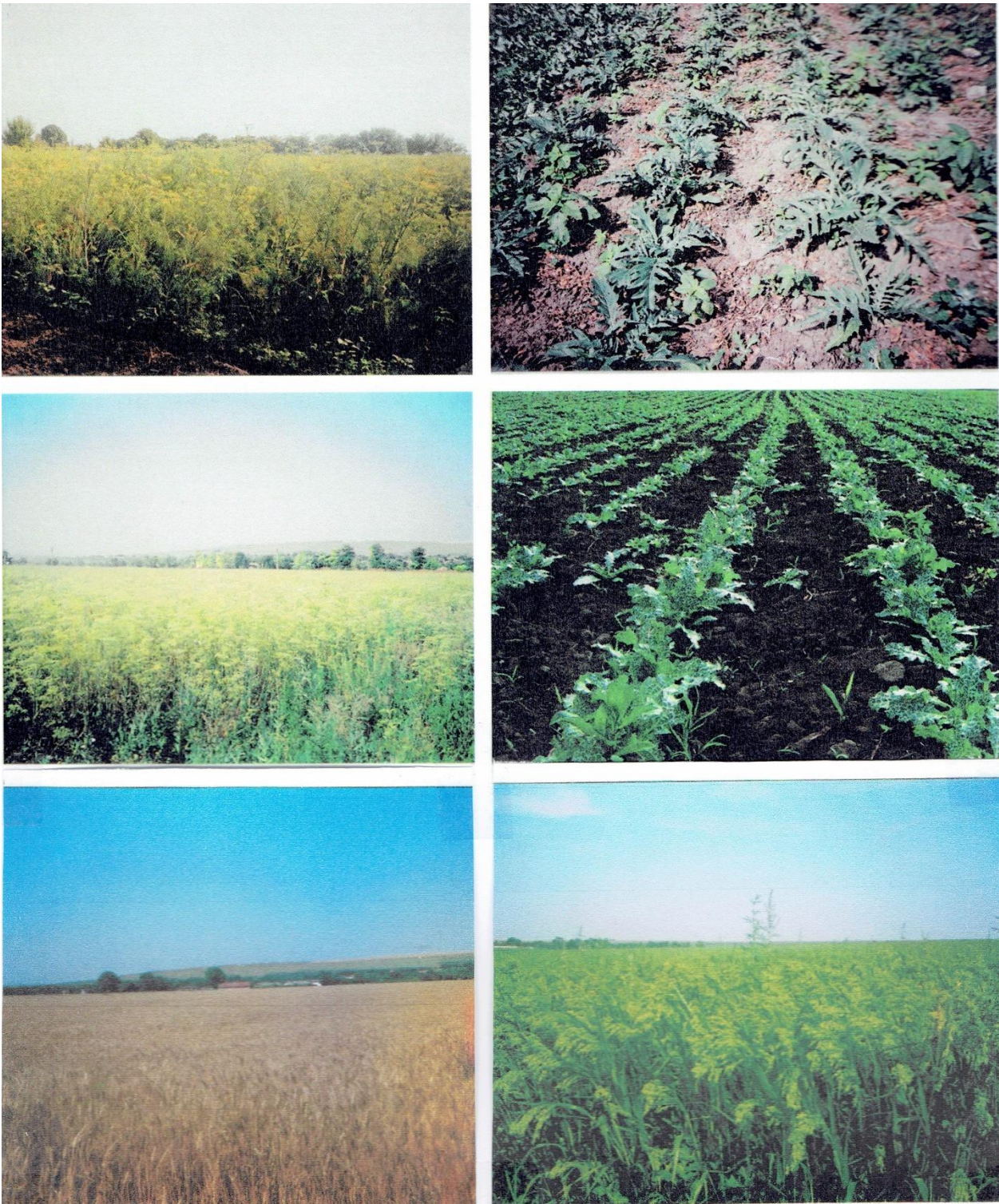


Fig.2 Some species of medicinal plants or associated: *foeniculum vulgare* (above left), *silybum marianum* (middle right), *coriandrum sativum* (middle left), *camelina sativa*, *trigonrlla procumbens*, *cynara scorymus* (above right), *ecologic wheat* (below left) and *panicum milliaceum* (below right). (Source 4).





Fig.3 Exhibition of STEPA farm (above) and the visit of the resort minister (below, second from the left). (Source 4)

Annual forages. Winter fodder. Regularly is sown oats + vetch, which is harvested in May. It prepares the soil by not deep plowing, and harrows discs and is sown with mustard as green manure.

Food miller or coriander. Both crops are harvested in summer time allowing an autumn and fertilization with 12-15 t/ha compost. We can use also another association, oats with clover .

Vetch with camelina mixed as plant support. It harvested in early July. Seeds are separated slightly owing to different size. Camelina is an oily plant, a seed of witch are used as raw material for vegetable oil extraction. Associated crops contribute to increase profitability utilization of the Earth. To exemplify a joint technology and economic efficiency: of Mustard and Lucerne. Lucerne and mustard I year and Lucerne year II.

Technology. Mustard was sown (March 10 to 20), a little later for a permit to cruciferous weeds rises and be destroyed by shame before sowing mustard, Mustard and Lucerne seed was 10 kh/ha.

After sowing a work of a soil cylinder cold crusher and fertilized by certified organic foliar fertilizer.

At harvest mustard, Lucerne is 10-15 cm high so that mustard harvest can do in good condition. The yields of mustard were around 600-1000 kg/ha and by autumn version was obtained two Lucerne yield.

Another technological innovation practiced by the STEPA farm is that apart from pure or associated organic products, it has commonly cultivated medicinal plants such as: *foeniculum vulgare*, *silybum marianum*, *coriandrum sativum*, *camelina sativa*, *trigonrlla procumbens*, *cynara scolynus* and others (fig. 2).

STEPA farm participated in demonstrational exhibitions and due to the pioneer status in the field and innovator it was honored by the visit of the resort minister (4), (fig.3).

At farm level organic agriculture was profitable too.

Table 1. Calculation of profitability at farm level 23456

<i>Crop</i>	<i>Total expenditure lei/ha</i>	<i>Profit lei/ha</i>	<i>Profit rate%</i>
Wheat	1318	1182	89.7
Mustard and Lucerne	1168	772	39.8
Winter fodder	997	253	25.4
Millet	1240	410	33.1
Sunflower	1059	141	13.3
Vetch and camelina	1132	468	41.3

Source: 2

As it can be seen in the table no.1, the wheat has the highest expenditure per ha, i.e 1318 lei/ha but also the highest profit 1182 lei/ha, with a profit rate of 89.7%. The second crop as profitability is vetch and camelina, with a rate of profit of 41.3%, in lei meaning 468 lei/ha, followed close s rate profit by mustard and Lucerne, 39.8%, even if at this crops the profit in lei is higher 772 lei/ha. Millet has a profit rate of 33.1% (410 lei/ha), winter fodder 25.4% (253 lei/ha) and the lowest rate of profit it can be seen at the sunflower, 13.3%, 141 lei/ha.

## CONCLUSIONS

1. Organic agriculture is expanded rapidly in the last decades due to the conjuncture factors such as: the need to built a sustainable agriculture, the emergence of consumers able to pay for more healthy food and not least as a profitable business.
2. After calculating the expenditures and profit on each crop, it can be seen that the most profitable crop is the wheat crop with a profit of 1182 lei/ha, comparing with the expenditures that are of 1318 lei/ha, it results a profit rate very high, 89.7%, meanwhile the sunflower has the smallest profit, of 141 lei/ha, the expenditures being of 1059 lei/ha, it results a low rate of profit, 13.3%.
3. In 2008, for example, the profit obtained on unit area was 1142 lei/ha much higher compared with the conventional system in this part of the country. On the complete cycle production of 6-7 in non irrigated conditions in Dobrogea can obtain a net profit of 530-540 lei/ha/year. With a profit rate of over 45%.
4. Expansion of organic agriculture in Romania will depend both on the growth of export opportunities and demand trends of the Interior for organic production.

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# ANALYSIS OF THE POTENTIAL OF THE PARK OF MACHINES AND AGRICULTURAL EQUIPMENT AT REGIONAL LEVEL

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**Summary:** *In Romania, over 73% of agricultural machinery in Romania have an exceeded service life, and the technical endowment of agricultural machinery farms has a direct influence on the market performance of the producers. The increase of productivity in the agricultural field depends to a large extent on the mechanization of the sector, which is supported by the funds allocated for investments in purchasing or the modernization of agricultural machinery parks. The purpose of this paper is to examine the agricultural mechanization sector in Romania, carrying out both a qualitative and a quantitative analysis of the data related to agricultural machines and machines. In order to highlight the differences at the regional level of development of investments in the mechanization of the farms, the two periods of implementation of the NRDP 2007-2013 and 2014-2020 were considered.*

**Keywords:** *agricultural machinery park, mechanization, investments*

**JEL classification:** *Q16*

## INTRODUCTION

Agriculture plays a strategic role in all countries of the world, as it is the main sector responsible for the food security of the population, at the same time having a special contribution to the overall process of sustainable economic development and environmental protection.

Technical equipment of agriculture is one of the essential elements in capitalizing on the potential existing in this sector, implicitly, in ensuring the food security of the country's population. The level of the factors of production represents the decisive element in the development of the production processes in agriculture.

The capital in agriculture, expressed by the quantity and quality of the technical-material factors, has a social importance, considering that the inadequate facilities of the agricultural holding with agricultural machinery and equipment, as well as with constructions with agricultural destination, is one of the main growth facto, of agricultural labor productivity.

The consequences of poor mechanization of agriculture or of inadequate equipment are reflected in: shallow plowing, increase of soil compaction, quality of crop care works, mechanical deterioration of the quality of the harvested products, increase of harvest losses, delay of the optimum period of work, polishing soil, water and air, spreading harmful substances due to exhaust gases or chemicals used for chemical protection, etc. To a great extent, the economic development depends on the quantitative, structural and qualitative evolution of the fixed capital.

The production and use of capital goods in the economic activity of the holding contributes to the increase of the productivity of the other factors of production..

The main results regarding the technical equipment of agriculture are presented below at national level and in regional profile.

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## MATERIALS AND METHOD

Within the study are processed statistical information that is provided by the National Institute of Statistics (INSSE), MADR and EuroStat.

For a closer examination of the mechanization sector, a qualitative and quantitative analysis of the data is processed, using the indicators: annual growth rate, standard deviation and coefficient of variation.

In order to highlight the regional differences, the 8 development regions of Romania will be studied during the NRDP programming periods 2007-2013 and 2014-2020.

## RESULTS

Making a report of the two periods studied, at national level, the total number of agricultural machinery and equipment registered an increase of 12% compared to the first period 2007-2013 (469.5 thousand units), recording annual rates of increase of 1.66%, respectively 2.17%, the coefficients of variation being around 3.3%.

Table 1. Regional distribution of the technical endowment of the park of agricultural machines and machines

Total agricultural machinery and equipment	Period 2007-2013				Period 2014-2018			
	Average	Annual Rhythm %	Standard deviation	Coefficient of Variation %	Average	Annual Rhythm %	Standard deviation	Coefficient of Variation %
Total	469510.57	1.66	15572.04	3.32	532752.8	2.17	17633.65	3.31
North- West	72990.29	4.31	6228.62	8.53	92966	4.04	5438.95	5.85
Center	60856.14	1.85	2673.23	4.39	71074.2	2.99	2950.83	4.15
North- East	51459.14	2.23	2253.80	4.38	62716.2	5.03	4689.12	7.48
South- East	57567.86	-0.75	1105.01	1.92	56887.2	-0.48	438.06	0.77
South-Muntenia	89454.86	2.14	3809.26	4.26	99130.4	-0.86	2154.33	2.17
Bucharest - Ilfov	3927.00	0.90	106.84	2.72	4060.8	0.35	20.02	0.49
South-West Oltenia	62831.86	1.41	1982.82	3.16	68867	1.90	1896.41	2.75
West	70423.43	-0.06	741.17	1.05	77051	3.23	5082.79	6.60

Source: data processed according to INSSE

Analysing at regional level it can be observed that:

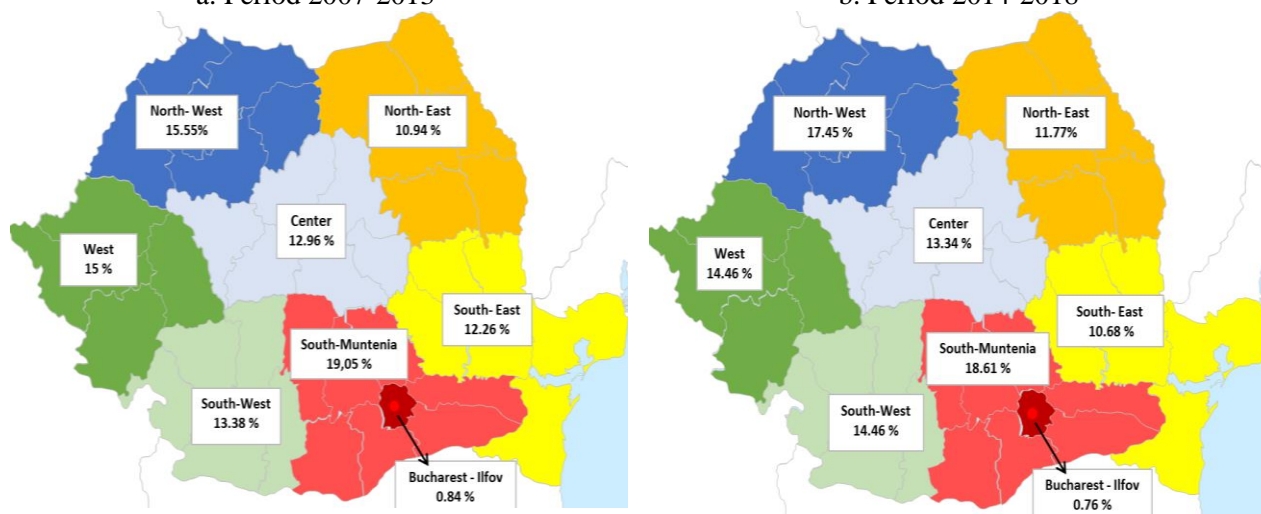
- The South-Muntenia region recorded the highest share of the number of agricultural machinery and equipment reported at national level, between 2007 and 2013, of 19.05% (figure no.1.a.), this fact being maintained on 2014-2018 period (18.61%). In the first analysis period, was recorded an average annual rate of 2.14%, with a coefficient of variation of 4.26%, and in the second period, an average negative annual rate of -0.86% was registered, with a coefficient of variation of 2.17%;

- According to the South –Muntenia region, the following two regions with the highest average number of agricultural machinery and equipment are North West and West ranging from 72.9 thousand units and 70.42 thousand units, with a standard deviation from the average of 6.22 thousand units and 741 units, for the first period studied;

- A negative annual rate was registered for the two periods considered in the South-East region, of -0.75% and -0.48% respectively. The number of a agricultural machinery and equipment

decreasing from an average value of 57.56 thousand units in the first period, to 56.88 thousand units in the second period.

Figure.1 The share of agricultural machinery and equipment at regional level  
a. Period 2007-2013 b. Period 2014-2018



Source: data processed according to INSSE

Source: data processed according to INSSE

By analysing the weight of agricultural machinery and equipment at regional level, it can be seen in figure no. 1. the fact that the South-Muntenia, North-West and West regions hold the majority of the national share in the two periods considered.

A decrease in the share of agricultural machinery and equipment, from the first period 2007-2013 to the period 2014-2018 can be seen in the regions: South-Muntenia, (from 19.05% to 18.61%), West (from 15% to 14.46%), South-East (from 12.26% to 10.68%) and Bucharest Ilfov (from 0.84% to 0.76%). This decrease in the weight of the 4 regions is counterbalanced with the increase of the weight in the South-West, Central and North-East regions.

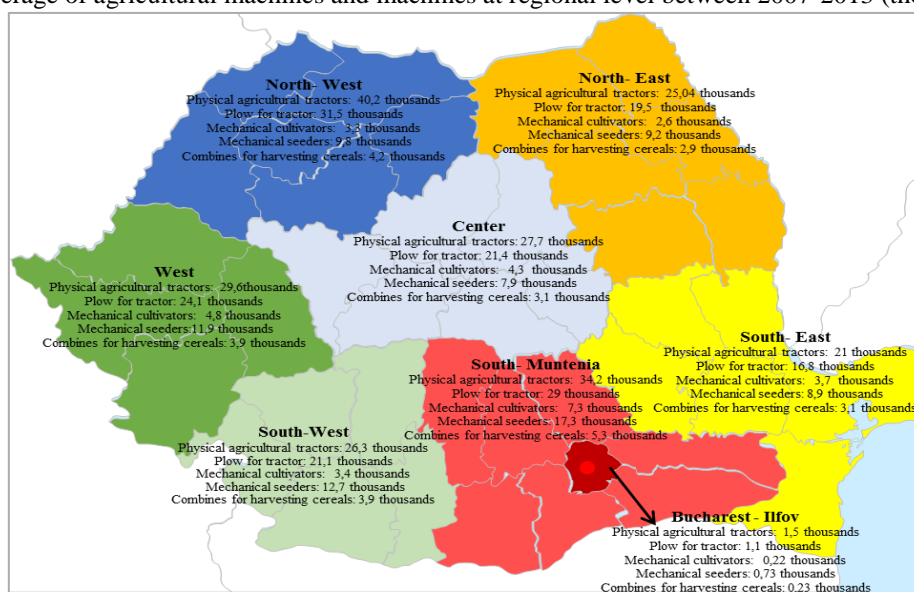
Table 2. Categories of agricultural machinery and equipment

Categories of agricultural machinery and equipment	Period 2007-2013			Period 2014-2018		
	Average	Standard deviation	Coefficient of Variation %	Average	Standard deviation	Coefficient of Variation %
Physical agricultural tractors	180696.86	5392.40	2.98	205803.00	8477.17	4.12
Plow for tractor	144624.57	3653.53	2.53	164905.20	5584.88	3.39
Mechanical cultivators	28274.00	804.47	2.85	29906.80	497.46	1.66
Mechanical seeders	70587.57	2430.83	3.44	78753.20	1753.09	2.23
Combines for harvesting cereals	25301.14	551.25	2.18	26851.20	655.36	2.44

Source: data processed according to INSSE

At national level it can be observed in table no. 2, that by analysing the categories of agricultural machinery and equipment, those with a significant share of the total are the categories that include physical agricultural tractors and plows for tractors. Comparing the averages of the categories studied in the two periods, an increase of the 5 categories with coefficients of variation between 1.66% and 4.12% is observed.

Figure 2 Average of agricultural machines and machines at regional level between 2007-2013 (thousands units)



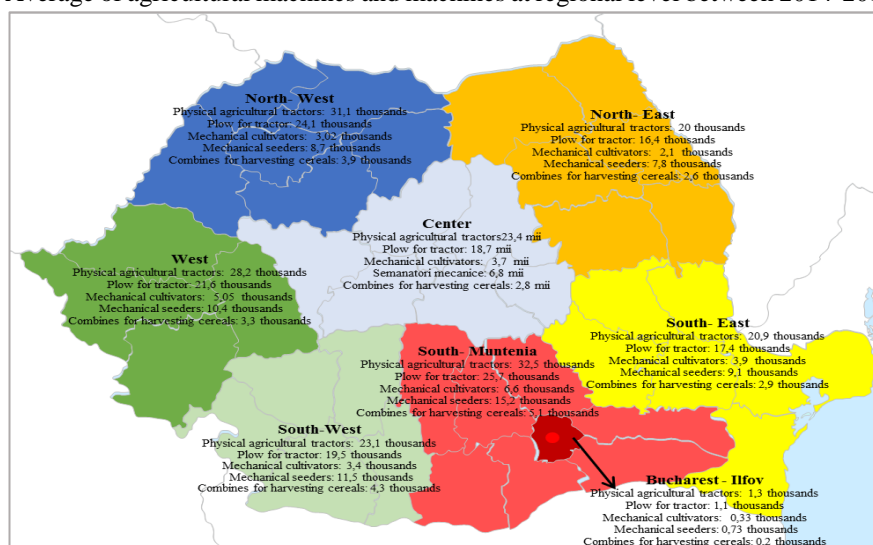
Source: INSSE processing data

Situation of the categories of agricultural machinery and equipment for the period 2007-2013 (figure nr.2) , at regional level is presented as follows:

- The regions with the highest number of agricultural tractors are South-Muntenia, North-West and West with average values varying between 28.2 thousand units and 32.5 thousand units. The Bucharest-Ilfov and North East region have the lowest average values of 1.3 thousand tractor units, respectively 20 thousand tractor units;
- In the case of plows for the tractor the distribution is similar, The regions in which the units average is the highest for this period are the South-Muntenia Region (25.7 thousand units) and North-West (24.1 thousand units);
- The average number of the period for mechanical cultivators is higher in the Western region (5.05 thousand units), and the lowest is found in Bucharest Ilfov Region (0.33 thousand units).

Compared to the first period, in the second period 2014-2018, the distribution of each class of machines and machines remains largely similar except that the average values of the number of units are higher. The average of the highest number of agricultural tractors is found in the North-West Region (40.2 thousand units) and South Muntenia (34.2 thousand units). Of the 5 categories taken for analysis, the smallest environments are recorded by the combined categories of harvesters and mechanical cultivators.

Figure 3. Average of agricultural machines and machines at regional level between 2014-2018 ( thousands units)

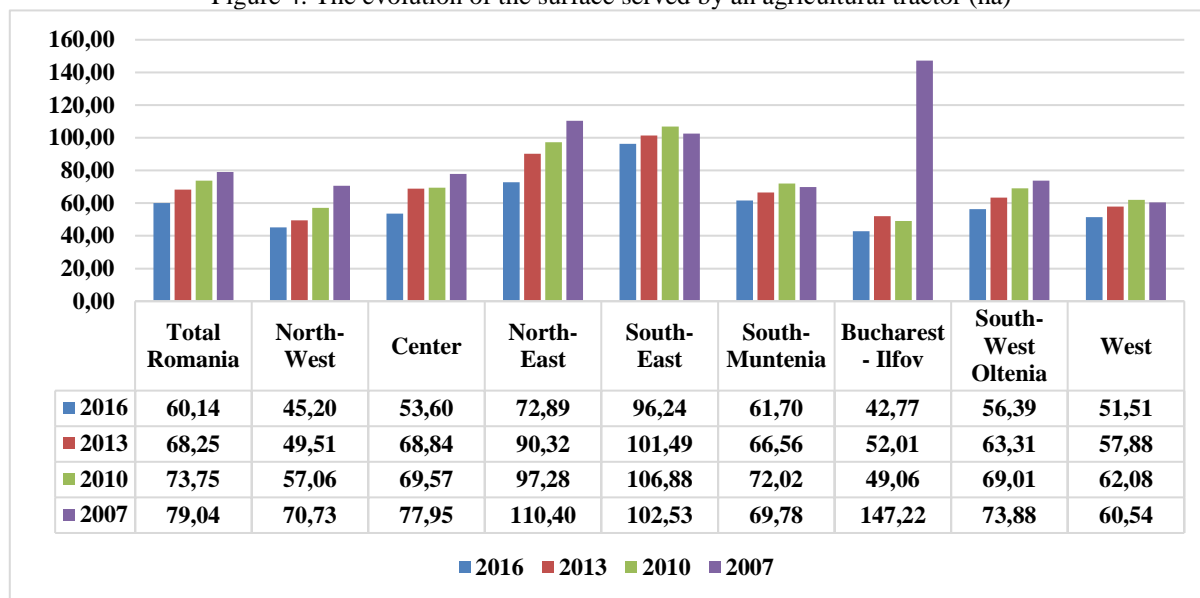


Source: INSSE processing data



Compared to the machines of the European states, the tractors in Romania are overloaded. If in 2007, the agricultural area served by a tractor was 79.04 ha, by 2016 it decreased by 24%, 60.14 hectares / tractor. At regional level it can be seen in figure no.4 that the regions with the highest average load of a tractor in 2007 were the Bucharest-Ilfov, North-East and South-East regions with values of over 100 ha / tractor. In 2016, the regions with the lowest values and below the national averages, of the theoretical load of the tractor are found in the North-West (45.20ha / tractor), Bucharest-Ilfov (42.77ha / tractor) and West (51, 51 ha / tractor).

