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CONTENT

THE IMPACT OF RESEARCH AND INNOVATION RESULTS ON THE DEVELOPMENT OF AGRICULTURE IN THE REPUBLIC OF MOLDOVA

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Abstract: *The results of the activity of the research/development sphere in the Republic of Moldova play an important role in dynamism of the sustainable development of the basic branches of the national economy: agriculture and the food industry. They contribute essentially to providing the country with agricultural raw materials and industrial processing products, sufficient for the needs of the domestic market and for export. Food security and food safety are closely related to the results of technological transfer of research and innovation results in the fields of agro biology and the food industry. The innovative cluster in these sectors of the economy of the Republic of Moldova consists of 9 biological institutes, 6 agricultural institutes and the State Agricultural University of Moldova. The present study also includes some issues of the impact of climate change and the decline of biodiversity, other challenges and risks to the development of agriculture and related branches of the country's economy.*

Keywords: *agricultural science, food security, innovation cluster, agro biology*

JEL classification: Q00

INTRODUCTION

Agriculture and the food industry are the basis of the development of the economy of the Republic of Moldova, taking into account that its specificity is agro-industrial. Approximately, out of 2 mln. ha of arable land, the share of the most productive areas, such as fruit growing, viticulture and vegetable growing, does not exceed 15%. The fields are occupied with cereal crops, sunflowers, soybeans, sugar beets, which provide the processing industry with agricultural raw materials and their export (Report ASM 2021).

Technical-scientific assistance in the country is provided by 6 research institutions and the teaching-professional staff of the State Agricultural University of Moldova. At the same time, 9 biological profile institutes realize their scientific potential, which carry out research in the fields of physiology, genetics, microbiology, ecology, forestry, etc. In total, in the sphere of research and innovation in the Republic of Moldova, there are approx. 500 researchers, specialists in the respective fields. Based on the results obtained, agro biological science makes an important contribution to food security and food safety in the country (Activity report, 2021).

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MATERIALS AND METHODS

The systemic analysis of the results of agrobiological research, reformed in 2018 by the amendments to the Code regarding research and innovation in the Republic of Moldova, attests to the important role of implementations in the national economy. The work "Trends in the economy of Moldova", edited annually by the National Institute of Economic Research, was consulted. The results included in the Report on the state of science in the Republic of Moldova, as well as the National Development Strategy "Moldova 2030", were also systematized (NDS "Moldova 2030", 2022).

The most relevant achievements of agro biological research in Moldova belong to the fields of horticulture; new varieties of vines (table, mixed and for industrial processing) were obtained, they are the result of over 10 years of work at the Institute of Genetics, Physiology and Plant Protection.

Eight new interspecific rhizogenic varieties, obtained for the first time by crossing *Vitis vinifera* L.V x *Muscadinia rotundiflora* Michx: Alexandrina, Augustina, Nistreana, Malena, Ametist, Algumax, Tethys and Sarmis were approved and included in the State Register of Plants of the Republic of Moldova. Possessing appreciated uvological qualities, these varieties are included in the context of elaborations related to global warming, being resistant to diseases and pests, they will form the basis of ecological viticulture (Sturza R., 2021).

The Scientific-Practical Institute for Horticulture and Food Industry implemented the Moldova grape variety on an area of approx. 10 thousand. ha, allowing the export of fresh product to Romania, the Czech Republic, Poland, Ukraine, Russia, Belarus and Kazakhstan. Researchers and businessmen say that the Republic of Moldova also became known thanks to the Moldova variety, which is placed among the most successful grape varieties with a red-purple color. The Italian concern Vivai Cooperativi Rauscedo, through an agreement with the Institute of Horticulture from Moldova, undertook to devirose the varieties Moldova, Codreanca, Moldavian Kişmiş and others, and to sale them in the states of Europe and North Africa. Royalty for the originating institute is about 50 thousand euros annually, plus sanitized and certified material.

The hybrids of the "Porumbreni" Institute of Phytotechnology entered the top 10 performers at the competitions held in Ialomița - Romania; the variety "Porumbeni 374" ensured a harvest of 19 tons of berries per 1 ha with their humidity of about 9%. Thanks to this performance, Romania supports the homologation of high-performance hybrids from Moldova in the space of the European Union states.

Approximately, 50,000 ha occupied in the Republic of Moldova with the cultivation of soybeans, approximately 40-45% of the areas are sown with the varieties of the "Selection" Field Crops Institute. Important areas are occupied with leguminous crops in the country also obtained and implemented by this well-known institute (peas, beans, etc.).

The fight against erosion, desertification and solanization of varieties in the country is based on the elaborations of the Institute of Pedology and Agrichemistry, obtained through collaboration with fellow researchers from Romania (ASAS) and Ukraine (ANSAU).

The collaboration of researchers from the Scientific-Practical Institute for Biotechnology in Animal Husbandry and Veterinary Medicine with colleagues from Romania, France and Italy allowed the testing and implementation of alpine goats in the conditions of the South and Central areas of the Republic of Moldova with an expected effect on the production of milk and derivatives from it, as well as the meat. The staff of the institute in collaboration with the Botanic Garden (Institute) in Chisinau have carried out important studies related to the provision of animal feed, premixes, vegetable proteins and other by-products to the animal husbandry sector: pressed pulp from fruits, vegetables and grapes, seeds and tomato.

The National Center "Acvagenresurse" through the high results obtained in the selection of the new varieties of Carp (silver and with large scales), provides through technological transfer 100% of fish fry for Moldovan fish farming.

The researchers of this important center for the national economy of the Republic of Moldova (the country is provided with practically 100% of fresh fish consumption) have been collaborating for several years with scientists from Hungary and the Russian Federation.

Although the agricultural machinery in Moldova comes from producers in the countries of the European Union, nevertheless in some positions the Institute of Agricultural Technology "Mecagro" develops and executes various machines for spraying vineyards and orchards, vegetables, foliar fertilization installations of agricultural crops, machines for grinding grain for animal feed etc.

Sprinklers were exported to Iran and Azerbaijan, and mini grain mills found their supply in Kazakhstan and other republics of Central Asian.

The State University of Agricultural Sciences of Moldova, led for 21 years by academician Gheorghe Cimpoies, has implemented multiple innovative technologies for apple, plum, cherry and sea buckthorn, the production of which is widely exported to Russia, Ukraine, Belarus and also to some EU states (Romania, the Baltic countries, etc.).

The Life Sciences Section (Agrobiology, Environment, Food Security) coordinated the scientific and innovative activity in the fields of agriculture, biology, ecology and the environment, regarding the realization of several projects. Among which: 2 research projects from the offer of research-innovation solutions regarding combating and mitigating the impact of the COVID-19 pandemic completed in 2021 and 48 projects from the State Program (2020-2023). This program includes the following projects: Strategic Priority Sustainable agriculture, food security and food safety - 26 projects, Strategic Priority "Environment and climate change" - 21, Priority Economic competitiveness and innovative technologies - 2; bilateral projects-3; project within the Horizon 2020-1 program; technology transfer projects-5 from 16 organizations in the field of research and innovation. The public hearing of the final scientific reports presented by the project leaders during the General Assembly of the Life Sciences Section from November 1-10, 2021 highlighted the fact that the scientific research planned for 2021 was carried out in the planned volume, in the established terms and at an appropriate methodical level.

The analysis of the state of security and food safety in the Republic of Moldova highlighted several vulnerabilities: insufficient domestic agricultural supply for a wide range of products, of which there are long-term deficits in meat, vegetables and fish; the instability of the internal agricultural supply, especially of vegetable production which indirectly affects animal production; high prices for some agricultural products; the low level of income of the population that generates food insecurity; inadequate road and sanitary infrastructure, especially in rural areas that generate food safety risks and nutritional insecurity; poor quality food consumption; the high share of calories from cereals and potatoes, as well as the low consumption of animal protein, which generates nutritional risks. There are population categories identified as having a high food and nutritional risk, including children, especially from rural areas.

Within the State Project 20.80009.5107.09 "*Improving the quality and safety of food through biotechnology and food engineering*" (2020-2023) which was carried out jointly by the Technical University of Moldova, the Institute of Genetics, Physiology and Plant Protection and the State University of Medicine and Farmacie "Nicolae Testemițanu", a study was carried out regarding the nutritional status of institutionalized school-aged children (11-17 years old), based on the model menu proposed by the Ministry of Health.

The nutritional value of complex lunches for the 12 days examined was 2069 kcal/day, which represents 82.8% of the average daily requirement of 2500 kcal/day.

The average daily intake of iron determined by experimental techniques covers 53.75% of the recommended norm. An algorithm was designed to predict dietary iron absorption based on the content of dietary factors that have the ability to promote or inhibit iron absorption. It is also possible to mention the results that were obtained by the team of the technological transfer project 21.80015.5107.245T "Development and implementation on an industrial scale of the technology for the production of supplements of biologically active substances from native (oleaginous) raw material in the form of capsules ", carried out at the Scientific-Practical Institute of Horticulture and Food Technologies. Within the project, the technology for the production of supplements of biologically active substances from local raw materials was developed and implemented: white grape seeds, red grape seeds, pumpkin seeds, at the enterprise "Ulei Eco Grup" SRL. The innovative technology for processing agricultural production (grape seeds, pumpkin seeds) through CO_2-extraction and encapsulation of biologically active substances was implemented. Finally, the drafts of the technological documents (Technological Instruction and Company Standard) for the manufacture of SBA supplements in the form of gelatin capsules were developed. Thus, the nutritional value was ensured and the biological effects of food were amplified through biotechnology and food engineering (Sturza R., 2021).

In the context of these vulnerabilities, but also in the context of the international situation, with a series of uncertainties regarding the circulation of goods and the galloping increase in prices for fuel and basic food, it is necessary to establish the priorities for improving the food security of the population, which could be classified like this:

- because agricultural production is the main and safest source for ensuring food products for the population, the most important strategic direction is to increase the role of agriculture as a provider of food security, with the following objectives: increasing the level of ensuring the population's food consumption from domestic production, especially for important products (cereals, vegetables, fruits, meat, processed foods), stabilizing the domestic agricultural supply.
- another strategic direction is - increasing the population's access to food and improving the quality of food, which can be achieved by increasing the purchasing power of the population, reducing the gaps related to access to food for different categories of the population, improving the food diet and ensuring food diversity.
- the third strategic direction refers to rural development and raising the educational level of the rural population, as premises for improving food and nutritional security. The targeted objectives are related to the modernization of the infrastructure and the increase in the educational level of the population. In this context, the project "Improving national food safety systems and regional cooperation" was initiated, which was financed by the Government of Turkey and implemented by the Food and Agriculture Organization of the United Nations (FAO) (2021-2023). The project includes as beneficiaries five countries in the region - Azerbaijan, Kyrgyzstan, the Republic of Moldova, Tajikistan and Turkey and will support the National Agency for Food Safety (ANSA) by training employees in the field of analysis, evaluation, identification and communication of risks in the food field.

A valuable national heritage also presents the local forms of agricultural crops, cultivated over many decades in peasant households, where varieties with valuable traits of productivity, quality, resistance and interest for improvement have been selected.

The intensification of agricultural production, the use of highly productive varieties and hybrids have gradually replaced traditional varieties. Currently, the diversity of these varieties has decreased significantly, but some species have been saved. Thus, among leguminous crops, local bean varieties are distinguished by considerable variability. In a much smaller volume, chickpeas, sorghum, lentils and beans are grown. The diversity of local corn populations has drastically decreased, among the most well-known saved and cultivated forms being Moldovenesc, Găganesc, Chinquantino, Orange, Lopusneac, etc. In particular, attention is paid to the glassy corn varieties used for the preparation of the national dishes - mămăliga. Currently, only some individual peasant households still grow such varieties of plants. Vegetable crops, represented by amateur varieties (that is, created by "amateur breeders"), or by selections (for 10-20 years) from commercial varieties that need to be preserved are: tomatoes, peppers, eggplants, onions, garlic, cucumber, squash, pumpkin, etc. In the small peasant households, the old varieties of fruit trees such as the apple with the old local varieties were still saved: Țiganka, Domnești, Lujanka, Golubok moldavskii, Mohorîta, Nestreț, Văratic dulce, Summer saffron, etc.; the plum with the old varieties Vinete de Codru, Bardace (several forms), Goldane, Vinete de Tiraspol, Perje Moldovenesti, Rotunda, Vinete de Vălcinet. A special interest for our country is the grapevine, the assortment of local varieties of which is less diversified. Thus the old varieties such as Coarna albă, Plavaie, Coarna neagră, Feteasca albă, Feteasca neagră, Codreanca, Busuioaca, etc. have a limited spread in poor households (Gaina B., 2021).

Increasingly frequent climate changes (drought, high temperatures) significantly affect natural systems. The most profound, direct and appreciable effects are reflected on cultivated species actively subjected to biological erosions. The continuous decline of biodiversity and the degradation of ecosystems reduce their capacity to function and may reach thresholds of irreversibility. The genetic diversity of cultivated plants is also strongly affected by the increased sensitivity to infectious diseases (fungal, viral), showing the increase in pathogenicity, in parallel with the increase in CO2 concentration in the air and temperature, which influences *plant* × *pathogen* × *environment* interactions. Genetics and plant breeding have had a profound impact on food production and will continue to play an essential role in the creation of cultivated plant gene pools. Conservation and restoration of the plant gene pool is a major and cost-effective objective in mitigating the effects of climate change.

Based on the involvement of a valuable initial material as parental forms, new hybrids of common wheat, durum wheat, triticale, tomato were obtained. Genotypes with high indices of productivity and biochemical quality of grains, seeds, and fruits were identified in the gene pools of grassy cereal crops, legumes, and vegetables (tomatoes). In promising tomato varieties with high taste properties, including, with fruit pigmentation genes - β (carotene), r (yellow flesh), genotypes with valuable biochemical indices were registered: dry substance - 5.69-8.05% , sugar – 3.43-4.61%, acidity – 0.43-0.54, vitamin C – 22.06-30.0 mg%. Genotypes with high content of carotene (3.89 mg/100g) and lycopene (1.39 mg/100g), compounds showing high antioxidant properties, were highlighted. Four varieties of plants were approved for which certificates were obtained - common wheat (Moldova 66), durum wheat (Sofidurum, Auriu 2), chickpea (Cogâlnic) (Bulimaga C., 2021).

Based on the effective utilization of plant genetic resources and advanced biotechnologies, in order to increase the adaptability of crop plants to climate changes, hybrid combinations with increased resistance to biotic and abiotic factors were created. Three varieties of vines on their own roots have been approved and patented: Alumna, Amethyst and Bega, which, thanks to their interspecific origin, possess resistance to phylloxera and cryptogamic diseases, extreme low and high temperatures, which will allow obtaining competitive and ecological productions, as well as the extension of the cultivation limit in the northern zone of the republic. The Avantaj grain sorghum variety, which provides 6.5 t/ha, was sent to CSTSP. Two varieties of garlic, Berechet and Moldobella, were approved and patented.

CONCLUSIONS

The impact of climate change and the decline of biodiversity are two of the most important challenges and risks for human society. It is about biodiversity at the level of plants, animals and microorganisms, a fact that conditions the approach to climate change from these three aspects. The key practices for biodiversity in the conditions of climate change aim at the following moments:

- conservation of biodiversity;
- implementation of sustainable agricultural practices;
- responsible management of natural resources;
- involvement of the local community.

The conservation of the genetic diversity of agricultural crops is also a major concern for European countries and is dictated by the EU Strategy and the Action Plan through objective 3 - Maintaining genetic diversity through the conservation of crop plants, which emphasizes the need to improve the adaptive capacity of crop plants, building resilience and reducing vulnerability to climate change. At the international level, in order to urgently solve the problems generated by climate change, the Sustainable Development Objectives were developed, a fact previously mentioned. In this context, a series of objectives is implemented in the Republic of Moldova, among which is Objective 2. Updated data on indicator 2.5.1. of SDG 2 with reference to plant and animal genetic resources for food and agriculture conserved in the medium or long term, were prepared and exported to the international megadatabase. At the same time, within the Institute of Genetics, Physiology and Plant Protection, the Country Report for the 3rd World Report on the Status of Plant Genetic Resources for Food and Agriculture was developed. Based on the approach no. 24-07/184/1879 of 21.05.2021 of MADRM (currently MAIA), the National Report on the measures taken to achieve the commitments provided for in the International Treaty on Plant Genetic Resources for Food and Agriculture was drawn up.

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AGRICULTURE'S CONTRIBUTION TO THE ECONOMIC RECOVERY – POSSIBILITIES OF REDUCING THE CURRENT INPUT CRISES

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Abstract: *This paper approaches an extremely current topic, namely the substitution of synthetic nitrogen, very expensive and polluting, with nitrogen of biological synthesis, through the peas and Rhizobium system, cheap and non-polluting. The entire economy is going through a period of crises, generated by people's ineptitude in managing precisely their most important problems, namely those of food and social security and safety. Over time, there has been a correlation between the price of gas, which 80% goes into the nitrogen processing, and that of fertilizers. In 2022, the price of gas increased, on average, 9 times, reaching 450 EUR/1000 m^3, and the price of fertilizers reached 1200 EUR/t. Between 2020 and 2022, the fuel price also doubled, and the value of other inputs was well above the multiplier of 2. By mid-2022, the price of wheat increased from 80-85 EUR/t, to 300-310 EUR/t, with very large fluctuations even from one day to another. However, the high price of wheat cannot cover all the expenses involved in the cultivation process, which puts mankind's bread in danger. The situation is similar for other agricultural crops. It's becoming clear that there is an urgent need to turn over research in order to find solutions for ameliorate the state of deep crisis in which bread and other food production are, as well as public health, after two years of the Covid-19 pandemic and during a war in the immediate vicinity of Romania's borders.*

Keywords: *wheat, peas, inputs, crisis, price increase*

JEL classification: Q11, Q12, Q14, Q16, Q17

INTRODUCTION

Nitrogen (N) is one of the basic elements of life and the strategic building block of proteins, including DNA and RNA acids. The Earth's main source of nitrogen is the atmosphere (the air), where it is found in 78%. As a gas, nitrogen has a density (D) of 1.251 kg/m3, resulting in a quantity of nearly 1 kg N/m3 of air.

$$N_{echiv} = 1,251 \text{ x } 0,78 = 0,97578 \text{ kg } N_2$$

So, above each ha and at a height of 1000 m (1 km) there is an amount of:

$$10.000 \text{ x } 1000 \text{ x } 0,97 = 9.700.000 \text{ kg N/ha} = 9.700 \text{ t N/ha}$$

According to some authors (Rutting et al., 2018), this amount would be much higher. There is, however, enough nitrogen for plant nutrition, both through Haber-Bosch chemical synthesis (very expensive and polluting) and through biosynthesis (bacteria and other fixing organisms).

Rhizobium bacteria, whose original name was *Bacillus radicicola*, fixes up to 280 kg N/ha by entering into symbiosis with the roots of legumes (Lohnis, 1921). There are numerous other species of microorganisms that have the ability to fix nitrogen in various forms (Bodirsky et al., 2012).

Agriculture, and not only it, is going through a period of crises (Horoiaș et al., 2022) generated by people's lack of skill in managing exactly their most important problems, namely the issues of food and social security and safety (Vatta et al., 2022). But it's not only that. A careful analysis of the international situation shows that these crises, with a very high probability, were generated by basic exponents of human society. As researchers, we are obliged to remove the negative side from our thinking and look for solutions to move society forward.

People need food, bread, but also many other foods. Given that the total value of the costs related to the use of inputs necessary for wheat production has become unimaginably high (Kostic et al., 2021; Langemeier & Zhou, 2022), we must find solutions to bring them back within the still bearable limits, in order to avoid new crises, such as food crisis, environmental crisis (Abrol et al., 2007; Martinez-Dalmau et al., 2021) etc.

For wheat crop management, we note that, at this moment, the realization costs have multiplied by a factor of 2.5 ± 15% (own calculations), so:

$$C = C_{2019} \times 2.5$$

, where: C = costs/ha in 2022;
C_{2019} = costs/ha in 2019.

For Romanian farmers this is a big problem. With the current technologies and price levels of inputs, it is not possible to do efficient and sustainable agriculture. The present paper presents the results of some studies carried out in 2022, is based on field research and aims to propose some solutions to solve the nitrogen deficiency, the basic nutrient element of plants, by replacing, even partially, the synthetic nitrogen obtained from fossil fuels, so expensive today, with nitrogen of microorganic biosynthesis (symbiosis, associative and free) taken from the air, atmosphere. Currently, for the south of Romania, this desired can be achieved by introducing the pea crop in the crop rotation used, being the legume with the best yield in non-irrigated conditions (Berca et al., 2018; Muniz et al., 2017).

MATERIALS AND METHODS

The aim of the work is to search for solutions for substituting nitrogen nutrition from chemical synthesis with nitrogen obtained through biochemical synthesis (symbioses, associations, free fixation).

The objectives of the article are:

a) reducing the very high costs currently generated by Haber-Bosch synthesis nitrogen nutrition;
b) reducing the carbon footprint of nitrogen nutrition, the largest one generated by wheat inputs – moving towards an ecological, bioeconomical nutrition.

In order to achieve the proposed objectives, research was carried out in the field regarding the influence of crop rotation, and especially the pea-wheat rotation, on the fixation of atmospheric nitrogen in locations in southern Romania (Teleorman and Calarasi counties). The amount of nitrogen fixed symbiotically on the roots of peas, variety Belmondo, as well as its availability to wheat was determined.

Starting from these researches, calculations were made to demonstrate how much nitrogen the pea can fix during its vegetation period, how much of it is used for its own production and how much it makes available to the wheat, which follows in the rotation. At the same time, it was aimed to find out the expenses that can be recovered from the sum of the costs of nitrogen nutrition for the wheat crop. Tools such as scatter analysis of functions and correlations were used to separate random from factorial (non-random) variations, to demonstrate the repeatability of the results obtained.

The studies were carried out in the southern part of the Romanian Plain, on soils of the chernozem type, more leached and with a loamy-clay texture in Teleorman county and less leached, slightly carbonated and with a clayey texture in Calarasi county.

Observations and measurements spanned a period of 10 years (2012-2021) and were carried out on research plots cultivated in subdivided plots, in 4 repetitions, in order to perform statistical calculations by analysis of variance.

RESULTS AND DISCUSSIONS

The research and calculations developed in this paper represent a model for reducing the large amounts of nitrogen applied from chemical synthesis and replacing them, as much as possible, with biosynthesis nitrogen extracted from the atmosphere.

There are at least three models of atmospheric nitrogen fixation by biochemical processes – free, associative and symbiotic. Taking into account the fact that the most productive biological fixation is in legumes, in order to achieve the objective of this work it is necessary to establish how we make as much of this nitrogen as possible reach the following crops. We can say that the solution to chemical nitrogen, very expensive and polluting, is atmospheric nitrogen, for several reasons:

- it is free;
- it is enough;
- is non-polluting;
- remains in the natural nitrogen circuit, without side effects;
- can be used through natural models or biotechnological engineering models.

The first solution consists in using rotations of at least 3-5 crops. In the rotation it is necessary to have at least one improving, nitrogen-fixing plant. In our own research in the two locations in southern Romania (Teleorman and Calarasi) a 4-year rotation was used, of the type: peas → wheat → maize/sunflower → rapeseed, and the results from the period 2012-2021 are presented in the form of a complex functions.

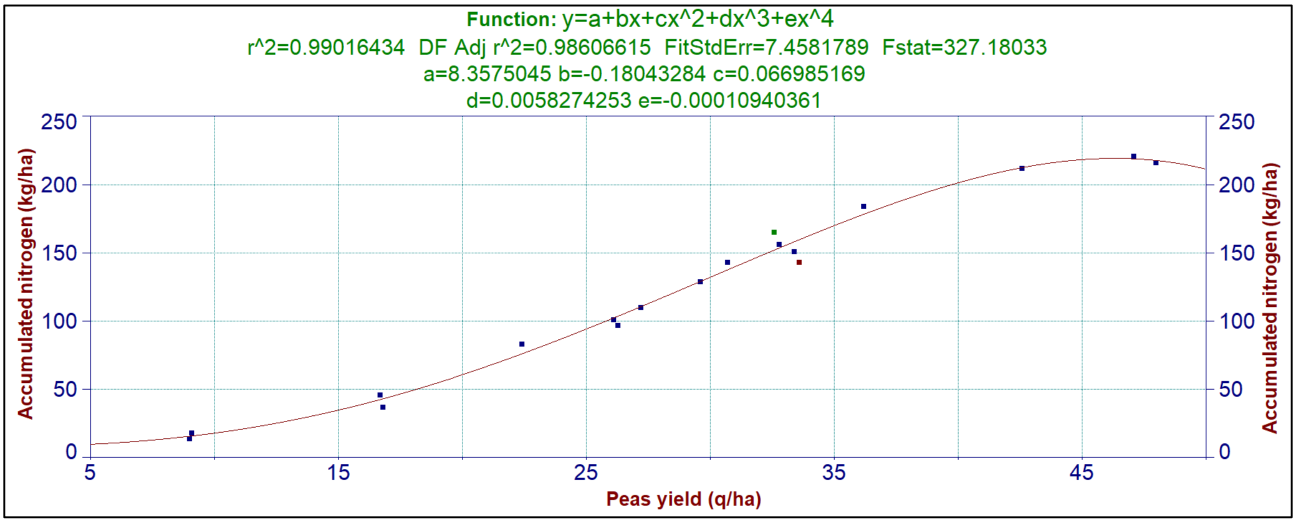

Fig. 1. Correlation between pea production and accumulated nitrogen, 10-year average, 2012-2021 (original)

From the large volume of data obtained during the 10 years of experimentation, in Fig. 1 shows the correlation between pea production, as a determining factor, and the amount of accumulated nitrogen. These averages were obtained by calculating production data and measuring nitrogen, at the end of each agricultural year, taking into account the differences generated by the action of biotic and abiotic factors, but also by the preceding plant. The amount of nitrogen fixed varies greatly from one year to another, being observed to be directly proportional to the pea production obtained. The fixation range starts from 17 kg N/ha in the year with the lowest production, going up to 216-221 kg N/ha when the maximum production of 4700 kg peas/ha was obtained.