Figure 4. The evolution of the surface served by an agricultural tractor (ha)



Source: INSSE and Eurostat processing data

Agricultural machinery and machinery to be more efficient from this point of view requires continuous and efficient investments in this sector. Replacing old agricultural machinery and equipment involves high costs, so that financial aid from national rural development programs is needed.

During the two programming periods PNDR it was observed that with the continuity of the financing of investments in the purchase of agricultural machinery and equipment, their number increased.

## CONCLUSIONS

The present study aimed at examining the park of agricultural machines and machines in the period 2007-2018 at both national and regional level. It can be seen from the analysis carried out during the two programming periods that significant investments have been made in the last 10 years in the renewal of the agricultural machinery and equipment park, many factors contributing to the realization of these investments to modernize the sector. Both the European funds and the rabla program, special co-financing credits and the purchase of second-hand machines have helped to support farmers in the purchase of machinery.

By increasing the number of modern and efficient farms, which cover large areas, investments in agricultural machinery and machines have also increased, allowing them to invest in agricultural machinery both with and without subsidies.

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## **SECTION 3**

### **RURAL DEVELOPMENT AND AGRICULTURAL POLICIES**

# RURAL DEVELOPMENT IN ROMANIA – EVOLUTIONS AND DISPARITIES AT REGIONAL LEVEL

SORINEL IONEL BUCUR<sup>1</sup>

**Abstract:** *Rural development was and continues to be considered an essential imperative, being one of the reasons for which the concept of sustainable development and diversification in the rural space has registered a high emergence frequency and debates in the specialty literature. The sustainable and complex development of the rural space means the implementation of some measures which should meet the need to eliminate the whole range of drawbacks of agriculture, respectively the gaps present between the different areals. In this context, on basis of public information using the well known statistical methods, the present approach wishes to realize a comparative inter-regional analysis from the demo - economic and social perspective of the Romanian rural space.*

**Keywords:** *rural development, disparities, regional dimension.*

**JEL Classification :** *R11, R12.*

## INTRODUCTION

The building of any local rural development strategy must start from the evaluation of the present situation, both by ratio to the own systems (demo-economic, social and ecological), and through the position held among the areals more or less similar. Placed in the South-South-East part of Romania, the South-Muntenia region is, as size, the third region of the country, re-grouping seven counties, the cumulated area of which represents around 15% of the total area.

With all the potential economic advantages generated by the border, in the South, with the Danube which ensures that direct connection to the Danube-Black Sea Channel, with exit to the Black Sea, but also the vicinity to Bucharest, at intra-regional level there are still significant gaps between the component counties, which is influencing the position held by the region through the ratio to the other development regions or at national level.

Starting from the considerations mentioned above, the realization of an inter-regional analysis of the indicators' system characterizing the rural space of the South-Muntenia region is giving to the decision factors a starting point in the identification of some sustainable local development niches.

## MATERIALS AND WORKING METHODS

In quantification of the position held by the South-Muntenia Region comparatively to the other development regions, the present approach is based on the utilization of public information, ensured, mainly, by the database of the National Statistical Institute, and the Community statistical support. We must state the fact that the present approach utilizes well known methods, the type of comparisons, structures and dynamics, the results being presented both in graphic form, and also in tables form.

## RESULTS AND DISCUSSIONS

In relieving the position held by the South-Muntenia Region in the national economy, comparatively to the other development regions there was taken into consideration a series of demo-economic indicators –primary and derived, the analysis of which permitted the stressing of the following aspects:

From the total area perspective, as we previously mentioned, South-Muntenia region was holding, in the year 2014, 14.5% of Romania's area, situating it on the third place among the 8

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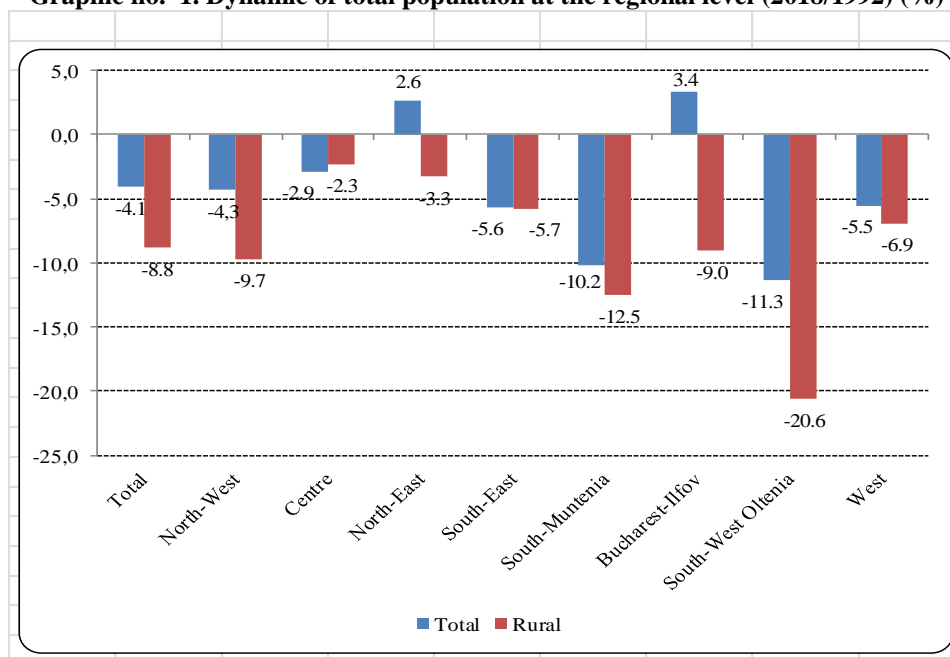
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development regions. Comparatively to the rest of the regions, the South-Muntenia region is holding the first place as regards the agricultural area (16.6% of the country's agricultural area), but also at the level of arable area, as share in the agricultural (21%).

The area of the rural space of the South-Muntenia region was representing in 2014, 91% of the total region's area, placing it, again on the first position and giving it a strong rurality character. As basis of the construction of any sustainable rural development, the total population registered in the period 1992-2018 a significant recoil, both at national level, and regional level. Comparatively to the other regions, South-Muntenia Region registered a diminution of the total population by 10.2 percentages, as in the rural environment the recoil should reach to 12.5 percentages.

Practically, the recoil of total population at the Region's level registers percentages exceeding the double of the national average, situating the Region, from this point of view, on the second place (after South-West Oltenia Region) (**Graphic no.1**).

**Graphic no. 1. Dynamic of total population at the regional level (2018/1992) (%)**



Source: Calculations on basis of data from Tempo-Online, NSI, 2019.

In absolute values, at the level of the year 2018, South-Muntenia Region was holding the second place, from the eight development regions, re-grouping not less than 14.5% from the total country's population, after the North-East Region (17.9%).

With 1.83 mill. persons in the rural space, South-Muntenia Region holds 18.9% of the total rural population at national level, being on the same second place after the regiunea North-East Region (22.3%).

Also, as share in total population of the region, in the year 2018, population in the rural of the South -Muntenia Region was re-grouping 57.2%, which is situating it comparatively to the other Regions on the first position (**Table no.1**), exceeding the national average by 24.3 percentages.

**Table no. 1. Evolution of the share of rural population in total population at the regional level (%)**

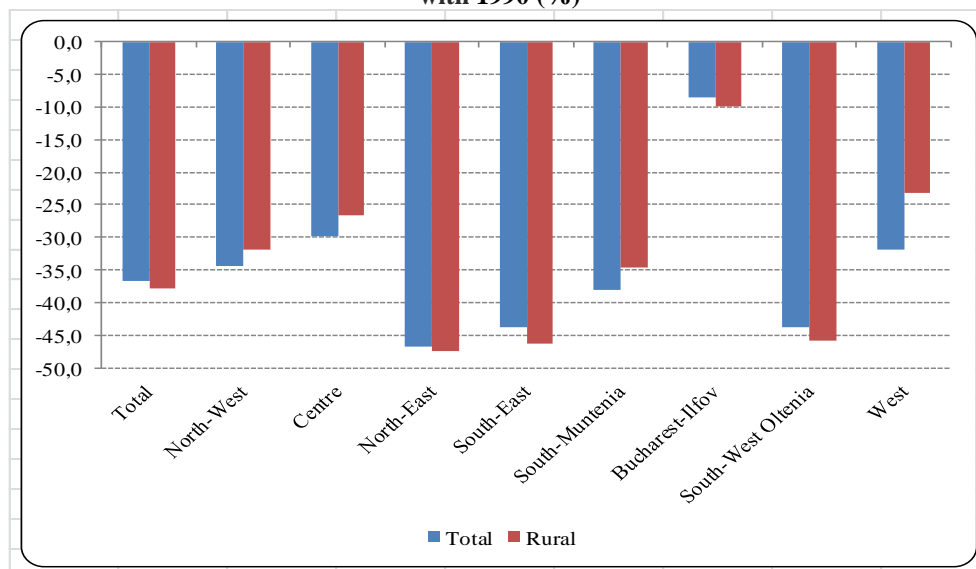
	Total	North-West	Centre	North-East	South-East	South-Muntenia	Bucharest-Ilfov	South-West Oltenia	West
1992	45.9	48.7	40.1	57.8	44.4	58.6	10.4	56.0	37.6
1993	45.5	48.3	39.8	57.4	44.1	58.2	10.4	55.5	37.4
1994	45.3	48.0	39.6	57.1	43.8	57.9	10.5	55.1	37.2
1995	45.0	47.7	39.2	56.9	43.6	57.7	10.5	54.8	36.7

1996	45.0	47.6	39.2	56.8	43.6	57.6	10.5	54.6	36.7
1997	44.9	47.4	39.2	56.7	43.5	57.5	10.5	54.4	36.6
1998	44.9	47.3	39.1	56.8	43.5	57.5	10.6	54.2	36.8
1999	44.9	47.3	39.2	56.9	43.6	57.5	10.6	54.1	36.8
2000	45.0	47.3	39.3	57.1	43.8	57.5	10.6	54.2	36.9
2001	43.0	45.3	38.1	54.2	43.3	56.8	6.7	51.5	34.1
2002	44.9	47.2	39.6	57.3	43.9	57.5	10.2	53.7	36.7
2003	44.9	47.2	39.3	57.4	43.9	57.4	10.2	53.1	36.8
2004	43.1	45.3	38.7	54.6	43.5	56.8	6.7	51.1	34.7
2005	43.4	45.6	38.8	55.0	43.6	56.8	8.6	50.9	34.8
2006	43.2	45.5	38.8	54.8	43.6	56.8	6.9	50.7	34.8
2007	43.2	45.3	39.0	54.9	43.7	56.8	6.9	50.6	35.0
2008	43.3	45.3	39.1	55.1	43.9	56.9	7.1	50.6	35.3
2009	43.3	45.3	39.2	55.2	43.9	56.9	7.2	50.5	35.4
2010	43.3	45.3	39.3	55.2	43.9	56.9	7.4	50.3	35.5
2011	43.4	45.4	39.5	55.3	44.0	57.0	7.6	50.2	35.7
2012	43.5	45.5	39.6	55.4	44.1	57.1	7.8	50.3	35.9
2013	43.5	45.6	39.7	55.2	44.1	57.1	8.0	50.3	36.0
2014	43.6	45.6	39.8	55.2	44.2	57.1	8.3	50.2	36.2
2015	43.6	45.7	39.9	55.0	44.2	57.1	8.5	50.1	36.3
2016	43.7	45.8	40.1	55.0	44.4	57.2	8.8	50.3	36.6
2017	43.6	45.9	40.2	54.8	44.4	57.2	9.0	50.2	36.8
2018	43.6	45.9	40.3	54.5	44.4	57.2	9.2	50.1	37.0

Source: Calculations on basis of data from Tempo-Online, NSI, 2019.

Evolutions registered at the population level were repercutated also upon the main demographical indicators, bot at national level, and regional level. In the rural, the birth rate decreased, situating the South-Muntenia Region on the sixth place among the fourth regions (Graphic no.2).

**Graphic no. 2. Dinamic of birth rate, at the regional level, by urban/ rural area in 2018 comparative with 1990 (%)**



Source: Calculations on basis of data from Tempo-Online, NSI, 2019.

Calculated as ratio between the live births number and the female population of 15 - 49 years old<sup>2</sup>, the fertility rate in the rural oscillates between 3.2 live born /1,000 women of fertile age (South-West Oltenia) and 43.9 live born /1,000 women of fertile age (Centre), the South -Muntenia region situating itself on sixth place among the eight development regions. In ratio to the year 1996, for which complete statistical information is available, fertility rate registered, per ensemble of the region, a recoil of 10.9%, while in the rural, the decline is almost of 33 percentages.

A favourable evolution is to be found as regards death rate and infantile death rate. From this perspective, comparatively to the year 1990, death rate reduced itself in the South -Muntenia region by 29.6%, reaching in the year 2018 to 3.8 dead born /1,000 live born, which places it on fourth place.

On the same decreasing trend is also situated the rate of infantile death, at the rural level of the South-Muntenia region, it diminished in the year 2018 comparatively to the year 1990 no more than less than 76.2 percentages, reaching to 7.5 deceased under one year old in ratio to 1,000 live born. From this perspective, the Region is situating itself on the third place among the 8 regions (**Table no.2**).

**Table nro 2. Demographic indicators at the regional level in 2018**

	<b>Fertility rate in rural area</b>	<b>Mortality rate in rural area</b>	<b>Infantility mortality rate in rural area</b>
Total	37.6	4.1	7.8
North-West	41.4	4.4	8.2
Centre	43.9	5.7	6.9
North-East	37.7	2.8	9.3
South-East	33.9	5.3	8.7
<b>South-Muntenia</b>	<b>35.8</b>	<b>3.8</b>	<b>7.5</b>
Bucharest-Ilfov	41.4	2.4	2.8
South-West Oltenia	32.2	2.7	6.9
West	38	5.8	6.1

Source: Calculations on basis of data from Tempo-Online, NSI, 2019.

The structural modifications intervened after 1990 at level of all the demo-economic and social pannels generated significant involutions also as regards the labour force and occupational degree. From this perspective, we must state that after 1990, the civil active population reduced itself with no less than 28 percentages at the level of South-Muntenia region, by 9 percentages over the national average, which is situating it on the third place in ratio to the eight development regions after North-East region (-30.7%) and South-West Oltenia (-30.4%).

Calculated as percentage ratio between the civil active population and work resources, the activity rate at the level of the South-Muntenia region is situated at 62.7%, with 7.4 percentage points under the national average. From this perspective the South-Muntenia region is situated on the fourth place among the 8 development regions.

We must not omit from view either the recoil registered at the occupied population level which is placing, nevertheless, the South-Muntenia region on the second place after the South -West Oltenia region (-31.9%)<sup>3</sup>, exceeding, practically, also the recoil of 20 percentages at national level with no less than 11.2 percentage points. These involutions have attracted after them also the reduction of the occupation rate, the South-Muntenia region being on the second place from the smallest occupational rate of the population.

At level of the year 2018 comparatively to the year 1996, the unemployment rate in the rural inscribed itself on a increasing slope, except the Regions: North-East, Bucharest and West where we see a reduction of it with percentages oscillating between -0.2% (West) and -2.6%

<sup>2</sup> Being expressed in number of live births to 1,000 women of fertile age (15 - 49 years old).

<sup>3</sup> Respectively with the second highest percentage of diminution .

(North -East). Practically, the South -Muntenia region was registering the fourth highest value of unemployment rate, respectively 5.9%, after the regions: South -East (7.4%), Centre and South -West Oltenia (6.2%).

Nevertheless, either as regards the number of employees the South-Muntenia region does not register a favourable evolution. Comparatively to the year 1990, in the year 2017, the average number of employees was reduced at the level of the South-Muntenia region by 5.2%, placing it on second place after South-West Oltenia (-52%) from the perspective of this indicator deterioration (**Table no. 3**).

**Table no. 3. Indicators of labour force at the regional level**

	Variation of civil economically population at regional level (2018/1990) (%)	Activity rate (%) 2017	Variation of employment population at regional level (2017/1990) (%)	Employment rate (%) (2017)	Unemployment rate in rural areas (%) (2018)	Variation of the employees' number (2017/1990) (%)
Total	-19.6	70.1	-20.0	67.3	4.7	-39.4
North-West	-14.0	73.7	-14.3	71.6	3.2	-30.5
Centre	-17.4	73.4	-15.7	70.8	6.2	-40.0
North-East	-30.7	59.7	-30.0	56.4	1.9	-50.3
South-East	-26.9	66.2	-28.6	62.4	7.4	-48.9
<b>South-Muntenia</b>	<b>-28.7</b>	<b>62.7</b>	<b>-31.2</b>	<b>59.5</b>	<b>5.9</b>	<b>-51.2</b>
Bucharest-Ilfov	19.7	89.8	14.0	88.6	5.8	-7.3
South-West Oltenia	-30.4	67.2	-31.9	62.3	6.2	-52.0
West	-18.8	72.7	-14.9	71.1	4.7	-37.4

Source: Calculations on basis of data from Tempo-Online, NSI, 2019.

The modifications intervened in population structure, but also of the labour force, to which are added the measures of economic policy implemented at national level, led to the maintaining of a high level of indicators, characterising the poverty level and the degree of social exclusion.

Even if these indicators are, after 2007, on a decreasing trend we must not omit from view the fact that these are situated still at high. Thus, at national level, 23.6% of the population is considered as poor<sup>4</sup>, this threshold being exceeded by four of the eight development regions respectively: South-West Oltenia and North-West (33.4%), South-East (29.6%) and South -Muntenia (24.9%).

Calculated as share in total population of persons of over 18 who, because of the lack of financial resources, can not afford the payment of some services /purchase of some products<sup>5</sup>, the rate of severe material deprivation is exceeding 20 percentages, both at national level (23.6%), and in four of the development regions. At level of the South -Muntenia region approximately 26% of the population is in this situation, placing the region, together South -East on the first position, with the highest values of the rate of severe material deprivation.

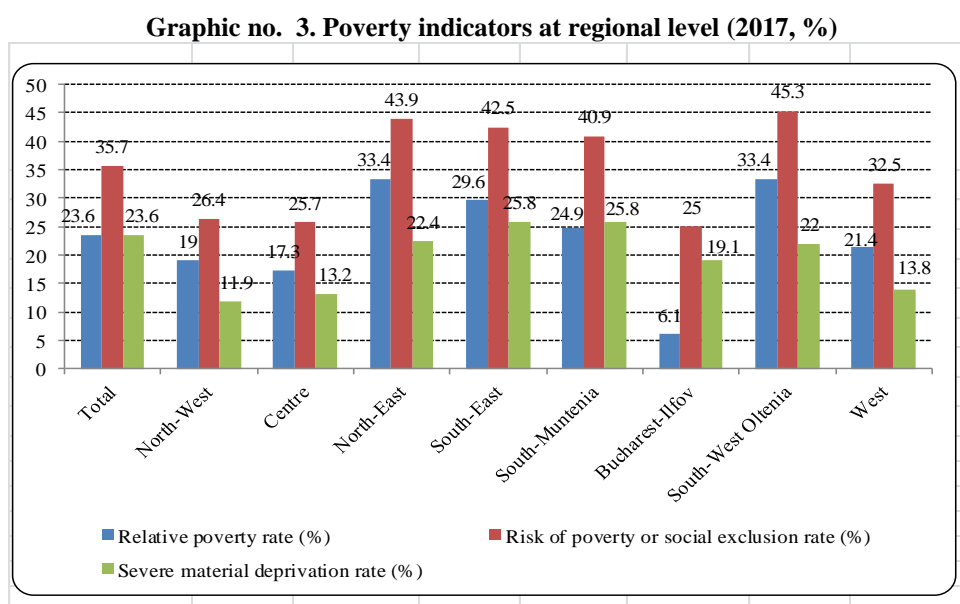
At level of the year 2017, approximately 41% of the population of the South -Muntenia region are exposed to poverty risk or to social exclusion<sup>6</sup>, being outpaced by the regions: South -West Oltenia, North-East and South -East. The high values in these four regions generated at

<sup>4</sup> Calculated as percentage of poor persons in total population .

<sup>5</sup> Payment in time of some utilities and other current obligations; - payment of a one week vacation per year, far from home; - consumption of meat, chicken, fish (or other protein equivalent) at least once at two; - the possibility to face, with own resources to some contingent charges; - the possession of a fixed or mobile phone; - owning a color tv set; - owning a washing machine; - owning a personal car; - ensuring the proper heating of the house payment.

<sup>6</sup> Persons making object of this indicator are in one of these situations at least: - have available incomes inferior to the poverty threshold; - are in a state of severe material deprivation; - are living in a household with a very reduced work intensity.

national level a rate of poverty risk of 35.7%. In other words, around a third of the population is exposed to this risk (**Graphic no.3**).



Source: Calculations on basis of data from Tempo-Online, NSI, 2019.

The analysis of the place occupied by the South-Muntenia region in the national economy ensemble can not make abstraction from the level of economic performance. From this perspective, we must say that, in the year 2016, the South-Muntenia region realized 27.1% of the Gross Value Added-total, increasing by 96.6% opposed to the year 1993.

Comparatively to the other regions, in the same reference year, the South-Muntenia region was on the first place from this point of view, on the second place being Bucharest-Ilfov region (12.2%) (**Table no. 4**).

**Table no. 4. Evolution of GVA share in total national GDP (%)**

	North-West	Centre	North-East	South-East	South-Muntenia	Bucharest-Ilfov	South-West Oltenia	West
1993	12.37	12.33	13.34	12.93	14.03	16.19	8.82	9.80
1994	11.67	12.21	12.61	12.37	15.34	15.16	10.58	9.84
1995	11.91	12.30	13.58	13.24	15.11	15.20	9.15	9.29
1996	11.90	12.45	13.62	13.11	15.10	14.88	9.32	9.42
1997	11.66	12.38	12.62	13.41	15.36	14.16	9.89	10.31
1998	11.87	12.10	12.55	12.95	17.61	13.44	9.47	9.86
1999	12.05	12.10	12.29	12.08	18.65	12.88	9.33	10.47
2000	11.31	12.10	11.83	11.76	22.50	12.27	8.68	9.41
2001	11.56	12.04	12.04	11.72	21.16	12.87	9.00	9.53
2002	11.88	12.21	12.10	11.75	21.42	12.66	8.29	9.61
2003	11.86	12.04	11.98	11.52	21.33	12.51	8.84	9.84
2004	11.92	11.65	11.56	11.87	21.42	12.94	8.68	9.89
2005	11.73	11.28	11.20	11.35	23.90	12.62	8.09	9.76
2006	11.87	11.51	10.98	11.26	23.38	12.69	8.15	10.09
2007	12.08	11.64	10.87	10.63	24.35	12.28	8.05	10.02
2008	11.30	11.08	10.56	10.31	26.62	12.35	7.77	9.93



2009	11.54	11.39	10.81	10.45	24.99	12.91	7.91	9.91
2010	11.28	11.23	10.50	10.63	25.73	12.51	7.94	10.06
2011	10.91	10.97	10.14	10.53	27.19	12.39	7.89	9.90
2012	11.35	11.38	10.31	10.89	26.49	11.95	7.77	9.77
2013	11.25	11.06	10.26	11.32	26.80	12.21	7.53	9.50
2014	11.47	10.96	10.05	11.26	26.78	12.99	7.23	9.18
2015	11.5	11.0	10.0	10.7	27.8	12.2	7.3	9.5
2016	11.8	11.3	10.1	10.4	27.1	12.2	7.2	9.7

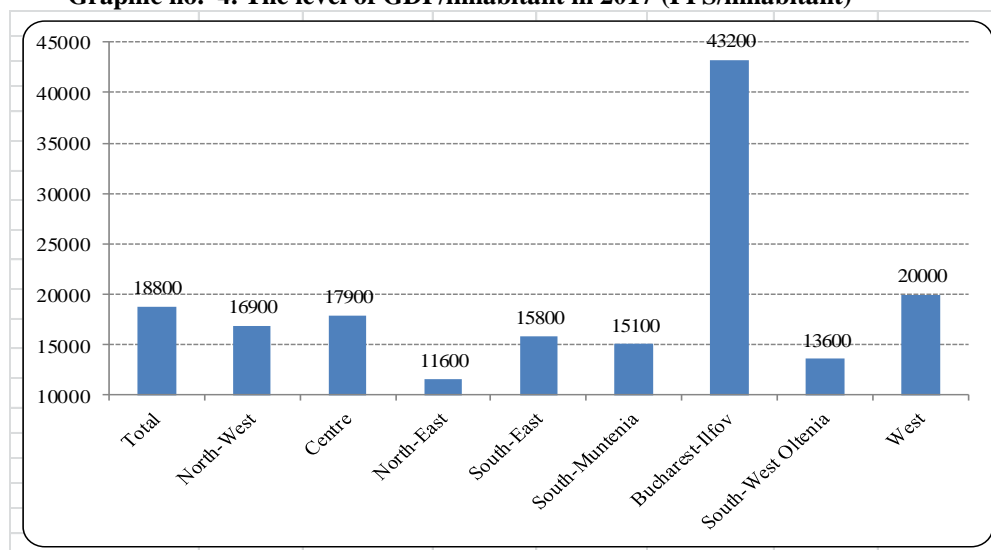
Source: Calculations on basis of data from Tempo-Online, NSI, 2019.

As regards the GDP per inhabitant, expressed in parity of the standard purchase power, this was on an increasing slope, in six of the eight development, exception being represented by the South-West Oltenia region where the GDP per inhabitant diminished in the year 2017 comparatively to the year 2007 by around 47 percentages.

The South-Muntenia region is situated on the second place, registering an increase of this indicator by only 67.8% in the period 2007-2017, while in the other 5 regions, the percentages of increase vary between 72.1% (Centre) and an over seven times increase in North -West region.

Synthesizing, in the year 2017, comparatively to the average community level (30000 PPS/inhabitant), Bucharest-Ilfov region exceeds by far this average, registering double values including national average. Except Bucharest - Ilfov, in the year 2017, over national average is situated only the West region, while South-Muntenia region is on fifth place (**Graphic no. 4**).

**Graphic no. 4. The level of GDP/inhabitant in 2017 (PPS/inhabitant)**



Source: Calculations on basis of data from Tempo-Online, NSI, 2019.

## CONCLUSIONS

Characterised by a high rurality degree, but also by the deterioration of the main demographical indicators, the South-Muntenia region manages to situate itself, in majority of cases, on the second or third place among the other development regions, either we speak of an evolution or involution of the indicators' value.

At regional level, the way of combining and utilizing the stock of existing resources led to the occupation of first position from the perspective of the economic performance registered, measured through the level of the gross value added obtained.

It is obvious that there are still significant gaps between the component counties, of which reduction process means a conjugated effort of the decident factors for the identification and

implementation of best measures, with direct effect upon the local level of development, but also the improvement of the living standard of the inhabitants of each community.

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# CAP REFORM - PREMISE OF THE BALANCE BETWEEN SUSTAINABLE FOOD SYSTEMS, QUALITY OF LIFE AND CONSERVATION OF TERRITORIAL RESOURCES

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**Abstract:** *The agriculture of the future can only be achieved, in terms of sustainability, and this requires that any development that will be carried out in this area has to be performed in respect of the three pillars: economic, social and environmental. However, in the context of globalization, there are suffering all elements that define sustainable local development, these being the ones negatively affected from economically, socially and environmentally perspectives. Thus, from an economic point of view, local economies suffer from a competitive disadvantage with a devastating effect over time, on consumers, the environment, and local cultural values, due to the existence of more intermediaries on the food chain. In this respect, a certain reconfiguration in agriculture is imperative through the reform in order to support the creation of sustainable food systems that produce safe, nutritious, environmentally, friendly and affordable food. It must provide answers to consumers and farmers who demand high-quality food while meeting the environmental, social and economic challenges, including food waste. More and more, consumers are interested in knowing where the food comes from, especially in the case of processed foods. Economists regard the environment as a subsystem of the economy, while ecologists see the economy as a subsystem of the environment, thus creating a synchronicity between the economy and the ecosystem on which it depends. Nowadays, because profit has to be obtained at any cost, there are neglected environmental factors, and this negligence will cost future generations that will be private by the essential elements of life.*

**Key words:** food systems, quality of life, agriculture, economic

**JEL Classification:** Q1, Q2, Q3, Q4

## INTRODUCTION

The study focused on identifying and analysing future actions and measures, with regard to the Common Agricultural Policy after 2020. In a global context, nutrition is a basic necessity for all and an important part of our cultures and traditions, at the same time, because of its intrinsic connection with almost all aspects of our well-being, including our environment, economy, health and society - food production and consumption is at the heart of the NUO 2030 Sustainable Development Agenda.

While over 820 million people suffer from hunger<sup>14</sup>, global food production is expected to increase 60% to feed the estimated 9 billion people that they will live on our planet by 2050<sup>3</sup>. Despite the fact that natural resources are dwindling, about one third of the world's food products for human consumption are wasted<sup>4</sup> (approximately 1.3 billion tonnes each year); ecosystems are also under pressure and biodiversity is lost (on land and sea).

Climate change is an additional critical threat to global food production and, in turn, food production and consumption has a profound effect on greenhouse gas emissions and the ability to maintain global temperatures at safe levels<sup>8</sup>.

Therefore, the way we produce, transport, store, transform, distribute and consume food - that is, "our food systems" - will largely determine whether the Sustainable Development Goals (SDGs), the Paris climate goals and the Aichi goals for biodiversity will be achieved.

The forthcoming Common Agricultural Policy - CAP should increase support for high quality locally produced foods. It should guarantee high animal welfare standards and promote the transition to organic production on a broader scale.

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The quality signs (logos) that indicate the names of the products with geographical indication (PDO / PGI / STG) contribute to the promotion of the areas from which they come and to the preservation and transmission of the future generations of traditional know-how and recipes. Thus, quality schemes are a tool for recognizing high quality, traditions and local values.

However, access to the market for local products from small producers is still difficult, and thus it is necessary to facilitate the development of short supply chains. These are able to ensure the development of direct business relationships between producers and consumers and contribute to the protection of the environment and sustainable development, by reducing the distance between the consumer and the producer, the consumer benefiting from fresh, healthier and nutritious products, by reducing the carbon footprint achieved. by reducing the pollution generated by the means of transport that ensure their supply, by reducing the storage / storage period and avoiding food waste due to the elimination of intermediate links.

The sustainability of the food supply chain is based on the interdependence of three links: farmers / producers, processors in the food industry and distributors. Their functioning is a priority and essential in terms of ensuring the quality and food safety of products that reach the consumer. Any instability or structural problem that appears on any of these three links negatively influences the entire chain, generating undesirable and syncopal effects in ensuring the continuity of the consumer supply with the respective products, as well as the price volatility.

## **MATERIALS AND METHODS**

Using the direct and indirect observation method, we highlight some important aspects necessary, which the new Common Agricultural Policy will have to continue, with the strengthening of the financing measures, which will ensure:

- Stimulating the development of direct commercial relations between producers and consumers (shortchain), so as to ensure the supply of consumers with fresh, quality and high nutritional value food;
- prioritizing access to financing of short chains (investments, marketing and promotion);
- supporting the producers in order to certify on the European quality systems the agri-food products;
- simplifying the access of producers to European funds intended for the promotion of agri-food products on the internal, intra-Community and third markets, through participation in fairs, exhibitions, presentation events.

However, in the pursuit of the profit to be obtained at any price, environmental factors are neglected, and this neglect will cost future generations who will be deprived of the essentials of life.

Economic indicators and economic theory do not explain how the economy undermines Earth's natural systems, with major repercussions on the environment, on the present and the future: expanding desertification, increasing carbon dioxide emissions, greenhouse gases, global warming, raising the level of the seas, the diminution of the sources of fresh water, the erosion and the loss of the fertility of the soils, the reduction of the surfaces with forests and pastures or hay, the disappearance of many species of plants and animals.

The more polluted the environment, the more human health is affected, influencing the third pillar of sustainable development, namely the social factor. The relations between the economic and the echo -ogenesis are at present an aspect of the utmost importance, being in an antagonistic relationship, the economic gain being the cause. Studies conducted internationally show that health status depends of the human-product-nature relationship, but the promotion and strengthening of health will depend on the optimal functionality of these relationships<sup>5</sup>.

Public health specialists are increasingly arguing that studies have shown that environmental changes, which cause changes such as urbanization, development of transport infrastructure, but also ecological processes such as the use of arable land and water, lower biodiversity by the

disappearance of certain species and climatic changes, they are in close connection with the health of the individual and the population.

The burning of fossil fuels has created carbon dioxide emissions over the earth's ability to neutralize them, leading to the accumulation of greenhouse gases, which are responsible for extreme weather events. Assuming that current trends will continue, global warming through the greenhouse effect becomes inevitable, causing imbalances between ecosystems. The faster these processes are, the more difficult it will be for the population to adapt without major consequences. Climate change has been permanent, but what is different now is the speed with which changes take place, as a result of non-compliance with environmental requirements.

Climate change further affects biodiversity, which in turn influences climate change. The IPCC report shows that approximately 20-30% of the plant and animal species evaluated so far are at increased risk of extinction, if the average global temperature rises by more than 1.5-2.5 ° C above 1980-1999<sup>1</sup>.

According to recent theoretical developments in sustainable development, the definition given in the Brundtland Report has been supplemented with the requirement to reduce the adverse impact on the environment, in order to obtain more goods and services, with less consumption of natural capital (doing more with less). This implies the increase of bio-efficiency, which means a reduction of the consumption of natural capital (or of the impact on the environment) to a unit of value or production of goods and services.

The EU was noted for its efforts to create the 2030 Sustainable Development Agenda and assumed to be a leader in its implementation. As included in the European Green Deal proposed by the European Commission, an EU strategy is needed to strengthen the sustainability of the food system, leading to a global transition to fair, sustainable food systems, respecting planetary boundaries and contributing to a circular economy. The "Farm to Fork" vision presented below aims to ensure that the Union's vision meets society's expectations and that all actors in the food chain, including the citizens themselves, are actively contributing to it. Given that the EU depends on international trade and global supply chains, the strategy must also take into account the social, environmental and economic impact beyond the EU's borders.

In this context, the EU is developing a new strategy - "From the farm to the fork" - which represents a new vision, to create sustainable food systems that will ensure, by 2030, healthy and accessible food, with preserving the health of the planet and ensuring improved livelihoods for all<sup>2</sup>. This new strategy aims to change the paradigm in the field of food production and consumption, with the main objective of creating a sustainable and equitable food system that will provide security and nutrition for future generations as well as respecting the planet's resources and contributing to the limits of the planet. development of the circular economy.

The advantages of the sustainable food system of the new strategy consist of:

- profitability and efficiency throughout - economic durability
- providing large-scale benefits for society - social sustainability
- generating a positive or neutral impact on the environment - environmental sustainability

The new strategy will take into account all actors in the food chain, from production, to consumption (agricultural / fishing, production / processing, storage, distribution, consumption and disposal of food waste).

## **RESULTS AND DISCUSSIONS**

The elaboration of the new strategy will be based on the following analyzes:

➤ The social dimension and the human health aimed at: demographic curve, life expectancy, poor population, malnutrition and obesity, high incidence of nutrition-related diseases (type 2 diabetes, cardiovascular disease, cancer), increasing antimicrobial resistance.

Global demographic trends are characterized by a growing and aging population and a continuation of urbanization. As the global population is growing at over 9 billion people by 2050, total food

demand is increasing by about 60%. "By the middle of the century, it is estimated that two thirds of the global population will live in the areas. urban, thus highlighting the tendency of depopulation of rural areas.

While life expectancy in the EU has increased (from 77.7 years in 2002 to 80.9 in 2017), there are still major health inequalities (up to 10 years in the hope of life) between countries and social groups, some of them being determined by diet.

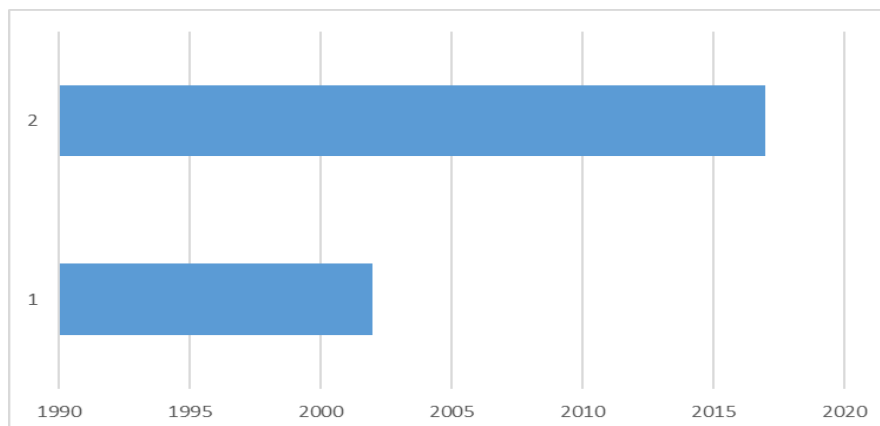


Figure 1. Comparison of life expectancy in the EU between the value in 2002 and 2017

Source: State of Food Security and Nutrition in the world, FAO 2019.

Own determination.

It is known that the number of undernourished, hungry people in the world has been steadily increasing since 2015, reaching in 2018, about 820 million, a situation similar to that of 2010-2011<sup>11</sup> being one of the engines of the world that generates migration patterns. populations.

Food is abundant and accessible in the EU. On average, EU households spend 15% of their disposable income on food. However, it is found that this figure varies significantly for different segments of the population, with food insecurity remaining a problem for about 40 million people in the EU<sup>10</sup>.

At EU level, consumer diets do not comply with dietary recommendations. While the intake of energy, meat, sugars, salt and fats continues to exceed the recommended limits, the consumption of healthy foods (whole grains, fish, vegetables, legumes and nuts) is low.

Poor dietary diets contribute to increasing weight of obesity and non-communicable diseases in the EU (type 2 diabetes, cardiovascular diseases and various tumors), with a devastating impact on human life and health maintenance costs, with 52% of the adult population being overweight in 2017 and over 15% obese<sup>9</sup>.

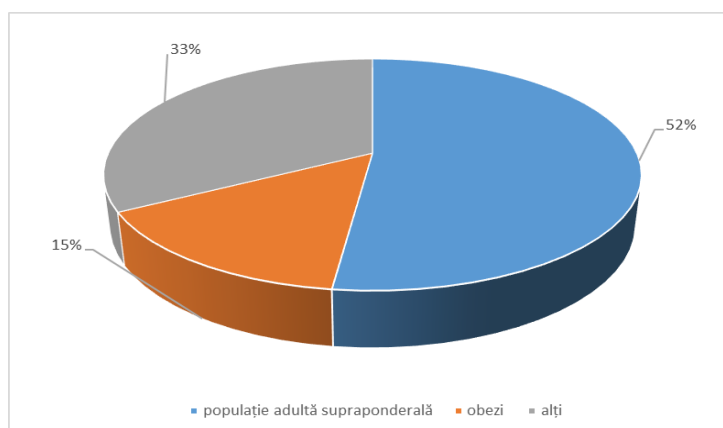


Figure 2. Increasing the share of obesity in the EU in 2017 .

Source: State of Food security and Nutrition in the world, FAO 2019.

Own determination.

➤ The dimension of environment and climate

Climate change, loss of biodiversity, waste and food waste, diseases and pests that are increasingly resistant or unknown to date in the EU (eg African swine fever).

Climate change is perceived as a threat that the next generation will have to face: global warming has already reached 1 ° C above pre-industrial levels and increases to about 0.2 ° C every 10 years. Extreme weather events, respectively - droughts, heat waves, storms and floods occurring all over the world and the significant upward trend<sup>11</sup> of temperature severely affects agricultural and seafood production and also contributes to ocean acidification and concentration of oxygen, with major impact on marine ecosystems and fish stocks<sup>12</sup>.

The affect in the sense of the loss of biodiversity, the degradation of the resources and the degradation of the natural ecosystem (soil depreciation, erosion, drought, the impact on the quality and volume of the water, the disappearance of the pollinators, etc.) are determined by the human activities including agriculture, the global growth of the population, combined with the need for food and energy, as well as the evolution of consumption patterns<sup>13</sup>. With the loss of biodiversity, in general, genetic diversity in agriculture (agrobiodiversity) is lost at a high level, lowering the potential for a more diversified and more resistant food system.

Food production extends the limits of the environment, and climate change increases these pressures: agriculture uses almost half of the world's cultivated land and constitutes, almost 70% of global fresh water losses and up to 90% of the surface, in some drought countries; agriculture, forestry and other sectors that involve land use generate a quarter of annual greenhouse gas (GHG) emissions. At EU level, agriculture produces about 1% of greenhouse gas emissions, with the addition of food processing and transportation<sup>9</sup>.

➤ Economic dimension:

The food supply chain is characterized by an uneven number of operators per stage and a continuous concentration process.

Many companies and organizations have responded to citizens' demand for sustainable supply chains, through guides and certification schemes on sustainable use as well as through direct partnerships with farmers.

Revenues from agriculture, fisheries and aquaculture occupy a lower share than other sectors. Although increasing the size of farms and companies leads to increased labor productivity, the primary sectors are not attractive enough for young entrepreneurs.

The digital revolution brings benefits in all food sectors, even if data collection is not carried out systematically. The use of digital applications in primary production, processing and marketing is increasing at EU level and at different stages of implementation, depending on the actors involved. The discriminatory division of digitization should be avoided, ensuring that all parties involved have access to these opportunities.

➤ International dimension:

The EU holds the position of a major exporter / importer of agri-food products having strict standards in terms of food quality and safety as well as animal welfare, exerting a significant influence on the competitiveness of producers in the intra-Community area and in third countries. In 2018, EU agri-food trade reached 254 billion, of which EUR 144 billion represents exports and EUR 143 billion imports.

Specificity of EU food production and consumption as well as imports of certain commodities (for example, animal feed, tropical fruit, seafood, palm oil, coffee) which, in turn, can impact sustainability in countries third parties as well as on global food systems.

The EU stands out for its safe and high quality food reputation which is a key factor for the EU's success in food exports. However, in the absence of global convergence, higher EU food standards may create competitive disadvantages for EU businesses, both on the EU market and in third countries, which may not have such strict standards.

➤ Consumer behavior:

Increased information requirements on the production method, sustainable source, origin and quality of food, attention to environmental and ethical issues, increased demand for organic and plant-based foods, transparency on the food chain, short supply chains, data perception food sustainability, environmental impact, decreased confidence in modern food production systems, fraud in the food chain is one of the principles to be considered when creating a sustainable food system<sup>6</sup>.

Labeling with clear and coherent sustainability information on the EU market, developing and implementing private certification schemes (ecological footprint, no genetic changes, animal welfare, fisheries and aquaculture sustainability, etc.) help consumers make rational, conscious choices, according to with individual interests.

Despite high food safety standards in the EU, consumers are losing confidence in modern food systems, their demands shifting to less processed and fresh foods, provided by short food chains<sup>7 15</sup>, which also results in reasonable prices in terms of quality. .

## CONCLUSIONS

In conclusion, compared to the global context, where it is estimated that the food and agricultural system, in line with the Sustainable Development Goals, could create an economic value of more than EUR 1.8 trillion by 2030, the EU is the first exporter and importer. of agri-food products in the world and is well positioned so that it can take advantage of the benefits of economic opportunities.

The global transition to sustainable food systems can be achieved through innovative, healthy, environmentally friendly, safe and nutritious food production and environmental and animal welfare, all of which represent one of Europe's leading brands.

Strengthening the sustainability of European food systems can help to increase the reputation for food and to provide a competitive advantage for EU companies, as the first actors in the supply of high quality and globally sustainable food in this field.

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# RURAL DEVELOPMENT IN THE REGION OF THE DANUBE DELTA - STRATEGIES AT EUROPEAN LEVEL AND IMPLEMENTATION AT THE NATIONAL LEVEL

RUXANDRA – EUGENIA POP<sup>1</sup>

**Abstract:** *The present paper aims to explore the contribution and implications of Romania to the development of the Danube region over the years, focusing on the interactions between internal and international factors. From the analyzed ones, we can affirm the fact that the internal factors play a secondary role in the development of the strategies, the majority role holding the international factors. Regarding the present and future strategies established at European level we can conclude that in their formulation the awareness should be extended to the perceptions of the local communities in the area, thus analyzing their identity, cultural heritage, economic and social potential of the analyzed areas. During the paper will analyze aspects such as: historical, geographical and socio-cultural context, the economic importance of the Danube in the European context, the European institutional framework for the international use of the Danube, the Strategy of the European Union at the level of the Danube region, national aspects related to the Danube Delta region.*

**Key words:** *Romanian Danube region, capitalization of the potential of the Danube Delta region, identity of the Danube region.*

**JEL Classification:** J18, Q38, Q58

## INTRODUCTION

The Danube is undoubtedly a river that has always had considerable economic importance for Europe, as it crosses 10 countries (Germany, Austria, Slovakia, Hungary, Croatia, Serbia, Romania, Bulgaria, Moldova, Ukraine) and 4 capitals (Vienna, Bratislava, Budapest, Belgrade). Also, the importance of the Danube Basin is given by the fact that about 81 million people live in this area, on an area of 817,000 square km, according to data provided by ICPDR, 2016 (International Commission for the Protection of the Danube River). Although it is the second longest river in Europe, it should be noted that Volga (the longest river in Europe) crosses only Russia, as opposed to the Danube.

From a geographical point of view, the Danube practically links three different regions of Europe, with different characteristics, with particularities and with different degrees of economic development, as follows.

- The developed region of Western Europe;
- The developed middle region of Central Europe;
- Less developed and developing region of Eastern Europe.

It is interesting to note that these three distinct regions are delimited by the three sections of the Danube, as follows:

- The first section: located between the Black Forest Mountains (Germany) and Hungary;
- The second section: located between Hungary and the Iron Gates;
- Third section: located between the Iron Gates and the Danube Delta;

From a cultural point of view, along the Danube four major dialects can be distinguished:

- German (in Germany and Austria);
- Slavic (in Slovakia, Croatia, Serbia, Bulgaria); Hungarian (in Hungary); Romanian (in Romania and Moldova).

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From an economic point of view, the importance of the Danube derives primarily from the activity of maritime, naval transport, dating back to the 7th century, when the Greeks were exploring certain parts of the river and completing trading activities. Astfel, prezența acestui fluviu a reprezentat baza apariției unor orașe importante ca Viena, Budapesta, Belgrad, Ruse. În prezent, rolul economic al Dunării nu este reprezentat doar de transport ci și de alte funcții economice, cum ar fi:

- *Generation of electricity* (for example, the hydroelectric power station at the Iron Gates);
- *Water source*, for both industry and population (for example, in cities like Vienna, Budapest, Belgrade, Russia);
- *Irrigation network for agriculture* (in countries such as Slovakia, Hungary, Serbia, Bulgaria);
- Fishing

After World War II, several projects were developed on a large scale to develop the transport function, the most important of which being:

- The Danube-Black Sea Canal, built in Romania (1987) between Cernavodă and Constanța;
- Rhine-Main-Danube Canal (1992), connection between the North Sea, the Atlantic Ocean and the Black Sea.

The major problem that derives from most of the mentioned economic activities is pollution, which affects the waters of the Danube, both for industrial use and for the consumption of the population, for irrigation and fishing. Thus, reducing pollution is a challenge that society must face, in order to preserve the environment but also to prevent severe economic losses.

Thus, taking into account the existing framework, we will analyze the European strategy for the Danube region, and the degree of its implementation, both at national and at European level.

## MATERIALS AND METHODS

In order to carry out the present work, the current legislative framework regarding the strategies of the European Commission for the Danube Delta, as well as the specialized literature for the case study area (the Danube Delta), and other publications of interest for the studied subject were analyzed.