The goal is to obtain, through symbiosis or another form of atmospheric nitrogen fixation, as much nitrogen input as possible, in order to reduce the extremely high costs of nitrogen fertilizers.

Starting, therefore, from the average values for 10 years – 2888 kg peas/ha and 183 kg N fixed, to which is added the 62 kg N/ha obtained in the roots, as the calculations in Fig. 2. The total accumulated nitrogen (from aboveground and underground parts of the pea crop) is 183 + 62 + 8.5 = 253.5 kg N/ha. From this amount, subtract the 116 kg N from the grains, resulting in an approximate value of 137.5 kg N/ha by simply incorporating the biomass, after harvesting.

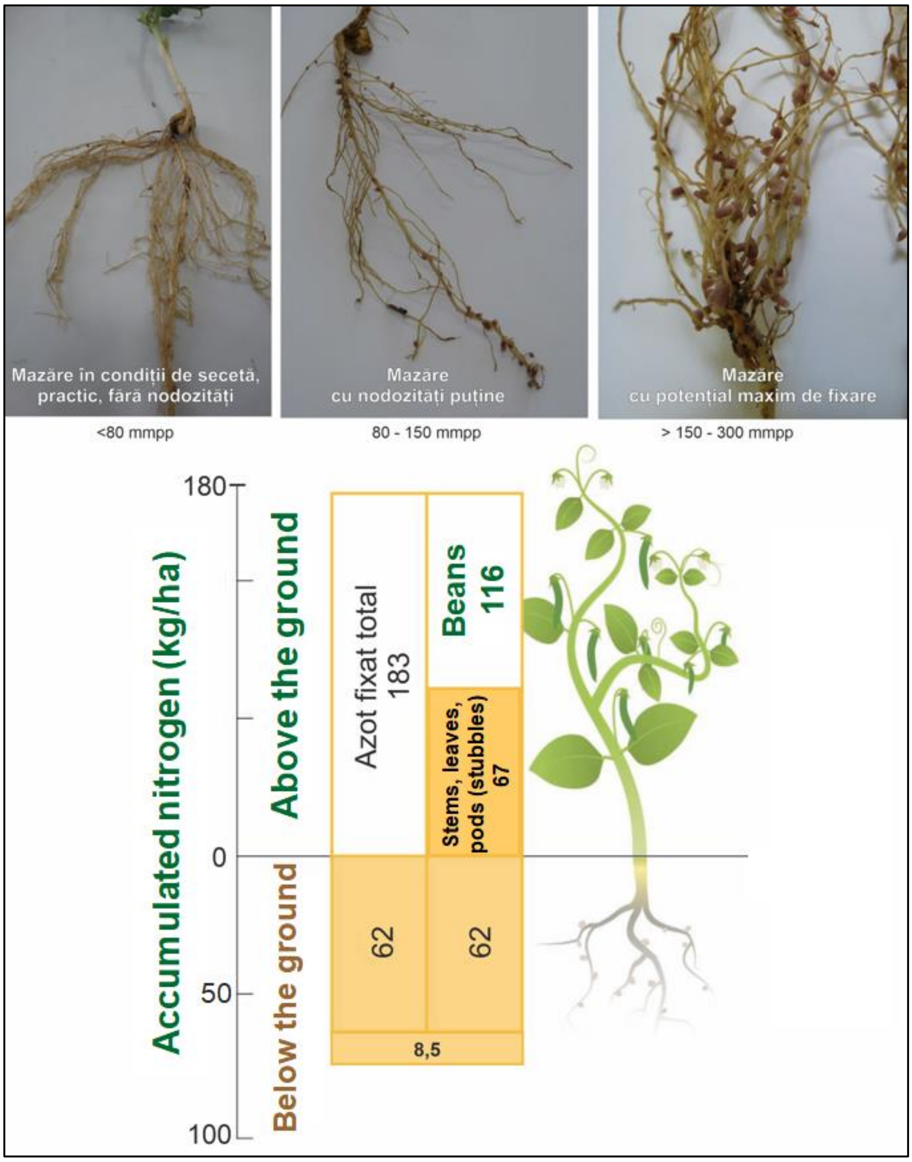

Fig. 2. The total amount of nitrogen fixed by peas, by plant components (original)

With the approximately 70 kg N left in the soil only from the peas (62 kg N/ha from the roots + 8.5 kg N/ha from the shaken grains and left in the soil = 70.5 kg N/ha) 3000 kg can be obtained wheat/ha, if this will be the next crop, as it was in our case. This means that we have halved the cost of nitrogen inputs – if we consider that a tone of fertilizer is €1200, it means that we could reduce the cost to €600, a substantial gain for any farmer.

Peas are an example and a handy variant for southern Romania, but there are other leguminous plants that fix large amounts of nitrogen and which have been included in research by various authors. Lupins and lentils are some of these legumes, fixing even more nitrogen than peas (Kelstrup et al., 1996). Also, perennial legumes (alfalfa, clover) can accumulate up to 300 kg N/ha, being very useful in the soil restoration process.

CONCLUSIONS

Pea is a basic proteinaceous plant that, in the research fields from southern Romania (Teleorman and Calarasi counties), obtained average yields over a period of 10 years of 2888 kg/ha, good harvests for a semi-arid climatic environment. In the experimental field the maximum production was 4700 kg/ha (Belmondo variety, 2021).

Soils in the south of the country have sufficient *Rhizobium leguminosarum* bacteria. The amount of nitrogen fixed by the biosynthesis of the symbiosis, on average over 10 years, was 124 kg N/ha. Nitrogen fixation correlates very significantly with the level of precipitation in April-June. In conditions of severe drought, the production was around 900 kg/ha, and the fixed nitrogen was 14-18 kg N/ha (year 2020). At more than 4700 kg of peas/ha and under conditions of sufficient and accessible moisture, the amount of nitrogen fixed is 216-221 kg/ha (years 2015 and 2021).

The correlation between grain pea production and accumulated nitrogen is very high and highly significant (r2 = 0.99; D = 99%). This function and the correlation allow us to estimate the amount of nitrogen that accumulates in Romanian soils, provided that the technological rules that influence the process of symbiosis and fixation are respected, with an emphasis on the elimination of monoculture.

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THE IMPACT OF THE LABOR DEFICIT ON THE DEVELOPMENT OF THE AGRICULTURAL SECTOR OF THE REPUBLIC OF MOLDOVA

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Summary*: The problem of providing the national agricultural sector with labor force has increased with the intensification of the process of migration of the rural population to cities or abroad. As a result, this exodus considerably decreased the supply of labor in the given sector, creating a constant deficit of the given resource. The purpose of the given work is to reflect the considerations of the emergence and evolution of the given subject, the analysis of the current situation and in perspective, the definition of the means of improving the capacity of labor insurance of the agricultural sector. The general research methods (empirical and theoretical methods) were used in the preparation of the report, the analysis of statistical data reflecting the demographic changes in the rural area as well as the dynamics of the involvement of the rural population in the agricultural production process were widely applied. The report reflects both the analysis of statistical data and the derived conclusions, and the results are interpreted through the prism of social changes and economic reforms carried out in the rural area of the Republic of Moldova.*

Key words: *agriculture, workforce, reforms, crisis, impact.*

JEL classification: R23, Q15, Q18.

INTRODUCTION

The labor force is one of the basic elements of the national economy. Therefore, ensuring production processes with that resource is a vital task for most economic sectors. currently, some fields, thanks to the implementation of automated technologies, can successfully substitute human physical force, but the domestic agricultural sector still requires the use of a large amount of labor.

This fact was valid both during the XX century, as well as at present, and the intensity of involvement of the rural population in agricultural processes is conditioned by social, political and economic factors. The series of agrarian reforms, diametrically opposed in terms of content and method of implementation, contained a common element – the extensive use of labor, available in the countryside until the end of the last century and insufficient today.

In the given context, the insufficiency of this resource requires a new reformation of the way of administering agricultural activities, a condition that requires the modernization of agricultural equipment, the use of advanced technologies, the transition from extensive to intensive agriculture with a high economic value.

RESEARCH METHODOLOGY, DATA AND HYPOTHESES

When preparing the given report, general research methods (empirical and theoretical methods) were used, the analysis of statistical data reflecting the level of involvement of the rural population in agricultural production processes was applied.

Primary documents represented by specialized literature (books, monographs, scientific reports and didactic materials, etc.), as well as secondary documents (statistics by field) were used as sources for the given research. The information provided by the National Bureau of Statistics of the Republic of Moldova and relevant international organizations was widely used.

RESULTS AND DISCUSSIONS

In the last one hundred years, the agricultural sector of the Republic of Moldova is one of the main users of the labor force, and the intensity of the involvement of the rural population in agricultural works being determined, to a large extent, by the impact of political, administrative and economic transformations.

The efficiency of the use of labor in the domestic agricultural sector depended, to a large extent, on the periods when the agrarian reforms were implemented, the instruments used to carry out the given changes, but also on the social and political situation in the respective eras. How efficiently and rationally the authorities used this resource can be easily deduced from the statistical data that fully illustrate these periods

The interwar period of Bessarabia (1918-1939) being characterized by an extensive process of both economic and social reformation, had a significant effect on the demographic structure, but also on the population trained in agricultural works. The administrative reform, started with the reunification of Bessarabia to the Romanian Kingdom and implemented throughout the period, but also the great Agrarian Reform of 1921, characterized by the redistribution of agricultural land among the peasants, created conditions for even more active involvement of the population in the agricultural sphere. This phenomenon was also strongly fueled by the decline of industrial branches, a fact that greatly diminished the quality of life in the urban environment.

Thus, according to the General Census of the Romanian Population of 29.12. 1930, the total population of Bessarabia (without the region on the right side of the Dniester River) was 2,863.4 thousand citizens with the following residence: urban area - 370.1 thousand inhabitants (13.0%), rural area – 2 493,3 thousand inhabitants, of which 1 468.6 thousand or 58.9% were considered active. Taking into account the total involvement of the rural population in agricultural work (both children and the elderly), 2,363,707 inhabitants of the respective environment declared, during the Census, that the exploitation of the soil is their basic occupation, thus demonstrating the highest level of labor force involvement in the domestic agricultural sector throughout the XX century [1].

Thanks to the agrarian reform, an action that attracted the majority of the population to the agricultural process, a large part of the peasants was able to increase their consumption of food products. Thus, meat consumption per unit of consumption reached 35 kg, milk – 102.8 liters, sugar – 2.4 kg [1].

However, the opportunity for efficient use of the manpower available at that time was substantially compromised. Due to the high land taxes, the lack of an efficient credit system, the insufficiency of mechanized agricultural equipment, the frequent periods of drought, the development of the Bessarabian agricultural sector has considerably stagnated. This fact generated, towards the end of the interwar period, a significant wave of emigration of the rural population to other regions of Romania or abroad.

The beginning of the post-war period was marked by a series of dramatic events that directly affected the entire region of Bessarabia. Re-annexed to the Soviet Empire in 1944 and renamed the Moldavian Soviet Socialist Republic (RSSM), the area was subjected to a radical political, social and economic restructuring.

With the end of World War II, the process of agricultural reform of the RSSM also started, a reform based on Leninist-communist axioms, which placed in the foreground the eradication of private property and the use of collective labor or the collectivization of agriculture. However, due to the disastrous economic situation, as well as the severe drought of 1946-1947, the reform process stagnated, being resumed on a larger scale only in 1949. As of January 1, 1950, there were 1,747 kolkhozes in the SSR comprising 468,422 private peasant households. Almost 228 thousand able-bodied men and 466 thousand women, 125 thousand teenagers and the total number of farmers constituting approximately 43% of the rural population were integrated into collective farms [2].

As in the interwar period, the insufficiency of mechanized agricultural machinery required the intensive use of labor - a sufficient resource at that stage. The given situation significantly hampered the development of the agrarian complex, labor productivity being low. This fact reflected directly on the standard of living of the rural population. The peasants were exploited by performing compulsory work in the collective farm, not being paid until after 1964. Until then, they received grain or other products only at the end of the year, according to the amount of work performed and calculated in work-days. The Stalinist system, which discriminated against the peasants, was gradually dismantled, Khrushchev (1953-1964) introducing a series of reforms by which the prices of food products were increased, thus increasing the incomes of the peasants. The same policy was continued by Brezhnev (1964-1982). However, at the end of the 70s, although the peasants performed about 80% of their work in the kolkhoz, the income from wages covered only 40% of their needs. The rest of the peasants' needs were covered by cultivating the plots of land next to the house, which were reduced by Khrushchev from 0.36 ha to 0.15 ha, although they produced 20-25% of the total agricultural production [1].

The gradual development of cities, the reindustrialization of the economy in the following years, the privileged working and living conditions of urban workers, compared to that of workers in the agricultural sphere, started the process of migration of the population from the villages. As a result, between 1950 and 1970, the number of the population trained in the agricultural process decreased by 93 thousand workers, a fact that amplifies the insufficiency of providing the sector with labor force. In the given context, the administrative bodies of the RSSM implemented a series of actions that drastically limited the migration of the rural population, forcing them to work only in the agricultural field. The freedom to settle in the city was restricted and conditional on obtaining the right of residence, which was a serious violation of human rights [5].

Another measure restricting the free movement of rural residents was limiting them from perfecting their identity documents (passports), or, without these documents, it was impossible to obtain a residence visa in cities. The only option for a change of job for Moldovan peasants was their employment in forestry works in the Far East of the USSR or clearing the steppes of Kazakhstan.

The economy of the Soviet Union was based on centralized planning and state ownership, a fact that allowed at the initial stage the initiation of an extensive process of industrialization of the country, a condition that more actively boosted the mechanization of agriculture. Thus, according to statistical data, in 1985, the records of agricultural households contained 52.4 thousand tractors, 30.4 thousand trucks, 4.4 thousand harvesters, 72.2 thousand units of agricultural machinery; being served by a number of 119.2 thousand mechanizes [3]. At that time, 757.1 thousand people (36.4% of the economically active population) were trained in RSSM agriculture. Subsequently, in the following five years, the number of employees in agriculture decreased precipitously, reaching 678.0 thousand people. in 1990.

In general terms, it could be stated that the Soviet period had a positive impact on the agricultural sector of the SSR. The intensive mechanization of agriculture allowed the increase of the labor productivity of the peasants. The maximum level (increasing by 84% compared to 1965) was reached in 1983. Later, due to the stagnation and severe recession in which the economy of the Soviet

Union was mentioned, this indicator went into recession, recording a regression of - 10% in 1990 compared to 1989.

Even the high level of qualification of workers in the agricultural sphere could not improve the economic situation that was worsening more and more in the collective agricultural households. As a result of the faulty administration of all production resources, the phenomenon of overestimating the results obtained (to demonstrate that the production commitments were fulfilled) and the extent of the migration of the rural population, which towards the end of this period became more and more difficult to control, the agricultural sector of RSSM was becoming an inefficient field that needed radical reformation.

The declining productivity of agricultural land, the very low productivity of labor led to the collapse of the planned economy, but also of the Soviet Union as a state.

Due to these circumstances, the Republic of Moldova was established as a state, orienting its economic development towards an economy based on market economic relations. The given situation created new premises for the start of the next agricultural reform based on the redistribution of the national agricultural land fund. At the same time, this fact required a change in the workforce management paradigm in the production process.

Starting with 1992, a long and complicated process of reorganization of the former collective households began. Initially, an attempt was made to apply a temporary transition method. The given method involved the collective management of these households, only that each member had the ownership right to a certain share of the patrimony of the given economic entity. In essence, these households, being renamed Agricultural Cooperatives, did not differ much from those of the Soviet type, except that they were completely self-managed. This type of management was able to ensure until 2000 (the year when the implementation of the "National Land Program" project began) the training of a total number of 766 thousand workers in the national agricultural sector [4].

The redistribution of the agricultural land fund through the mentioned project served as a strong impetus for the new owners to manage their acquired lands individually. At the same time, if the land redistribution happened according to the plan, then the division of the technical-material base suffered a total collapse, being destroyed both the fixed funds and the entire fleet of cars and tractors. As a result, some of the employees, later employed in the agricultural sector, found themselves unemployed, being forced to find other sources of livelihood. The sharp regression of the sector from a semi-intensive agriculture to a subsistence agriculture only amplified the number of people who abandoned the given sector.

The dramatic decrease in the standard of living, the lack of jobs or the low remuneration of employees in the agrarian sector amplified even more strongly the migration process of the rural population. Consequently, in 2020, only 175.9 thousand people were trained in agriculture, or 73% less than in 2000.

In order to reduce the negative impact on the lack of labor in the agricultural sector, the central authorities have started an extensive process of consolidating agricultural land, taking into account, at the same time, the principle of the right to property. A set of mechanisms were developed and adopted with the aim of developing the land market, creating optimal conditions for the establishment and activity of new forms of agricultural enterprises. Agricultural entrepreneurs, with the support of the state, managed to implement a series of measures aimed at compensating for the lack of labor in the given sector. These include: procurement and use of modern agricultural techniques, application of modern production technologies with maximum mechanization of agricultural operations etc. As a result, the value of global production obtained in 2021 by agricultural enterprises was 1,550 million USD, an indicator that represented an increase of 7.4 times compared to 2000 [6].

In the given context, the intensive mechanization of agriculture had a positive effect on reducing the impact of labor shortage in the given sector. But the given transformation increased even more the share of cereal and technical crops in the structure of the sown areas (up to 92.3%) and the decrease of the total area of land occupied by horticultural crops.

Currently, the national agricultural sector has reached the point when it is obliged to identify a new development vector, which can be: a. the further development of the production model based on the maximum use of mechanized techniques but with a structure totally dominated by cereal crops and of the technical ones; b. the transition to the agriculture model with high economic value but with the involvement of an increased number of skilled workers.

The first option, based on the specialization of agricultural enterprises in the cultivation of only cereals and technical crops, was and is a measure that temporarily mitigated the lack of labor, but the positive effects are already exhausted, the eminence of the risk that the entire sector will enter into -in a long process of stagnation being eminent.

The second option has as its essence the diversification of the cultivation of agricultural crops, giving priority to those with an added value, as well as the attraction of qualified labor. The realization of this model requires a longer period, requires greater investments but also time to perfect the personnel involved in the production process.

As a result, the qualification of the workers will contribute to the increase of productivity and the quality of the work performed, which will allow the rationalization of the use of labor force. In turn, the given action will increase the level of labor remuneration and make physical activity in the agricultural sector more attractive.

CONCLUSION

During the XX century, the rural area of the Republic of Moldova was a stable supplier of labor for the agricultural sector. Depending on the political, social and economic context, the efficiency of using this resource in that period remained quite low.

The interwar era was characterized by a record number of citizens involved in agricultural work, but the very low level of mechanization of production operations considerably reduced the efficiency of the use of this fund.

The post-war or Soviet period, marked by a radical reformation of the agrarian sector, based on a collectivization of all production resources, intensively used the available labor force. The low standard of living of the rural population, at that time, triggered the process of migration to the cities, creating a labor shortage in the given sector. To counter this phenomenon, the authorities imposed a rigid control over the migration process. As a result, the majority of the rural population was forced to work only in the agricultural sphere. Regardless of the fact that until the end of the Soviet era, a very high level of mechanization and automation of agriculture was achieved, labor productivity remained low, labor management in agricultural processes was defective. As a result, the early 1990s were marked by a total degradation of collective agricultural households.

With the independence of the Republic of Moldova, and with the transition to the economic system of the market economy, the agricultural sector was again reformed, with the emphasis on private property. The reform was characterized by a long period of change, followed by a severe economic decline and a considerable reduction in the number of workers trained in agricultural work. This fact radically changed the structure of cultivated crops, with a total dominance of cereal and technical crops. The horticultural sector, where the labor force is used the most, has been and continues to be the most affected by the lack of this resource.

In perspective, the main objective of the agricultural field is the transition to the system of sustainable agriculture with a high economic value, and this fact requires the attraction of a large number of qualified labor force. Therefore, one of the priorities of the authorities at all levels is to attract and raise the level of training of the workforce that is currently available in Moldovan villages.

The development of methods to make the use of labor more efficient in the national agricultural sector serves as a research objective or theme for the collaborators of the Institute of Economic Research, an activity that is carried out within the State Program "***Development of new economic instruments for evaluating and stimulating the competitiveness of the Republic's agriculture" Moldova for the years 2020-2023" (number - 20.80009.0807.16.)***.

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ECONOMIC EFFECTS OF RASPBERRY PRODUCTION ON THE FAMILY FARM[1]

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Abstract: *The paper presents the results of research related to raspberries production in the Republic of Serbia with a focus on the Zlatibor district and selected agricultural holding located in the area of the municipality of Arilje. The research was conducted in accordance with the real data from practice. The pedo-micro-climatic conditions in this area are suitable for raspberries cultivation being within the optimal values for its production. Water resources are also adequate for irrigation applications during the growing season. Research has shown that the total costs of production on the selected (representative) agricultural holding amount to €8,198.5/ha when the irrigation and manual harvesting of raspberries are applied. The annual financial result (profit) is favorable and amounts to €27,649.9/ha. The economic and financial results of the research showed that raspberries production is extremely profitable in this part of Serbia.*

Keywords: *raspberries, production, economic analysis, costs, profit.*

JEL Clasiffication: Q0; Q10; Q12

INTRODUCTION

Fruit growing is a very important branch of agriculture in the Republic of Serbia, as fruit production accounts for about 11% of the value of total agricultural production *(Strategy for the development of agriculture of the Republic of Serbia 2014-2024).*

Considering the climate, land and water resources on the one hand, as well as the vicinity of the market, the existence of cold storage facilities, processing facilities and dryers on the other, in all parts of Serbia there are suitable places for cultivation of some types of fruit. However, some types of fruit are grown in areas with unfavorable agro-ecological conditions, which results in unsuccessful and economically unjustified production. Therefore, it is of utmost importance to be aware of reionization when growing fruit. Certainly, for most fruit species there are several main production regions in Serbia. According to the representation, pome fruits (peach, apricot, plum, cherry, sour cherry, apricot) are in the first place, followed by apple fruits (apple, pear, quince, medlar, gooseberry, hawthorn), berries (raspberries, blackberries, strawberries, currant, gooseberries, blueberries, mulberries), while stone fruits (walnut, hazelnut, almond, chestnut) are the least represented. According to the areas on which they are grown, the dominant fruit species is the *plum* (grown on an area of 72,569 ha), followed by the *apple* (grown on an area of 27,034 ha), which is available in the data of *Statistical Office of the Republic of Serbia, Statistical Yearbook 2022.*

In terms of export value, raspberries are the leading fruit species in Serbia. 1,900.1 t of fresh raspberries valued 6,802.3 thousand USD were exported from our country, in 2001. Most of it was

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exported to the countries of the European Union (1,878.2 t in the value of 6,753.2 thousand USD),(https://data.stat.gov.rs/Home/Result/170304?languageCode=sr-Cyrl&displayMode=table&guid=b0462e45-3394-4be4-992c-162751e0a6ea).