## RESULTS AND DISCUSSION

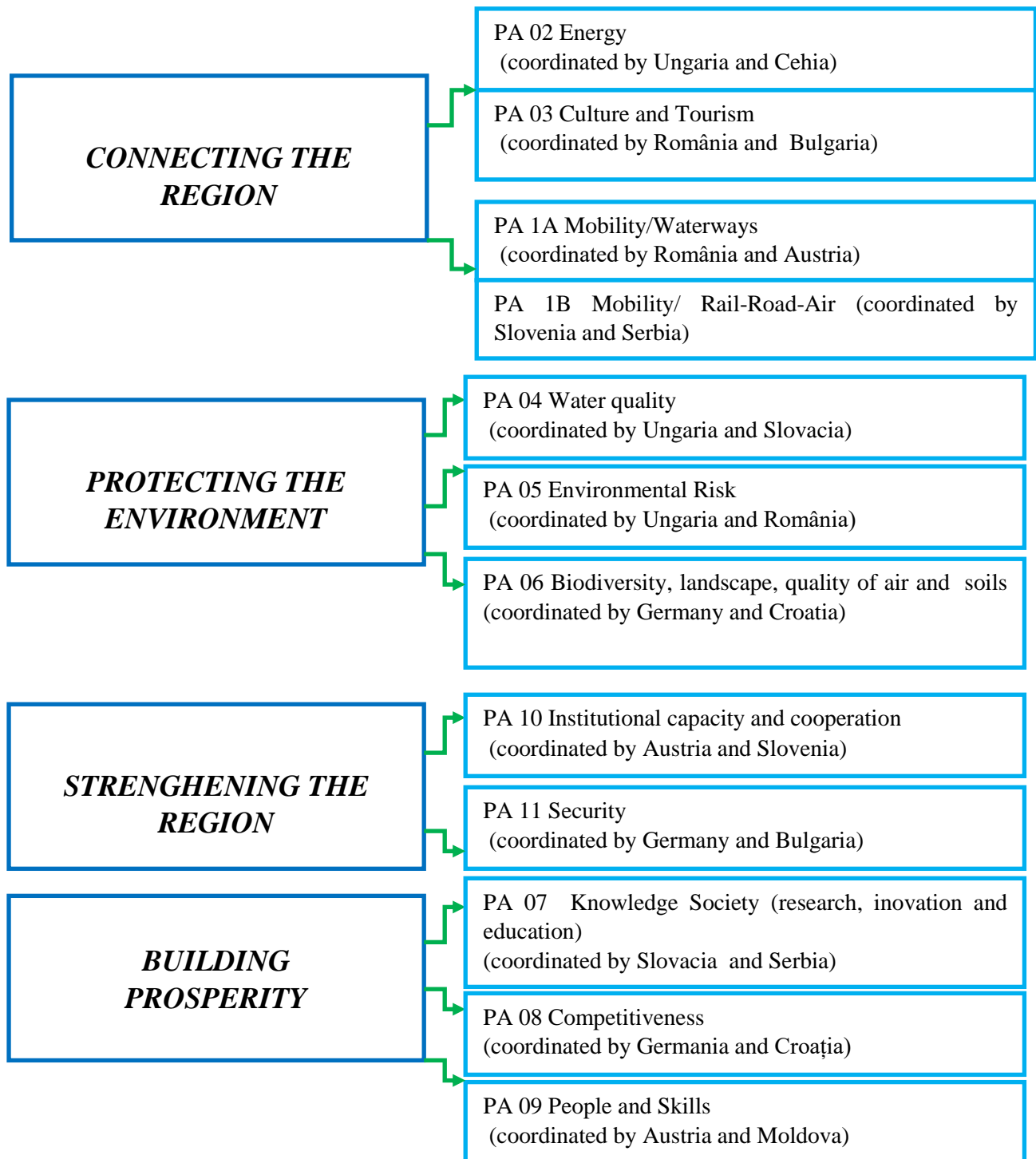
The strategy of the European Commission for the Danube Region (2010) envisages 14 countries of which 9 countries are Member States (Germany, Austria, Hungary, Czech Republic, Slovakia, Slovenia, Bulgaria, Romania, Croatia) and 5 non-Member States (Serbia, Bosnia and Herzegovina, Montenegro, Ukraine and Moldova). Currently, at the level of the European Union, four strategies are distinguished, at the macro-regional level:

- EU Strategy for the Baltic Region
- EU Strategy for the Adriatic and Ionian Region;
- EU Strategy for the Alpine Region;
- EU Strategy for the ***Danube Region*** (European Commission, 2016)

At the level of the last strategy of the 4 mentioned, a series of objectives and challenges are outlined, which are intended to be addressed: *improving the quality of the modes of transport (road infrastructure, water, railway); the development of the energy network, the elimination or diminution of the existing gaps in the areas of interest, the improvement of the cooperation and coordination in the level of education, research and innovation, the improvement of the security and the security.*

The European Strategy for the Danube Region is structured on 4 pillars and 12 priorities, each priority being coordinated by 2 countries called Priority Area Coordinators (see figure 1).

**Figure 1 – Pillars and Priority Areas (Strategy of the Danube Region)**



Source: <https://danube-region.eu/>

This strategy is not provided with a separate budget but requires the participation of the Member States in order to use the funds that are part of the cohesion policy or other European financial instruments, which can be obtained from international organizations or from bilateral donations. This financial aspect implies that the countries of the Danube region should develop a long-term, integrated approach in order to use these funds in a most competitive and synergistic manner.

Romania is one of the countries with high access to the river but this is not sufficiently exploited to the real potential, proof in this regard being also the multiple scientific publications in which the region was analyzed historically, geographically, socially, politically and culturally. . In order to capitalize on the economic potential of the Danube, a country or a region must be either a producer of goods, which can lead to selling over longer distances, including by river transport, or a significant buyer of goods, which can attract sellers' attention and attract high demand. These two hypotheses are linked to each other, in the sense that you cannot have high purchasing power if you do not produce and sell something in return, to have financial resources. Unfortunately, the historical and geographical past of the Danube area in Romania has brought it into a passive rather than an active position.

Among the most important weaknesses of the analyzed region we can mention: Capacitatea administrativă locală de a crea și implementa strategii pe termen lung, în ceea ce privește infrastructura, mediul înconjurător, cercetare și educație;

- The policy of the European strategy in force of not having a distinct budget for this, which leads to the need to have very developed capacities of coordination and administration, which is not necessarily characteristic for Romania;
- The current geopolitical context between Romania, Bulgaria, Serbia, Moldova and Hungary, in terms of cooperation between these states.

## CONCLUSION

In this paper, we analyzed aspects related to the studied area, from the geographical, historical and also the current context. Also, it was tried to synthesize the Strategy of the Danube Region, of the pillars and priorities relevant for it, but also their degree of implementation at national level and not only.

We tried to delimit the weaknesses and strengths of the studied area and the areas on which strategies can be implemented continuously, both in the short and medium term on the studied area.

Romania has a high potential for the economic development of the Danube region, and several projects will certainly be developed in the areas of interest for the analyzed area, such as energy, transport, fisheries, agriculture, and tourism.

At present, there are two positive aspects characteristic of the area analyzed in the paper, such as membership of the European Union, on the one hand, and on the other hand the existence of the EU Danube Strategy. Both aspects thus allow access to additional financial resources and a better management of the use of these resources.

For the development and capitalization of the economic potential in the Danube area of Romania, it is important that the central, regional, local authorities, both the state and the private ones, to the actors from the business, academic and civil society fields, to cooperate, to identify possible projects to develop the area and to support these actions in the long term, especially in the areas of interest of the area such as agriculture, fisheries, tourism, infrastructure and transport.

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# COMPARATIVE ANALYSIS OF THE BASIC INFRASTRUCTURE DEVELOPMENT LEVEL, BY URBAN-RURAL TYPOLOGY

MIHAI ALEXANDRU CHÎȚEA<sup>1</sup>

**Abstract:** *The present paper follows the evolution of the basic infrastructure development, at county level, focusing on the urban-rural typology, on a ten-year period, starting from the premises of its importance to sustainable development at territorial level. The paper turns to usual statistical methods for the analysis of the indicators specific to this domain, derived from official statistical data sources. The working hypothesis was the following: there is a significant disparity between the categories of counties, by urban-rural typology, namely a lower development level in the case of predominantly rural counties, compared to intermediate and predominantly urban ones, a process that imposes a concentration of investment efforts at this level, in order to reduce the current territorial disequilibrium.*

**Keywords:** *basic infrastructure, county level, urban-rural typology.*

**JEL Classification:** O18.

## INTRODUCTION

The present paper follows the evolution of the main indicators that express, in the author's vision, the basic infrastructure development across counties, on a ten-year period from the moment of Romania's accession to the European Union, by urban-rural typology. This represents a key element to support the economic development of a territory, being one of the most important factors taken into consideration by the potential investors in their decision to develop the existing/ new businesses. In this context, Puia asserts that the development of infrastructure has been a major priority at the level of the actors involved in the socio-economic activity, from public authorities to private organizations and civil society [3]. Romania's integration into the European Union structures represented an essential moment, from this point of view, through the inflow of European funds meant to narrow the territorial gaps between the EU New Member States and the EU average. According to the National Commission for Prognosis, the implementation of the structural funds had a net positive effect on the Romanian economy and society [1]. This process was doubled by the financial efforts from the national budget, so that the evolution of specific indicators followed an upward trend, however differentiated by the urban-rural typology. As expected, the development process mainly targeted the rural and intermediate areas, which, at the moment of accession, had a less developed basic infrastructure compared to the predominantly urban areas. In this context, the efforts focused on these areas determined a stronger dynamics of specific indicators, yet the final values continue to signal out a series of territorial gaps that are maintained between the categories of territorial units, by urban-rural typology.

## MATERIALS AND METHODS

In order to evaluate the basic infrastructure development level by counties, we used classical statistical analysis methods, tracking the evolution of 4 specific indicators, considered relevant in our approach, namely the share of modernized roads in total public roads and the share of localities connected to the public utility networks (drinking water, natural gas supply, sewerage networks). The data were extracted from the Tempo-online database of the National Institute of Statistics and processed in Excel. For the graphical representations we used GIS GeoDa software, in which we introduced the values resulting from primary data processing, corresponding to the 42 counties in Romania. Based on them, graphical representations of map type were generated, which highlight the evolution of selected indicators across counties, in the period 2007-2017.

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## RESULTS AND DISCUSSIONS

The first indicator considered relevant for the evaluation of the basic infrastructure is the share of modernized roads in total public roads. The quality of road transport infrastructure is an important indicator for any potential investor, the fast access to the national and European road network being an essential condition for carrying out various economic activities. According to Fistung, as a member of the EU, Romania needs to modernize the transportation system, according to the European common market principle [2]. It is without doubt that the extension of the road network (including here the highways) is also an important element, but having in view the particularities of such an endeavor, i.e. the high costs involved and the long execution time, we consider that, from the perspective of the current approach, a qualitative indicator (modernization of road infrastructure) better corresponds to our purpose.

At national level, in the period 2007-2017, the length of public roads followed a slightly upward trend, to reach 86099 km in the year 2017, by 6.4% higher compared to that in the year 2007. The slow expansion rate of the public road network was based on both economic and institutional factors. The lack of coherent programs for road transport infrastructure extension, the difficulty of providing funding from the public budget, as well as the complexity of attracting European funds for this purpose (including here the long periods of time necessary for preparing the technical and financial documentations, the bidding procedures and the execution of works), aspects that have been increasingly reported in recent years in the public space, both by the representatives of the business environment and of the civil society, have determined the same slow increase rate of the length of public roads.

By urban-rural typology, a stronger rate of road infrastructure extension and modernization in the period 2007-2017 was noticed in the case of predominantly rural counties; the national rural development programs of the two programming periods, as well as the local development programs have essentially contributed to the improvement of the road network quality at this level, the share of modernized roads being 43.7% in the year 2017, above that of intermediate counties. In the case of these counties, road infrastructure also benefitted from investments in the investigated period, both for the extension of the road network and for road modernization.

**Table 1. Evolution of the length of public roads, by urban-rural typology, 2007-2017**

County category	2007		2017	
	Length-km	% modernized	Length-km	% modernized
Predominantly rural	45982	29.7	49204	43.7
Intermediate	34021	23.1	36006	35.8
Predominantly urban	890	63.1	889	54.1

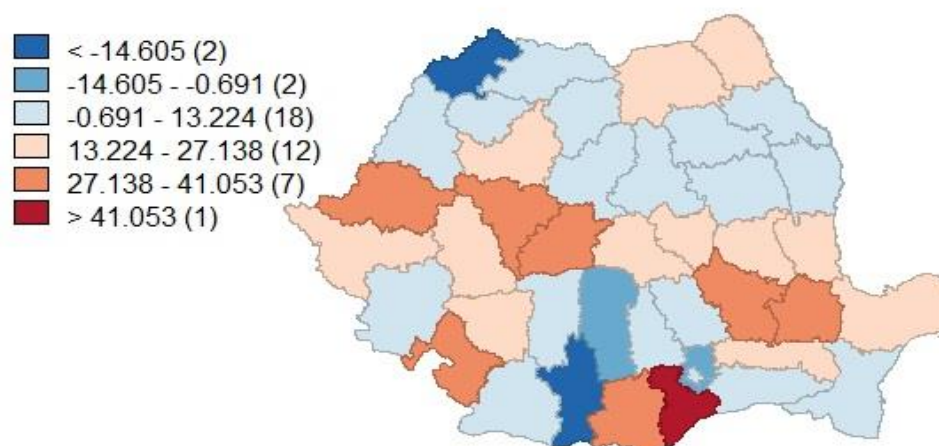
*Source: author's processing based on Tempo Online data, NIS*

Another interesting aspect can be noticed in the predominantly urban counties, where the share of modernized roads decreased from 63.1% in the year 2007, to 54.1% in 2017. This in the conditions in which, for Bucharest municipality, the road network has been entirely modernized, the difference being made by the county Ilfov, where the share of modernized roads decreased from 59.5% to 48.9%. This phenomenon can be attributed to the fast development of the economic activities and of the real estate sector in the investigated period, which led to the significant increase in traffic values (heavy traffic in particular) and to a faster deterioration of road infrastructure implicitly, for which no sufficient funds were allocated.

At county level, in the period 2007-2017, most territorial units had an upward evolution in terms of road quality infrastructure, represented by the increase in the share of modernized roads in total roads. The counties Olt, Satu Mare, Ilfov, Argeş and Maramureş are an exception, in which this share decreased, in certain cases significantly: Olt – -19 pp, Satu Mare – -16.7 pp and Ilfov – -10.6 pp. In this category we find units representing all the types of counties, by urban-rural typology. As regards the counties where the road infrastructure quality increased, these are mainly represented by the predominantly rural counties, being concentrated in the south-eastern, southern,

north-eastern, central, western and south-western areas, among which we mention the following: Buzău (+27.4 pp), Mehedinți (+27.9 pp), Arad (+30.0 pp), Teleorman (+32.8 pp), Alba (+35.1 pp), and Giurgiu, which ranks 1<sup>st</sup> with +42.7pp.

**Figure 1. Dynamics of the share of modernized roads, at county level, 2017/2007 (percentage points)**



*Source: author's Geo Da processing, based on Tempo-Online, NIS data*

However, the road infrastructure quality at county level remains an important problem – the investments made in this field in the investigated period contributed to its improvement, significantly in certain cases, but the present modernization level continues to be low, below 50%, for most territorial units.

Another important indicator for the evaluation of the development level of the technical infrastructure is represented by the share of localities connected to the drinking water supply network. As a basic element of infrastructure, alongside with the sewerage network and the natural gas supply network, its presence at county level contributes not only to the increase of the population's life quality but it is also an important criterion for carrying out economic activities at this level.

Nationwide, in the period 2007-2017, the investments made both through the national development programs, with financial support from the EU, and through the local initiatives, determined the expansion of the drinking water supply network at national level. As a process that requires a certain technical complexity, the network expansion was performed at a slower pace, yet constantly, throughout the investigated period. This was translated, at national level, by the increase of the share of localities with drinking water supply network from 62.5% in the year 2007, to 79.7% in 2017, by 14.5 percentage points respectively.

**Table 2. Evolution of the share of localities with drinking water supply network, by urban-rural typology, 2007-2017**

County category	2007		2017	
	No. of localities with drinking water supply network	% of total	No. of localities with drinking water supply network	% of total
Predominantly rural	1194	62.9	1462	77.0
Intermediate	853	68.9	1040	83.7
Predominantly urban	23	56.1	32	78.0

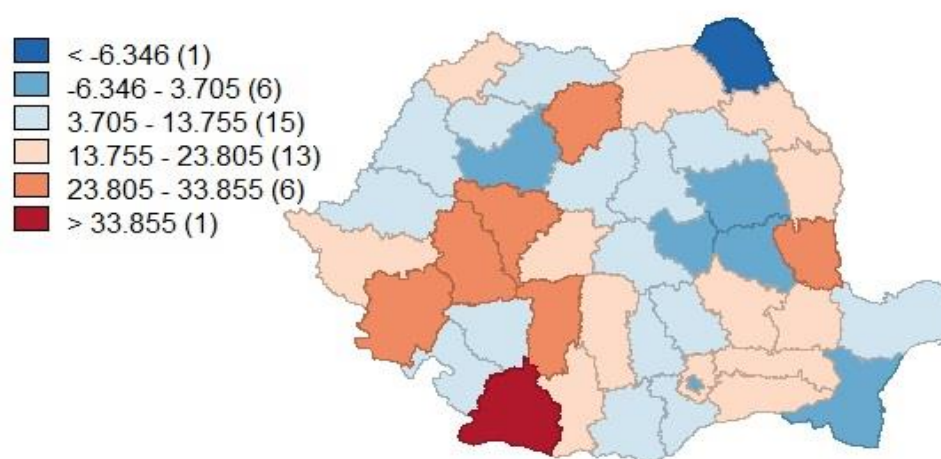
*Source: author's processing based on Tempo Online, NIS data*

As regards the evolution by urban-rural typology at county level, all the three categories of counties followed an upward trend of the share of localities with drinking water supply network in the period 2007-2017.

As expected, the efforts mainly targeted the predominantly rural areas: in this case the number of localities with drinking water supply network increased by 268 in the investigated period; in this conditions, by the end of 2017, the share of localities benefiting from drinking water supply reached 77.0%, close to that of the urban areas. In the case of urban localities, excluding Bucharest municipality (where the presence of the water supply network was maintained constant), the evolution of the indicator was strictly based on the development of the network in Ilfov county, where the number of localities increased from 23 in the year 2007, to 32 in 2017, leading to the increase of this share, per total rural areas, from 56.1% to 78.0%.

At county level, in the period 2007-2017, most territorial units followed an upward trend in terms of the share of localities with drinking water supply network. Botoşani county is the only exception, where this share decreased from 67.9% to 61.5% in the investigated period.

**Figure 2. Dynamics of the share of localities with drinking water supply network, at county level, 2017/2007 (percentage points)**



*Source: author's Geo Da processing, based on Tempo-Online, NIS data*

Other 3 counties, namely Constanţa, Bucharest municipality and Vrancea had identical values with those from the reference year. The counties that followed a strongly increasing trend in terms of water supply network extension (with an increase by over 20 percentage points) are located in the north-eastern, south-eastern, southern, north-western, central and south-western areas, being mainly predominantly rural counties: Buzău (+20.7 pp), Satu Mare (+23.6 pp), Alba (+26.9 pp), Vâlcea (+28.1 pp), Bistriţa-Năsăud (+30.6 pp) and Caraş-Severin (+33.8 pp).

We also find a predominantly urban county in this category, namely the county Ilfov, as well as 3 intermediate counties, namely Iaşi, Galaţi and Dolj. Although at the end of the year 2017 most counties had values over 80%, there are still territorial units with modest values in terms of the share of localities with drinking water supply network, namely Giurgiu, Teleorman, Suceava and Dolj.

An important element of the basic infrastructure is represented by the sewerage network, this complementing the drinking water supply network. Although the two networks can also exist separately, in environmental protection terms, the existence of the sewerage network ensures the disposal of wastewater from households and economic operators through a circuit that finally allows wastewater treatment before it is released into the natural circuit. On the other hand, having in view the complexity level of such an endeavor (in technical, economic, execution period terms), the expansion of the sewerage network is a more expensive and complicated process, presupposing a longer period of time for its execution.



Nationwide, in the period 2007-2017, the share of localities with sewerage network followed an upward trajectory, from 23.1% in 2007, to 39.3% in 2017.

By urban-rural typology, the counties with the most numerous sewerage network extension projects in the investigated period were the predominantly rural counties, the number of localities with sewerage network increasing from 374 in the year 2007, to 702 in 2017, so that their share in total localities increased by 17.3 percentage points. However, this remains a low value, so that more than 60% of the localities in this category do not have access to this basic infrastructure element.

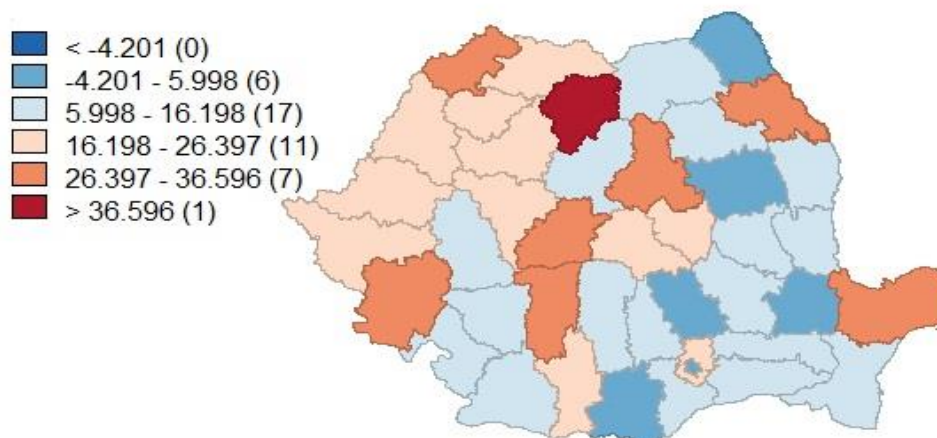
**Table 3. Evolution of the share of localities with sewerage network, by urban-rural typology, 2007-2017**

County category	2007		2017	
	No. of localities with sewerage network	% of total	No. of localities with sewerage network	% of total
Predominantly rural	374	19.7	702	37.0
Intermediate	342	27.6	520	41.9
Predominantly urban	19	46.3	29	70.7

Source: author's processing based on Tempo Online, NIS data

In the intermediate counties the sewerage network also increased in the analyzed period, the share of localities increasing from 27.6% in 2007, to 41.9% in 2017; in this case, too, most localities are not connected to the sewerage network. In the case of predominantly urban counties, except for Bucharest Municipality, the investments in network expansion were made in the county Ilfov, the number of connected localities increasing from 18 to 28 in the investigated period.

**Figure 3. Dynamics of the share of localities with sewerage network, at county level, 2017/2007 (percentage points)**



Source: author's Geo Da processing, based on Tempo-Online, NIS data

At county level, in most units the share of localities with sewerage network increased in the period 2007-2017; the counties Bacău, Botoșani and Brăila are an exception, with a decreasing trend by more than 2 percentage points. At the opposite pole, i.e. the territorial units with significant increases of the share of localities (by more than 20 percentage points), we can mainly find predominantly rural counties, like Alba (+21.2 pp), Covasna (+22.2 pp), Harghita (+26.9 pp), Tulcea (+27.5 pp), Vâlcea (+29.2 pp), Satu Mare (+33.6 pp), Caraș-Severin (+36.4 pp) and Bistrița-Năsăud, which ranks first, with 38.7 pp. 4 intermediate counties – Timiș, Cluj, Sibiu, Iași, as well as a predominantly urban county – Ilfov, complete this ranking. In terms of territorial distribution, these are mainly found in the north-western, central and western areas. Despite an obvious development of the sewerage network in all the categories of counties, most of them still have low values of the share of connected localities, i.e. under 50%; in certain counties, such as Teleorman,

Brăila, Giurgiu, Botoșani, Dolj, Ialomița and Vrancea, the share of connected localities is even under 20%. Only 6 counties exceeded 60% at the end of the period of analysis, out of which 3 predominantly rural counties (Caraș-Severin, Covasna and Harghita), an intermediate county (Cluj) and two predominantly urban counties (Ilfov and Bucharest Municipality).

The last specific indicator for basic infrastructure is the share of localities with natural gas supply network. Alongside with the drinking water supply network and the sewerage network, the natural gas supply network is a key element of basic infrastructure. Nationwide, in the period 2007-2017, efforts were made to extend the natural gas supply network, but having in view the technical and economic particularities, the intensity of this process was low, and the share of localities increased by only 3.5 percentage points.

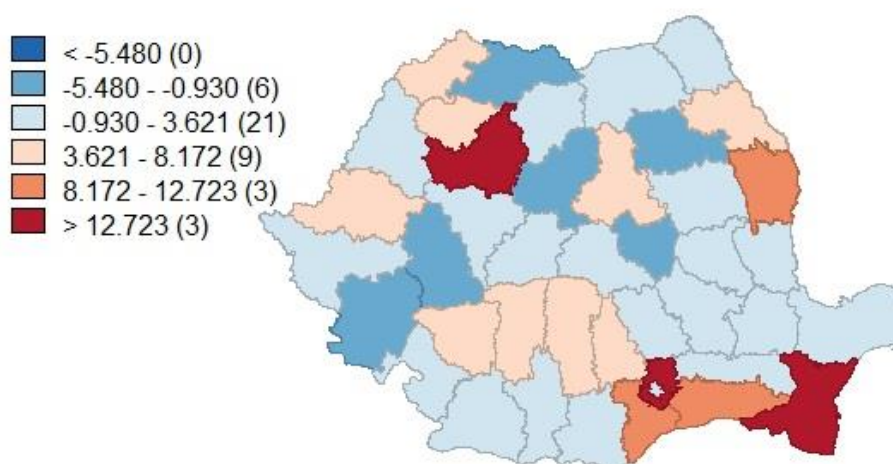
**Table 4. Evolution of the share of localities with natural gas supply network, by urban-rural typology, 2007-2017**

County category	2007		2017	
	No. of localities with natural gas supply network	% of total	No. of localities with natural gas supply network	% of total
Predominantly rural	412	21.7	469	24.7
Intermediate	363	29.3	414	33.3
Predominantly urban	32	78.0	38	92.7

Source: author's processing based on Tempo Online, NIS data

By urban-rural typology, the expansion of the natural gas supply network mainly targeted the predominantly rural and intermediate counties, the number of localities increasing by 57 and 51 respectively, in the period 2007-2017. This process determined the increase of the share of localities with natural gas supply network to 24.7% in the predominantly rural counties and to 33.3% in the intermediate counties, which are still low values. In the case of predominantly urban counties, the share of localities reached 92.7% in late 2017, due to the expansion of the network in Ilfov county.

**Figure 4. Dynamics of the share of localities with natural gas supply network, at county level, 2017/2007 (percentage points)**



Source: author's GeoDa processing, based on Tempo-Online, NIS data

By counties, in the investigated period, the share of localities connected to the natural gas supply network increased, yet at a slow rate. An exception is represented by the counties Covasna, Hunedoara, Maramureș, Caraș-Severin, Neamț and Mureș, where the evolution followed a decreasing trend, in the sense of decrease in the number of localities with natural gas supply

network and of the share in total localities respectively. In this group we find both predominantly rural and intermediate counties. At the opposite pole, i.e. counties with a stronger increase of the share of localities, we can mainly find predominantly rural units – Satu-Mare, Dâmbovița, Călărași, Vaslui and Giurgiu and intermediate units – Constanța and Cluj, as well as one predominantly urban unit, i.e. Ilfov county. Out of these, in the year 2017, only 3 counties had a share of localities connected to the natural gas supply network of over 50%. The counties with the most extended supply network in the year 2017 were Brașov (72.4%), Sibiu (76.6%), Mureș (80.4%), Ilfov (92.5%) and Bucharest municipality (100%). In the case of Mureș county, although the number of localities with natural gas supply network decreased, the share continued to be one of the highest at county level in late 2017. However, the presence of the natural gas supply network remains low in most counties, with shares below 30%. In certain cases, like in the counties Mehedinți, Teleorman, Tulcea and Botoșani, the share did not exceed 10%.

## CONCLUSIONS

The decade that passed from the moment of Romania's accession to the European Union marked an obvious process of basic infrastructure development at county level, which received significant financial support from the European programs devoted to infrastructure development. Furthermore, these also represented an impetus for national authorities to focus their efforts and resources on complementing the EU funds and participate in basic infrastructure development programs. Together, these contributed to the upward evolution of specific indicators, mainly in the predominantly rural and intermediate counties, which were the main beneficiaries of the European and national programs. However, at the level of most specific indicators, there is still a significant gap between these and the predominantly urban counties, and this situation highlights the need to continue the efforts of expansion/modernization of the public utility networks in these areas in the next programming period as well. This process is an essential condition both for increasing the people's quality of life and for supporting the overall economic development, by ensuring the basic conditions for carrying out any economic activity.

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# RURAL HOUSEHOLD TYPOLOGY ACCORDING TO THE SOCIO-ECONOMIC DEVELOPMENT PERSPECTIVES

LORENA FLORENTINA CHIȚEA<sup>1</sup>

**Abstract:** *The Romanian rural household is the socio-economic unit for which the agricultural activity continues to be the main source of income or at least of supplementing incomes in the form of self-consumption; thus, most rural households overlap the agricultural household farms/peasant farms/small-sized farms. The actuality of this topic results from the ever increasing importance of small farms in the European Union, the literature highlighting their role in the production of environmental public goods, food security, preservation of traditions and local crafts, being the main driving engine of the rural area, with important role in the demographic, economic and social vitality of the Romanian countryside. The paper intends to establish a typology of the rural households in territorial profile according to the agricultural/non-agricultural employment level, to provide a first information on the degree of rural household dependency on the farming activity. The main working hypothesis is the following: the communities with numerous rural population and lower average age have a higher share of non-agricultural occupations. The methodology used is based on Pearson correlation method that can be positive (in the case of direct correlations) or negative (in the case of inverse correlation) between the analyzed variables.*

**Keywords:** *rural area, rural household, rural development*

**JEL Classification:** *R20, Q 01, O2*

## INTRODUCTION

The actuality of the present paper stems from the need to identify a series of measures regarding the employment of the rural population, which could support the demographic, social, economic and cultural vitality of rural area in the context of accession to the European Union. For the orientation and promotion of demographic, economic and social policy programs, the individual analysis is needed, at the level of person, as well as the analysis at household level, this being the socio-economic unit where decisions are made with regard to the demographic, social (educational), economic behavior of each individual in part.

The Romanian rural household is the socio-economic unit for which the farming activity continues to be the main source of income or at least of supplementing incomes in the form of self-consumption; thus, most rural households overlap the agricultural household farms/peasant farms/small-sized farms. The actuality of this topic stems from the ever increasing importance of small-sized farms in the European Union, and the literature emphasizes their role in producing environmental public goods, food security, being the main driving engine of the rural area, with an important role in the demographic, economic and cultural vitality of the Romanian countryside.

At the moment of Accession to the EU, Romania's agrarian structure was a dual structure, in which small farms represented 99.55% of the total number of farms and used 65.20% of total utilized agricultural area (UAA), while the large farms accounted for only 0.45% of total number and used 34.80% of total UAA [5]. At ten years after the accession, the number of small farms decreased by 13.6% and the utilized agricultural area operated by these was down by 29.3%, while in the case of large farms a consolidation process took place, the number of farms increasing by 47.5% and the utilized agricultural area operated by these increased by 16.5% [1]. Both the legislation of the transition period and the new agricultural programs in the pre-accession period led to an increase in the discrepancy between the rural households with agricultural activity (subsistence and semi-subsistence farms) and the large competitive commercial farms that are eligible for attracting EU funds.

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## MATERIALS AND WORKING METHODS

A database at county level has been used, based on the data provided by NIS in Tempo-online. The indicators used referred to the demographic component: rural population, demographic dependency and demographic renewal ratios; for the economic component, the indicators were: share of wage earners in total labour force, employment in agriculture, agricultural output value and wage earnings in agriculture.

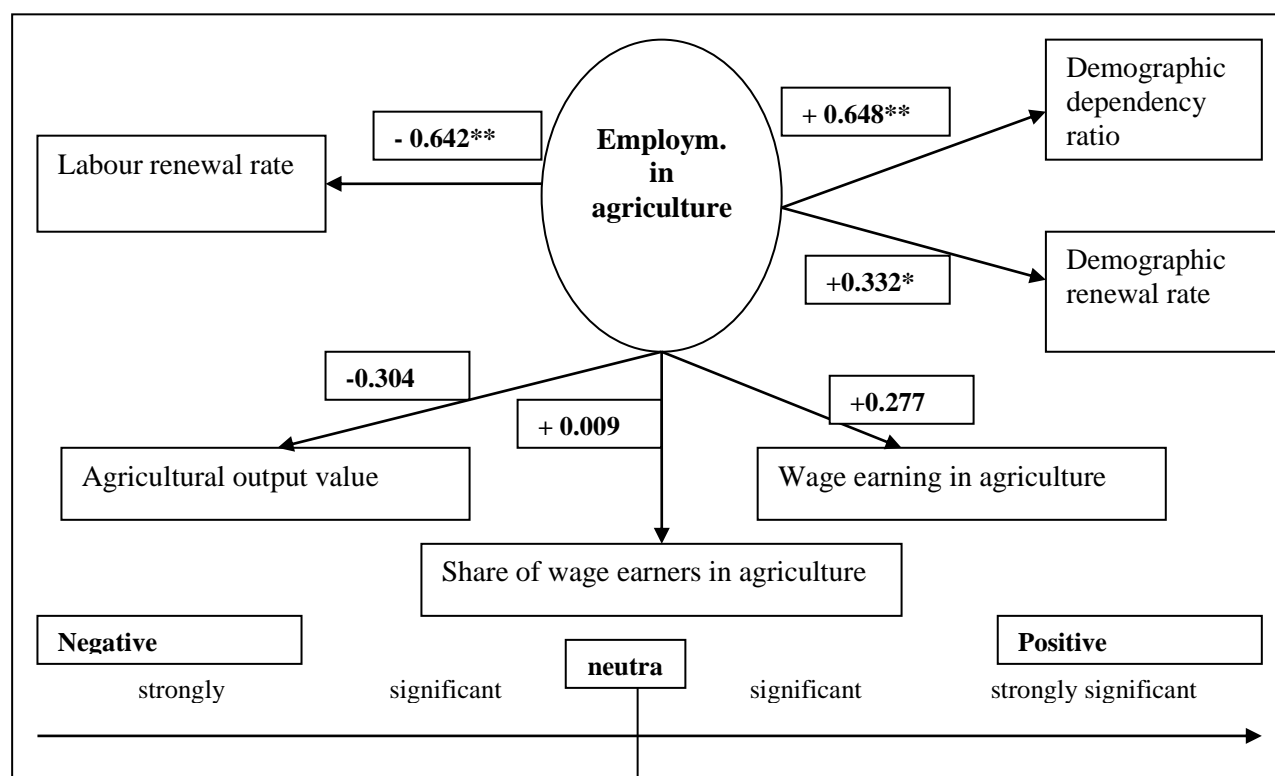
Modelling the specific variables is needed for understanding the socio-economic phenomena complexity in the Romanian rural area. Pearson correlation coefficient is frequently used in the economic and social sciences to measure the correlations between the analyzed variables. The analysis is based on Pearson correlation method that can be positive (in the case of direct correlations) or negative (in the case of inverse correlations) between the investigated variables [2], [3].

## RESULTS AND DISCUSSIONS

The paper intends to establish a typology of the rural household in territorial profile according to the agricultural/non-agricultural employment level to provide a first information on the degree of rural household dependency on the farming activity. The main working hypothesis is the following: the communities with numerous rural population and lower average age have a higher share of non-agricultural occupations.

The indicators from which we started in our scientific approach are grouped into two categories: demographic indicators (rural population, demographic dependency ratio, demographic renewal rate) and economic indicators (employment in agriculture, labour renewal rate, agricultural output value, wage earnings in agriculture). These are chosen by the author so as to be relevant to the subject, to provide available data. Following the analysis based on Pearson method, the resulting correlations are presented in the figures below.

**Figure no. 1. Scheme of correlation between the share of population employed in agriculture and the selected demographic and economic indicators**



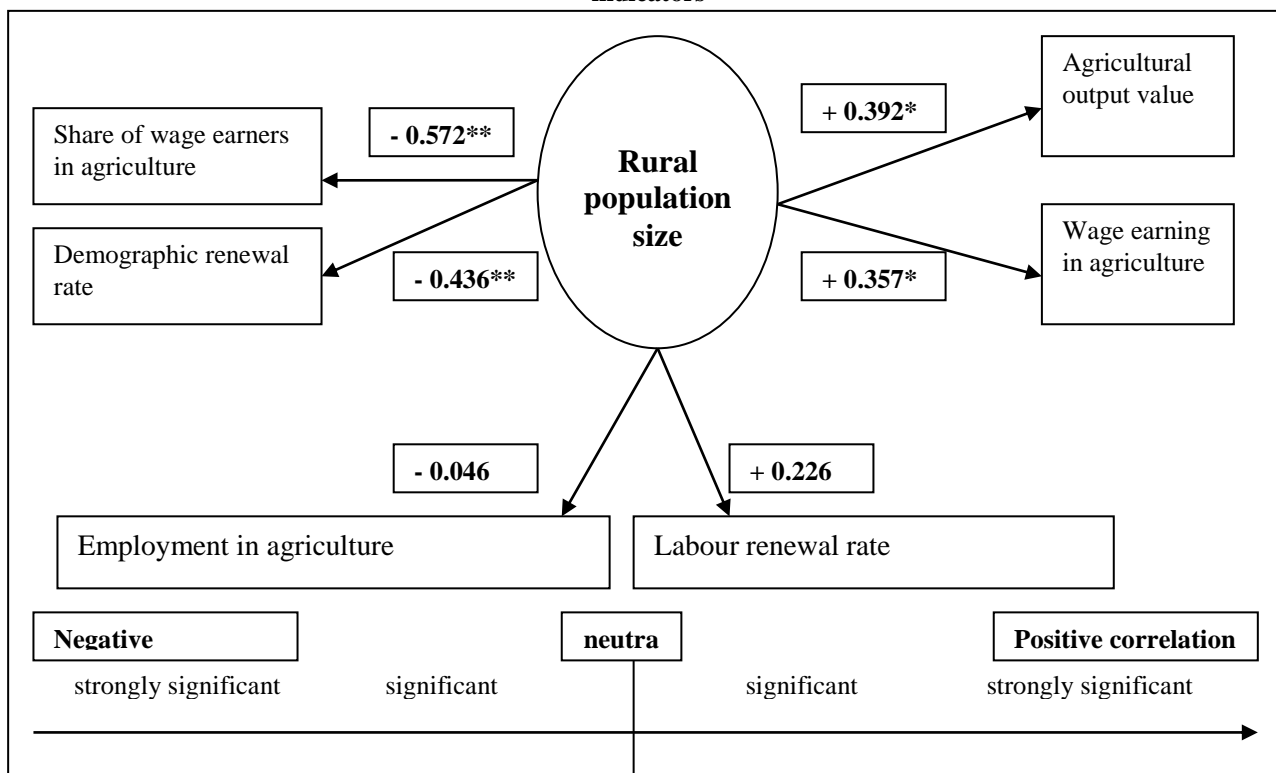
Note: \* significant correlation, \*\* strongly significant correlation

Source: author's calculations based on NIS data, through SPSS software

In order to verify the main hypothesis of the paper, we started from the correlation of employment in agriculture indicator with the other demographic and economic indicators. Thus, the high share of population employed in agriculture strongly correlates with a higher demographic dependency ratio (+0.648\*\*), which denotes an aging population employed in agriculture. This unfavourable situation is also revealed by the strongly significant negative correlation between the employment rate in agriculture and the labour renewal rate (-0.642\*\*).

The employment in agriculture does not correlate with the agricultural output value or with the average wage earnings in agriculture, which reveals the subsistence character of agriculture in the counties where farming activities prevail. As employment in agriculture has no impact on the economic activity, the typology by the degree of employment in agriculture is no longer of scientific interest in the present paper, and the analysis of the demographic dimension will be considered, having in view the following indicators: rural population size and dependency ratio.

**Figure no. 2. Scheme of correlation between the rural population and the selected demographic and economic indicators**



Note: \* significant correlation, \*\* strongly significant correlation

Source: author's calculations based on NIS data, through SPSS software

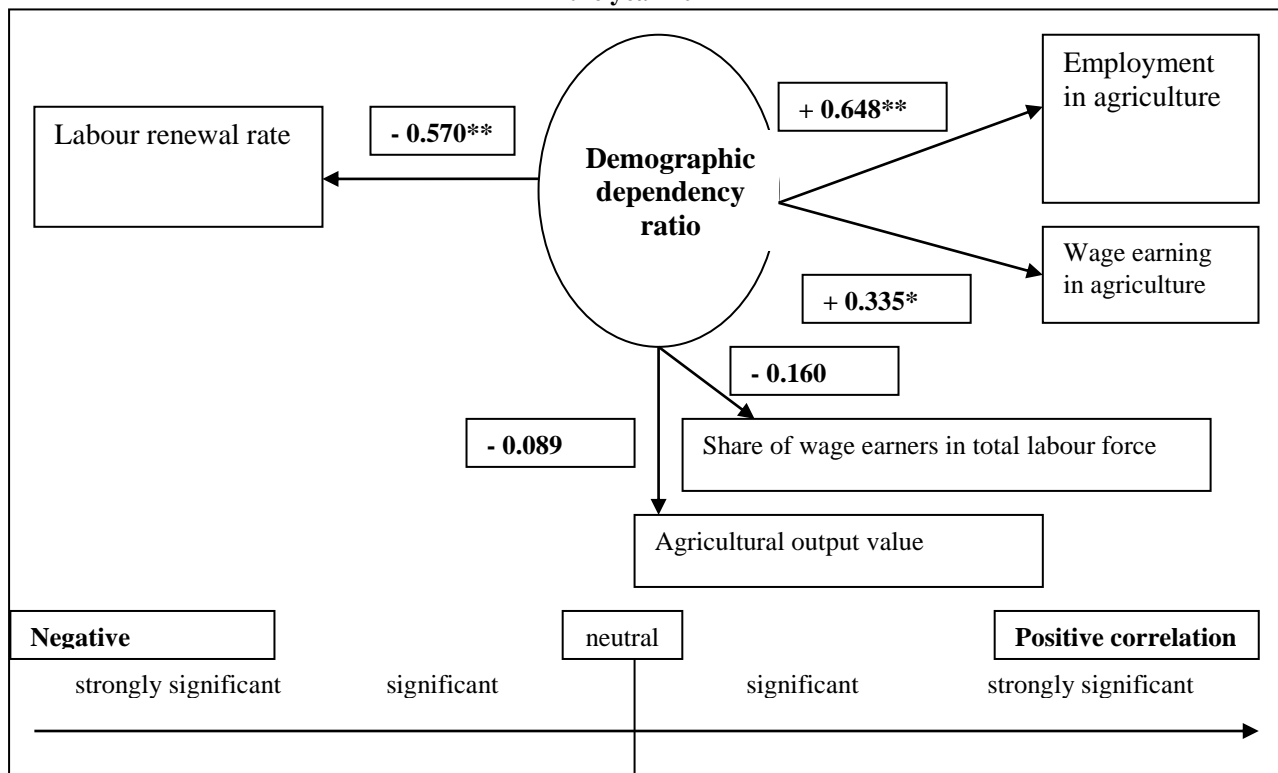
The rural population influences the economic activity, so that there is a significant direct correlation with the agricultural output value (+0.393\*) and the earnings in agriculture (+0.354\*). In other words, a numerous rural population generates an intensification of agricultural activity, which leads to higher wage earnings in agriculture, which leads us to the empirical conclusion that a numerous rural population increases the level of production.

Rural population does not influence the labour renewal rate or the employment in agriculture. Yet there is a strongly significant negative correlation instead between rural population size and the share of wage earners in total labour force (-0.573\*\*).

The demographic dependency ratio is an indicator of the demographic burden on the economically productive population, being one of the most important indicators used in the evaluation of the financial impact of the aging process on the pension system. The indicator does not take into consideration the "dependent" persons who are economically active or the persons of working age who are dependants. The higher the dependency ratio, the higher the pressure exerted by the inactive population on the active population. In the absence of firm economic development

policies, the aging of the population may impede the increase of the living standard of the population.

**Figure no. 3. Scheme of correlation between the demographic dependency ratio and the economic indicators, in the year 2017**



Note: \* significant correlation, \*\* strongly significant correlation

Source: author's calculations based on NIS data, through SPSS software

The demographic dependency ratio strongly significantly correlates with the employment in agriculture indicator ( $+0.648^{**}$ ) and it significantly correlates with the wage earnings in agriculture ( $+0.335^{*}$ ), yet it bears no influence on the agricultural output value ( $-0.089$ ). In other words, the higher demographic dependency ratio, the more important is the agricultural activity for the rural population, yet in economic terms this does not represent added value. The demographic dependency ratio has a strongly significant negative correlation ( $-0.570^{**}$ ) with the labour renewal rate, which is normal in the conditions in which a high demographic dependency ratio directly correlates with the aging of the population.

From the analysis of the demographic and economic indicators using the Pearson correlation, the strongest correlations are generated by the demographic indicator: rural population size. Thus, we opted for establishing the rural household typology according to the demo-economic development potential for the demographic criterion, by the indicator: average demographic size of the commune, which highlights a series of relevant information on the demographic and economic development prospects of rural households. Thus, the following typology has been established:

- rural households with very low development prospects (endangered): in the counties where the average number of inhabitants per commune is 2468;
- rural households with low development prospects (at a critical threshold): in the counties where the average number of inhabitants per commune is 3338;
- rural households with medium development prospects: in the counties where the average number of inhabitants per commune is 4382;
- rural households with good development prospects: in the counties where the average number of inhabitants per commune is 5166;
- rural households with urbanization prospects: in the county Ilfov, where the average number of inhabitants per commune is 7002.

Table no. 1. Demographic and economic indicators related to the typology of rural households according to the socio-economic development perspectives

	A	B	C	D	F
Rural population	159951.83	232928.10	346392.14	480462.00	224055.00
Average demographic size of the commune	2468.40	3338.40	4382.34	5166.26	7001.72
Average demographic size of the village	661.66	798.45	1095.95	1149.43	2462.14
Demographic dependency ratio	53.37	51.41	47.98	47.03	43.35
Demographic renewal rate	98.81	87.22	82.00	65.06	105.00
Labour renewal rate	1.71	1.72	1.74	1.72	1.26
Employment in agriculture	27.87	26.59	25.04	23.61	13.35
Share of wage earners in agriculture	2.89	2.21	1.48	1.23	1.72
Agricultural output value	1611866.08	2042775.15	2171106.71	2103620.00	672750.00
Average wage earning in agriculture	1776.08	1799.90	1941.86	1847.00	2142.00

Source: NIS - Tempo online

## CONCLUSIONS

From the above analysis, the main working hypothesis has been confirmed, the degree of importance decreases employment in agriculture as communities are numerous, but the agricultural production value and the average wage in agriculture. Confirming once again the predominantly subsistence agriculture with low productivity and competitiveness.

For the establishment of a hierarchy of rural households by the demo-economic development potential, we started from the assumption that a good criterion could be the degree of agricultural employment; yet as a result of the Pearson correlations, a very weak influence on the economic results has been noticed. Following the Pearson analyses, among the demographic and economic indicators, the most appropriate criterion (average demographic size of a commune) has been identified in order to highlight a series of relevant information on the demo-economic development prospects of rural households.

The households with the lowest demographic and economic prospects are those with the highest demographic dependency ratio, as well as with the highest demographic renewal rate, with a high labour renewal rate respectively; yet these values cannot contribute to the demographic/economic regeneration of the rural households from the respective counties. In economic terms, we can notice the lowest agricultural output value and the lowest wage earnings, in the context in which the employment rate in agriculture is the highest, together with the highest share of wage earners in agriculture.

The households with good demographic and economic prospects are located in the counties with the largest-sized communes and villages; yet even though the demographic dependency ratio is lower compared to the other categories, it cannot be supported by the low demographic renewal rate. From the demographic point of view, the development potential in the counties with good development prospects is not supported by a real potential of demographic regeneration, but rather by the current demographic situation in which the population of working age and the elderly population prevail, and the share of the young population is quite low.

As the county Ilfov has a special status, given its proximity to the capital city, it has been proposed to establish a special category for this county within the typology "rural households with urbanization prospects". This category is characterized by a large demographic size, with the lowest dependency ratio, the only category that ensures its demographic regeneration having a 105% demographic renewal rate. In economic terms, the agricultural production obtained in this category is not important, the percentage of population employed in agriculture being the lowest, yet the highest wage earnings in agriculture can be noticed in this category.