In the same year, in 2021, Serbia exported 97,961.5 t of frozen raspberries (sugar free) worth USD 426,143.1 to all countries of the world, but frozen raspberries from our country are mainly exported to the countries of the European Union (approximately 78% of the total of exports), i.e. 76,275.4 t with an export value of USD 320,042.4 (*https://data.stat.gov.rs/Home/Result/170304?languageCode=sr-Cyrl&displayMode=table&guid=f0c8ff73-6171-4d69-998d-164cfb439633*

Apart from the export value, raspberries are a special type of fruit with pronounced specificities compared to other fruits. The high content of vitamins, minerals, specific microelements and similar caused that raspberry fruits as well as raspberries' leaves have significant medical characteristics, which is the reason of popularity of these fruit and its in demand both on the domestic and on the world market, and is used for the treatment of many diseases as well as for prevention *(Mišić P., et al. 1998, Milivojević J. et al., 2000).*

Commercial production of raspberries in our country began in 1920, while its intensive production began in the last twenty years *(Mišić P. et al., 2004).* High fertility, a long tradition in cultivation, long-term export to the world market and the status of "Serbian raspberry" have significantly contributed to the intensification of raspberries production. Family agricultural holdings were gradually formed into family companies with a rounded production cycle (raspberries plantations and mini-coolers), creating the final product, i.e. frozen raspberries, which are in high demand on the world market *(Veljković B., et al., 2006, Petrović S., 2004).* Regarding the assortment of raspberries in Serbia, the Vilamet variety dominates (about 95%), followed by miker with 3-4%, and all other varieties with 1-2% *(Kljajić, N., 2014).*

In recent years, the image of areas under raspberries in Serbia has changed. New raspberries plantations with multi-bearing varieties were established in areas where traditionally raspberries were never grown, especially in Vojvodina. On the other hand, raspberries production was abandoned in the regions where raspberries are grown the most, partly due to the unprofitability of production and partly due to the poor price of raspberries several years ago, as well as the lack of seasonal workers. Also, looking back several years, the occurrence of early frosts, stormy rains followed by the appearance of hail, and in 2020, along with all these occurrences, there were also floods that affected particularly Western Serbia and caused great damage and production loss.

Raspberries yields are still relatively low, although some examples from practice show that, with the full application of all necessary agrotechnical measures, the raspberries yields can reach a value of 10-15 t/ha, or even more, in the period of full bearing.

MATERIAL AND METHODS

The subject of research in this paper are the production and economic indicators of raspberries production on an individual agricultural holding in the Zlatibor district. The goal of the research is to observe the basic indicators of raspberries production and to evaluate the level of profitability of this production. The research should give the answer to the question of how growing raspberries in the Zlatibor district (an example of an agricultural farm) is economically justified.

The concept of this paper is that the first part includes an analysis of the representation of areas under raspberries plantations, the achieved total yield and the achieved average yield in the Republic of Serbia, as well as at the level of the Šumadija Region and Western Serbia in the ten-year research period (from 2012 to 2021). The review of relevant changes in observed phenomena (area under fruit species and total production) was performed using the average annual rate of change. Also, in the first part of the paper is given a description of the world's largest raspberry producing countries and an overview of the export of frozen raspberries from Serbia to the countries of the world as well as to the countries of the European Union, expressed in thousands USD, as well as the average annual purchase prices of raspberries in the Republic of Serbia for the ten-year research period.

The second part of the paper refers to the analysis of the main economic indicators of raspberries production, which was carried out in 2021, where the production and economic results per unit area were obtained based on the data of one agricultural holding in the municipality of Arilje. The economic parameters of production were determined based on the value of raspberries production, production costs, financial results and economic efficiency of production.

For the purposes of research in this paper, data from statistical publications of Statistical Office of the Republic of Serbia (SORS) for the period 2012-2021 and the Food and Agriculture Organization of the United Nations (FAO) were used, as well as the available scientific and professional literature that deals with this subject. The data are presented in tables and graphs with the application of statistical and calculative methods for solving such tasks and problems in science and practice.

RESEARCH RESULTS AND DISCUSSIONS

Based on official data of the Statistical Office of the Republic of Serbia, the average area under raspberries plantations in the last ten-year period (2012-2021) amounted to 18,891 ha. The data presented in Table 1 show that the largest areas under raspberries plantations in the Republic of Serbia were in 2020 (20,807 ha), and the least in 2012 (11,996 ha). The average fertile area for the same period was 18,891 ha. The highest total yield of 127,010 t was achieved in 2018, and the lowest of 70,320 t was achieved in 2012. The average value of the total yield for the ten-year period is 102,410 t. Regarding yield expressed in t/ha, the highest achieved yield was in 2015 (6.0 t/ha), and the lowest in 2020 (4.9 t/ha), while the average value for the research period for the observed ten years was 5.5 t/ha.

Table 1. The average value of areas and yields of raspberries in the Republic of Serbia for the period 2012-2021. year

Period of research	Harvested area, ha /arable land, ha	Index (2013=100)	Total yield (t)	Index (2013=100)	Yield, t/ha	Index (2013=100)
2012	11.996	100,00	70.320	100,00	5,9	100,00
2013	13.118	109,35	74.682	106,20	5,7	96,61
2014	14.792	123,31	82.683	117,58	5,6	94,92
2015	16.211	135,14	97.165	138,18	6,0	101,69
2016	20.194	168,34	113.172	160,94	5,6	94,92
2017	21.861	182,24	109.742	156,06	5,0	84,75
2018	22.654	188,85	127.010	180,62	5,6	94,92
2019	23.249	193,81	120.058	170,73	5,2	88,14
2020	24.028	200,30	118.674	168,76	4,9	83,05
2021	20.807	173,45	110.589	157,27	5,3	89,83
Average	***18.891***		***102.410***		***5,5***	
Average annual rate of change	***6,31***		***5,16***		***-1,18***	

Source:https://data.stat.gov.rs/Home/Result/130102?languageCode=sr-Cyrl&displayMode=table&guid=02d2de7e-c59c-4884-8c29-ac929c23b706

The data shown in Table 2 present that at the level of the Zlatibor district, the largest areas under raspberry plantations were in 2020 (19,268 ha), and the least in 2012 (10,635 ha). The average fertile area for the same period was 15,466 ha. The highest total yield of 104,894 t was achieved in 2018, and the lowest of 63,506 t in 2012. The average value of the total yield for the ten-year period is 86,328 t. Regarding the yield expressed in t/ha, the highest achieved yield was in 2015 (6.1 t/ha), and the lowest in 2020 (5.3 t/ha), while the average value for the research period for the observed ten years was 5.7 t/ha.

Table 2. The average value of areas and yields of raspberries in the Šumadija region and Western Serbia for the period 2012-2021. year

Period of research	Harvested area, ha /arable land, ha	Index (2013=100)	Total yield (t)	Index (2013=100)	Yield, t/ha	Index (2013=100)
2012	10.635	100,00	63.506	100,00	6,2	100,00
2013	11.143	104,78	63.604	100,15	5,7	91,94
2014	11.909	111,98	66.857	105,28	5,6	90,32
2015	13.210	124,21	80.845	127,30	6,1	98,39
2016	16.404	154,25	93.076	146,56	5,7	91,94
2017	18.175	170,90	91.273	143,72	5,0	80,65
2018	18.503	173,98	104.894	165,17	5,7	91,94
2019	18.746	176,27	102.653	161,64	5,5	88,71
2020	19.268	181,18	101.824	160,34	5,3	85,48
2021	16.669	156,74	94.749	149,20	5,7	91,94
Average	***15.466***		***86.328***		***5,7***	
Average annual rate of change	***5,12***		***4,54***		***-0,93***	

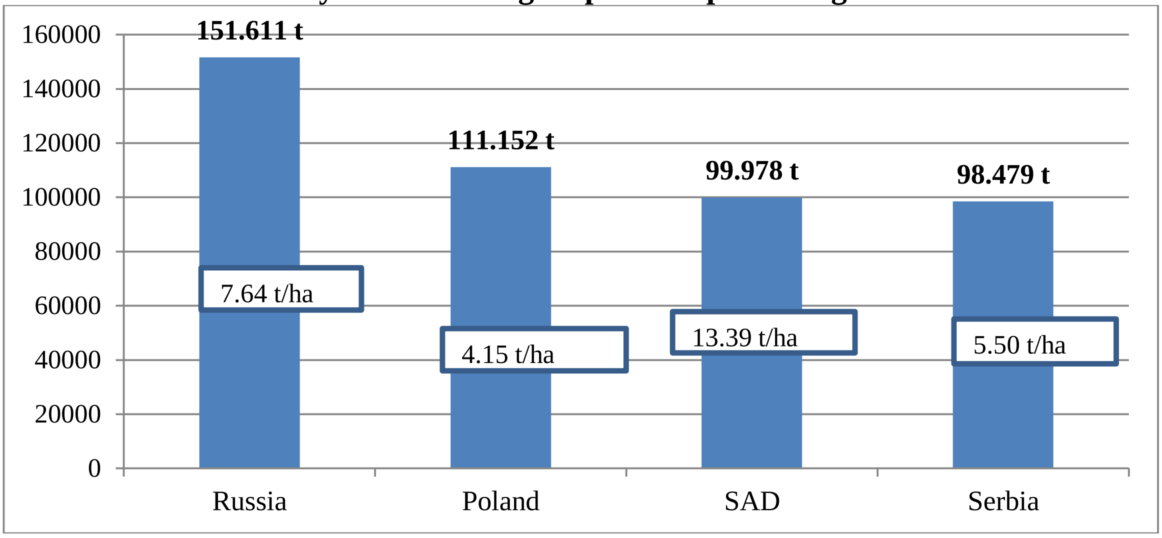
Source:https://data.stat.gov.rs/Home/Result/130102?languageCode=sr-Cyrl&displayMode=table&guid=02d2de7e-c59c-4884-8c29-ac929c23b706

In the region of Šumadija and Western Serbia, where also the Zlatibor region belongs, the situation is similar to that of the entire territory of Serbia. From 2012 onwards, there is a trend of growth in the area under raspberries plantations, as well as an increase in yield corresponding to the increase in the area under raspberries plantations.

The Zlatibor region belongs to the region of Šumadija and Western Serbia and includes ten municipalities: Užice, Arilje, Bajina Bašta, Kosjerić, Nova Varoš, Požega, Priboj, Prijepolje, Sjenica and Čajetina. The total number of agricultural holdings in this area is 43,829, which have a total of 202,051 ha of agricultural area. One of the most important branches in this area and at the same time the most profitable is fruit growing because it enables the development of less developed parts of this area. Orchards are spread over 23,049 ha of agricultural area, with the largest area under orchards in the municipality of Arilje (3,368 ha), and the smallest area under orchards is in the territory of the municipality of Sjenica (129 ha), *(Municipalities and Regions in the Republic of Serbia, 2021. year).*

Compared with the countries that are considered to be the world's leading producers of raspberries, Serbia occupies a high position in terms of the amount of raspberries produced (Graph 1).

Graph 1. Average volume of production (t) and yield of raspberries (t/ha) for the period of 2012-2020. years in leading raspberries producing countries.



Source: The authors' calculation by given data https://www.fao.org/faostat/en/#data/QCL

The average raspberries yield in Serbia is 5.5 t/ha, and that average is higher than the average raspberries yield in Poland, which is 4.2 t/ha. It is obvious that data on average yields do not reflect the real state of raspberries production. According to data from the Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia, there are two groups of producers among raspberries producers. One part of the producers applies modern production, introducing and implementing all agrotechnical measures, irrigation systems and similar, thereby raising the yield close to the genetic potential of raspberries, which is about 20 t/ha, while a large number of producers maintain already existing plantations, without introducing new technology and thus it achieves average yields, i.e. around 5 t/ha. In this way, the level of production in Serbia is maintained, but the quality is lost. The solution to increase the yield but not to the detriment of its quality would be in expert testing of varieties and clones, improving the production of certified planting material and improving the production technology, applying innovative technologies in the production itself *(Keserović Z., Magazin N., 2014).*

Table 3. shows the export of raspberries from Serbia for the period 2012-2021. year to all the countries of the world as well as to the countries of the European Union.

Table 3. Export of sugar free frozen raspberries for the period 2012-2021. year

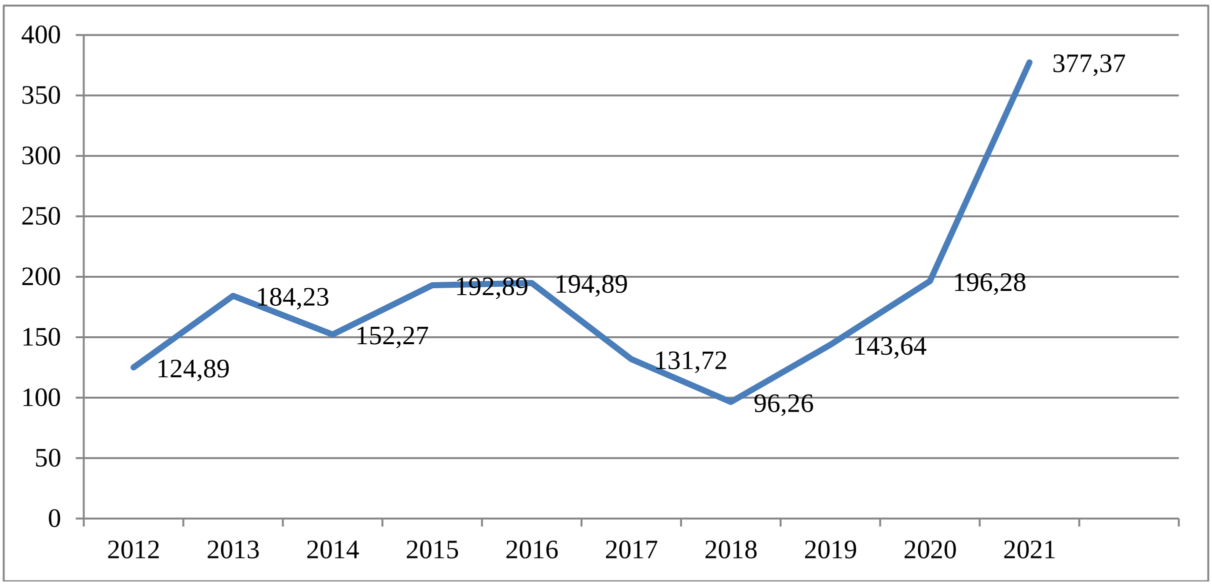
Years	**All countries**		**The European Union countries (28)**	
	Quantity (t)	**Value in thousands of USD**	**Quantity (t)**	**Value in thousands of USD**
2012	64.268,1	135.648,1	60.201,1	126.216,0
2013	61.416,9	187.357,7	56.821,0	171.539,8
2014	73.252,6	236.517,6	64.933,4	207.713,4
2015	93.731,6	267.566,4	83.400,1	234.569,4
2016	85.956,9	247.883,5	77.009,8	219.853,6
2017	94.000,2	233.233,4	81.689,1	201.121,6
2018	103.275,8	225.763,8	87.884,2	190.062,9
2019	114.354,2	234.343,9	99.145,6	199.705,1
2020	107.745,2	295.896,5	82.582,6	217.716,0
2021	97.961,5	426.143,1	76.275,4	320.042,4
Average	**89.596,3**	**249.035,4**	**76.994,2**	**208.854,0**

Source: https://data.stat.gov.rs/Home/Result/170304?languageCode=sr-Cyrl&displayMode=table&guid=f0c8ff73-6171-4d69-998d-164cfb439633

The largest amount of exports was achieved in 2019 (114,354.2) with a value of 234,343.9 thousands USD, while the smallest amount of raspberries was exported in 2013 (61,416.8 t) worth 187,357.7 thousands USD. These data refer to the export of raspberries to all countries of the world. Unlike exports, the import of raspberries into our country is insignificant. Raspberries are mainly exported in frozen state (about 98%), mainly to the countries of the European Union (Germany, France, Belgium, Great Britain, Sweden, Holland, Poland; Austria). In recent years, the production of processed raspberry products (juices, jams, etc.) has been on the rise *(Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia, market report, 2020).*

The average purchase price of raspberries, obtained from the values for the analyzed period (Graph 2), is 179.38 dinars/kg.

Graph 2. Average annual purchase prices of raspberries in the Republic of Serbia for the period 2012-2021. year



Source:[*https://data.stat.gov.rs/Home/Result/0302010302?languageCode=sr-Cyrl&displayMode=table&guid=979941fa-6bf1-4025-a55c-f5d362ff4b4e*](https://data.stat.gov.rs/Home/Result/0302010302?languageCode=sr-Cyrl&displayMode=table&guid=979941fa-6bf1-4025-a55c-f5d362ff4b4e)

The price of raspberries is defined by the principle of supply and demand on the market, so accordingly, the purchase prices of raspberries varied significantly by year of production *(Kljajić N. et al., 2022).* Until 2016, there was a trend of price growth followed by a drop in the price of raspberries. During the COVID pandemic, the demand for raspberries increased proportionally to the decrease in raspberries stocks on the world market, which led to a significant increase in prices.

Economic results of raspberry production on a family holding

The economic analysis of the results of raspberries production on a selected family holding in the Zlatibor district is based on the calculation of raspberries production on 1.0 ha of land. The cultivation of the raspberries variety "Willamette" on this family holding takes place in a vertical trellis formed by wooden posts and wire supports. The Raspberry field is in the period of full fertility and there is a drip irrigation system installed on it. The raspberries planting distance is 2.5 m x 0.25 m, that is, the row spacing is 0.25 m and the row spacing is 2.5 m. In the raspberry field, during the year, on several occasions, the space between the rows is maintained with a motor cultivator, as well as around the rows, i.e. the seedlings, the soil is hoeed by hand. The agricultural holding has all the necessary machinery and equipment for carrying out work in the raspberry field.

Harvesting is done manually, in the period from the second half of June to the second half of July. After harvesting, the fresh raspberry fruits are classified into two categories and the largest percentage are handed over to the local buyer, i.e. the cold storer. The remaining part is sold on the market or on the farm itself to well-known customers from the surrounding area.

In the analyzed year, the realized raspberry yield was 11.1 t/ha. When calculating, the purchase price that was realized in 2021 and which amounted to 378 din/kg, i.e. €3.21/kg, is used.

Considering that in our country raspberries are mostly grown on areas smaller than 1 ha, the research results and economic indicators are calculated per 1 ha. An area of 1 ha represents one of the adequate sizes of plantations on which raspberries can be grown in the relevant production areas of our country, and at the same time it is practical for presenting the achieved production and economic results.

The total costs of production include **the costs of materials** (raspberries seedlings, pillars and wires for supports, mineral fertilizers, manure, protective agents-pesticides, packaging, which includes plastic crates for packing 3 kg of raspberries, irrigation equipment and other material costs), **costs of depreciation and use of machinery** (transportation and spreading of mineral fertilizers, spreading of manure, treatment with protective agents, inter-row processing, transport), **costs of labor** (pruning, manual hoeing around seedlings, harvesting with packaging of raspberry fruits), **and costs of applying irrigation**, which is shown in Table 4.

Table 4. Raspberries production calculation (P=1,0 ha)

Element	Quantity	Unit of measure	Price (€/unit of measure)	Total value (RSD)	Total value (EUR)	Structure (%)
I INCOMES						
Raspberries production (kg)	11,150		378,0		**35,848.4**	
Total income				**4,214,700**	**35,848.4**	
II COSTS						**100,0**
1. Material costs				**337,107.0**	**2,867.3**	**34,97**
1.1. Replacement seedlings	117	pcs	30,0	3,510.0	29,9	0,36
1.2. Poles and wires for replacement	20	pcs	150,0	3,000.0	25,5	0,31
1.3. Mineral fertilizer				43,270.0	368,0	4,49
1.4. Stable manure				44,340.0	377,1	4,60
1.5. Pesticides				63,250.0	538,0	6,56
1.6. Packaging	5,000	pcs		150,345.0	1,278.8	15,60
1.7. Irrigation system				13,520.0	115,0	1,40
1.8. Other material costs				15,872.0	135,0	1,65
2. Costs of depreciation and use of machinery				**54,570.0**	**464,1**	**5,66**
2.1. Transportation and spreading of mineral fertilizers	1	ha		4,820.0	41,0	0,50
2.2. Spreading of stable manure		ha		3,760.0	32,0	0,39
2.3. Protective treatment		ha		33,625.0	286,0	3,49
2.4. Inter-row processing	2	ha		5,785.0	49,2	0,60
2.5. Transport	10	by tour		6,580.0	56,0	0,68
3. Labor costs				**572,220.0**	**4,867.1**	**59,37**
3.1. Pruning	2	working day		58,200.0	495,0	6,04
3.2. Manual harvesting around seedlings	6	working day		11,520.0	98,0	1,20
3.3. Harvesting and packaging	22	working day		488,400.0	4,154.1	50,67
4. Irrigation costs				14,100.0	119,9	1,46
Total costs				**963,897.0**	**8,198.5**	
III PROFIT					**27,649.9**	

Source: The authors' calculation has been made through field research (2021); * Exchange rate of National Bank of Serbia on day 31/07/2021 (1 RSD= 117,57 €)

Total costs, market value of production and realized profit were obtained based on collected data on costs in the production process and the amount of yield. Calculation includes total costs, where material costs are calculated based on market prices.

The total costs of regular raspberries production on the family holding in Arilje amount to €8,198.5/ha. This cost showed into a value per kg is €0.61/kg, which compared to the selling price of raspberries is a significantly lower value and represents an exceptional benefit for raspberries producers. By comparing the calculated costs and realized income in raspberries production in 2021, a profit of €27,649.9/ha, or €2.48/kg, was realized, at the sale price of raspberries in 2021, the year of approximately 378 din/kg, or €3,21/kg.

The economic efficiency of raspberries production shown in this research is 3.37 and is represented by the ratio of the realized value of production and the total costs in the production process. This value is an indicator of how many euros of production value were realized per euro of total production costs *(Kljajić N., et al., 2017, Jelocnik M., et al., 2021).*

Table 5 shows critical values in raspberries production. If the yield and price values of raspberries are taken into consideration, its production can be characterized as low to moderate risk.

Table 5. Critical values in production

Description	RSD (kg/ha)
Expected yield (EY)	11,150.00
Expected price (EP)	378,00
Subventions (S)	0,00
Variable costs (VC)	963,897.00
Critical price: CP = (VC - S) / EY	**86,45**
Critical yield: CY = (VT - S) / EP	**2,549.99**
Critical variable costs CVC = (EY x EP) + S	**4,214,700.00**

Source: The authors' calculation has been made through field research (2021)

Production on family holding can be completed and thereby strengthen on the market through the association of several producers into specialized cooperatives and associations of raspberries producers, then by processing and packaging a quantity of produced raspberries into juices, jams, etc., as well as by improving production through the introduction of innovations and new scientific knowledge in practice.

CONCLUSION

Raspberries are extremely profitable fruit species, especially from the area of Serbia, where raspberries have been traditionally grown for years, achieving high yields of extremely high-quality fruits. Regardless of the fact that agricultural producers have found interest in growing raspberries in all parts of Serbia, the area of Western Serbia, especially Valjevo, Arilje, Požega, Ivanjica, is still the center of its production. This is supported by the results from the family holdings of raspberries producers in this region.

The economic indicators determined in this paper confirmed that raspberries production in the Zlatibor district of our country is extremely economically profitable. The financial result on the surface of 1 ha of a representative agricultural holding is positive and amounts to €27,649.9/ha. The total value of production costs is €8,198.5/ha. Total production costs include material costs, depreciation and use of machinery, labor costs and irrigation costs. Labor costs have the largest share in the structure of total costs, and within them, the costs of picking and packing raspberries. Those costs amount to €4,154.1/ha or 59.67% of the total costs.

The purchase price of raspberries was 378 din/kg or €3.21/kg in 2021. This price of raspberries per kilogram is significantly higher compared to the cost per kg of raspberries (€0.61/kg), so the realized profit is €2.48/kg of raspberries.

The raspberry sector is loaded with numerous problems. Some of the problems producers dealing with are purchase at a single price, poor organization of smaller producers with the aim of association, absence of raspberries classification during purchase, absence of quality and health safety control of raspberries, etc. On the other hand, cold storers themselves as buyers of products also face numerous problems, such as the inability to predict the future selling price at the time of purchase, the use of unfavorable loans for purchase, and similar.

In order to maintain the competitiveness of „Serbian raspberries" on the world and European markets, which significantly contributes to the agricultural sector of Serbia, it is important to ensure the minimum purchase price of raspberries in all areas of our country where they are grown. In order to further encourage farmers' interest in its production, it is necessary to maintain a controlled difference between the purchase price of fresh raspberries and the export price.

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BIOECONOMY APPROACHES IN THE EUROPEAN CONTEXT

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Abstract: Against the background of the scarcity of fossil resources and the reduction of the availability of agricultural land, the emergence of climate change and the growth of the world population, it has become necessary to design sustainable and efficient strategies from the point of view of resource management, in order to ensure the prosperity of future generations. These strategies need to include integrated concepts across multiple sectors and levels of activity. Such a concept is considered bioeconomy. The present work represents a review of the definition of the bioeconomy in European states, the evolution of the concept and the variety of existing approaches. It will be demonstrated that the bioeconomy represents an emerging sector that is based on the creation, development and revitalization of economic systems based on a sustainable use of renewable biological resources, in a balanced way. The bioeconomy has evolved from an almost esoteric concept to becoming the core of development strategies at regional and national as well as local levels. It has also permeated the sphere of interest of the scientific and technological communities and financial and economic and industrial circles. It should be emphasized that the bioeconomy does not represent a new industry or economic sector, but a combination of production-processing sectors and final markets that are characterized by the use of renewable resources, natural resources, ecological technologies and efficient recycling.