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4. \*\*\* NIS, 2018, Tempo-online
5. \*\*\* NIS 2016, *Farm Structure Survey*

# DETERMINING FACTORS OF THE LIVING LEVEL IN RURAL COMMUNITIES IN THE SOUTHEAST REGION

RUXANDRA – EUGENIA POP<sup>1</sup>

**Abstract:** *Within the present paper, some of the most important representative factors for the standard of living of the population in the south-eastern region of our country will be analyzed. It is also desired to present an overview of the current situation regarding the labor market in the territory of this region and the elements that define this market: the degree of development of the area, the supply and demand on the labor market, socio-demographic factors, economic factors. Starting with the 1990s, after the austere communist period, at the national level, from the point of view of the standard of living Romania has stood at a considerable distance from the average recorded at the level of the other European Member States, although, in the last decades, there have been transformations various social-economic level. According to the data, almost half of the population of Romania (40% on average) is affected by the risk of being on the verge of poverty. In order to carry out the present work, the main data used were taken from specialized databases, such as Eurostat, TempoOnline (database of the National Institute of Statistics) and others.*

**Keywords:** *poverty line, standard of living, national economy, unemployment rate*

**Jel Clasification:** *Q15, R1*

## INTRODUCTION

The South-East region of the country (Brăila, Buzău, Constanța, Galați, Tulcea, Vrancea), has a population of 2545.9 thousand inhabitants, in this region there is a great ethnic, linguistic and religious diversity (Russians, Greeks, Turks, Tatars). In 2018, according to the Labor Force Balance, the region's labor resources amounted to 1520.7 thousand people out of which the civilian employed population represented 62.4%. The unemployment rate registered on March 31, 2019 was 4.5%, with 44.5 thousand unemployed registered. From the point of view of participation in the main economic activities, the share of the civil employed population in agriculture is 25.1%, while the share of the civil employed population in services is predominant (44.6%), and in industry and construction it is 30.3%.

Agriculture holds an important share in the region's economy, with agricultural production being significant. The region ranks first in the country in terms of the area of fruit trees. Fisheries and aquaculture, along with fish processing and trade in fish and fish products, are traditional activities in the South-East Region.

The region also has a diversified industry: petrochemical, metallurgical, machine building, construction materials, food and textile industry. In this region there are important industrial centers: combined (iron and steel, petrochemical), shipyards with tradition (from Brăila, Galați, Tulcea, Constanța and Mangalia), pulp and paper factories, combined petrochemical from Năvodari, nuclear power station from Cernavodă. Another important sector for the region, with a significant number of employees, is the naval one.

According to ANOIM statistical data, the most important employers in the region, as number of employees were: ArcelorMittal Galați SA, SC Shipyard Damen Galați, SC Vard Tulcea SA, Arabesque SRL, DGRFP Galați, Damen Shipyards Mangalia, Raja SA.

The specificity of the South-East Region is represented by the disparities between the concentration nodes of the industrial and tertiary activities (Brăila - Galați; Constanța - Năvodari), the isolated complex industrial centers (Buzău, Focșani), areas with tourist specificity (the coast and the Danube Delta) and the large areas with areas of agricultural and wine growing. Thus, Brăila and Constanța counties are characterized by a higher rate of population employed in industry and construction, Buzău and Vrancea with higher percentage of population employed in agriculture, Constanța and Galați in services.

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## MATERIALS AND METHODS

In the present work the following working methods will be used:

- dissemination of existing information in the specialized, domestic and international literature of interest;
- quantitative and comparative analysis of the existing statistical data in the database of the National Institute of Statistics regarding elements of interest for shaping the standard of living of rural communities in Tulcea and Constanta counties.

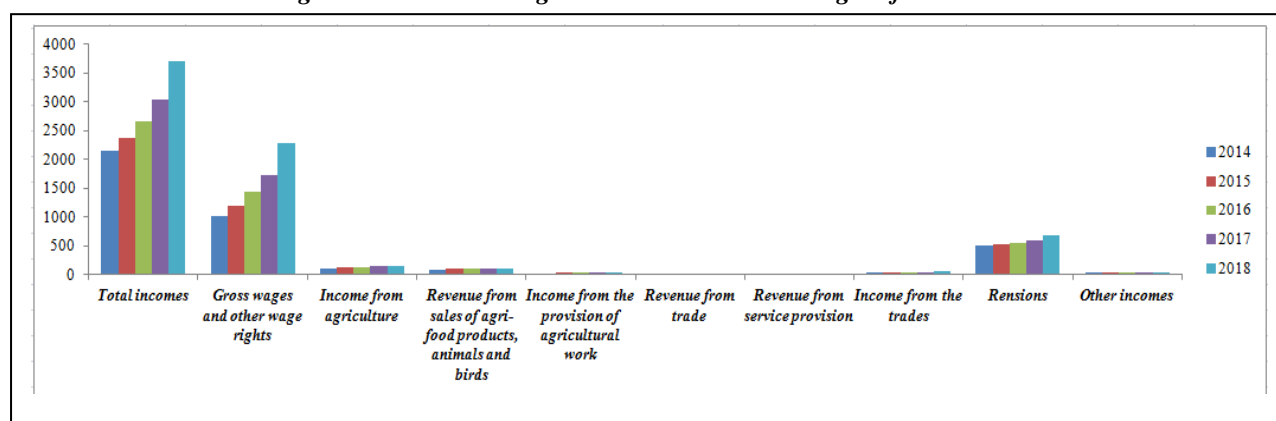
## RESULTS AND DISCUSSIONS

In the specialty literature, several factors have been identified for assessing the standard of living of the population in an area, region. A first defining factor to characterize the standard of living is the *income* and expenditure of the population, referring mainly to the level of gross registered wage. Closely related to this factor are elements related to the labor market, such as: the unemployment rate, the employed population rate. Another important factor is the degree of material deprivation of the population.

Regarding the *incomes*, as a determining factor of the standard of living, based on the statistical data provided by the INSSE, we can say that in 2018, it does not show big differences from one region to another, but higher incomes were registered in capital, in the center of the country and in the North-West region, a lower level being registered in North-East, South-East and South-Muntenia, which can be explained by the fact that high values of the population are recorded in the territory of these regions aging, a lack of alternatives, lower economic efficiency, a low level of foreign direct investment.

Thus, in graph 1, we present the level of incomes registered between 2014 and 2018, according to the main social categories, in the area of interest for the present work:

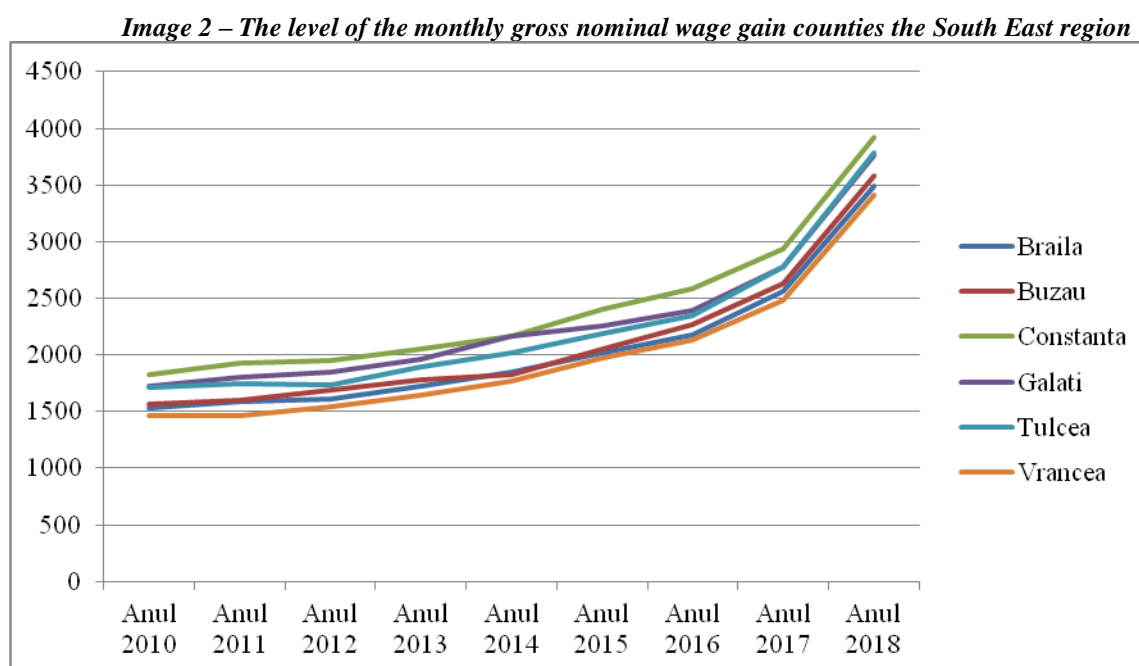
*Figure 1 – Income categories in the South East Region from 2010-2018*



Source: <http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table>

Thus, we observe an increase in all the categories of incomes analyzed, between 2014 and 2019, out of the total incomes, the highest share occupying, as it was natural, the incomes obtained from the gross wages or other material rights.

Analyzing the most important form of income, namely the monthly gross nominal salary, we can say that on the territory of the South East Region its highest level is registered in Constanta and Galați county, at the opposite pole being counties like Brăila and Buzau ( see image 2):



Source: data processing available at <http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table>

What we observe is the fact that the curve that defines the level of the earnings was ascending for all the counties in the South-East region of the country.

Regarding the degree of economic development, it is noted that the GDP registered in the analyzed region followed an upward curve during the years 2010-2016 (see table 1):

**Table 1**

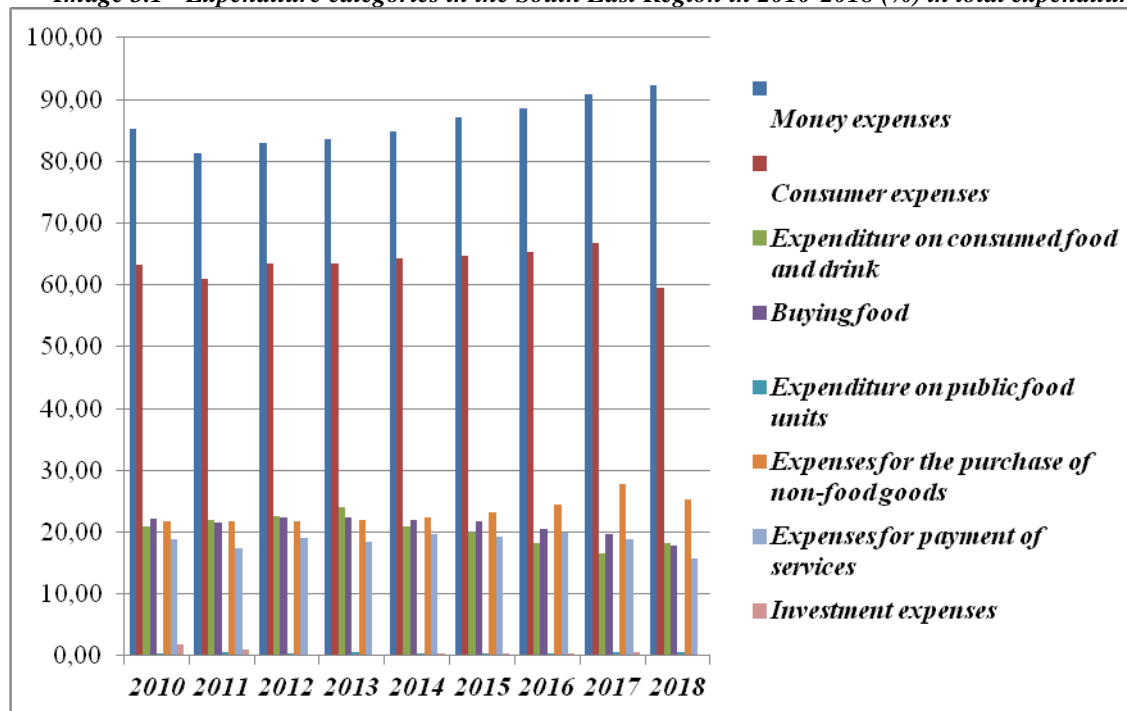
<b>The GDP evolution at the South-East Development Region level</b>								
<b>County</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2016-2010 (%)</b>
<b>Brăila</b>	6123,8	6943,8	6945,8	7410,7	7360,7	7710,3	8382,3	<b>36,88</b>
<b>Buzău</b>	7900,1	8051,6	8714,8	9579,7	9438,8	10258,4	10435,3	<b>32,09</b>
<b>Constanța</b>	21157,3	24891,6	26322,5	30566	33947,8	32791,6	34433,7	<b>62,75</b>
<b>Galați</b>	10912,9	10957,1	11318,6	12195,1	12646,9	12613,6	12970,1	<b>18,85</b>
<b>Tulcea</b>	4467,4	5230,4	4902,8	5252,4	5151,4	5519,2	5944,9	<b>33,07</b>
<b>Vrancea</b>	5745,3	5652,5	6205,9	6620,6	6748,1	7296,6	7743,5	<b>34,78</b>

Source: data processing available at <http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table>

The counties that recorded the highest level of GDP are Constanta and Galați, and at the opposite pole are counties like Tulcea and Brăila. The highest growth during the analyzed period was also recorded in Constanta County.

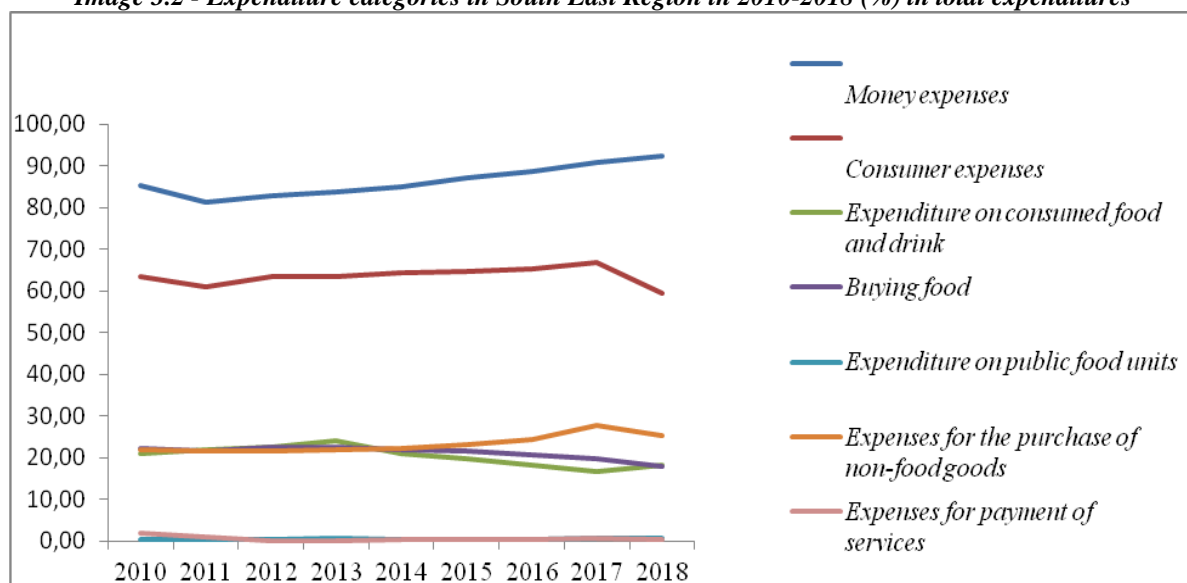
Regarding the level of expenses recorded in the territory of the South-East region of Romania, we submit under analysis image 3.1 and image 3.2:

**Image 3.1 - Expenditure categories in the South East Region in 2010-2018 (%) in total expenditures**



Source: prelucrare după <http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table>

**Image 3.2 - Expenditure categories in South East Region in 2010-2018 (%) in total expenditures**



Source: data processing available at <http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table>

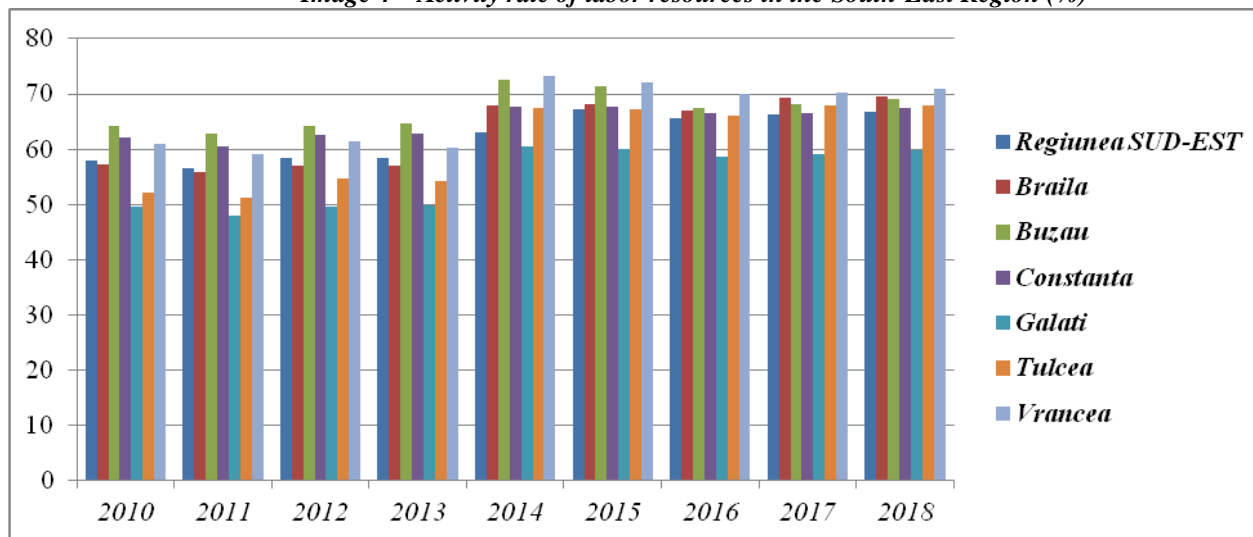
Thus, analyzing the image no. 3.1 and 3.2, we can mention the following:

- the largest share of the total expenses is spent on food and beverages consumed, but also on the purchase of non-food goods;
- the most important decrease is the investment expenses, in 2018 reaching a weight of 0.27%, compared to 2010, when they registered a share of 1.92% of the total recorded expenses;
- the share of expenditures in the level of total expenditures on non-food goods increased from year to year, while the share of expenditures on food expenditures decreased from year to year, which again supports the assertion that the style of food life and consumption of the population has undergone changes in the last time period;

- we also observe a minor increase in the share of expenses incurred within the food units, but we can still say that in this region a small part of the population attends the units with this profile.

Regarding the labor market, we analyze according to the existing statistical data defining elements for the area of interest, such as: the activity rate of labor resources and the unemployment rate.

*Image 4 – Activity rate of labor resources in the South-East Region (%)*

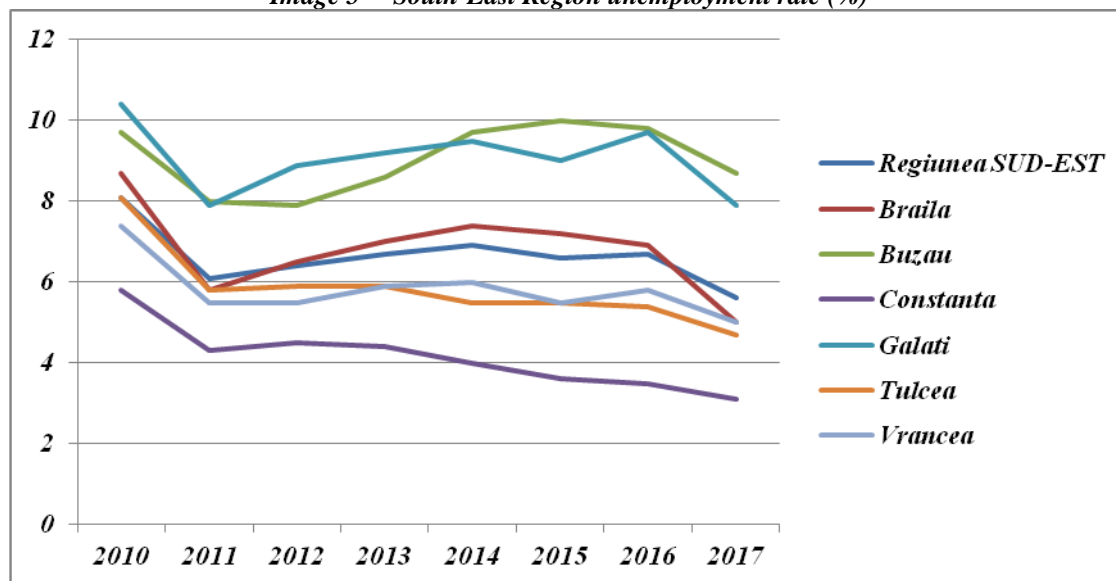


Source: prelucrare după <http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table>

According to the National Institute of Statistics, in 2018, the employment rate of the working age population was 65.5%, increasing compared to the previous year, but still below the average registered at European level. In terms of employment, the most affected are the young people, with a degree of employment slightly over 25%. In the rural area there is employment in the agricultural sector (over 60%). The agricultural sector took over the labor force that did not activate in the industry and offered an activity that provided, for many families, the necessities of food, compensating and supplementing the incomes with a small subsistence production. In the urban environment there is a development of the tertiary sector, with an increase of the population employed in the field of services (80% in 2018), which offers financial opportunities and the resources necessary to ensure the quality of life.

Although the values registered in 2018 for the unemployment rate in Romania are classified below those registered at the European Union level (Eurostat, 2018), the underutilization of the workforce is a permanent concern of the population in Romania, causing a non-homogeneous distribution of the population's income, with effects on standard of living and quality of life. The dynamics of the unemployment rate show a series of fluctuations, but with an upward trend in recent years, reaching locally, values of over 14%. Unemployment affects the population in the urban and rural areas equally, but the Romanian communities are the most affected rural ones, with an aging population.

**Image 5 – South-East Region unemployment rate (%)**



Source: data processing available at <http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table>

Thus, the unemployment rate registered lower values in counties such as Tulcea, Constanta, Braila and higher values in counties like Buzău and Galați.

Another eloquent indicator for drawing the standard of living of the population in the South East Region of the country is the poverty rate (see table 2):

**Table 2 - Poverty rate by regions during the period 2014-2017**

<i>Development regions</i>	<i>2014</i>	<i>2015</i>	<i>2016</i>	<i>2017</i>
Northeast	36.1	35.9	36.1	33.4
South East	34	32.4	31.2	29.6
South-Muntenia	25.5	30.6	24.8	24.9
South West Oltenia	28.3	32.1	34.2	33.4
West	27.5	19.8	25.1	21.4
Northwest	20.4	19.2	17.1	19
Center	20.4	17.8	20.8	17.3
Bucharest Ilfov	4.8	5.9	10.2	6.1

Source: prelucrare după <http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table>

In 2017, the highest poverty rates were registered in the North-East and South-West regions Oltenia (33.4%) and South-East (29.6%), and the lowest in Bucharest-Ilfov (6, 1%). From the analysis of the evolution of the poverty rate in 2017 compared to 2014, it can be seen that almost all regions have experienced decreases in the last year. The largest decreases were found in the West (6.1 percentage points), South-East (4.4 percentage points), Center (3.1 percentage points) and North-East (2.7 percentage points). Poverty rate increases in the analyzed period were recorded in the South-West Oltenia region (5.1 percentage points) and Bucharest-Ilfov (1.3 percentage points).

## CONCLUSIONS

In this paper we tried to draw an overview of the standard of living in the South East Region, statistically analyzing indicators such as: income and expenditure of the population in the area, the rate of the active population and the unemployment rate, the poverty rate, the level of GDP- of the recorded. Thus, we can conclude the following:

- analyzing the most important form of income, namely the monthly gross nominal salary, we can say that in the territory of the South East Region its highest level is registered in Constanta and Galați county, at the opposite pole being counties like Brăila and Buzau ;
- the curve that defines the level of the earnings was ascending for all the counties in the South-East region of the country;
- the counties that recorded the highest level of GDP are Constanta and Galați, and at the opposite pole are counties like Tulcea and Brăila. The highest growth during the analyzed period was also recorded in Constanta County;
- the share of expenditures in the level of total expenditures on non-food goods increased from year to year, while the share of expenditures on food expenses decreased from year to year, which again supports the assertion that the style of food life and consumption of the population has undergone changes in the last time period;
- although the values registered in 2018 for the unemployment rate in Romania are classified below those registered at the European Union level (Eurostat, 2018), the underutilization of the labor force is a permanent concern of the population in Romania, causing a non-homogeneous distribution of the population's incomes, with effects on the standard of living and quality of life;
- in 2017, the highest rates of poverty were registered in the North-East and South-West regions Oltenia (33.4%) and South-East (29.6%), and the lowest in Bucharest-Ilfov (6,1%).