Keywords: *bioeconomy, strategy, sustainable development, agriculture, biotechnology*

JEL classification: A1, A12, Q57

INTRODUCTION

The 21st century began with numerous problems manifested at the global level - population growth, poverty, hunger, climate change, financial and economic crises, pollution. The main driver of the emergence of problems related to the effects of climate change is represented by the highly industrialized human activity since the middle of the 20th century. This is mainly caused by the fact that economic activity is based on the use of fossil resources. Unfortunately, fossil resources are finite and their exploitation and use negatively affects the planet in many ways, with a major risk of compromising the quality of life of future generations. In addition, the world's population does not stop growing and, implicitly, the demand for resources, goods and services continues to increase. Fossil fuel shortages, world population growth, the climate crisis and other global challenges require a critical shift in human development.

The bioeconomy, or bioresource-based economy, uses renewable resources to provide human society with food, materials, energy and more. This is known as a primary step towards sustainable development. The transition from the traditional economy to a bioresource-based economy is one of the major changes that address global challenges by using natural resources, mitigating climate change and ensuring global food security (Dietz et al., 2018).

Bioeconomy is still a rather abstract concept, largely unexploited, both at the European level and in our country. In Romania, this model has a rather slow pace of development, although our country possesses enormous potential in terms of the progress of the bioeconomy sectors. First of all, it is necessary to raise awareness, to enrich the theoretical and practical knowledge that regulates this concept, to increase the technological transfer and the proper exploitation of the current results of scientific research.

Having these in mind, this article is presenting an overview of bioeconomy approaches in the European context.

Definitions and bioeconomy approaches

The definition of the bioeconomy has evolved over time (Birch and Tyfield, 2013; Staffas et al., 2013) , and recent research has characterized the bioeconomy as a polysemic term, which includes three main **Error! Reference source not found.** (Giampietro, 2019; Vivien et al., 2019) .

The first pillar is developed in a perspective of economic growth based on the ***development of biotechnology*** supported by the OECD, multinational companies and start-ups.

The Organization for Economic Cooperation and Development (OECD) used an early form of the notion of bioeconomy in 2004, stating that "A bioresource-based economy is defined as a concept that uses renewable bioresources, efficient bioprocesses and industrial eco-clusters to produce bioproducts, jobs and incomes that fall within the scope of sustainable development" (OECD, 2004). Five years later, the same institution defined the bioeconomy as the process of "transforming knowledge from the field of natural sciences into new, sustainable, eco-efficient and competitive products" (OECD, 2009) showing the link between the bioeconomy and sustainable development. This definition was aimed at the potential of innovations in the transformation and efficient use of biological resources.

In the definition of the American concept, although the aspect of sustainability was not emphasized, the main idea was similar to the one above: "A bioeconomy is based on the use of research and innovation in the biological sciences to create economic activity and benefits for the general public" (The White House, 2012) .

The main objective of this bioeconomy approach is economic growth and job creation (Staffas et al., 2013; Pollack, 2012) . Thus, although the positive contribution to the intensification of the unwanted effects of climate change and aspects related to environmental conservation is assumed, economic growth is clearly prioritized above the principles of sustainability.

The application of biotechnologies in various industrial sectors, as well as the commercialization of research and innovation results, will generate added value. Thus, economic growth is generated through the exploitation of biotechnologies, and suppliers of raw materials and materials, intermediaries in the relationship between biotechnology research firms and investors, play an important role in stimulating economic growth around the bioeconomy (Morrison and Cornips, 2012) . Consequently, investments in research and innovation will result in the production of scientific knowledge of high economic value, and this is an absolutely central aspect in this version of the bioeconomy.

For example, in the agricultural and agro-industrial sector, biotechnology applications play a significant role. These applications start from increasing the productivity of primary production to processed finished products, with increased added value, based on biotechnological processes (Lokko et al., 2018) .

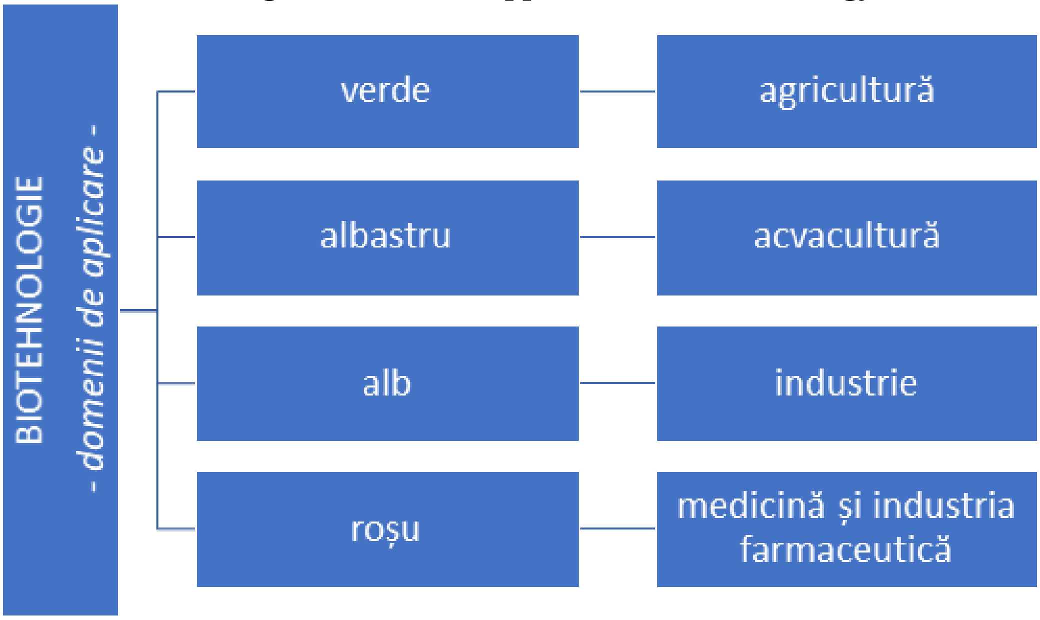
Biotechnological applications can be classified in the following areas:

• ***green biotechnology***: it is biotechnology applied to agricultural processes, for example obtaining transgenic plants resistant to adverse environmental conditions, adaptable in different soils, as well as plants resistant to diseases and pests.

• ***blue biotechnology***: includes marine and aquatic applications of biotechnology; this branch of biotechnology deals with the development of aquaculture, the care of marine creatures, the treatment of polluted or waste water, and the production of food derived from the sea.

• ***white biotechnology***: applies exclusively to the improvement of industrial processes; this uses yeast, molds, bacteria and enzymes with industrial applications. For example, engineering an organism to produce a useful chemical; the use of enzyme systems as catalysts in industrial production flows;

Figure 1. Fields of application of biotechnology



Source: own processing

• ***red biotechnology***: applies to medical processes, e.g. engineering organisms to produce antibiotics; regenerative therapies and the application of genetic engineering to cure disease.

The use of knowledge-based bioeconomy as a policy concept and the growing awareness of the economic contributions of industrial biotechnology at the intersection of its implementation helped launch the current notion of bioeconomy (Viaggi, 2018) .

Biotechnology applied in agriculture, offers a wide variety of scientific approaches to the improvement of plants, animal breeding and microorganisms, aiming at the development of solutions for the productivity and sustainability of agriculture. These scientific tools are very diverse and include, for example, tissue culture, molecular breeding, genetic engineering, molecular diagnostic tools. They assist breeders in providing new high-quality varieties, help farmers detect diseases, or serve industry to produce molecules with high added value to improve food or health.

The second pillar is the one developed at the European level. In the EU strategy launched by the European Commission in 2012 on the bioeconomy, this term is defined as "the production of renewable biological resources and the transformation of these resources and waste streams into value-added products such as food, animal feed, bio-products and bioenergy" (European Commission and Directorate-General for Research and Innovation, 2012) . Through this strategy, Europe has established the theoretical foundations for a ***resource*** - efficient economy. The goal of the bioeconomy is to build an economy based on the consumption and production of goods and services from the direct use of biological resources and its sustainable transformation (European Commission, 2018) .

This approach presents the bioeconomy as a general concept, which mainly concerns the production and conversion of biological resources and waste streams into value-added products. The bioeconomy is based on innovations that replace the dependence of human activity on petroleum resources, by exploiting biomass, for example, by developing small-scale biorefineries and methanizers to produce energy (European Commission, 2018) .

The bioresource-based vision of the bioeconomy focuses on replacing fossil fuel-based electricity, fuel and chemical production (Birch and Tyfield, 2013) . A key objective is the development of new value chains for traditional industries based on biological resources (Bugge et al., 2016) .

Figure 2. Bioeconomy in Europe according to EU Bioeconomy strategy

In the specialized literature, seven industrial branches are identified whose technological flow is based on the use of renewable natural resources for the production of bioproducts. These sectors contribute to the development of the bioeconomy, as follows: agriculture and forestry,

biorefineries, bio-chemicals, enzymes, packaging produced from renewable materials, forestry products and natural fiber textiles (Golden et al., 2015; Wreford et al. ., 2019) . Although they include them in the bioeconomy concept, some authors exclude from the category of bioproducts the traditional sectors that use bioresources in the production flow, such as: in agriculture for the production of food, feed or biofuels, as well as the pharmaceutical industry (Parisi and Ronzon. Tevecia, 2016 ; Pellerin and Taylor, 2008) .

The third pillar is based on the first statements of the term bioeconomy, from an ***ecological economic perspective*** (Georgescu-Roegen, 1971) . The innovations and knowledge that fall within the scope of development of this vision of the bioeconomy are directed towards the inclusion of the existing limits of the natural environment of a certain territory. An example in this regard is the implementation of agro -ecological and agro-forestry practices (Schmidt et al., 2012) .

Although closely related to the second approach, that of resource substitution, the bioecological view focuses more on the role of ecological processes in optimizing energy and nutrient use, promoting biodiversity and avoiding monoculture and soil degradation (Bugge et al., 2016) . From this point of view, what is important is the potential of regionally focused processes and systems, rather than the central role that the previous two views give to research and development activities within globalized systems (Marsden, 2012) .

Therefore, the existing opportunities for the development of rural and peripheral regions are emphasized (Levidow et al., 2013) . An important emphasis is placed on achieving the growth of the rural economy by bringing to the market products with high added value, high quality, with territorial identity. Also, this vision emphasizes the practical implementation of cultivation systems based on agro-ecological principles and bio-ecological engineering techniques (Marsden and Farioli, 2015; Pereira et al., 2018)

A key topic related to this is bio-ecological engineering techniques that aim to "design agricultural systems that require as few agrochemical and energy inputs as possible, relying instead on ecological interactions between biological components to enable agricultural systems to increase their own soil fertility, productivity and crop protection" (Levidow et al., 2013) .

With reference to the determinants of innovation, the bioecological vision of the bioeconomy highlights the identification of bio-ecological practices favorable to biodiversity conservation and environmental protection (Marsden, 2012; Siegmeier and Möller, 2013) and ecological interactions related to the reuse and recycling of materials, thus reducing waste and increasing land use efficiency.

This approach to bioeconomy also directs its attention to the implementation of circular economic processes, making the connection between the concept of circular economy and bioeconomy. The primary importance of the recycling and reuse of biological resources and other resources in the processes of the cascade use of raw materials, within industrial production is emphasized. In this sense, the bioecological vision of the bioeconomy shares features of the circular economy.

In short, the bioecological vision translates into supporting the bioeconomic transition with landscape and ecosystem approaches, rehabilitating degraded land for the production of biomass and other ecosystem services, protecting biodiversity, reducing losses and waste, also focusing on demand management and replacement or avoidance critical products (e.g. plastic), reversing the critical trends of overexploitation of natural resources and environmental degradation.

CONCLUSIONS

Certainly, defining the concept of bioeconomy has become one of the key issues in the development of innovation policies. According to what is reported in the specialized literature, the bioeconomy can be a decisive factor in contributing to the sustainable growth of global economic systems. Regardless of the underlying approach, the bioeconomy is expected to contribute to the sustainable improvement of agricultural productivity, ensure global food security, improve processes related to human and animal nutrition and health, create smart bioproducts and sustainable biofuels, contribute to the adaptation to climate change food-providing sectors (agriculture, forestry, aquaculture) and other ecosystems to adapt to climate change.

Therefore, improving the application of bioeconomy principles seems to become a reasonable choice. The transition to the bioeconomy needs a solid foundation in terms of several key sectors and activities in the economy, such as: research and innovation, the development of new and more efficient technologies; dynamic industrial, agricultural, economic and financial sectors; and, above all, coherent political initiatives aimed at financing a dynamic development of these sectors.

Last but not least, to be successful, the bioeconomy must be accepted by society. Therefore, society must be deeply involved in the multilateral dialogues conducted to develop the bioeconomy agenda, in establishing its objectives, outcomes and, of course, in identifying its potential benefits and risks. This would involve discussing sensitive ethical topics, including the use of arable land, drinking water, the creation of biorefineries, the governance of the bioeconomy or conflicts of interest over resources.

Some hotly debated priority issues in resource use, such as the food versus fuel debate, have been resolved, at least in the European Union (EU). The safety and quality of food and feed must take precedence over any other issue, regardless of its monetary value.

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THE MARGINAL PROFITABILITY OF THE PRODUCTION'S MAIN FACTORS IN AGRICULTURAL FARMS FROM ROMANIA DEPENDING ON THE ECONOMIC SIZE

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Abstract: *The economic dimension of the agricultural farm is intensively studied both by agricultural specialists, who usually want farms as large as possible, but also by agrarian economists who measure the profitability of the factors involved in obtaining agricultural production at the scale of the economic dimension. In addition to established technical-economic indicators, such as: gross product, profitability, labor productivity, which show the overall efficiency of the factors, specific indicators are also used that show the separate efficiency of the factors through the marginal profitability, calculated with the help of elasticity coefficients. The paper used data provided by FADN- Eurostat, to calculate the elasticity of the capital and labor force, consumed in the agricultural holding, for the period 2007-2020, calculating the Cobb-Douglas production function. The coefficients of elasticity were calculated and compared for the six classes of economic size of the agricultural holding, from the South Muntenia Development Region, in order to draw conclusions regarding the profitability on capital and labor force, at the scale level. The authors aim to continue their studies with the analysis of elasticity coefficients at the level of the development regions of our country and their comparison with similar indicators from farms at the level of some regions of the European Union countries.*

Keywords: *agricultural farm, coefficient of elasticity, Cobb-Douglas function, scale economy.*

JEL classification: D01, D24

INTRODUCTION

The Cobb Douglas production function is widely used both as a theoretical model and as a tool for evaluating the profitability on capital, labor and technical progress (*Debertin D, 1986*). The Cobb Douglas function helps in the optimal use of production factors (*Pamphile D, et al, 2020*).

After a comparative study of several types of production functions, it was concluded that the Cobb Douglas function best highlights the contribution of capital factors and labor in agricultural production (*Rakotoarisoa N., 2020*).

The Cobb-Douglas function, through the indicators it provides, highlights the complexity of research on the assessment of the determinants contribution of the economic growth by economic sectors (*Betancourt EW et al, 2020*). The elasticity coefficients of the Cobb Douglas function help us to calculate the marginal effect of the factors and also the effect of the action of the law of diminishing yields of the factors (*Zaman Gh , et al . , 2022*).

The present study followed the analysis of the elasticity coefficients that reproduce the marginal profitability of the factors, at the scale level on the economic dimensions of the farms in the South Muntenia Development Region, with the help of the production function of the form: Y(prod)= $K^{\wedge\alpha}.F^{\wedge\beta}.\lambda t$, where: Y(prod)= farm-level production expressed in euros, K= farm-level capital, expressed in euros; F= labor force consumed at farm level, expressed in UAM (Annual Labor Units); α = elasticity of capital; β = elasticity of labor and λ t = elasticity of technical progress over time.

MATERIAL AND METHOD

In the analysis of the profitability of agricultural holdings, the physical dimension and the economic dimension of the agricultural holdings are used. The size of agricultural holdings can be approached as a physical dimension and an economic dimension.

The physical size of agricultural holdings refers to the agricultural area used (SAU) on average by the agricultural holdings, number of animals (UVM) on the agricultural holding, number of workers (AWU) on the agricultural holding and other physical units on the agricultural holding. In our country, due to the very small average physical size of 3.4 ha per holding, the Strategy for the development of the agri-food sector in the medium and long term 2020-2030 encourages the merging of agricultural land through voluntary association, by leasing or buying land (*MADR, 2015*). It is also recommended to register agricultural properties in the national cadastre system, optimize the way subsidies are granted for small holdings, facilitate the association of farmers, introduce a minimum commercial size (*CE, 2020*).

The economic dimension is one of the important criteria in accessing European funds for agriculture. The economic size of the farm is determined on the basis of the Total Standard Production (SO-Standard Output), expressed in euros (Reg. CE 1.242/2008), at the level of the farm. SO is calculated by multiplying the area, respectively the number of animals in the holding, with the coefficients of each crop, respectively species (*Agroinfo, 2017*).

Eurostat statistics provide a classification of agricultural farms into six classes of economic size, depending on the SO, but also a classification according to the weight occupied by a certain agricultural activity, in 8 groups and in 14 groups, by countries and regions of development, starting in 2004 (*FADN, 2022*).

The study of the elasticity coefficients was done with the help of the Cobb-Douglas function, with technical progress, by classes of economic size, grouped according to Eurostat statistics (*FADN, 2022*). CD functions were calculated for the 6 groups of economic size, for the period 2007-2020, for the South-Muntenia Development Region.

The form of the Cobb-Douglas function with technical progress was:

Y(Gross product (€/farm)) = AK(€/farm)^α . L(UAM/farm)^ $^{\beta}$. λt (time), where:

A= constant coefficient; α=elasticity coefficient of capital, β=elasticity coefficient of labor and λ=elasticity coefficient of technical progress in time period t.

In the final equation, the three elasticity coefficients were verified by simulating the increase of each factor by 1% and evaluating the percentage increase of the gross product. At the same time, the multiple effect of α. b.λt was calculated empirically, by simulating the simultaneous increase by 1%, of the three factors of the function (Necula *Raluca et al., 2016).* The significance of the function was evaluated by the coefficient of determination and the correlation coefficient, for transgression probabilities of 0.05(*significant); 0.01(** distinctly significant) and 0.001(***highly significant).

The calculation of the tendency of the coefficients of elasticity, for the 6 classes of economic size, was done with the second degree parabola equation and the maximum and statistical significance of the equation was calculated (*Merce E., 2018*).

RESULTS AND DISCUSSION

The South Muntenia region borders the southern part of the Southern and Eastern Carpathians towards the Romanian Plain and has the Danube river as its natural border. The relief of the region is characterized by variety, amphitheater-shaped layout and the predominance of low-altitude landforms. Plains and meadows occupy 70.7%, hills 19.8%, and mountains only 9.5% of the region's surface. The South Muntenia region has the largest area of agricultural land in the country (2,433,534 ha), of which arable land occupies most of the agricultural area (80.90%), followed by pastures (11.77%), hayfields (4.47%), vineyards (1.16%) and orchards (1.69%). The South Muntenia region stands out for its high share of rural settlements, so the share of the population in 2018 was 42.8% in urban areas and 57.2% in rural areas. The main sectors that contributed, in 2017, to the formation of the regional GDP in South Muntenia were: industry - with a weight of 36.24%; agriculture and fishing – with a weight of 7.51%; trade, services and others with 51% (of which constructions 5.27%) (ADR Sud – Muntenia, 2021).

The analysis in the South-Muntenia Development Region, for the period 2007-2020, followed 3 levels: 1) Analysis of the evolution of indicators: output (€/farm), assets (€/farm), labor input (AWU/farm) and SAU (ha/farm), by classes of economic size; 2) Analysis of R(k) and R(AWU) ratios by classes of DE and 3) Analysis of elasticity coefficients, respectively elasticity coefficients, of capital and labor on the DE scale of agricultural farms, for the period 2007- 2020, in the South Muntenia Development Region.

1) Analysis of the evolution of indicators: output (€/farm), assets (€/farm), labor input (AWU/farm) and SAU (ha SAU/farm), by DE classes

From the analysis of the evolution, with the help of the annual growth rate, by size classes, of the gross product (Pb) and the total capital (k) at the level of farms, by DE classes , for the period 2007-2020, it was found that these indicators have growth trend during the analyzed period, in the 1st grade, (2.06% and 3.2%); in the 3rd grade (1.8% and 2% **) and** in the 4th grade (1.5% and 0.4%).

Table 1. The main indicators evolution per farm, by DE classes, for the period 2007-2020, in the South-Muntenia Development Region

Economic dimension (DE)		2007	2010	2015	2019	2020	Average(MU)	Coef. Var. (%)
(1) 2 000 - < 8 000€	Output (mii €/farm)	4,8	7,3	6,5	6,3	6,2	12,6	**2,06**
(2) 8 000 - < 25 000€	Output (€/farm)	24,4	16,6	19,9	17,5	17,1	18,0	**-2,53**
(3) 25 000 - < 50 000€	Output (€/farm)	0,0	45,8	54,7	42,8	38,5	45,3	**1,76**
(4) 50 000 - < 100 000€	Output (€/farm)	0,0	90,9	89,2	83,2	80,5	32,7	**1,53**
(5) 100 000 - < 500 000 €	Output (€/farm)	553,9	271,8	303,3	239,4	297,7	28,0	**-6,25**
(6) >= 500 000€	Output (€/farm)	1194,6	2096,8	1351,3	1105,3	1563,8	21,4	**-0,60**
(1) 2 000 - < 8 000€	Assets (mii €)	21,4	26,3	28,2	32,4	27,2	14,7	**3,23**
(2) 8 000 - < 25 000€	Assets (mii €)	51,4	45,4	52,6	59,2	47,9	11,6	**1,10**
(3) 25 000 - < 50 000€	Assets (mii €)	0,0	84,8	86,7	107,7	74,6	44,3	**1,98**
(4) 50 000 - < 100 000€	Assets (mii €)	0,0	152,6	127,4	160,8	142,3	42,9	**0,36**
(5) 100 000 - < 500 000 €	Assets (mii €)	894,7	540,6	549,3	667,4	598,8	25,3	**-2,23**
(6) >= 500 000€	Assets (mii €)	2477,8	3688,2	2736,6	2941,7	3008,4	18,3	**1,33**
(1) 2 000 - < 8 000€	Labour input (AWU)	1,79	1,16	0,98	1,01	1,2	21,0	-4,31
(2) 8 000 - < 25 000€	Labour input (AWU)	3,15	1,40	1,15	1,14	1,5	35,1	**-7,52**
(3) 25 000 - < 50 000€	Labour input (AWU)		2,16	1,45	1,48	1,7	21,8	**-4,44**
(4) 50 000 - < 100 000€	Labour input (AWU)		2,81	1,80	1,71	2,5	16,4	**-4,42**
(5) 100 000 - < 500 000 €	Labour input (AWU)	21,99	6,90	3,83	3,72	6,5	74,7	**-12,78**
(6) >= 500 000€	Labour input (AWU)	42,06	33,23	14,32	14,95	23,5	41,7	**-7,65**
(1) 2 000 - < 8 000€	SAU (ha)	3,4	3,5	3,3	3,4	3,1	14,0	**-0,04**
(2) 8 000 - < 25 000€	SAU (ha)	14,6	11,5	10,1	9,9	9,7	19,9	**-2,99**

Economic dimension (DE)		2007	2010	2015	2019	2020	Average(MU)	Coef. Var. (%)
(3) 25 000 - < 50 000€	SAU (ha)	-	58,3	35,8	36,5	40,9	21,8	**-1,94**
(4) 50 000 - < 100 000€	SAU (ha)		157,8	97,6	91,4	118,0	23,7	**-5,00**
(5) 100 000 - < 500 000 €	SAU (ha)	546,5	511,5	374,3	375,2	431,7	17,6	**-2,85**
(6) >= 500 000€	SAU (ha)	1.907	1.649	1.399	1.340	1547,4	13,8	**2,68**

Data source: FADN, 2022, https://agridata.ec.europa.eu/extensions/FADNPublicDatabase/FADNPublicDatabase.html

Of these, only in the 4th class, there is an increase in the gross product higher than the increase in the total capital. In classes 2, and 6, there is a decrease in the gross product on the farm, while the capital has increases. In the 5th grade, a simultaneous decrease in gross product (-6.3%) and capital (-2.2%) is observed (Table 1).

The analysis of the annual growth rate of labor consumption on the farm highlights that it decreased during the period 2007-2020, on all types of DE farms with rates between -12.8% on farms in the 5th class, to -4.3% for farms in the 1st class.

The analysis of the physical size of the farms results in a decrease between an annual rate of -5.0% for farms in the 4th class to -1.9% for farms in the 2nd class. The farms in the 1st class maintain their average size of 3.1 ha, compared to the value of 3.4 ha/farm at country level. As a growth rate, only farms from the 6th grade increased, respectively 2.68% (Table 1).

2) Analysis of R(k) and R(AWU) ratios by economic size classes.

The trend analysis of the link between the evolution of the gross product on the farm, the total capita on the farm and the labor consumption on the farm was done by analyzing the annual growth rate of the ratios: gross product/capital, gross product/labor consumption, gross product on the farm per 1 ha SAU, the ratio between Pb plant production and Pb animal production (V/A) and by the structure of the main crops (cereals, oleaginous and other crops).

From the analysis of the ratio R(k), respectively of PB/1€ capital, it appears that it is decreasing from one size class to another and what is interesting is that this decrease is increasingly larger as the size of the size class increases, from 0.56% in the 1st class, to -1.38% in the 2nd class and to -3.11% in the 6th class (Table 2).

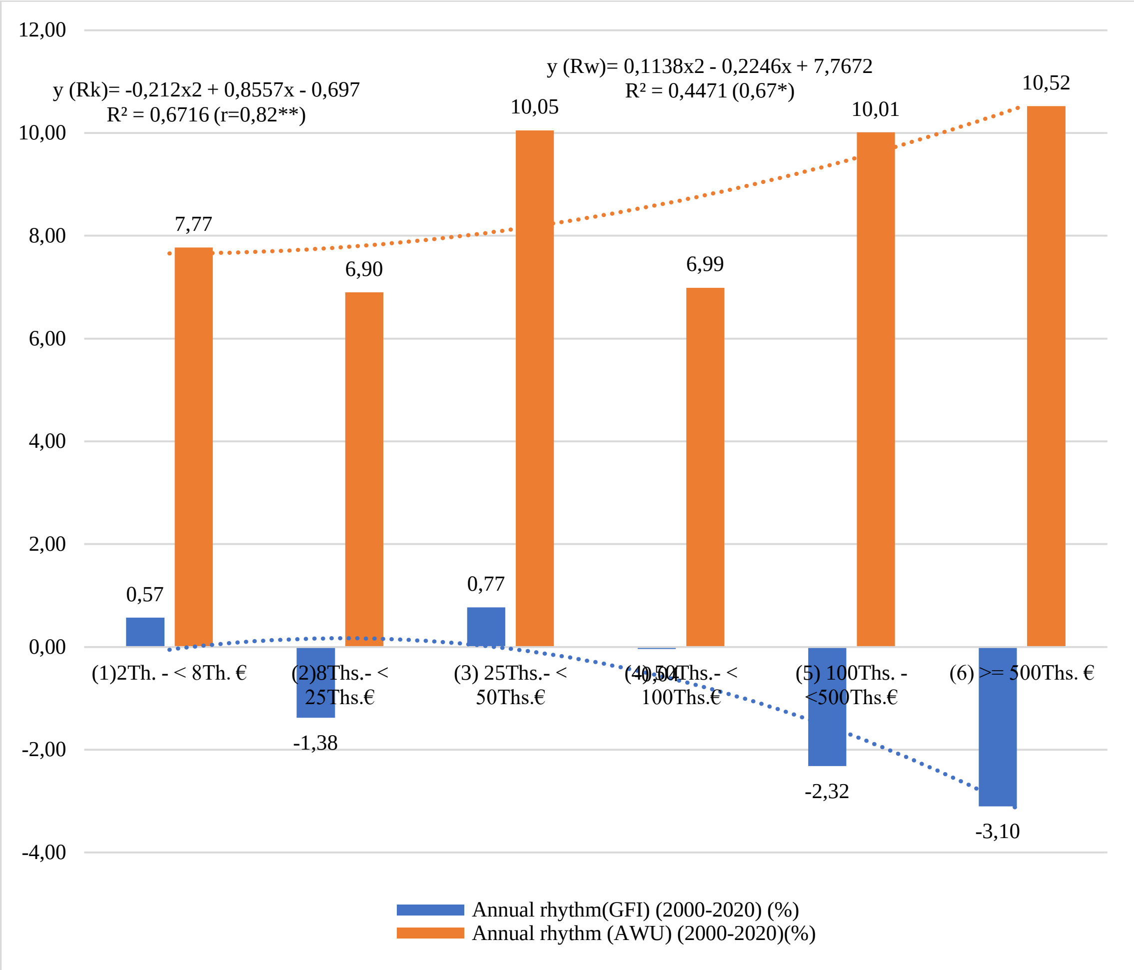
To measure the correlation between the rates of annual growth of the ratio R(k) and DE of the farms, we used the equation of the second degree, from which a distinctly significant correlation emerged (r=0.82**). This strong correlation very well mirrors the universal law of diminishing yields as one of the factors gets higher and higher.

Table 2. The evolution of R(k) and R(F) ratios by economic size classes of farms, in the South -Muntenia development region, for the period 2007-2020

Economic Dimension (DE)	Assets (Total)					Labor input (AWU) (Total)				
	Ratio (k)= (Gross Farm Income (€)) / (Total assets (€))				Rhythm R(GFI) (2000-2020)	Ratio (AWU)=(Gross Farm Income (€))/ (Total labor input (AWU))				Rhythm R(AWU) (2000-2020)
	2007	2020	difference	%	%	2007	2020	difference	%	%
(1) 2 thousand - < 8 thousand €	2.03	2.22	0.19	109.4	0.6	2704	6251	3,547	231.2	7.77
(2) 8 thousand- < 25 thousand €	2.33	2.20	-0.13	94.3	-1.4	7748	15345	7,597	198.1	6.91
(3) 25 thousand- < 50 thousand €	1.54	1.88	0.35	122.5	0.8	14472	28899	14,427	199.7	10.05
(4) 50 thousand- < 100 thousand €	1.48	1.64	0.17	111.2	0.0	23572	48637	25,066	206.3	6.99
(5) 100 thousand -<500 thousand €	1.82	1.42	-0.40	77.8	-2.3	25189	64342	39,154	255.4	10.01
(6) >= 500 thousand €	2.17	1.19	-0.97	55.1	-3.1	28403	73935	45,533	260.3	10.52

Data source: FADN, 2022, https://agridata.ec.europa.eu/extensions/FADNPublicDatabase/FADNPublicDatabase.html

Figure 1. Annual growth rates, by classes of DE of GF (gross product/capital) and AWU, by classes of DE, for the period 2007-2020, in the South Muntenia region



In the same way it was calculated to find out the correlation R(AWU) with DE of the farms and a significant correlation resulted (r=0.67*).

Table 3. The evolution of R(k) and R(F) ratios by economic size classes of farms, in the Sud-Muntenia development region, for the period 2007-2020

Economic dimension (DE)	Average reports 2007-2020					Structure of crops		
						Cereals	Oleaginous	Other cultures
	€ /ha SAU	€ /LU	€ / work	Ratio(V/A)	V/A	%	%	%
(1) 2Thousand - < 8Thousand €	2,050	948	5,528	0.73	0.73	40.3	6.9	52.8
(2) 8 Thousand- < 25 Thousand €	1,799	934	12,367	1.18	1.18	33.5	10.6	55.9
(3) €25,000- < €50,000	1,137	961	27,705	1.80	1.80	48.0	21.4	30.6
(4) 50 Thousand- < 100 Thousand €	767	947	35,448	5.51	5.51	54.9	27.9	17.2
(5) 100 Thousand -<500 Thousand €	694	1,134	55,440	17.42	17.42	58.1	32.9	9.0
(6) >= 500 thousand €	1,016	1.007	74,665	2.50	2.50	62.0	32.5	5.5

Data source: FADN, 2022, https://agridata.ec.europa.eu/extensions/FADNPublicDatabase/FADNPublicDatabase.html

The dynamic analysis of Pb per ha SAU, by classes of DE, for the period 2007-2020, highlights a decrease by classes of DE, from 2050 €/ha SAU in the 1st class, to 694 €/ha SAU in the 5th grade. Approximated with the parabola of the second degree (Figure 2), it shows us a highly significant correlation (r=0.96***).

Analysis of livestock production per UVM (€/UVM), this is around €950/UVM (Table 3) with a slight increase in the 5th and 6th classes. As a trend, the correlation coefficient between value animal production on UVM and DE of farms is significant (r=0.62*).

Figure 2. The correlation between €/ha OR Ratio (Th=thousand)

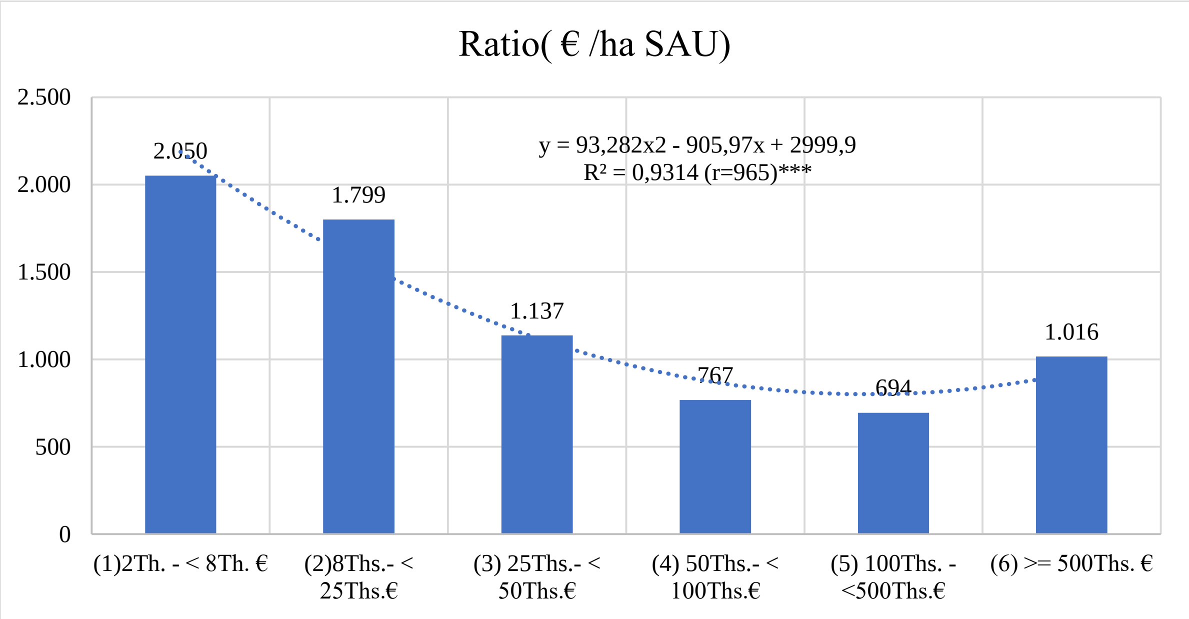
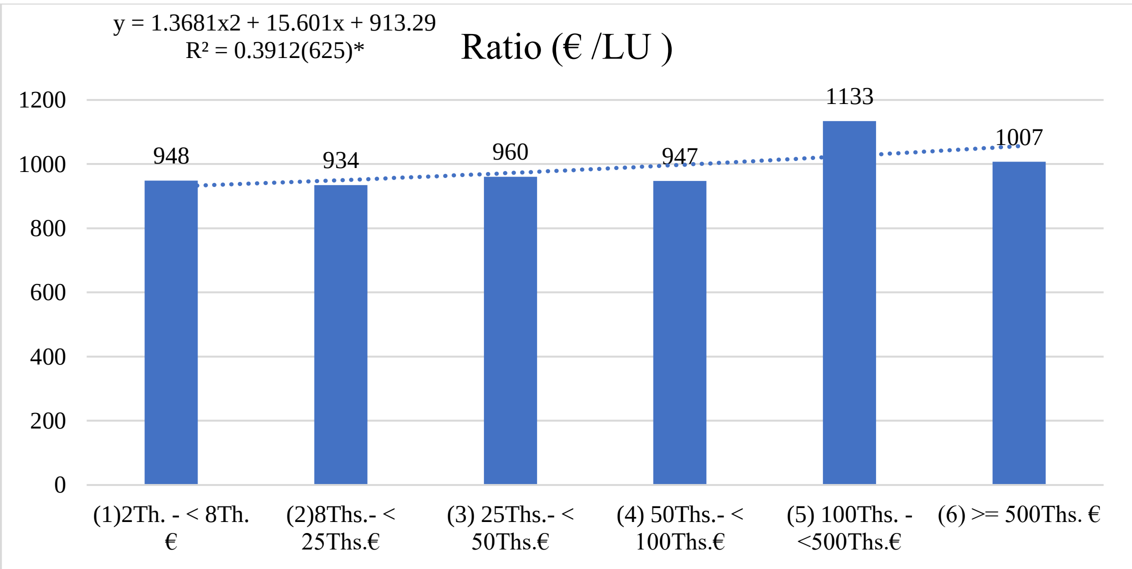


Figure 3. The correlation between the Ratio and DE of the farm €/LU and DE of the farm (Th=thousand)



It is interesting to analyze the value ratio between plant and animal production. It increases from 0.73 in the 1st grade to 17.42 in the 5th grade, after which it decreases to 2.50 in the 6th grade, a ratio close to 1.80, which characterizes the 4th of DE. This indicator of 2.50 is explained by the fact that large farms have focused on raising animals, which are profitable by raising them in large combined farms (cattle, pigs, birds).

Figure 4. The correlation between the V/A Ratio according to the DE of the farm (Th=thousands)

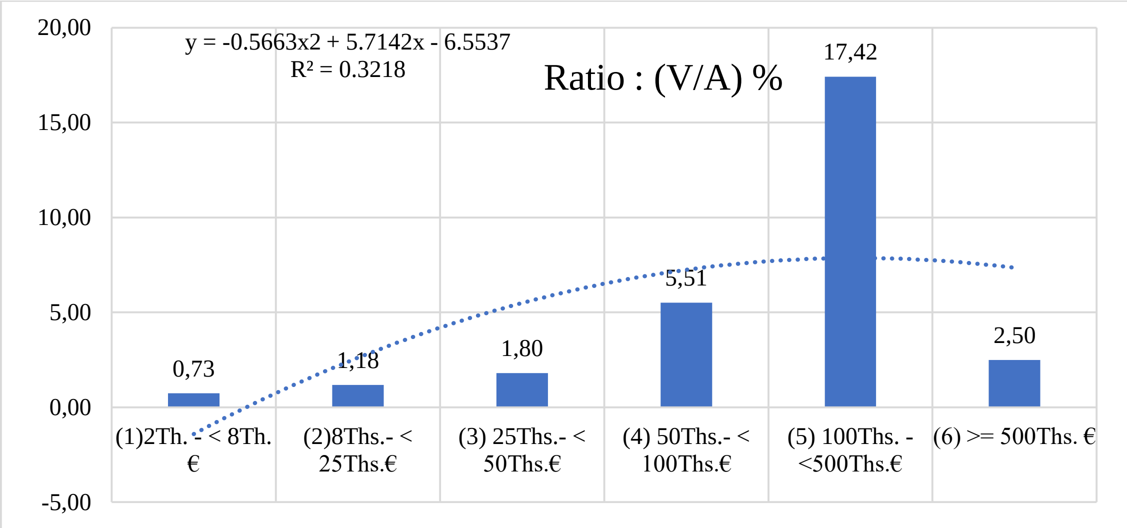
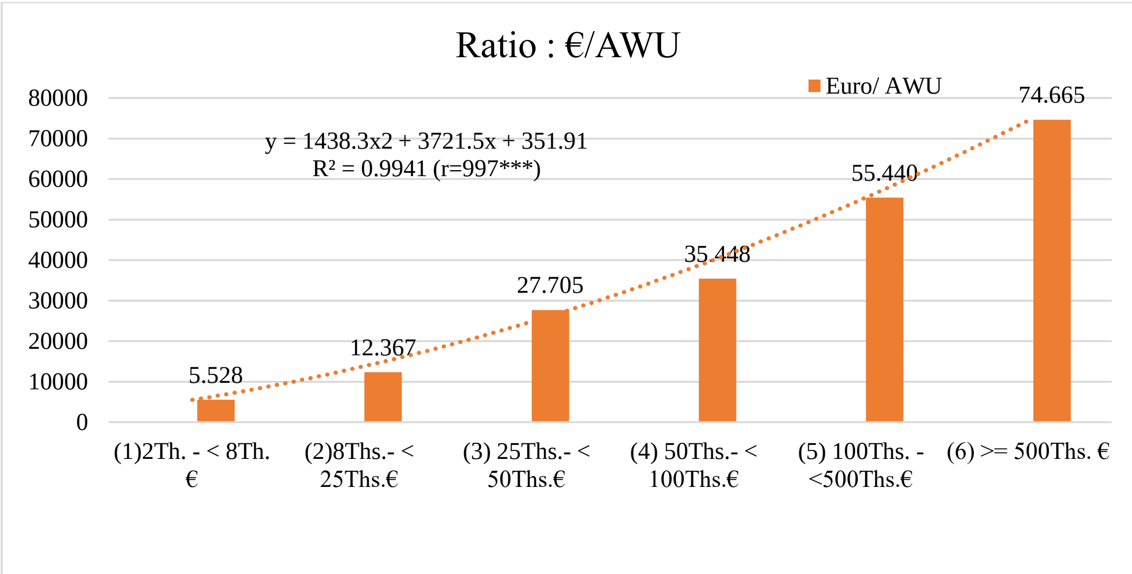
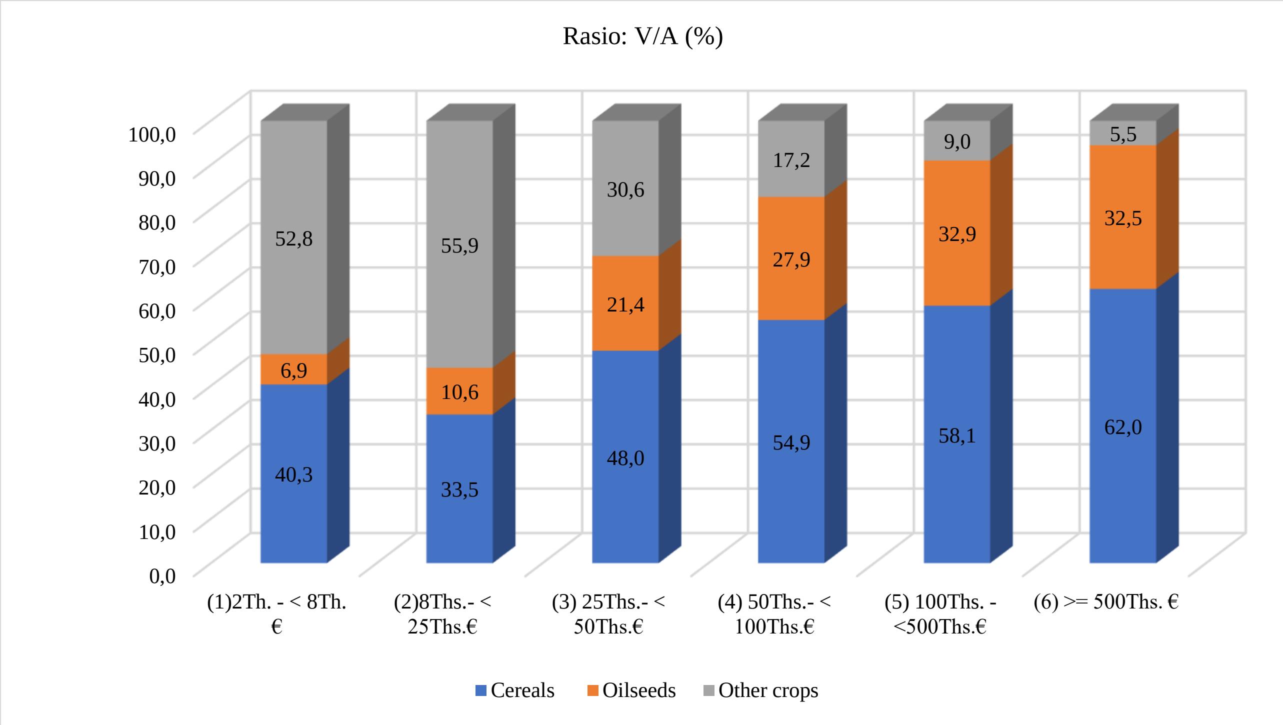


Figure 5. The correlation between the €/AWU Ratio and the DE of the farm (Th=thousands)



The dynamic analysis of Pb per AWU, by DE classes, for the period 2007-2020, highlights a continuous increase of the gross product per AWU, from 5528€/AWU in 2007 to 74665€/AWU in 2020. This the trend is statistically very significant depending on the economic size of the farm (r=0.997***).

Figure 6. The value structure of the main crops according to the DE of the farm (Ratio V/A %)



From the analysis of the value structure of crops (Table 3, Figure 6), it is found that cereals represent 40.3% in the 1st class of DE and reaches 62.0% in the 6th class of DE . As well as oleaginous crops which represent 6.9% in the 1st class of DE and 32.5% in the 6th class of DE. Cereal crops and oleaginous plants together hold 47.2% in the 1st DE class and reach 94.5% in the 6th DE class , due to the orientation towards the most profitable crops and the most complete mechanization.

3) The elasticity coefficients analysis, respectively of the capital and the labor force on the DE scale of agricultural farms, for the period 2007-2020, in the South Muntenia Development Region.

The elasticity coefficient analysis gives us the opportunity to ascertain the qualitative part of the tendency of the return on capital and labor force by DE classes.

Table 4. The correlation between the economic dimension and the CD elasticity coefficients and some technical and economic indicators that characterize the farms of the South-Muntenia Development Region, for the period 2007-2020

Economic dimension (DE)	Cobb-Douglas				Meaning			Average farm indicators				
	a	β	λt	α.β.λ.t	R^2	r	Sgnf..	SAU	Ratio (V/A)	Ratio (O/I)	LU	
	wave.	wave.	wave.	wave.	%	wave.	x	Ha	wave.	wave.	No.	LU/ha
(1) 2Th. - < 8Th. €	0.66	-0.59	-0.03	-2.45	0.63	0.79	**	3.07	0.74	1.30	3.48	1.13
(2) 8Th.- < 25Th.€	0.54	0.54	0.03	3.87	0.61	0.78	**	9.66	1.18	1.38	8.45	0.87
(3) 25 Th.- < €50 Th.	-0.05	0.35	0.04	4.27	0.32	0.57	*	40.93	1.80	1.29	17.98	0.45
(4) 50 Th.s- < €100 Th.	0.08	0.47	0.03	3.16	0.25	0.50	*	118	5.51	1.17	16.91	0.15
(5) 100Th. -<500Th.€	-0.14	0.69	0.05	5.80	0.62	0.79	**	432	17.45	1.05	31.28	0.06
(6) >= €500 Th.	0.58	-0.12	-0.03	-2.78	0.44	0.66	*	1,547	2.50	1.13	588.0	0.36
Coef . Determination (D)	0.61	0.42	0.67	0.64	x	x	x	0.96	0.95	0.88	1.00	x
Coef . Correlation.(C)	0.78**	0.65*	0.82**	0.80**	x	x	x	0.97***	0.97***	0.93***	0.99***	x
Min-Max determination of coef . α and β of the CD function			Coef . parable					SAU	x	x	x	x

Economic dimension (DE)	Cobb-Douglas				Meaning			Average farm indicators				
	a	β	λt	α.β.λ.t	R^2	r	Sgnf..	SAU	Ratio (V/A)	Ratio (O/I)	LU	
	wave.	wave.	wave.	wave.	%	wave.	x	Ha	wave.	wave.	No.	LU/ha
Economic dimension	a	β	of	b	c	R	Sgnf .	Ha	x	x	x	x
381.3 Th. euros	-0.248		0.000005	-0.004	0.436	0.780	*	562	x	x	x	x
379.8 Th. euros		0.825	-0.000005	0.004	0.047	0.652	*	366	x	x	x	x

Data source: FADN, 2022, https://agridata.ec.europa.eu/extensions/FADNPublicDatabase/FADNPublicDatabase.html

The analysis of the capital's elasticity coefficient (α), by classes of DE of farms in the South-West Oltenia Region, shows us that the contribution is positive in 4 classes of DE of farms. In the 1st grade of DE, it has the highest contribution of 0.66, in the 2nd grade of 0.54, it decreases to 0.08 in the 4th grade and increases in the 6th grade to 0.58. Overall, the trend calculated using a parabola of the second degree (Chart 6, r=78**) helps us to calculate the minimum trend of -0.248, which corresponds to a farm with an economic size of €380 Th. per farm and an area of farm of 562 ha.