The lack of alternatives and economic efficiency affects the population in the South East region of the country, especially the population employed in sectors that do not provide the financial opportunities and resources needed to adopt a response and adaptation model.

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 \*<https://ec.europa.eu/eurostat>  
 \*<https://ec.europa.eu/eures/main.jsp?lang=ro&acro=lmi&catId=9460&countryId=RO>



# AGROTOURISM POTENTIAL AS PART OF SUSTAINABLE RURAL DEVELOPMENT IN ROMANIA

ELENA SIMA<sup>1</sup>

**Abstract:** *The rural economy is more developed and more dynamic if it has a more diverse structure, and if the share of non-agricultural economy is higher. In this context, the agrotourism is a field that is growing in popularity as producers try to diversify their activities and increase profits that can support economic development in the countryside through sustainable use of tourism resources and maintaining the rural community cultural and social diversity. Our paper focuses on specific opportunities and constraints that influence the progress of agrotourism activities as viable entrepreneurial solutions for self-sustainable rural communities in Romania from the perspective of European integration. The results have shown that agrotourism activity in the areas where it was implemented and developed, had a very strong and favourable impact not only on the economic and touristic framework of localities, but also on their social, cultural, spiritual and even ecological framework.*

**Keywords:** *sustainable development, non-agricultural activities, agro-tourism, Romania.*

**JEL Classification:** *Q01, R33.*

## INTRODUCTION

Sustainability leaves from the idea that human activities are depending on the environment and resources. Health, social security and economic stability of society are essential in defining life's quality. As result, a sustainable society is a society which is modelling its economic and social system such that the global natural resources and the support systems of life be maintained for the next generations.

In Romania, as a Member State of the European Union, ever since the year 1997 steps have been made towards the identification of the priorities for a sustainable development at national and local level, as well as for the incorporation of the sustainable development principles and practices in the ensemble of the Romanian public programs and policies. The national rural development program identifies as priorities the improvement of the rural infrastructure, the increase of life and working standards and the maintaining of population in the rural zones through the development and diversification of economic activities generating incomes and multiple activities (<https://pndr.ro>). This applies to the sustainability principles as the rural zones remain attractive for the next generations.

In the context in which agriculture is still considered "a strategic sector of Romania due to the country's natural advantages and due to the economic and social environment" agro-tourism (an activity as many others, organized and developed in the rural environment by the members of a farm/agricultural household, which means the combination of the agricultural and tourism activities) becomes an alternative source of incomes and labour employment supported financially by European funds, and the Romanian agro-touristic potential represents a component of the sustainable rural development (<http://www.madr.ro>).

## MATERIALS AND METHOD

Having in view the positive role which is played by the promotion and development of agro-tourism activity as activity complementary to the agricultural one, organically integrated in the farms' economy, as well as benefiting by a non-polluted picturesque environment, and by the touristic natural attractions and the traditions and habits present in the village environment, the paper proposes itself an inventory of the opportunities and constraints at the basis of this activity development in our country. The methodology used is based on the analysis and synthesis of

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information regarding the evolution of the Romanian agro-tourism activity, supported through the agricultural and rural development policy. The statistical data was completed with information comprised in articles, studies, reports and governmental and nongovernmental documents.

## RESULTS AND DISCUSSIONS

In Romania, agrotourism is a form of tourism emerged from the need to find some solutions for increasing the rural farms incomes by putting into value their economic potential. This potential refers both to the existent accommodation potential, prepared and arranged mainly for the guests' receiving, and to the goods and services supplied for consumption to persons coming into the rural environment for relaxing, rest, leisure. In function to the natural, cultural, folklore environment of the region, agro-touristic services offered can vary from meals' serving, accompanying and touristic guide on certain tracks or initiation in certain traditional crafts, to the practicing of some sports or assistance to a series of traditional habits in the locality or zone (poems sessions, village dances, carols, church holidays, traditional fairs, folklore shows, etc).

According to the legal regulations, the rural households/farms' orienting to the completion of their incomes from the agricultural activities with incomes from touristic activities should be rearranged keeping the rural and archaic specific. The specific manifested through the construction materials, working technics, architecture, decorations, furniture must be re-discovered and kept as such, being protected from the urban civilization's contaminations.

The main condition for a farm/household to receive the name of agrotouristic boarding house is to have sufficient rooms for its own family and supplementary capacities to accommodate and feed, proper hygiene and sanitary conditions, means of information and other comfortable adjacent elements in order to constitute an attraction for the tourists.

The licence for the accommodation and feeding of tourists, as well as the certificate for the classification of the comfort degree are granted by the central public institution responsible in the tourism field together with the respecting of the following criteria:

- spaces and access destined to tourists must be separated from those of the host;
- the accommodation rooms must be detached with direct access from the hall or from the stairs' house, must be spacious, sunny, shiny, with the heating possibility, furnished strictly corresponding to the norms, preferably with simple, traditional rustic furniture, eliminating the objects lacking utility for the tourists;
- to exist balconies and terraces at the rooms or halls destined to the tourists endowed with lounges, osier armchairs, tables and electric light;
- to have a day room destined to the tourists for serving the meals, leisure, lecture, games, watching tv and others;
- to have sanitary groups endowed with cold and warm water, which must be well kept and perfectly clean;
- to exist the possibility to prepare the meal by the tourists in a separate space or in the kitchen of the host with the possibility of separating the compartments and equipments for tourists;
- to exist places and objects for children to play.

Rearranging of a farm/household with agrotouristic boarding house needs a quantitative and qualitative evaluation of the touristic potential and supply at micro-territorial level, as well consulting, assistance and funds on whole period of its formation as entity in tourism. In Romania, there are a multitude of actors involved in the development of agro-tourism in Romania. Some of them play a role more important than others, but each brings a contribution in the development of agro-tourism. Main actors can be classified in governmental institutions, local public administrations, members of the private touristic sector, nongovernmental organizations, local communities, financiers, university environment, tourists. Among non-governmental organizations involved in the development of agro-tourism activities, we enumerate:

- The Romanian Federation for Mountain Development (1990), promoting support under any form to the mountain dwellers, including the organization and development of agro-tourism;

- The Romanian Agro-tourism Agency (1995), aiming at agro-tourism connection to the international tourism system;

- The National Association for Rural, Ecological and Cultural Tourism in Romania ANTREC (1994), member of the European Federation of Rural Tourism (EUROGÎTES), well known on international and national plan as a leader in the development of the rural Romanian tourism, as well as the keeping of the Romanian traditional culture (<http://www.antrec.ro>).

Sustainable development of agro-tourism activities in the boarding houses requires among others:

- improvement of infrastructure to support the agro-tourism businesses;
- continuing to reduce bureaucracy with regard to the establishment and operation of agro-tourist boarding houses;

- a better information of the population with regard to the governmental programs for private initiative stimulation;

- popularization of the successful business examples of the Romanian entrepreneurs;

- establishment of local public administrations as promoters of profitable management of the tourism patrimony through the initiation of programs providing support to rural tourism.

According to specialized research, the promotion and development of agro-tourism activities in the rural areas are generating multiple positive effects at economic, social and cultural level through:

- putting into value the local natural and cultural potential;
- increasing the number of jobs, both in the tourism sector and in other auxiliary sectors, of services and management of local resources;

- increasing the living standard and education of the involved population ;

- maintaining the local population in the zone;

- preserving and promoting traditional occupations;

- stimulating certain profitable tourism activities (hotels, restaurants, transport, handicrafts, guide services, etc.);

- diversification of the local economy, mainly in the adjacent rural areas, where agriculture has no development possibilities;

- fostering rural economy development through an additional demand for agricultural products and financial capital;

- improvement and modernization of the local transport, communication and technical infrastructure, with advantages for the local population;

- increased interest in environmental protection inside the protected natural areas;

- fostering inter-cultural communication between local people and tourists.

In the absence of a proper management of the agro-tourism activities in the boarding houses there appear the following negative effects:

- change of land destination, often with good farm yields and well positioned, which is attracted into the tourism business;

- favouring the speculative attitude in the land sale-purchase process, without a well-defined juridical status;

- destruction of soil, flora, fauna and the change of the ecological equilibrium by tracing paths and roads for tourist circulation in the sensitive areas in terms of biodiversity;

- “urbanization” of rural areas and development of “mass tourism” in many natural reserves or natural parks near the tourist villages, etc.

The most substantial financial support required to promote and develop agro-tourism activities in the Romanian countryside has been ensured:

- in the period 2000-2006, through the European Pre-Accession Program SAPARD (Special pre-Accession Programme for Agriculture and Rural Development), Measure 3.4 “Development and diversification of economic activities generating multiple activities and alternative incomes”;

- in the period 2007-2013, through the National Rural Development Programs, Measure 313 “Encouragement of tourism activities”, Axis 3: “The improvement of life quality in the rural areas and rural economy diversification”;

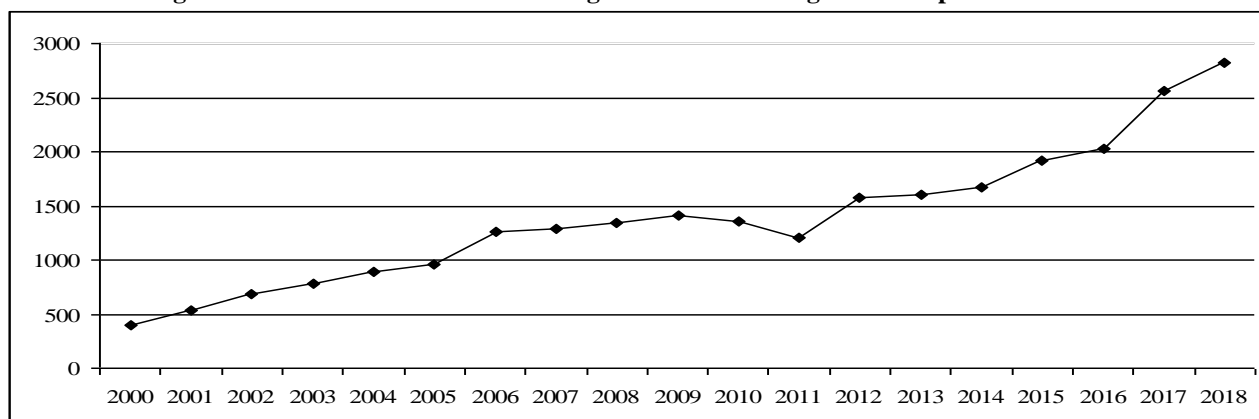
- in the period 2014-2020, through the National Rural Development Programs, Measure 06 “Development of agricultural holdings and enterprises”, Priority P6 “Private investment in non-agricultural sector”. (<http://www.afir.info/>)

The eligible investments supported by the European funds targeted:

- to increase, improve and diversify the small-scale tourism accommodation facilities - agro-tourism boarding houses and private investments in the leisure tourism infrastructure;
- to develop the information and promotion the agro-tourism services;
- orientation, counselling and training in the agro-tourism services domain granted to the inhabitants in the rural environment;
- to develop the local on-line biking systems for the rural tourism accommodation facilities within the rural area connected at regional and national systems.

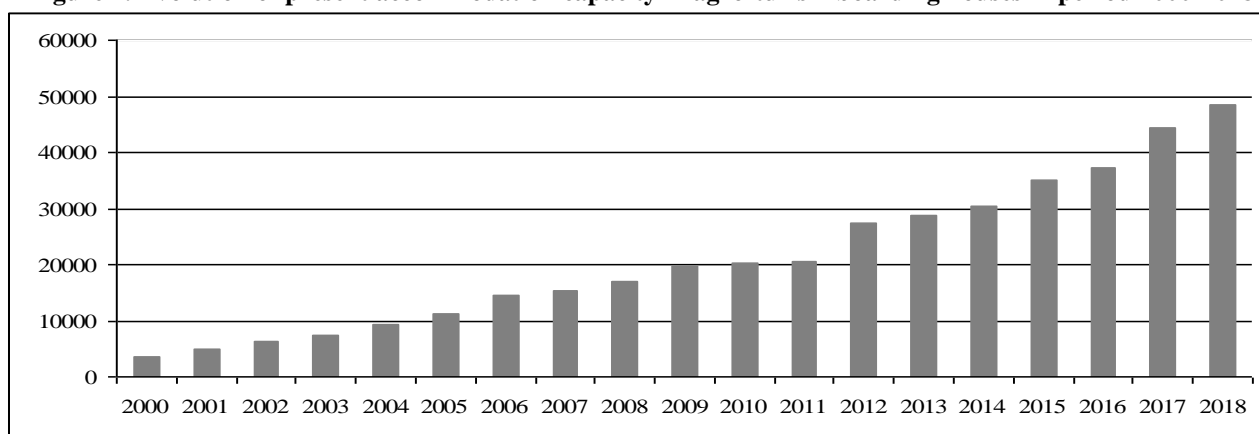
As result of these investments, in the analysed period it was registered a certain increase of the number of agro-touristic boarding houses, registered statistically from 400 in the year 2000 to 2,821 in the year 2018 (Fig.1) and of the accommodaton capacity from 3,544 places in the year 2000 to 48,574 in the year 2018 (Fig.2).

**Figure 1. Evolution of the number of agro-turism boarding houses in period 2000-2018**



Source: Tempo-online database, 2019

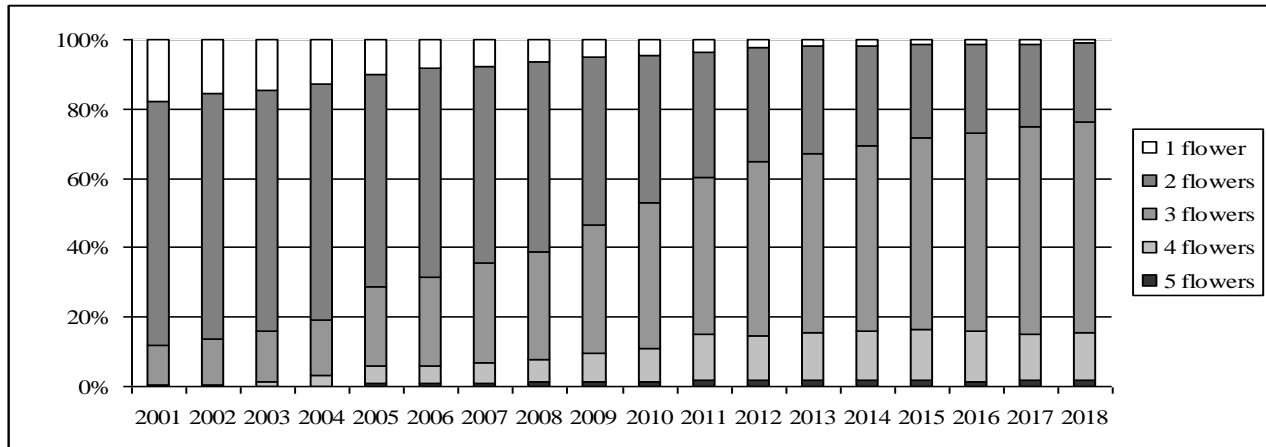
**Figure 2. Evolution of present accommodation capacity in agro-turism boarding houses in period 2000-2018**



Source: Tempo-online database, 2019

The quality of the services supplied and the level of endowment of the agro-touristic boarding houses, evaluated fom 1 to 5 flowers /daisies, evolved in favour of the category: 3 flowers /daisies (Fig.3).

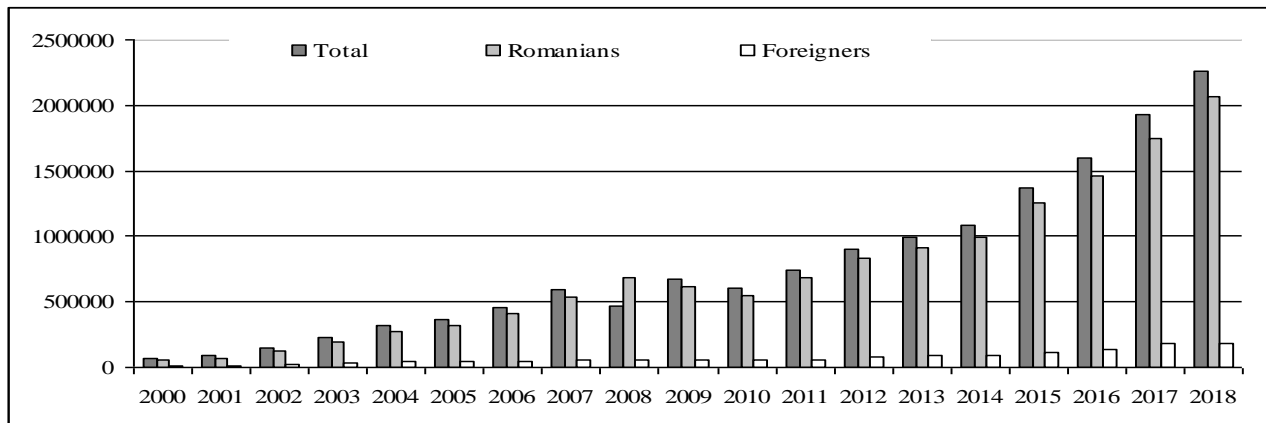
**Figure 3. Evolution of function accommodation capacity in agro-turism boarding houses, by comfort categories, in period 2000-2018**



Source: Tempo-online database, 2019

The number of Romanian tourists who chose to bed in the agro-touristic boarding houses increased from 53,804 persons in the year 2000 to 2,068,888 persons in the year 2018 (Fig. 4).

**Figure 4. Evolution of tourists number bedding in agro-turism boarding houses, in period 2000-2018**



Source: Tempo-online database, 2019

The Romanian agro-touristic potential is also supported by the variety of natural and anthropic resources determined by the proportionality, concentric disposal and the exposure in amphitheatre form of the three major relief forms (mountains, hills, plains), as well as the maintaining of cultural traditions (literary, musical, popular art, folk art, gastronomy, religious habits, etc.).

The main Romanian agro-touristic destinations are mainly situated in the mountain and hilly zones in the counties: Braşov (Bran, Moeciu), Harghita (Tuşnad, Praid), Cluj, Sibiu (Sadu, Tălmăcel), Maramureş (Săpânţa), Suceava, Neamţ etc.

The present development of the agro-touristic activities is the result of an in-sufficient exploitation of the material resources, of the deficitary education, the low level of the utilities, as well as of the phenomenon of massive migration to the urban or to other states of the world.

Also, from the annual reports about progresses regarding the implementation of the National Rural Development Programs in Romania made by the Ministry of Agriculture and Rural Development it results an average level of financial absorption of measures encouraging rural tourism and implicitly agro-tourism because of lack of own resources of the stakeholders and the difficulties with which they are confronting to obtain the loans ensuring the co-financing necessary to projects' implementation, as well as because of the long period of financing and implementing the integrated infrastructure projects. The reasons for the slow development of the Romanian agrotourism are also holding to the up to bottom approach of the different strategies, to the non-

implication of authorities and rural communities, to the systematic non-allocation of funds initially foreseen and to the lack of any priorities to be maintained on a sufficiently long term.

## CONCLUSIONS

In the last decades, the world of the Romanian village was in a continuous transformation process leading to the modification both of the rural localities specific, and of the demographic, occupational, values coordinates of the population.

In this context, agro-tourism proved to be an antidote of the subsistence agricultural production structures, a privilege of the economic phenomenon of pluriactivity and a promotor of founding of a rural society the socio-economic basis of which is represented by the middle class.

For the analysed period, the European programs for the financing the investments in the Romanian agro-tourism represent an opportunity insufficiently put into value, although in the zones in which agro-touristic activity developed, this had a strong favourable impact not only upon the economic and touristic framework of the localities, but also upon their social, cultural, spiritual and ecologic framework.

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# REALITIES AND PERSPECTIVES OF ROMANIAN BEEKEEPING

AURELIAN BULIGA-ȘTEFĂNESCU<sup>1</sup>

**Abstract:** *This article presents an analysis of the beekeeping sector in Romania and its prospects. In order to carry out this research, data about the honey producers' associations, official statistical information, articles and specialized scientific treatises were processed. Romania is one of the most important honey producers in the European Union. It boasts about 40 thousand beekeepers, out of whom 23161 are registered in associations, totaling over 1.69 million bee families. Every year, over 25 thousand tons of honey are produced on average. From this point of view, the best year was 2015 when Romania ranked first in Europe, with a production of 30.1 thousand tons of honey. However, in terms of consumption, Romania is at the bottom of the ranking. Annually, a Romanian consumes only 550 grams of honey on average. In 2018 Romania exported honey worth \$ 49.4 million (occupying the 14th position globally, with 2.2% weight) and imported honey worth \$ 11.4 million (occupying the 27th position globally, with a weight of 0.5%).*

**Keywords:** *honey production, bee families, producers, beekeeping*

**Classification JEL:** *Q10, Q13, Q17, O13*

## INTRODUCTION

The need for food as diverse as possible has been increasing lately, honey representing a food with nutritional, prophylactic and therapeutic properties essential for the human body (9), which is why beekeeping has become more and more important in the economy. Beekeeping contributes to economic growth, being a source of income, especially for rural populations (7). Its importance derives from the rational use of natural and human resources (13), but also from the pollination of entomophilic crops (2). Romania's natural conditions favor the process of growing bees (9), and have led to obtaining an important honey production, especially in recent years. The main feature of the Romanian market of honey is that most of the production is provided by small private producers, who, by accessing European funds after 2007, were able to improve the quality of honey due to the new technologies implemented in production, processing and marketing.

## MATERIALS AND METHODS

From the data published by the National Institute of Statistics, we collected and processed the information regarding the total population of bee families by development regions and the honey production obtained, according to the objectives pursued in this paper. The period analyzed is 2007-2018. Some indicators were compared with the period 1990-2006. In order to obtain a better image of the sector's support, we analyzed the National Beekeeping Program's indicators of evaluation.

The research method used is the statistical-mathematical analysis of the data - a research method that studies the phenomena and processes from a quantitative point of view, in order to describe them and to discover the laws that govern their manifestation, by calculating the statistical parameters.

## RESULTS AND DISCUSSIONS

According to the data presented in table 1, the trend regarding the number of bee families at national level has been increasing after 2007. Only in 2010-2011 there was a slight tendency towards decreasing the number of hives, after which the upward trend was resumed until 2018. In 2007, 982368 families were registered in Romania. In 2018 the number of families reached 1689500, increasing by 707132 (table no. 1).

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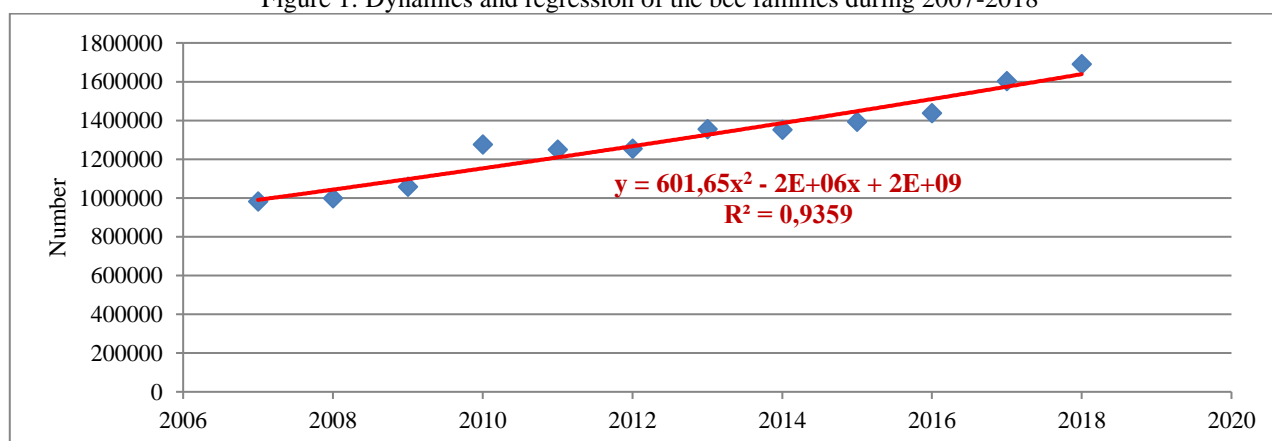
Table no. 1: Evolution of the number of bee families by development regions during 2007-2018

Development regions	2007	2010	2013	2018	2013/2007	2018/2013	2018/2007
	Nr.	Nr.	Nr.	Nr.	%	%	%
North-West	128863	170269	170933	230616	132,65	134,92	178,96
Center	145051	184046	195713	211229	134,93	107,93	145,62
North-East	138702	178685	195333	219341	140,83	112,29	158,14
South-East	127034	152529	138325	282384	108,89	204,15	222,29
South	145949	193084	192110	228880	131,63	119,14	156,82
Bucharest-Ilfov	22444	19207	18248	16598	81,30	90,96	73,95
South-West	141516	197052	270707	324392	191,29	119,83	229,23
West	132809	180045	172849	176060	130,15	101,86	132,57
<b>Total</b>	<b>982368</b>	<b>1274917</b>	<b>1354218</b>	<b>1689500</b>	<b>137,85%</b>	<b>124,76%</b>	<b>171,98%</b>

Source: Own calculation based on the data provided by National Institute of Statistics (8)

From the data provided by the NIS and processed in table no. 1, it results that in the period 2007-2018, the number of bee families is on an ascending line, for almost all the development regions of the country (figure 1). During the period analyzed, there was a decrease of 5846 in the number of hives in the Bucharest-Ilfov region, the loss amounting to 26.05% of the number registered in 2007.

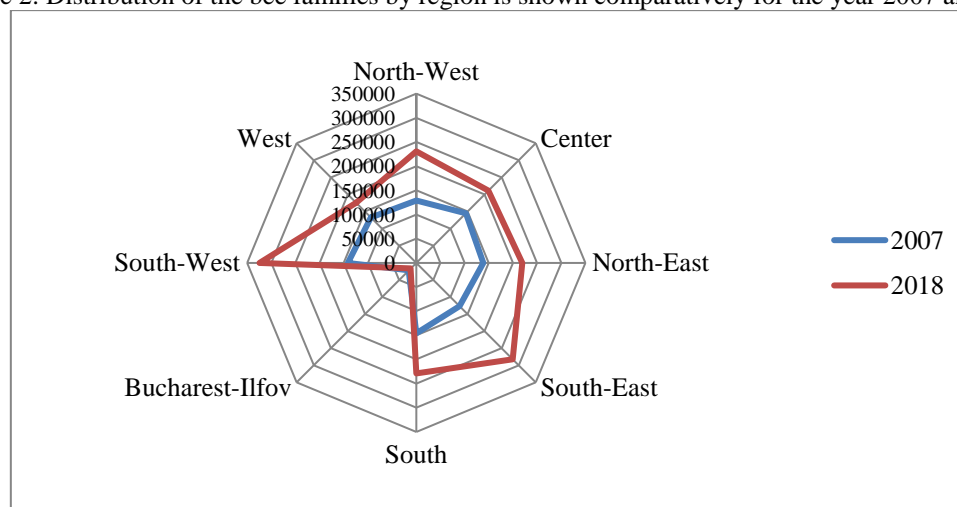
Figure 1: Dynamics and regression of the bee families during 2007-2018



Source: Own design based on the data provided by National Institute of Statistics (8)

In the South-West Oltenia region, a greater oscillation of the number of bee families was observed, between 2007-2018 (figure 2). There was an increase by 129.22% in the number of families. Thus, more than 182876 bee families existed in 2018.

Figure 2: Distribution of the bee families by region is shown comparatively for the year 2007 and 2018



Source: Own design based on the data provided by National Institute of Statistics (8)



In the South-East region the growth of the bee population was more than 100%. In 2018, compared to 2007, there were 122.29% more families. The difference was 155,350 bee families. The North-West region reported a 78.96% increase in bees.

In the rest of the development regions of the country the increases were lower than the national average calculated. In the North-East region there was an increase by 58.13%. Thus, 80,639 bee families were reported in 2018, compared with 2007, the year of Romania's accession to the EU. The number of bees in the South-Muntenia region was 56.82% higher. Increases of 45.62% and 32.56% respectively, were calculated for the Center and West regions, from the reports provided by the INS.

Table no. 2: Descriptive statistics for the number of bee families in the period 2007-2018

Development regions	Mean	Standard Error	Median	Standard Deviation	Coefficient of variation	Annual growth rate	Minimum	Maximum
	Mii	Mii	Mii	Mii	%	%	Mii	Mii
North-West	168,42	9054,63	170,60	31,36	18,62	5,70	127	231
Center	184,29	6737,70	190,11	23,34	12,66	3,33	145	211
North-East	180,24	8215,48	185,99	28,46	15,79	3,53	138	219
South-East	160,97	14666,74	139,78	50,81	31,56	9,21	127	282
South	190,10	7692,86	192,60	26,65	14,02	4,08	146	228
Bucharest-Ilfov	17,3	857,15	17,18	2,97	17,16	-0,15	14	22
South-West	238,47	18896,65	244,52	65,46	27,45	9,98	141	324
West	163,84	4706,09	169,60	16,30	9,95	2,89	133	180
<b>TOTAL</b>	<b>1303,65</b>	<b>63495,54</b>	<b>1312,95</b>	<b>219,95</b>	<b>16,87</b>	<b>5,48</b>	<b>982</b>	<b>1689</b>

Source: Own calculation based on the data provided by National Institute of Statistics (8)

The trend of the indicator of the number of bee families, in the period 2007-2018, was ascending, except for the Bucharest-Ilfov region. However, the annual rate of decline of the bees was quite low (-0.15). The calculated coefficient of variation (17.16%) places the annual reports of the number of bee families in a medium variation segment.

At the national level, the annual average of the period was calculated at 130,3657.33 bee families. The annual rate was positive, indicating a growth rate of 5.48. The coefficient of variation (16.87%) indicates an oscillation classified as a mean of the changes in the number of bee families reported from year to year.

According to the data provided by the INS and processed in table 2, during the mentioned period, the South-West Oltenia region saw the highest growth rate of the number of bee families, namely 9.98%. The coefficient of variation was 27.45%, indicating a large variation in the number reported annually. The annual average was 23,8471.58 bee families, with a minimum of 141516 families registered in 2007, while a maximum of 324392 families was reached in 2018. The second highest rate, 9.21%, of the number of bee families was reached in the South-East region. As there was an accelerated increase of this indicator from year to year, the variation was a big one (the calculated coefficient of 31.56%), like in the South-West region.

In the West region there is a smaller oscillation of the number of the bee population, the coefficient of variation being 9.95%. It is the only region with little variation. According to the data processed in table 2, between 2007-2018, in the rest of the regions, the coefficient of variation indicates an average fluctuation in the number of bee families. The number of hives in the North-West region also saw an upward trend. The annual growth rate was 5.7. The annual average indicates a number of 168424.92 bee families. The South-Muntenia region followed the national trend, with the population of bees increasing at a rate of 4.08. Between 2007-2018, the average growth rate in the region was 190099.33 bee families. The trend was also upward for the Northeast region. Here the growth rate was lower than that calculated at national level (3.53). Similarly, the Center region reported annual increases in the number of bee families. The rate of 3.33 was less pronounced.

You can find below the centralized results, for each development region, regarding the comparison of the number of bee families in the periods 1990-2006 and 2007-2018. The table also contains the conclusions of the t test.

It is considered:

$H_0$  - there is no significant difference between the two analyzed periods P1 (1990-2006) and P2 (2007-2018) =  $t_c < t_{(\alpha; n-k)}; p \geq \alpha$ .

$H_1$  - there is a significant difference between the two periods P1 (1990-2006) and P2 (2007-2018) =  $t_c \geq t_{(\alpha; n-k)}; p < \alpha$

Table no. 3: Student's t test for comparing the average number of bee families from 1990-2006 and 2007-2018

Development regions	Calculated value of test t	Probability associated with the test	The theoretical value of the test t	Conclusions	
North-West	6,4420129	2,3084E-06	1,7340636	Hypothesis H0 is rejected	The calculated values of the statistical test t are high in relation to the theoretical values and the probability is small with respect to the significance threshold and in conclusion we can say that there is a statistically significant difference between the two periods.
Center	8,8053949	1,0102E-09	1,7032884	Hypothesis H0 is rejected	
North-East	5,1677733	3,2332E-05	1,7340636	Hypothesis H0 is rejected	
South-East	3,7537904	0,00106865	1,7613101	Hypothesis H0 is rejected	
South	6,0029624	1,6913E-06	1,7108821	Hypothesis H0 is rejected	
South-West	6,2651794	7,5705E-06	1,7530504	Hypothesis H0 is rejected	
West	10,540858	5,4796E-11	1,7081408	Hypothesis H0 is rejected	There is no statistically significant difference between the two periods.
Bucharest-Ilfov	-2,7886351	0,00585493	1,7291328	Hypothesis H0 is accepted	

Source: Own calculation based on the data provided by National Institute of Statistics (8)

In table no. 4 are presented the results obtained after verifying the influence of the regions on the number of bee families. The F test was used for this verification.

We considered

$H_0$  - the regions are not a factor influencing the number of bee families ( $F_c < F_{(\alpha; k-1; n-k)}; p \geq \alpha$ )

$H_1$  - regions are a factor influencing the number of bee families ( $F_c \geq F_{(\alpha; k-1; n-k)}; p < \alpha$ )

Table no. 4: Results of the ANOVA test application

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	3,41E+11	7	4,88E+10	38,28206	4,2E-24	2,115472
Within Groups	1,12E+11	88	1,27E+09			
Total	4,53E+11	95				

Source: Microsoft Excel - Anova: Single Factor

From the calculations it was found that  $F_c = 38.28206 > F_{(0.05; 224)} = 2.115472$ ,  $p = 0 < \alpha = 0.05$  result rejecting hypothesis  $H_0$ . We can conclude (accepting hypothesis  $H_1$ ) that the development regions in Romania influence the number of bee families.

The honey production by a family of bees in the period 2007-2018 recorded a negative rate. For further analysis, the research was extended by comparing the pre-accession period 1990-2006 with the post-accession period 2007-2018.

The average for the period 1990-2006 was 16.14267 kg honey, produced by a family of bees. Between 2007-2018, the average was higher, of 17.9205 kg honey. The coefficient of variation calculated for the first period was 24.44%, highlighting a greater variation of the level of production. In the second period a coefficient of 11.70% was calculated, the variation of the production level being medium. The lowest production by a bee family was 6.8568 kg honey, recorded in 1991, while the highest production, 21.55898 kg honey, was reached in 2004. The minimum for the period 2007-2018 was 13, 35309 kg honey for a family of bees, whereas the maximum production was 20.06993 kg honey. Therefore, the trend of production achieved by each family of bees was downward, as the maximum production decreased in the period 2007-2018, compared to the period 1990-2006.

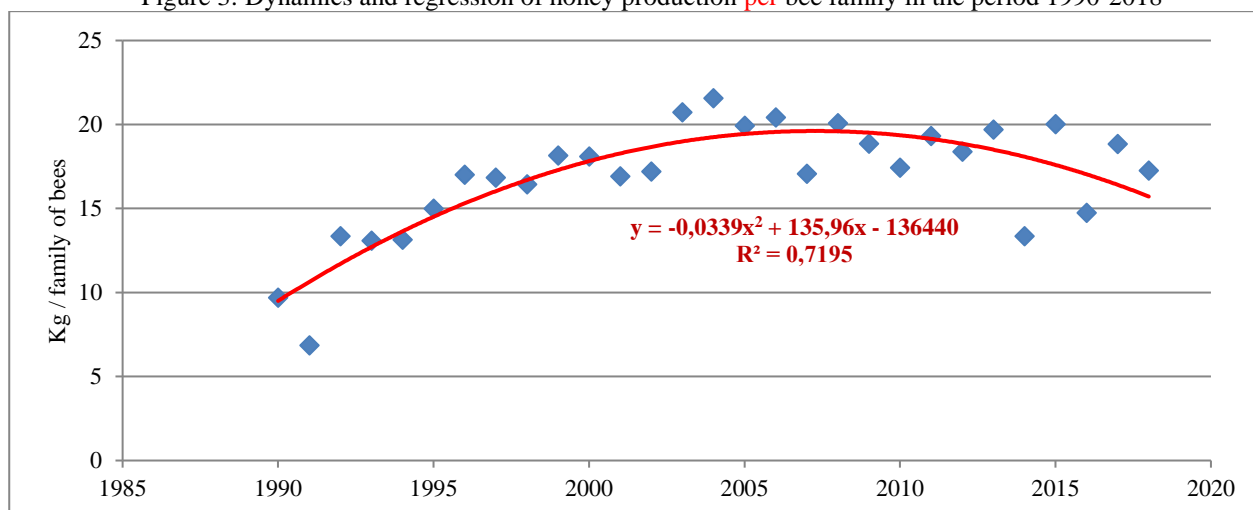
Table no. 4: Comparative presentation of the descriptive statistics of honey production per bee family during the periods 1990-2006 and 2007-2018 (kg honey / bee family)

	1990-2006	2007-2018
Mean	16,14267	17,9205
Standard Error	0,957167	0,605457
Median	16,914	18,61097
Standard Deviation	3,946501	2,097363
Sample Variance	15,57487	4,398933
Coefficient of variation	24,44764	11,70371
Annual growth rate	4,766176	-1,39081
Minimum	6,8568	13,35309
Maximum	21,55898	20,06993

Source: Own calculation based on the data provided by National Institute of Statistics (8)

Between 1990-2006, the annual rate was positive, highlighting a significant increase in the honey production corresponding to each family of bees, Although the number of bee families increased significantly during the post-EU period, the output of each family was lower during the same period. The annual rate was negative, indicating a decrease in production (-1.39).

Figure 3: Dynamics and regression of honey production per bee family in the period 1990-2018



Source: Own design based on the data provided by National Institute of Statistics (8)

According to figure no. 3, the largest honey production by a bee family, of 21.54 kg, was reached in Romania in 2004. According to the statistical data provided by the NIS, after this year the trend was decreasing, with certain oscillations determined by the weather conditions.

By expanding the research, the following aspects were identified:

- the inability of farmers and beekeepers to cooperate. Also, beekeepers complain that bees are dying in our country because pesticides have been banned since 2013 only in the EU, but not in Romania. We mention that Romanian authorities request annual exemptions for the use of neonicotinoid pesticides from the European Union.

- beekeeping has to cope with frequent adverse weather conditions (for example, a de minimis aid of 20 lei will be granted for each bee family for 2019, a year affected by such conditions) (MADR).

- in 2018, the production of 19 kg obtained by a family of bees, ranked Romania on the 18th position at European level (the European average being 22 kg) (6).

Considering the fact that:

- there are many statements made by beekeepers on various media channels claiming that the production obtained in 2018 was 30 kg, and in recent years it has varied between 30 and 50 kg,

- the beekeeping sector has benefited from consistent subsidies through both the National Apiculture Program (NAP) and PNDR. We will provide more details about the NAP, by means of which 22.5 million euros were allocated only in the period 2017-2019, at the end of the article. Regarding the financing of beekeeping through the NRDP, we can mention that in the financial year

2014-2020, the AFIR concluded more than 2,100 financing contracts in the amount of 47.86 million euro (AFIR, 2018),

- the field inspections carried out by the AFIR failed to take beekeepers unawares. This procedure allowed the "borrowing or lending" of beehives among beekeepers and the change of identification plates before the visit of the control bodies,

- it was only in 2017 when the legislation regarding the identification of bees and hives was amended, and as a result, the marking of the hives with paint became compulsory. The new regulation came out of the necessity of imposing fair play among the beekeepers who benefit from community and national funds,

we can conclude:

- it was expected that after the investments made in the period 2007-2019, both the competitiveness and the productivity of the beekeeping sector in Romania will increase. The trend of honey production extracted from a family of bees from the pre-accession period (figure 3) was supposed to continue to grow to the level of developed countries (Germany 35 kg, UK 34 kg, Austria 30 kg);

- corroborating the trends indicated by the regression equations in Figures 1 and 3, it can be observed that the honey production achieved by a family of bees diminished due to the decrease of the production, whose growth rate was much smaller than the rate of the number of families of bees. From table 6 it is shown that in 2018 compared to 2004, the number of bee families increased by 90.2%, while the production of honey extracted increased only by 52.2%;

- the INS data on the number of bee families do not reflect the reality in the field because:

- some beekeepers falsely declared to own a larger number of bees, in order to be able to grow UDE, with a view to fulfilling the eligibility condition for financing projects;
- after the completion of the projects with the aid of European funding, the beekeepers (especially the small-scale ones) abandoned the business and moved to other areas that bring safe incomes (most emigrated); as a result, in many courtyards in the Romanian countryside, only some empty boxes (hives without bees) can be seen in an advanced state of degradation.

- it is imperative to find solutions to increase the accountability of the factors involved (beekeepers, local public authorities, associations, central institutions, etc.) to operate / declare all movements of bee population (inputs, outputs).

Table no. 6: Evolution of honey production extracted from a family of bees (kg)

	1990	2000	2004	2007	2010	2013	2018	2018/2013 (%)	2018/2010 (%)	2018/2004 (%)
Production of extracted honey (thousands of tons)	10,58	11,75	19,15	16,77	22,22	26,68	29,16	109,31	131,23	152,2
Families of bees (thousands)	1091,3	648,8	888,2	982,37	1274,9	1354,2	1689,5	124,76	132,52	190,2
Production of honey extracted from a family of bees (kg / family of bees)	9,69	18,10	21,55	17,06	17,43	19,69	17,26	87,62	99,03	80,06

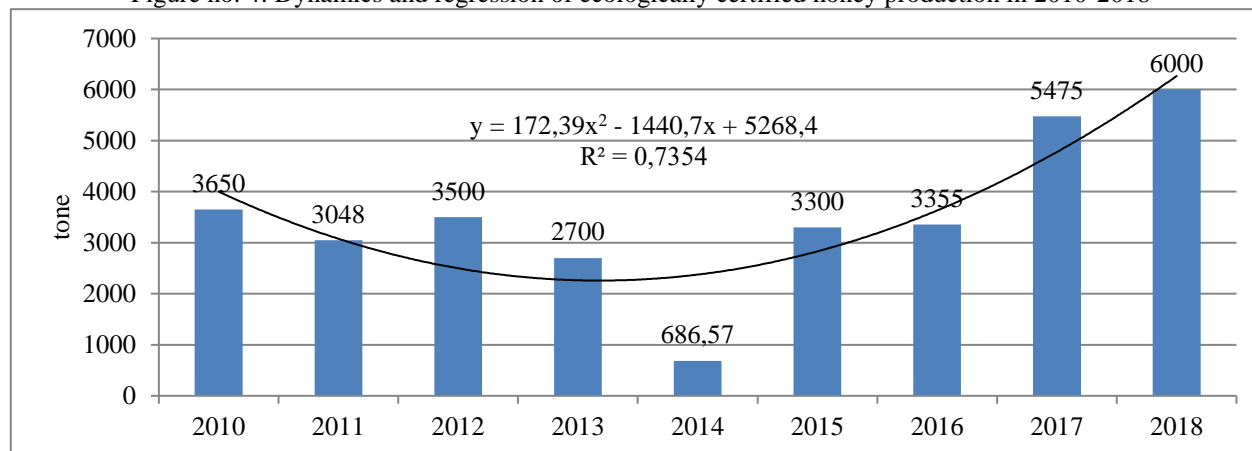
Source: Own calculation based on the data provided by National Institute of Statistics (8)

According to the data provided by the associations responsible with the beekeeping sector, 23161 beekeepers were registered in Romania in 2018, 113.12% more than in the previous year. Most beekeepers (13946) manage up to 75 hives. A total of 2979 beekeepers exploit over 150 hives, and the activity of the other 6336 beekeepers is limited to farms which have between 75 and 150 hives. 20589 beekeepers were registered on the lists of the associations in the field, with the right to participate in the activity of honey trade and to access European and government funds. The cost of honey production per kilogram, was on average 12 lei in 2018 (5).

The number of certified beekeepers followed an upward trend, together with the increased demand for organic products, as a result of the growing consumer confidence in them.

6000 tons of organic honey were produced in 2018 by the Romanian beekeepers, 525 tons over the production in 2017. From the data presented in figure no. 4, in 2017, compared to the previous year, the increase of the organic honey production was by 65%, more precisely 2120 tons.

Figure no. 4: Dynamics and regression of ecologically certified honey production in 2010-2018



Source: \*\*\* European Commission (2019), Notification of apiculture programme (5)

Ecologically certified products are much appreciated by foreign markets, so 80% of such honey is exported to countries such as: Germany, France, Italy, Austria, Japan, Canada and China (12). In 2017, out of the total honey production, 3300 tons were exported to EU countries, while 7.83 tons were exported to non-EU countries (5).

The assortments of ecologically certified honey products are various, such as: acacia, linden, polyflorine, mango, black grass, pollen, grass, propolis, and royal jelly.

In the last years, the beekeeping sector in Romania has undergone a significant development due to the financial support programs from the EU or national budget, which were aimed at improving the working conditions and the increase of the competitiveness of this sector, by setting up or modernizing bee farms and by treating the families of bees with medicines to combat varicose veins and nose-moses. The support of the apiculture sector through the National Beekeeping Program exceeded 70 million euros in the period 2007-2018.

In 2018, the total number of beekeepers who benefited from the programs for supporting the beekeeping sector, was 5282, 738 more than in the previous year. It has to be noted that the beekeepers applied individually for financial assistance. The funds were used to purchase 99,428 bee families and 16616 boxes. The number of queen bees purchased was significant, 77072, by 114.87% more than in 2017 (5).

The National Beekeeping Program carried out during the period 2017-2019 aimed at applying specific measures. Thus, over the entire period, 22.58 million euros were allocated. The sources of the funds are as follows: 50% European funds and 50% funds from Romania's state budget. The largest amount was allocated for taking measures aimed at repopulating: the purchase of mates (queens) and / or bee families for conventional or organic beekeeping. This amounted to 3.53 million euros in 2017, 3.75 million euros in 2018 and 3.76 million euros in 2019. Each year, between 27% and 28% of the total funds were allocated for the rationalization of transhumance/ pastoral hives by purchasing boxes and beekeeping equipment. Beekeepers received funding between 5.8 % and 6.18% to improve their bee products. 15%-16% of the budget of the program were allocated annually for the control of diseases such as varroosis and nose-mosis. In the first year of the program, the laboratories for analysis received an amount of 320 thousand euros for their modernization (10).

The measures aimed at increasing the efficiency of the beekeeping system will continue to be applied. For the period 2020-2022, 44.85 million euros will be allocated through the same program, 98.6% more than the previous allocation (5).



## CONCLUSIONS

Romania ranked second in the EU, with regard to the number of bee families it held, having a potential of 11% of the total registered in the EU. In terms of its total honey production, our country was at the top, with approximately 29.2 thousand tons of honey produced in 2018. In the last 5 years, the honey production in Romania has increased steadily by over 71%, compared to 18040 tons obtained in 2014. According to the data provided by MADR, the number of the bee families existing in 2018 is distributed to a number of 23161 beekeepers who are registered. The development of Romania's beekeeping has been achieved owing to the European funds which our country has benefited from after accessing the EU, and they amount to 10% of the funds allocated in the field by the European community (1). The main beneficiaries of European funds for the beekeeping sector are the countries who have the most numerous families of bees.

The future of Romanian beekeeping is closely linked to the domestic market but, unfortunately, the prospects of its development are bleak. So far, beekeepers have taken advantage of the funds received, but have neglected the most important aspect: the profitability of the business. Due to the fact that the Romanian farmers obtain the lowest purchase price of honey from the processor (1.82 euro / kg in 2018 - below the cost of production, respectively half of the average price at the level of the European Union), which considerably diminishes their incomes (3), they try to compensate for the loss by charging high prices on the domestic market. This has led to the loss of a large segment of the domestic market, which was occupied by cheap imports of honey from outside the EU. It is imperative that beekeepers should regain the internal market by lowering the prices charged.

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