The analysis of the labor force elasticity coefficient (β) shows that it is positive in four classes 2nd (0.54), 3rd (0.35), 4th (0.47) I a 5th (0.69). It is negative in farms where the elasticity coefficient of capital (α) is also negative, respectively in the 1st (-0.59) and 6th (-0.12) classes. By calculating the trend with the parabola of the second degree, which is significant (Chart 7, r=0.65*), a maximum coefficient of 0.825 results, which would correspond to a farm with an economic size of €379 Th., respectively of a farm of 366 ha SAU.

Figure 7. The correlation between the capital elasticity coefficient (α) and the DE of the farm

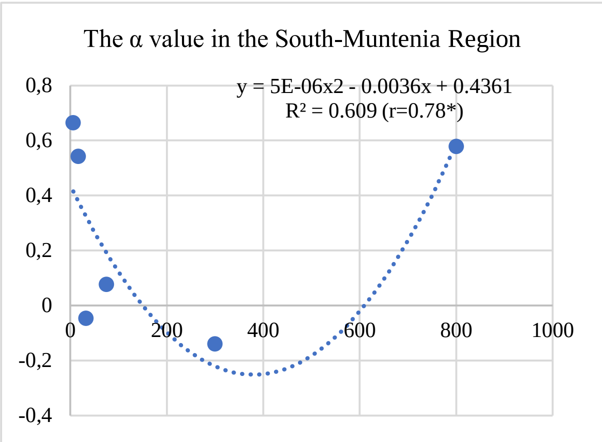
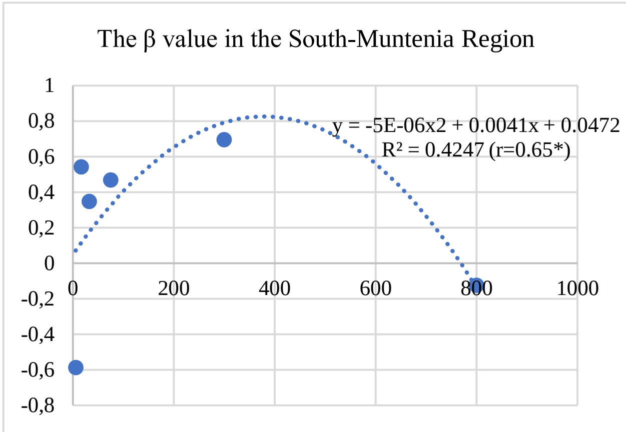


Figure 8. The correlation between labor force elasticity coefficient (β) and farm DE



The analysis by classes of DE of the coefficient of technical progress (λ), shows us that it has a negative value for farms in the 1st (-0.03) and 6th (-0.03) classes (Figure 9), which can be explained by an endowment with fixed assets. By approximating the trend with the parabola of the second degree, (distinct statistically significant, r=0.82**), it results that the trend has a maximum of 0.055, which corresponds to farms with an economic size of €340 Th. per farm, respectively of a farm of 330 ha SAU.

Figure 9. Correlation between the elasticity coefficient of technical progress (λt) and DE of the farm

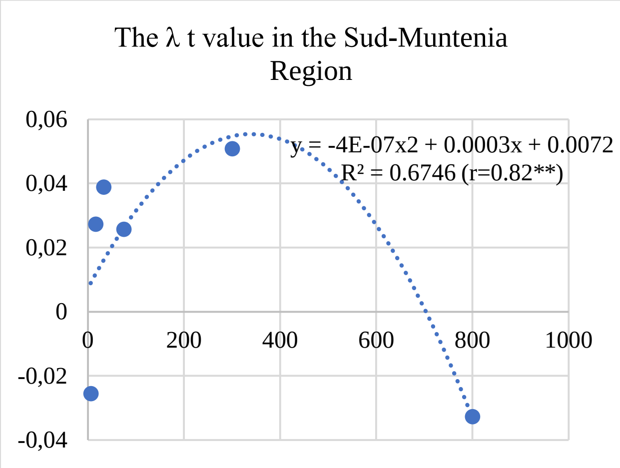
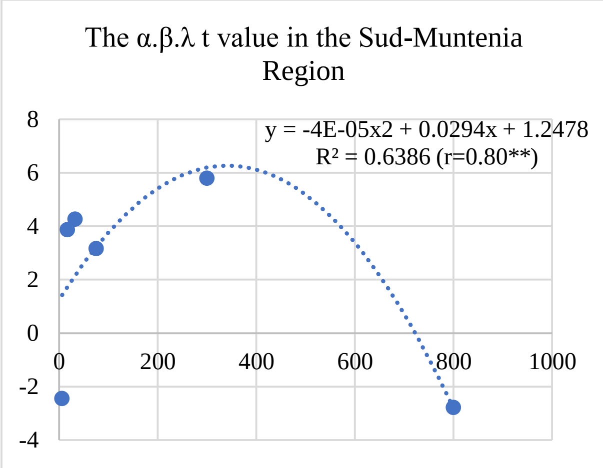


Figure 10. Correlation between the multiple elasticity coefficient (α.β. λt) and DE of the farm



The combined influence of the three coefficients was empirically calculated by simulating the three factors simultaneously with 1%, which resulted in the multiple elasticity coefficient of the three factors (α.β. λt), which has negative values in class 1- a (-2.45) and 6th (-2.78) and positive in the other classes, with a maximum value of 5.80 in the 5th class of DE .

By approximating the trend with the parabola of the second degree, (distinct statistically significant r=0.80**), it follows that the trend has a maximum of α.β. λt =6.26, for farms with an economic size of € 341 Th. per farm, respectively of a farm of 332 ha SAU.

CONCLUSIONS

a) The marginal return on capital (α) on the scale of the economic size of agricultural farms from the analysis carried out demonstrates a rather important downward trend in classes 1 and 5 and falls under the law of diminishing yields.

b) The marginal profitability of labor on the scale of economic size of agricultural farms registers a very significant increase from -0.59 in the 1st class to 0.69 in the 5th class.

c) The marginal profitability of technical progress (λt) on the scale of economic size of agricultural farms shows negative values in classes 1 and 6 and positive values in the other classes. The trend analysis results in a maximum (λt =0.055), for a farm size of €340 Th.

d) The combined marginal profitability of the 3 factors has a synergistic effect of α.β. λt =6.26, which corresponds to a farm size of €340 Th.

e) The analysis of the marginal profitability trend demonstrates a minimum of capital (α= -0.263) for an economic size of €381.3 Th. per farm, a maximum of the labor force (b= 0.833), a maximum of technical progress (λt = 0.055) and a maximum of the combined effect (αβ λt = 6.26). This demonstrates that the maximum profitability of the factors for the period 2004-2020, in the South Muntenia Development Region, is located at farms with an economic size between 340 and 380 Th. €/farm.

f) Contrary to the general perception that in very large farms in terms of area, the gross product would consist only of plant production, the analysis shows that the ratio (V/A) of 2.5, i.e. almost a third is obtained from production animal. This ratio is close in value to the 3rd and 4th DE classes.

g) We consider it necessary to continue the research also at the level of other development regions and some development regions in the countries of the European Union, with a view to a wider evaluation of the marginal profitability of the factors.

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GRAINS MARKET IN THE COUNTRIES IN THE BLACK SEA, CASPIAN SEA BASINS AND IN COUNTRIES WITH INDIRECT ACCESS TO THE BLACK SEA THROUGH THE DANUBE – RECENT DEVELOPMENTS

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Abstract: *The current context generated by the armed conflict between Ukraine and Russia brings to the foreground an important issue concerning the international trade in cereals, mainly the transit of cereals from/to Ukraine via the Black Sea to/from Ukraine's trading partners. While the transit of cereals from/to Ukraine is mainly via the Black Sea, the cereal trade from Russia can be done both through the Black Sea and the Caspian Sea, given Russia's position with direct access to the two seas. In this context, the present study aims to carry out an analysis of the evolution of the cereal market in the countries bordering the Black Sea and the Caspian Sea, as well as in some countries with indirect access to the Black Sea, through the Danube, the analysis focusing on the main cereals, namely wheat and maize.*

Key words: *piața cerealelor, producție, cerere, comerț exterior.*

JEL Classification: Q10, Q11, Q17.

INTRODUCTION

Located between Europe and Asia, the **Black Sea** is part of the Atlantic Basin, being directly surrounded by 6 riparian states, namely Bulgaria, Georgia, Romania, Russia, Turkey and Ukraine. Located between Europe and Asia, the **Caspian Sea** borders five countries, namely Russia, Azerbaijan, Iran, Kazakhstan and Turkmenistan.

For some countries, the access to the Black Sea is also possible via the Danube, respectively via the countries bordering the Danube that have no other direct access to the sea or for which the transport distance is much too long for transport on the Danube, in this case Moldova, Serbia, Hungary, Austria, Slovakia.

Given Romania's geostrategic position, grain trade has acquired increased importance in the current international context.

MATERIAL AND METHOD

The present study is based on information provided by FAOSTAT database. The investigated period of time is 2015-2019, also 2020, depending on the data available. The analysis is based on established statistical methods such as comparisons, structures and dynamics, the indicators analyzed for the two types of cereals (wheat and maize) being the following: physical production, domestic demand, demand for food consumption, consumption/capita/year, producer price, as well as foreign trade indicators, respectively import and export, both in quantitative and value terms.

RESULTS AND DISSCUSION

Recent developments on the wheat market

One of the oldest cultivated crops in the world, ***wheat*** is considered the most important cereal, due to its multiple uses, both in population's consumption and for animal feed. In the year 2020, wheat rank first in the world in terms of cultivated area, with 219,006,893 ha.

In the context of the objective of the current approach, it should be specified that the latest statistical information on the balance of wheat and wheat products is limited to the level of the year 2019.

However, from the analysis of the available statistical information, the following issues are worth noting. The countries bordering the Black Sea had a total production of wheat and wheat products of 138,544 thousand tons in the year 2019, representing 18.1% of the world wheat production, up by 1.4 percentage points compared to 2015. Russia ranks first, with the greatest wheat production in the year 2019 (53.7% of total production obtained in the six riparian countries bordering the Black Sea), followed by Ukraine (20.5%) and Turkey (13.7%); Romania ranks fourth, with 7.4% of total production (Table no. 1).

Table no. 1. Evolution of the production of wheat and wheat products (thousand tons)

	2015	2016	2017	2018	2019
Black Sea riparian states					
Bulgaria	5014	5665	6135	5834	6322
Georgia	126	127	98	107	101
Romania	7964	8432	10036	10145	10298
Russia	61786	73346	86003	72136	74453
Turkey	22600	20600	21500	20000	19000
Ukraine	26532	26099	26209	24653	28370
Caspian Sea riparian states					
Azerbaijan	1640	1800	1770	1992	2114
Iran	11542	14609	12723	14521	16819
Kazakhstan	13747	14985	14803	13944	11297
Turkmenistan	1406	1600	1000	1000	1500
Countries with indirect access to the Black Sea					
Austria	1726	1970	1437	1371	1597
Hungary	5331	5603	5246	5246	5378
Serbia	2428	2885	2276	2942	2535
Slovakia	2082	2434	1771	1928	1939
Moldova	922	1293	1251	1163	1147

Source: authors' own calculations based on FAOSTAT data, 2022

In the Caspian Sea Basin, except for Russia that has direct access both to the Black Sea and the Caspian Sea, the other four riparian states bordering the Caspian Sea obtained a total production of wheat and wheat products of 31,730 thousand tons in 2019, accounting for 4.1% of world total production. It should be specified that 53% of the wheat production of these countries was obtained in Iran, a production greater by 45.7% than in 2015. As regards the production of wheat and wheat products obtained in the countries with indirect access to the Black Sea, via the Danube River, it should be noted that in the year 2019, their production cumulated 12,596 thousand tons, accounting for only 1.6% of the world production, down slightly compared to 2015 by 0.1 percentage points. Out of the five countries, Hungary and Serbia obtained no less than 62.8% of the total wheat production of the five countries.

At the level of the balance of resources necessary to cover the domestic demand, determined as the sum of domestic production and imports, it is worth noting that in the investigated period, the share of imports in usable resources varied significantly at the level of each country and mainly across the three basins, on comparative basis. Thus, while in Georgia, for instance, the share of imports in total resources represents more than 80%, up compared to 2015, Ukraine ranks first, with the lowest share of imports, practically covering a significant percentage of its resources from domestic production. As regards the Caspian Sea Basin and the countries with direct access to the Danube, the significant share of imports in Azerbaijan and Austria is worth noting, the remaining countries covering the necessary of their resources mainly by domestic production.

At the level of uses, except for a few states where no relevant information was identified, the share of exports in total uses ranges from 0.11% (Georgia) to 88.09% (Bulgaria), so that in Kazakhstan, wheat exports represent no less than 73.2%, up by about 4 percentage points compared to 2015. In the countries with indirect access to the Black Sea via the Danube, it is worth noting a higher capitalization through export of domestic production, with Hungary and Serbia on top positions in the year 2019.

As regards domestic demand, it should be mentioned that the six riparian states bordering the Black Sea had a total domestic demand of wheat and wheat products of 77452 thousand tons, accounting for 10.7% of global domestic demand, down by one percentage point compared to the domestic demand in the year 2015. With the exception of Russia, where domestic demand increased by 3.9%, in the other five countries domestic demand decreased by percentages ranging from -35.2% (Ukraine) to -3.8% (Turkey). In the year 2019, out of the total domestic demand, 55.1% (42675 thousand tons) was intended for food consumption in the six countries, slightly increasing by 1.4 percentage points compared to 2015. By countries, in the year 2019, the quantity of wheat and wheat products for human consumption in total domestic demand ranged from -1.56% (Bulgaria) to 12.75% (Ukraine).

The annual consumption of wheat and wheat products, expressed in kg/capita/year, in the period 2015-2019, is characterized by a decreasing trend, with an oscillation range between -16% (Ukraine) and -2% (Turkey). However, it should be noted that, compared to the annual world consumption per capita, all six Black Sea riparian states significantly exceeded the world average of 65.94 kg/capita/year. The evolution of the domestic demand of wheat and wheat products, of the quantity of domestic demand intended for food consumption as well as of the consumption/per capita/year is summarized in the table below.

In the case of the Caspian Sea riparian states, the same increasing trend can be noticed in the period 2015-2019, in terms of domestic demand, quantity of domestic demand intended for food consumption, as well as annual consumption of wheat and wheat products per capita. Thus, in the reference period, the domestic demand increased by percentages oscillating from 2.4% (Kazakhstan) to 16.5% (Austria). It is worth noting that from the group of the Caspian Sea riparian countries and of those with indirect access to the sea, Iran, Hungary and Slovakia are on a downward trend in terms of annual consumption, domestic demand and food consumption demand.

As regards producer prices, international statistics provides information up to the level of 2020. From this perspective, it can be noticed that the producer price for wheat increased in five of the six Black Sea riparian states by percentages ranging from 0.8% (Romania) to 45.4% (Ukraine), the only exception being Turkey, where the wheat producer price decreased by almost 25 percent in six years. It is also worth noting that Georgia and Ukraine have the highest producer price (over 200 euros/ton), Romania being on the 4th position in the ranking of the six states.

Similarly, to the Black Sea riparian states, there was an increasing trend in wheat producer prices in the Caspian Sea riparian states and in the countries with indirect access to the Black Sea, with different intensities between countries. Except for Azerbaijan, where the price decreased by almost 42 percent, significant price increases were noticed in Iran and Kazakhstan, while in the countries with indirect access to the Black Sea the highest price increase was noticed in Moldova.

Regardless of the geographical location of the analyzed countries, the increase in producer prices can be justified by the high input values, as well as, in some cases, by the extensive farming practices, with low productivity. Producer price is also a relevant indicator by comparison with the average import and export price. From this perspective, from the analysis of available data referring to the trade balance, the following aspects must be highlighted:

- In two of the Black Sea riparian states, namely Georgia and Turkey, there was a decreasing trend in both the imported quantities and the value of imports. In Georgia, the value of imports had a greater decline than the imported quantities, which means a diminution of the average import price, while in Russia the imported quantities decreased by about 53%, while the value of imports decreased by about 13%;
- In the other four Black Sea riparian states, in the period 2015-2020, we can notice a significant increase of imports, in both quantitative and value terms, the most significant increase being noticed in Ukraine, followed at a short distance by Turkey;
- Unlike the Black Sea riparian states, the countries from the Caspian Sea basin had a significant increase of their imports in the six years in Kazakhstan and Turkmenistan, the latter having a particular situation, increasing its imports from 20 tons (2015) to 70278 tons (2020);
- A divergent trend is also specific to countries with indirect access to the Black Sea, via the Danube, where, with the exception of Slovakia and Hungary, wheat imports increased both in quantitative and value terms.
- As regards wheat exports, it is worth noting that these increased significantly, both in quantitative and value terms in most analyzed countries. Georgia is an exception, where both the exported quantities and their value decreased by over 90%, being followed by Moldova and Austria.
- Compared to the Black Sea riparian states, in Turkmenistan wheat exports increased almost three times over the six years and consequently the export value also increased.

Speaking about the economic performance and the better valorization of wheat production through export, we must bring to discussion a comparison between the producer price, the average import and export prices. Thus, for instance, in Romania's case, in the first two years of the reference period, the average import price exceeded the producer price by percentages ranging from 6.3% (2015) to 9.4% (2016), Romania ranking second next to Turkey, where the import price was lower than the producer price by percentages that oscillated between -11.1% (2015) and -20.5% (2016). After 2016, although there was a change in these percentages, Romania has continued to be placed in the first two positions in the ranking, depending on the year, in terms of average import prices compared to producer prices.

Yet a different situation could be noticed in terms of average export prices, compared to producer prices. From this perspective, for instance, compared to the other riparian states from the Black Sea basin, Romania exported wheat at an average price higher than the producer price by percentages ranging from 16.4% (2016) to 21.5% (2018), being surpassed from this point of view by most other countries. Unlike the Black Sea riparian states, import and export price variation compared to producer price had significant oscillations and intensities, both from year to year and from country to country. Influenced by the exported quantities and by the marketing period of the year, the average import and export prices are significantly higher than producer prices, with the exception of Iran, where these prices are mostly lower than producer prices.

In the context of the above, i.e. of the evolution of producer, import and export prices, their coefficient of variation is also important, as an element of price volatility, as well as of their possible convergence. From this perspective, the existence of a high and increasing coefficient of variation of producer prices is worth mentioning, mainly in the Caspian Sea riparian countries. Compared to producer prices, the variation of import and export prices tend to diminish mainly in the countries from the Black Sea basin, followed by the countries with direct access to the Danube.

The Caspian Sea riparian countries maintain a high variability level, mainly in the case of average export prices, which is also a noticeable trend in the average import prices in the countries with direct access to the Danube (Table no. 2).

Table no. 2. Evolution of the coefficient of variation in the prices of wheat and wheat products in the three analyzed basins (%)

	2015	**2016**	**2017**	**2018**	**2019**	**2019/2015 (percentage points)**
	Producer price					
Black Sea basin	29.9	30.0	23.6	12.2	12.0	-17.9
Caspian Sea basin	82.8	100.1	98.6	89.7	92.9	10.0
Countries with direct access to the Danube	11.4	10.2	11.2	8.9	8.3	-3.1
	Average import price					
Black Sea basin	56.9	85.5	83.9	66.4	14.1	-42.8
Caspian Sea basin	8.4	103.8	88.3	25.1	18.8	10.3
Countries with direct access to the Danube	51.0	66.9	74.2	67.5	53.1	2.1
	Average export price					
Black Sea basin	46.2	48.9	32.8	26.1	25.6	-20.6
Caspian Sea basin	73.4	48.9	72.4	77.2	115.9	42.4
Countries with direct access to the Danube	20.4	24.0	21.1	20.8	16.3	-4.0

Source: authors' own calculations based on FAOSTAT data, 2022

Recent development on the maize market

Next to wheat, maize is one of the essential cereals, ranking second in the world in the year 2020, in terms of cultivated area, with 201,983,645 ha. In the year 2019, the world production of maize and maize products totalled 1,148,688 thousand tons, up by 9.4% compared to its level in 2015. The maize production in the six Black Sea riparian states was 77,861 thousand tons in the year 2020, which represents 6.8% of the world production, up by 1.6 percentage points compared to the production of the year 2015. 86.8% of the total production of 77,861 thousand tons was obtained in three of the six states, namely Ukraine (46.1%), Romania (22.4%) and Russia (18.3%). In dynamics, the production of maize and maize products had a noticeable increasing trend, Romania ranking first with a production increase by 93.2% compared to the year 2015, followed by Bulgaria and Ukraine (Table no. 3).

Table no.3. Evolution of maize production in the period 2015-2019 (thousand tons)

	2015	2016	2017	2018	2019	2019/2015 (%)
	Black Sea riparian states					
Bulgaria	2697	2226	2563	3478	4060	50.5
Georgia	185	244	143	194	207	11.9
Romania	9021	10746	14326	18664	17432	93.2
Russia	13173	15282	13208	11419	14282	8.4
Turkey	6400	6400	5900	5700	6000	-6.3
Ukraine	23328	28075	24669	35801	35880	53.8
	Caspian Sea riparian states					
Azerbaijan	214	224	236	248	284	32.7
Iran	1169	1171	694	607	1400	19.8
Kazakhstan	734	762	785	862	896	22.1
Turkmenistan	51	50	50	40	40	-21.6
	Countries with indirect access to the Black Sea					
Austria	1638	2180	2076	2130	2299	40.4
Hungary	6633	8730	6739	7963	8230	24.1
Serbia	5455	7377	4018	6965	7345	34.6
Slovakia	929	1710	1066	1516	1445	55.5
Moldova	1077	1392	1773	2074	2130	97.8
World total	**1052254**	**1127106**	**1138583**	**1125415**	**1148688**	**9.2**

Source: authors' own calculations based on FAOSTAT data, 2022

The four countries from the Caspian Sea basin, with the exception of Russia, which is included in the Black Sea riparian states, obtained a total production of maize and maize products of 2620 thousand tons in 2019, which represents only 0.23% of the world production, up by 0.02 percentage points from the production of the year 2015. Like in the case of countries from the Black Sea basin, the production of maize and maize products also increased in the Caspian Sea riparian countries, yet the increases were significantly lower, both quantitatively and in percentage, than those in the Black sea riparian countries.

Among the countries with indirect access to the Black Sea via the Danube, Hungary and Serbia hold the first two positions in terms of the production of maize and maize products obtained in 2019. The five countries with indirect access to the Black Sea actually achieved 1.9% of world production, up 0.4 percent from the level of 2015. Although in 2019, Hungary and Serbia held the top two positions in terms of production, in terms of dynamics, Moldova and Slovakia recorded the highest increases in the production of maize and maize products, i.e. by 97.8% (Moldova) and by 55.5% (Slovakia), compared to the level of 2015.

At the level of the balance of resources needed to cover domestic demand, it should be noted that in the investigated period, the share of imports in usable resources varied significantly both at the level of each country, but mainly across the three analyzed basins. Among the countries of the Black Sea basin, Turkey ranks first in terms of supplementing domestic resources through imports, with 42.01% of resources basically coming from imports. The Caspian Sea basin is "dominated" by Iran, where 84% of the internal resources come from imports, this country recording significant peaks in imports in the period 2017-2018.

In terms of uses, the significant share of exports in total uses is worth noting, which reached 97.1% in Russia, followed at short distance by Ukraine, Bulgaria and Romania. The important position held by the Black Sea riparian states in the export of maize and maize products is also strengthened by the valorization of maize production from the countries with access to the Black Sea via the Danube. Actually, the Danube – Black Sea corridor is an asset for Romania not only in terms of foreign trade, but also from the perspective of the Danube river as an import means of transporting grains to Constanța port.

While the production of maize and maize products increased in all investigated countries, with different percentages and intensities, in terms of domestic demand, the quantity intended for food consumption and the annual consumption, the situation is different at the level of each indicator and country. Thus, for instance, in Ukraine the domestic demand decreased by about 37% in the year 2019 compared to 2015, while the domestic demand intended for food consumption increased by no less than 62.9%. By a relatively similar percentage (66.2%), in the year 2019, Ukraine increased its annual consumption of maize and maize products per capita as compared to the year 2015. In Romania, in the period 2015-2019, an increase in all the three indicators could be noticed, the annual consumption of maize and maize products increasing by about one third in the year 2019 compared to the annual consumption in the year 2015. The same tends can be also noticed in the Caspian Sea riparian states; in Turkmenistan, for instance, the annual consumption of maize and maize products increased by 133.3% compared to its level in 2015.

Unlike the Black Sea and Caspian Sea riparian states, in the countries with indirect access to the Black Sea via the Danube, the situation is different. Even though the domestic demand increased, except for Serbia, by percentages ranging from 12.8% (Slovakia) to 61.8% (Hungary), the quantity of maize and maize products and the annual consumption increased very little. Thus, for instance, the annual consumption increased by percentages ranging from 1.6% (Serbia) to 5.4% (Austria).

As an expression of economic efficiency, the producer prices for maize and maize products followed an upward trend in most analyzed countries in the period 2015-2020, with five exceptions, namely Georgia, Turkey, Azerbaijan, Austria and Slovakia. It must be noted that in the year 2020, Romania ranked 2nd among the six Black sea riparian states, with the second highest producer price in maize, namely 190.9 USD/ton, up by 0.6% compared to the price recorded in 2015. Actually, out of the 13 states for which statistical information is available, Romania ranks 4th in terms of the highest producer prices, these being on an upward trend.

As regards the foreign trade in maize, it is worth mentioning that out of the 15 states for which relevant statistical information is available, Turkey had the largest increase in maize exports, both quantitatively and in value, followed by Austria, Moldova, Serbia and Ukraine.Although Romania's maize production is on the rise, the country could not best valorize its production through exports, which increased by only 10.3% (quantitatively and in value) in six years, while imports increased by 92.4% (in quantitative terms) and by 12.1% (in value).

As it has been mentioned before, when we speak about economic performance and better valorization of maize production through exports, we must also refer to a comparison between producer prices, average import prices and average export prices. As a general observation, in the year 2020, the average import prices were clearly higher than producer prices, while the average export prices had higher values than producer prices, with the exception of Iran and Moldova, by percentages oscillating between 0.9% (Ukraine) and 439.1% (Georgia). Romania's maize exports had average prices by 14.4% higher than producer prices in the year 2020, which is a relatively low percentage compared to that of Austria, Turkey, Hungary and Slovakia.

As in the case of wheat, the price variation is significant in the three analyzed basins. In the case of producer price, most variations and increases are found in the countries from the Caspian Sea basin, while the oscillations of average import prices are significant in all three basins, being on an upward trend of volatility again in the Caspian Sea basin. While the variations of producer prices and average import prices are different as intensity and dynamics, the variation of average export prices tend to increase in all three basins, by no less than 41.5 percentage points (the Black Sea) and by 50.4 percentage points (the Caspian Sea) (Table no. 4).

Table no. 4. Evolution of the variation coefficient of prices in maize and maize products in the three analyzed basins (%)

	2015	2016	2017	2018	2019	2019/2015 (percentage points)
	Producer price					
Black Sea basin	25.0	21.3	19.9	14.3	14.1	-11.0
Caspian Sea basin	76.6	97.2	93.3	93.9	97.7	21.1
Countries with direct access to the Danube	6.2	4.9	7.7	10.1	7.8	1.6
	Average import price					
Black Sea basin	104.0	102.9	115.1	91.8	88.1	-15.9
Caspian Sea basin	20.0	127.6	139.0	90.1	61.3	41.4
Countries with direct access to the Danube	97.7	92.8	98.8	79.4	102.1	4.4
	Average export price					
Black Sea basin	67.1	39.9	68.9	69.6	108.6	41.5
Caspian Sea basin	127.0	183.0	134.4	106.0	177.4	50.4
Countries with direct access to the Danube	7.7	39.9	43.7	47.9	55.6	47.9

Source: authors' own calculations based on FAOSTAT data, 2022

CONCLUSIONS

As essential cereals in food consumption, as well as with multiple other uses, given the biological and nutritional characteristics, wheat and maize occupy the first two positions in terms of cultivated area in 2020. Recent international developments bring to the foreground the issue of meeting the necessary domestic consumption needs, from import inclusively, as well as the valorization of domestic production through export in the two groups of cereals. Although on the horizon of the year 2020 there were still no signals about possible bottlenecks of the commodity traffic through the Black Sea, the position and importance of countries from the Black Sea basin in foreign trade should not be overlooked. The Caspian Sea basin also adds to this, Russia being the country with direct access both to the Black Sea and the Caspian Sea. At the same time, the access of some of these countries to the Black Sea via the Danube gives Romania a geostrategic position in the trade with cereals.

Although the production of the two cereals is on an upward trend in the countries that were the object of this study, it should be noted that Romania could not best valorize the obtained production through export, producer prices being much higher than those practiced by other countries. It is also worth noting the high consumption of the two cereals, which generally continues to increase year by year, with a few exceptions.

In the context of the above, we consider that the two types of cereals will continue to play an important role in the agriculture of the Black Sea and Caspian Sea riparian states, as well as in the agriculture of countries with indirect access to the Black Sea, through the Danube. Although the only maritime port in Romania is the port of Constanța, we consider that it can ensure the commercialization of wheat and maize from the Black Sea riparian states, through an optimization of the port activity, in compliance with the legal provisions from the Customs Code or other legal regulations applicable to non-EU states.

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INTERNATIONAL TRADE OF CEREALS: THE CONTRIBUTION OF ROMANIA

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Abstract: *Benefiting from pedoclimatic conditions favorable to grain cultivation, Romania was an important player in international trades. In the context of the current geopolitical changes, the paper aims to identify the position occupied by Romania in the global trade of maize and wheat in the period 2017-2021. For this purpose, exports and imports of maize and wheat by quantity and value were analysed on the basis of statistical data available on speciality sites such as ITC. Thus, we note that in 2021, Romania ranked 5th in the ranking of corn exporters, in terms of quantity and 9th in terms of wheat exporters. The quantities and values recorded for the imports of maize and wheat indicated that Romania was not in the top positions in the world rankings, although there was an increasing trend in these indicators during the period under study.*

Keywords: *cereals trade, maize, wheat, imports, exports, Romania*

JEL classification: Q11, Q13, Q17

INTRODUCTION

The paper presents Romania's contribution to the international trade of cereals (wheat and maize) in the reference period 2017-2021, precisely to highlight whether there have been changes in the context of climate change that have led to variations in the yields obtained on the analyzed crops.

The agricultural sector makes a significant contribution to the Romanian economy, especially when considering its share in the national gross domestic product. Moreover, this industry plays a key role in Romania's international trade and acts as one of the pillars in ensuring food security nationally, as well as in the EU and other countries (Constantin M et al., 2022).

In Romania's external cereal trade, the main items are wheat and maize, with over 40% weight for both exports and imports (Pânzaru R.L. et al., 2018). The structure of Romanian crops or crop production is dominated by cereal production. (Voicilaș M., 2014). Wheat is one of the most important plants grown in the world, with a great deal of food. As a result of its importance, wheat is cultivated on all continents (Smedescu D. et al., 2018).

The international trade with cereals is running by means of the activities carried out by the main "market actors": producers, exporters and importers in the context of the continuous of cereals demand and consumption (Popescu A. et al., 2018). A study conducted for the period 2007-2016

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highlights that Romania exported 11 times more maize and 34 times more wheat during the last decade. Also, it imported less maize but more wheat mainly for re-export (Popescu A., 2018).

Climate change affects global land area and agricultural production in a variety of ways, including differences in annual rainfall, average temperature, heat waves, CO_2 emissions, etc. (Jannat A. et al., 2022).

MATERIALS AND METHODS

In this paper, the bibliographic method is used and the world grain trade is analyzed, highlighting the main importers and exporters of corn and wheat, in terms of quantity and value. Thus, the position occupied by Romania in this ranking is also identified.

The period covered by the study was 2017–2021, and the analyzed indicators, which were processed based on statistical data taken from the International Trade Centre (ITC) website, were: the quantities of maize and wheat exported and imported by Romania, as well as the exports and value imports recorded for these cereals, compared to the main countries involved in the global trade in cereals.

An important element in this analysis is the interpretation of the data represented in tabular and graphical form. Thereby it is presented a clearer overview of the trade flows by year, by product and by quantity that allows us to analyse in detail the main challenges and opportunities.

RESULTS AND DISSCUSION

Figure 1 presents the main exporters of maize worldwide. We note the ranking on the first position of US of America, with a value of maize exports of 19,112,373 thousand $, in 2021, increasing in comparison to 2017. Argentina ranks second with 9,064,172 thousand $. Among the most important exporters were Ukraine, Brazil, UAE and France.

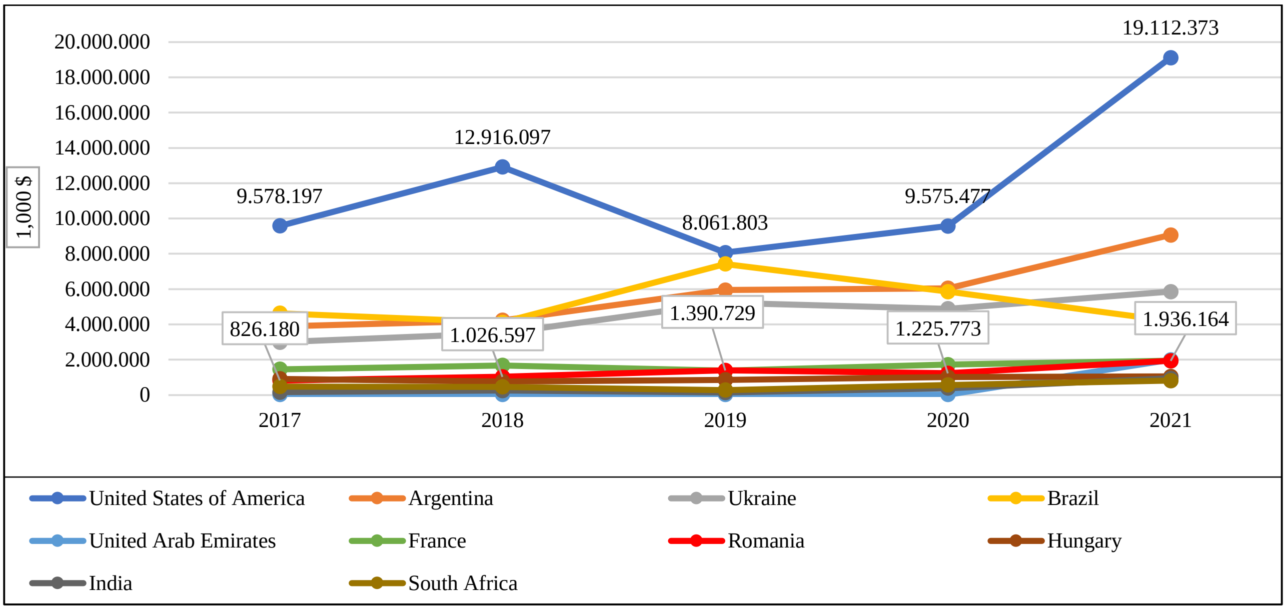

Fig. 1 World's Leading Maize Exporters (1,000 $)

Source: ITC

Romania ranked 7th in 2021, with an export value of 1,936,164 thousand $. In the period 2017-2021, the value exports of corn in our country increased by 234.35%. Romania was the second EU country in this top.

In the ranking of quantitative maize exports, the US of America ranked first, registering 70,042,258 tons in 2021 and an increasing trend compared to 2017. It was followed by Argentina (39,947,476 tons), Ukraine and Brazil (Figure 2).

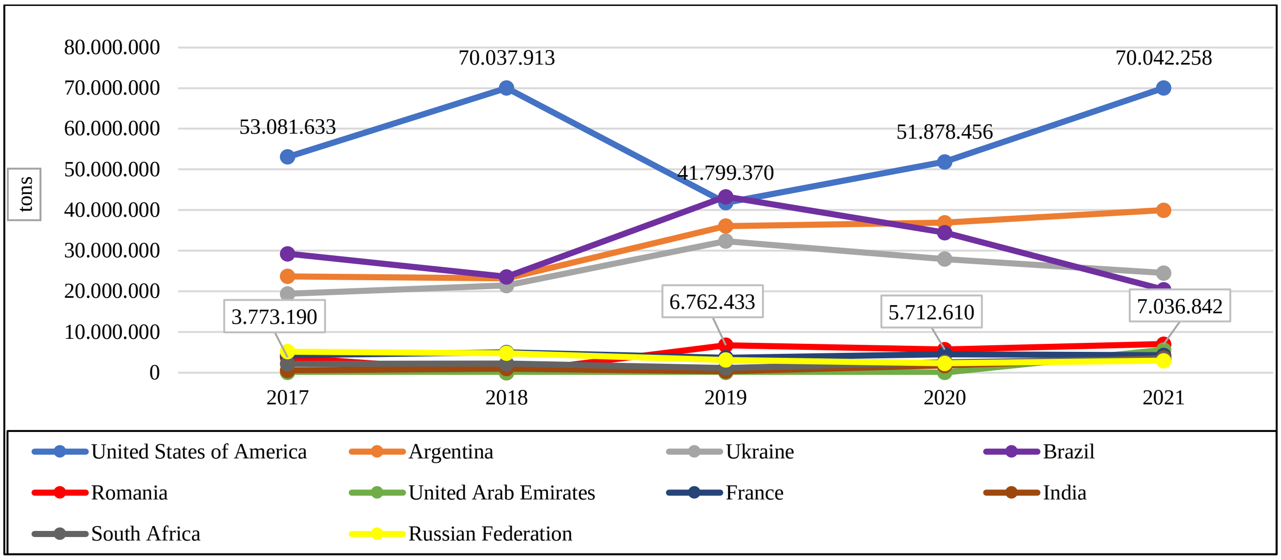

Fig. 2 Main global maize exporters (tons)

Source: ITC

In terms of quantity exports of maize, Romania ranked 5th, with 7,036,842 tons, ahead of established exporters such as UAE and France. We can notice an increase in the quantities of maize exported for the period 2017-2021, by 186.5%, but they are about 10 times lower than the exports of US of America. At the same time, we must mention that for 2018 there are no available data on the quantity exports of maize of Romania on the ITC website.

In the top value exporters of wheat, in 2021, could be found the Russian Federation, with 7,301,689 thousand $, closely followed by US of America and Australia (Figure 3).

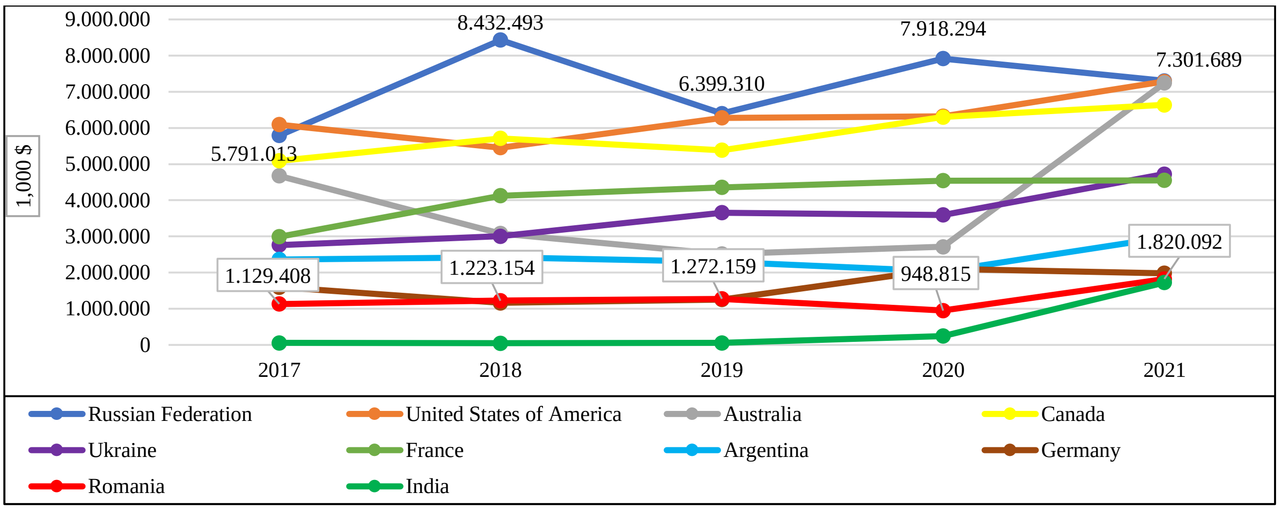

Fig. 3 Main wheat exporters worldwide (1,000 $)

Source: ITC

The 9th place was occupied by Romania, which recorded an export value of 1,820,092 thousand $. Romania was the third EU country in this top, after France and Germany. Value exports of wheat increased by 161.15% between 2017 and 2021.

Romania also ranked 9th in terms of quantitative wheat exports, with 6,941,076 tons (Figure 4). Their increase for the period 2017-2021 was of 118.69%.

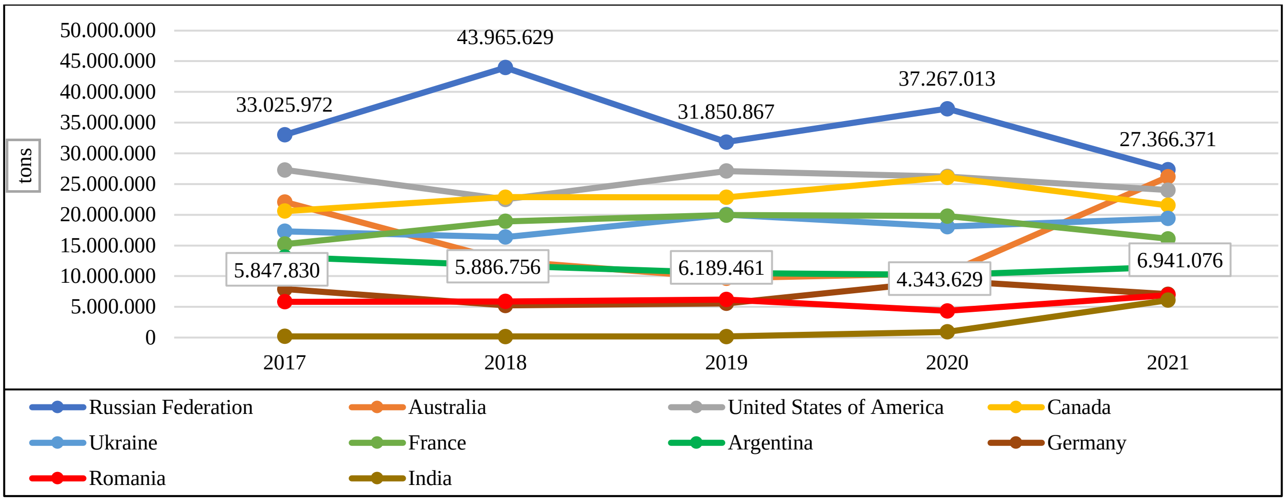

Fig. 4 Main wheat exporters worldwide (tons)

Source: ITC

The three largest exporters of wheat in 2021 were: the Russian Federation, 27,366,371 tons, Australia and the US of America. If the value exports of the Russian Federation registered increases, the quantitative exports decreased by 17.14%.

Figure 5 shows the main importers of maize worldwide, in terms of value, which were, in order, China, Mexico and Japan. There is a 13-fold increase in Chinese imports in 2021 compared to 2017. Spain and the Netherlands were the EU member states in this top, which ranked 8th and 10th.

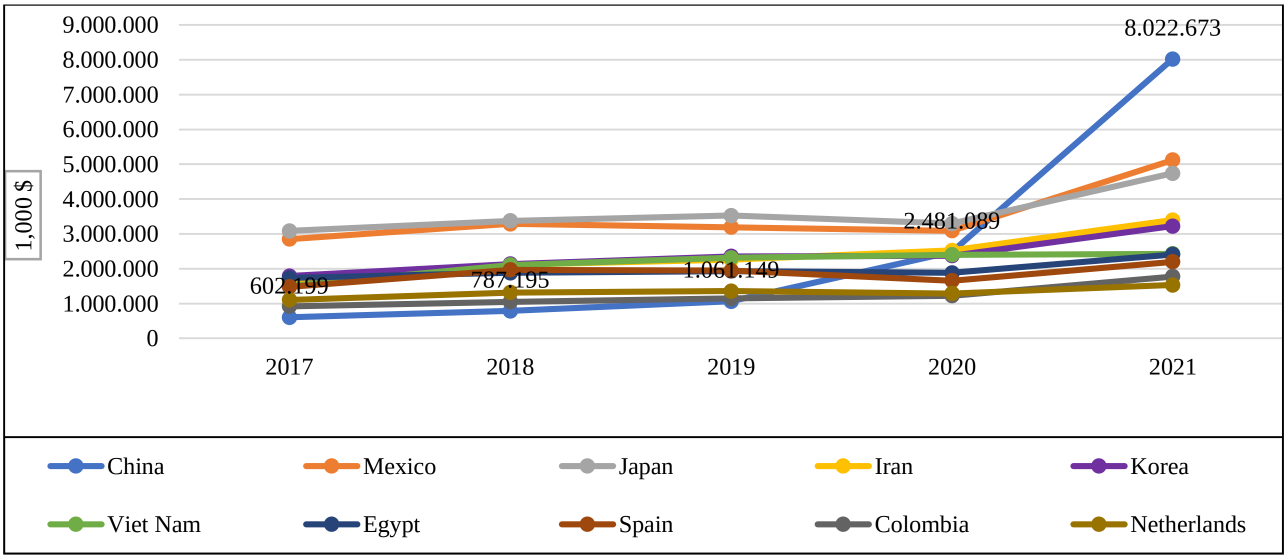

Fig. 5 Major Importers of Corn Worldwide (1,000 $)

Source: ITC

Trinidad and Tobago imported the largest quantity of maize in the analyzed period, which reached 83,433,259 tons in 2021. Other major importers were: China, Japan, Korea and Viet Nam (Figure 6). Among the EU member states, Spain was the first country in the top and ranked 7th.

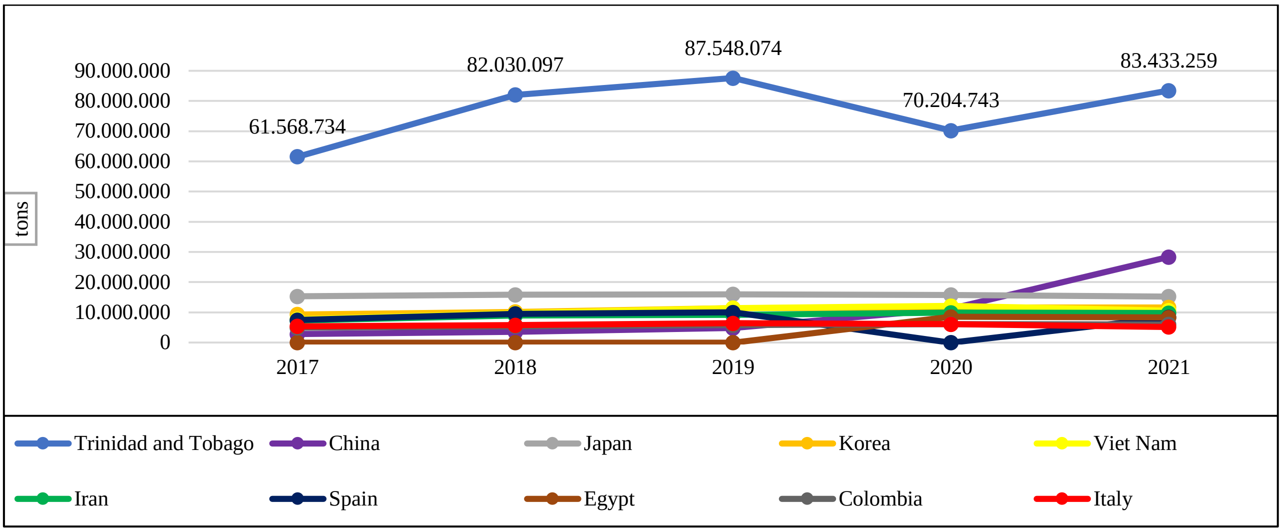

Fig. 6 Main importers of maize worldwide (tons)

Being an important exporter of corn, Romania was not in a leading position in the category of imports. Thus, it occupied the 30th position, recording in 2021 imports of wheat amounting to 361,254 thousand $ (Figure 7 A). Compared to 2017, imports registered an upward trend, with an increase of 252.68%.

The data available for the period 2017-2020 also showed that the quantities of maize imported by Romania increased, from 463,117 tons in 2017 to 1,338,839 tons in 2020, which placed it on the 198th place (Figure 7 B).

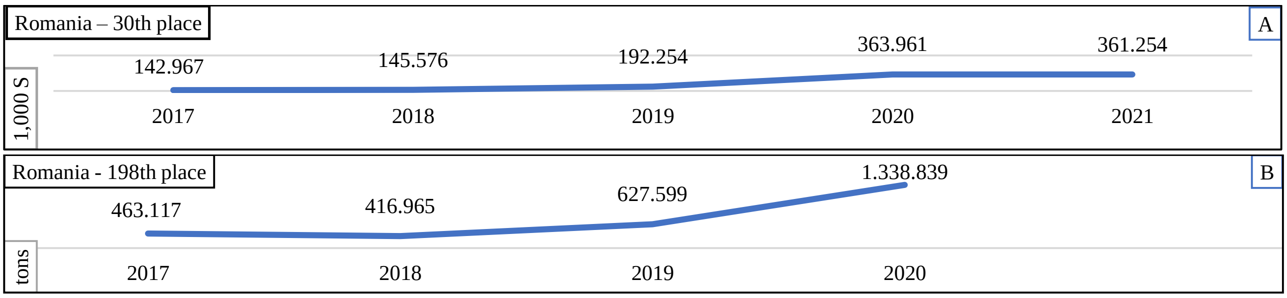

Fig. 7 A. Value imports of maize for Romania (1,000 $);
B. Quantitative imports of maize for Romania (tons)

From the analysis of the data presented in Figure 8 results that Indonesia was the main importer of wheat worldwide, registering a value of 3,548,356 thousand $ in 2021, being followed by China and Nigeria. Italy was the first of the EU countries in the top and ranked 8th.

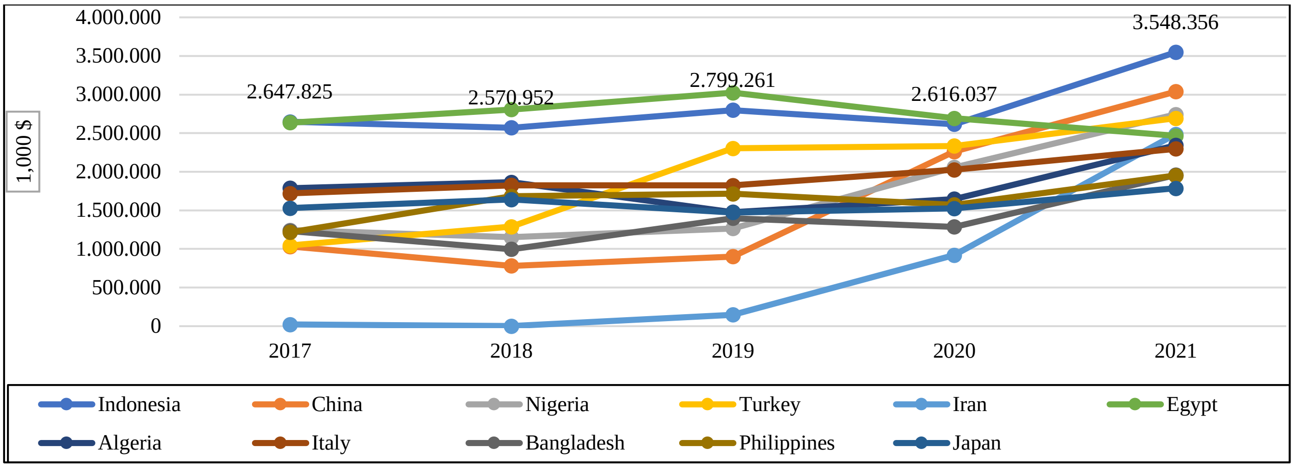

Fig. 8 Major Importers of Wheat Worldwide (1,000 $)

Source: ITC

Romania ranked 50th, with wheat imports amounting to 257,186 thousand $ in 2021, with an increase of 112.23% compared to 2017 (Figure 9).

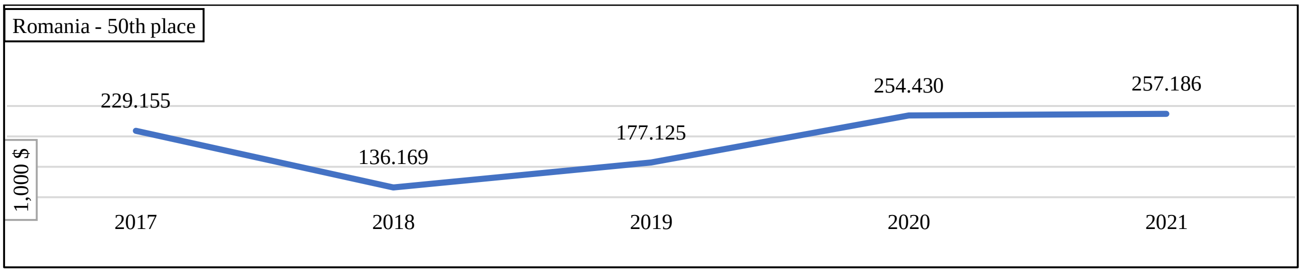

Fig. 9 Romania's Wheat Value Imports (1,000 $)

Source: ITC

Quantitative imports of wheat worldwide are shown in Table 1. Burkina Faso ranked first in 2021 and recorded the largest increases in wheat imports. It was followed by Indonesia and China.

For Romania were presented data available until 2019, which placed it on the 186th place.

Table 1 Main wheat importers worldwide

(tons)

	Importers	**2017**	**2018**	**2019**	**2020**	**2021**	**2021/2017 %**
1	Burkina Faso	159,605	150,829	132,741	149,874,175	199,012,216	124,690.46
2	Indonesia	11,434,134	10,096,299	10,692,978	10,299,699	11,481,354	100.41
3	China	4,296,486	2,876,127	3,204,806	8,151,217	9,711,384	226.03
4	Turkey	4,990,864	5,781,059	10,008,146	9,659,191	8,877,309	177.87
5	Italy	7,430,202	7,453,384	7,368,558	-	7,298,494	98.23
6	Bangladesh	6,639,761	4,839,307	6,879,079	6,027,570	7,152,727	107.73
7	Iran	73,862	360	548,621	3,284,650	7,075,228	9,578.98
8	Brazil	6,022,221	6,817,138	6,575,607	6,159,925	6,225,072	103.37
9	Philippines	5,294,054	6,695,010	6,647,558	6,138,664	6,036,242	114.02
10	Japan	5,705,950	5,652,151	5,331,434	5,373,855	5,126,074	89.84
…	…						
186	Romania	1,249,985	695,333	880,290	-	-	-

Source: ITC

The quantities of wheat imported by Romania varied, but after the decrease in 2018, there was a slight increase in the following period.

The above data show relatively clearly the areas of interest for Romanian exporters – Asian and African states that are major consumers and importers of cereals. Competition is also represented in particular but not limited to countries such as Ukraine, the Russian Federation, Germany etc., in general states with strong agriculture. We thus have a series of highlights on the areas where we need to focus our attention and the competitors.

AKNOWLEDGMENTS

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CONCLUSIONS

Given the geopolitical instability in the last period, Romania must take advantage of its position in the grain trade, especially with maize and wheat.

We are dealing with a window of opportunity that must ultimately lead both to the consolidation of its position on the international market and especially to the consolidation of its own food security. Romania is currently facing difficult choices that need to be made in order to be in a position to choose and not to be put on an undesirable path.

To this end, the funds available at European level must be used to their fullest potential in order to catch up with other European countries. Massive investment is required in both new technologies and the development and retention of the relevant agricultural workforce.

At the same time, the importance of infrastructure emerged. We are talking on the one hand about the infrastructure necessary for the safe storage of cereal products and in the desired quantities and volumes. On the other hand, the conflict in Ukraine has demonstrated the need for a functioning transport infrastructure, capable of taking over large volumes quickly and resilient in the face of various shocks.

One final conclusion concerns the importance of an active diplomatic network to support the grain trade. We need an active network of agricultural attachés and diplomats who actively support trade in agricultural products of all kinds and who are able to create the necessary economic alliances.

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EVOLUTION OF THE CEREALS MARKET IN ROMANIA IN THE PERIOD 2017-2021

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Abstract: *The paper presents the evolution of the market for the main cereal crops (wheat, corn, barley) at the national level in the period 2017-2021. These cereals, as well as others, constitute one of the groups of food carriers that occupy the largest share of the total food consumed, representing for the population the basic food present in the daily meals in different forms. In this study I proposed to analyze statistical data regarding cultivated areas, production, prices, consumption, import, export, the particularities of this market and based on I will draw a series of conclusions from them. The research method used in the study is statistical processing, economic analysis, but also the calculation of certain indicators based on the official data available on specialized websites. Due to the pedoclimatic conditions, Romania is considered a cereal country. Statistical data show that in 2021 Romania was the second largest exporter of cereals in the EU, the first place being corn.*

Keywords*:* *grain market, consumption, evolution.*

Clasificare JEL*:* Q11, Q13, L11

INTRODUCTION

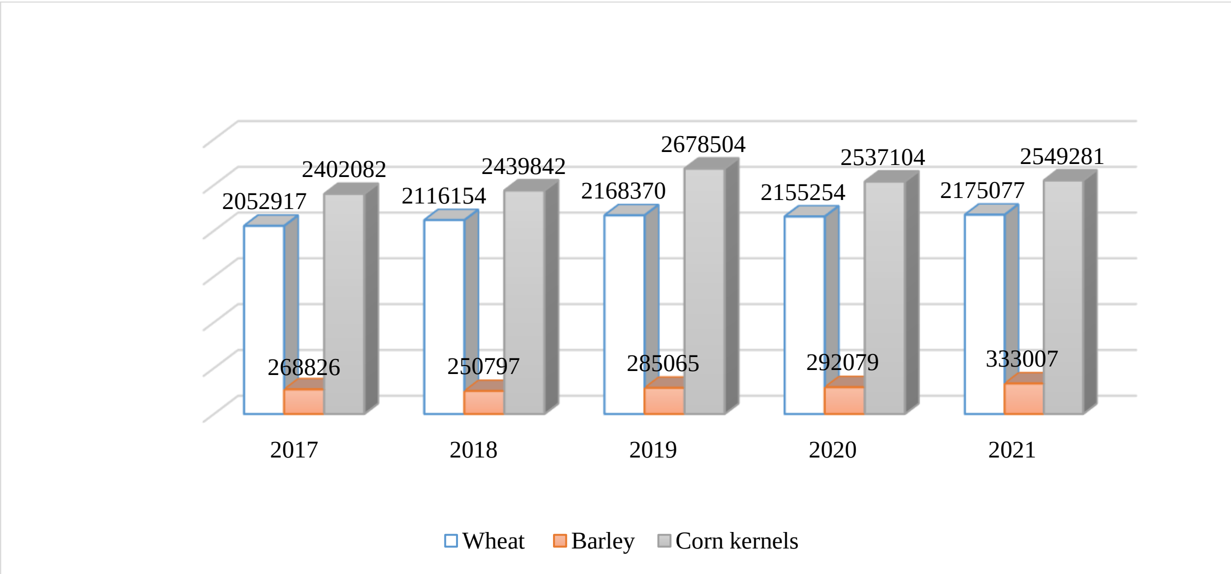
In this paper I proposed to study more closely the cereal market, over the last five years, analyzing the existing statistical data, regarding productions (wheat, corn, barley), cultivated areas (wheat, corn, barley,) consumption, prices, import, the export, the particularities of this market but also the conclusions that are the basis of this study. Cereals are seasonal agricultural products, which can be stored and preserved for periods longer than one year(Ion Raluca Andreea, 2005). For this reason, but also because of its food qualities, wheat is considered a product strategically, for national reserves(SWOT-Analysis-National-Strategic-Plan-2021-2027,MADR). The main cereal crops characteristic of our country are the following: wheat, corn and barley, this being the main reason why I chose to analyze these crops. These cereals, along with others, represent one of the groups of food carriers that make up the largest percentage of the total the food consumed, which provides the population with basic food (Constantin Maria, 2007).

MATERIAL AND METHOD

The research method used in the study is the statistical processing and economic analysis of official statistical data such as INS, MADR, but also websites, specialized magazines. Based on these data, comparative analyzes of the cereal market at the national level were carried out.

RESULTS AND DISCUSSION

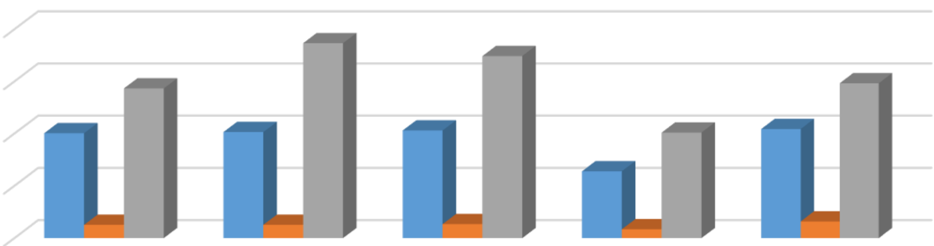
At the national level, in 2021, the cultivated area of wheat registered an increase of 5.95% compared to 2017, when a cultivated area of 2,052,917 hectares was recorded. For the barley crop, the cultivated area in the last year of study had an increase of 23.87% compared to 2017 where a cultivated area of 268,826 hectares was recorded. The area cultivated with grain corn had an increase of 6.13% compared to 2017 when a cultivated area of 2,402,082 hectares of grain corn was recorded.



Graphic 1. Surface cultivated

Source: National Institute of Statistics data processing

Graph no. 2 shows the total production of cereals (wheat, barley, grain corn) at the national level over a period of five years. An increase in the wheat crop in 2021 of 3.97% compared to 2017 was recorded In the barley crop, an increase of 25.33% was recorded in the last study year compared to 2017 when a production of 1,271,734 was recorded. In the grain corn crop, the highest value was recorded in 2018 with a value of 18,663,939 tons and the lowest value in the five years of analysis was recorded in 2017.



	2017	2018	2019	2020	2021
Wheat	10.034.955	10.143.671	10.297.107	6.392.369	10.433.751
Barley	1.271.734	1.276.620	1.340.389	847.241	1.593.802
Corn kernels	14.326.097	18.663.939	17.432.223	10.096.689	14.820.693

Wheat Barley Corn kernels

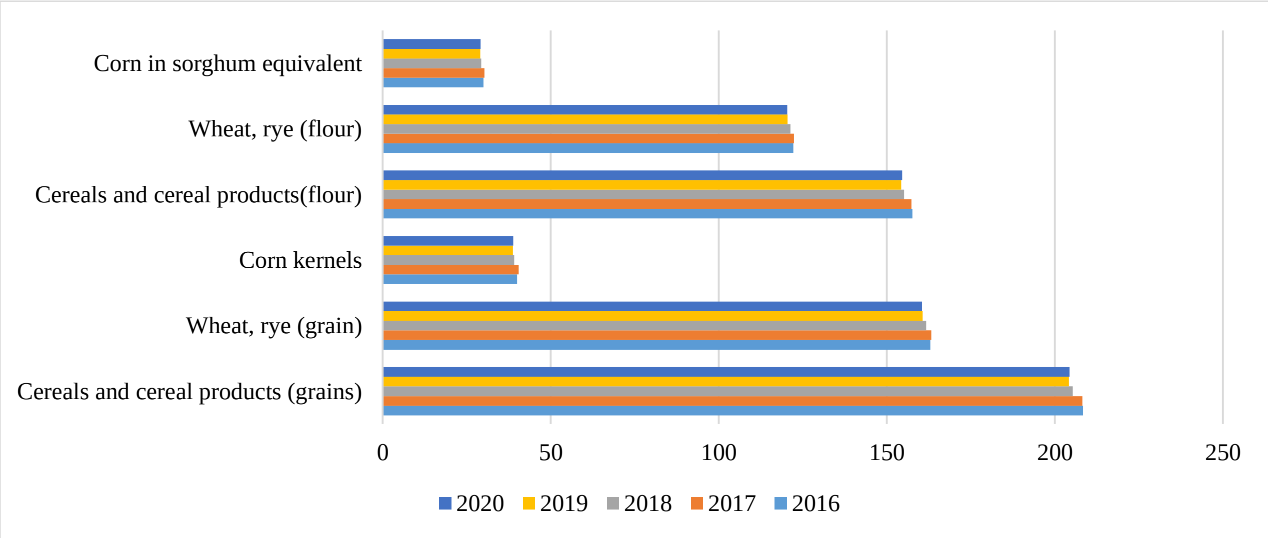
Graphic 2. Total production

Source: National Institute of Statistics data processing

Table 1. Average annual consumption (kg)

The main food products	*Period*				
	2016	*2017*	*2018*	*2019*	*2020*
Cereals and cereal products (grains)	208.4	208.2	205.3	204.2	204.4
Wheat, rye (grain)	163	163.2	161.7	160.7	160.5
Corn kernels	40	40.4	39.1	38.7	38.8
Cereals and cereal products (flour)	157.6	157.3	155.1	154.3	154.6
Wheat, rye (flour)	122.2	122.4	121.3	120.5	120.4
Corn in sorghum equivalent	30	30.3	29.3	29	29.1

Source: National Institute of Statistics data processing

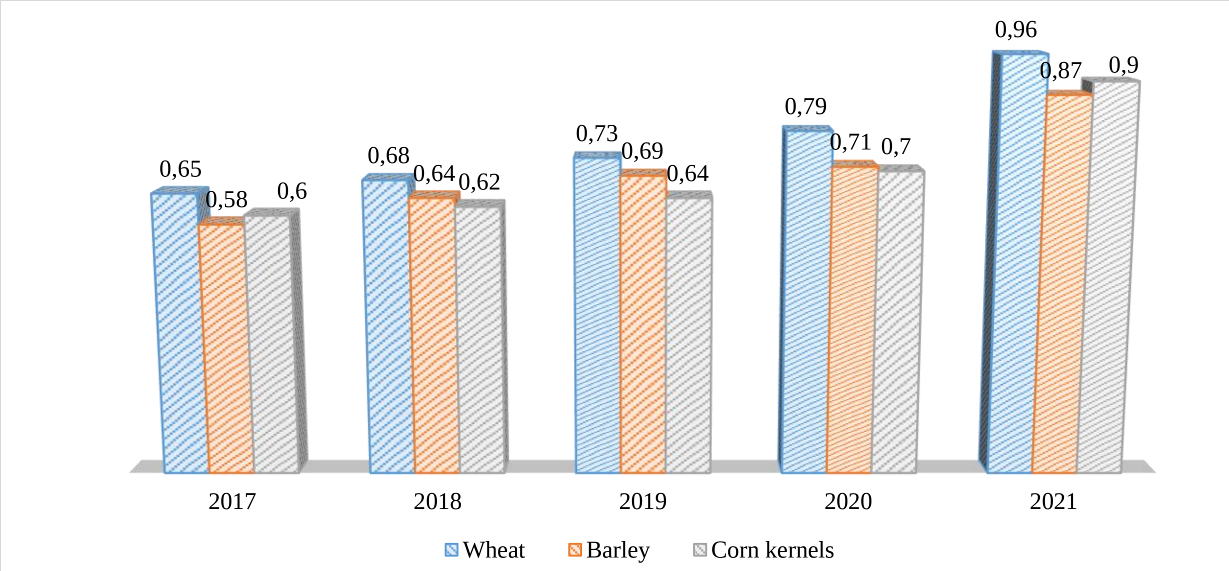


Graphic 3. Average annual consumption

Source: National Institute of Statistics data processing

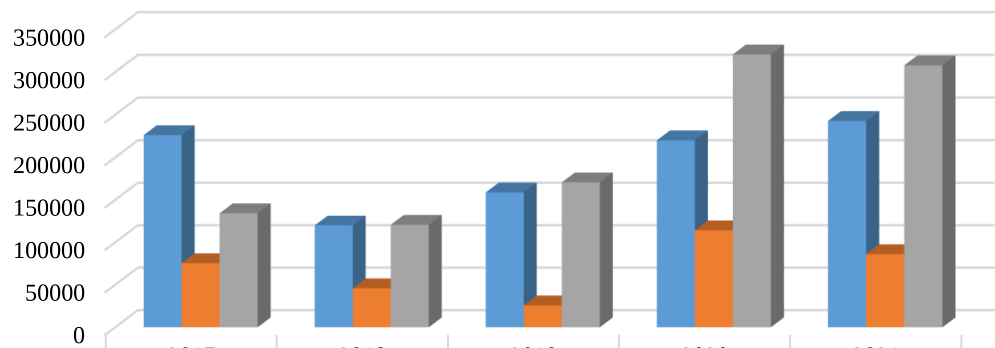
In graph no. 3, the average annual consumption per inhabitant (kg) in the period 2016-2020 is presented. For cereals and cereal products, a maximum of 208.4 kg/year was recorded in 2016 and a minimum of 204.2 kilograms in 2019. For wheat, rye (grains), a maximum of 163.2 kilograms/inhabitant was recorded/year in 2017 and in 2020 a consumption of 160.5 kilograms/inhabitant/year was recorded, the lowest consumption during this period. For grain corn, we have a recorded maximum of 40.4 kilograms/inhabitant/year and a minimum of 38.7 kilograms/inhabitant/year in 2019. For cereals and cereal products (flour), a maximum of 157 was recorded, 6 kilograms/inhabitant/year and a minimum of 154.13 kilograms/inhabitant in 2019. In the wheat, rye (flour) category, a maximum of 122.4 kilograms/inhabitant/year was recorded. In the category of corn in maize equivalent, the average annual consumption reached a maximum of 30.3 kilograms in 2017 and a minimum of 29 kilograms.

Graph no. 4 shows the evolution of prices for wheat, barley and grain corn over a period of five years. The wheat crop had an increasing evolution in 2021 compared to the first year of the study by 47.69%. the barley crop saw a 50% increase in 2021 compared to 2017. For the grain corn crop, the price reached 0.90 lei/kg in 2021 from 0.65 lei/kg in 2017, representing an increase of 50%. A cause of these increases could be due to the very high demand but also to the production costs that have increased a lot in the last period.



Graphic 4. The price of cereals (lei/kg)

Source: National Institute of Statistics data processing



	2017	2018	2019	2020	2021
Wheat and meslin	226144	120020	158953	220088	242702
Barley	75565	45933	25742	114343	86205
Maize	134436	120776	170785	320767	307932

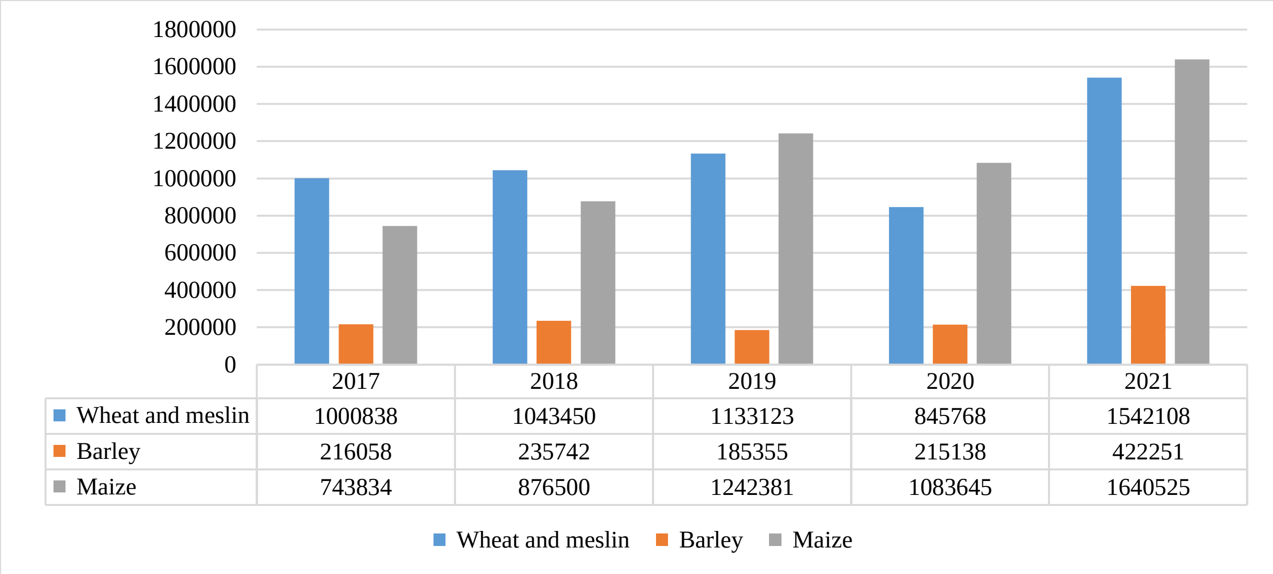
Wheat and meslin Barley Maize

Graphic 5. The value of the import (th. euro)

Source: National Institute of Statistics data processing

In graph no. 5, the import value of wheat and meslin recorded a maximum of 242702 thousand euros in 2021 and a minimum of 120020 thousand euros in 2018, resulting in an increase in 2021 compared to 2018 of 50.55%. Import value barley recorded a maximum of 114,343 thousand euros in 2020 and a minimum of 25,742 thousand euros in 2019. The value of corn imports recorded a maximum of 320,767 thousand euros in 2020 and a minimum of 120,776 thousand euros in 2018.

Graph no. 6 shows the export value in the period 2017-2021. In the wheat and meslin category, the export value reached a maximum of 1542108 thousand euros and a minimum of 845768 thousand euros recorded in 2020. The maximum export value of barley was recorded in 2021 with a value of 422251 thousand euros and the minimum was recorded in 2019 with a value of 185355 thousand euros. The export value of corn recorded a maximum of 1640525 thousand euros in 2021 and a minimum of 743834 thousand euros in year 2017. Analyzing the situation of the national export value, we observe an increase in 2020 for wheat and meslin and in 2021 for barley and corn, this ranking us in the ranking of the largest grain exporters.



	2017	2018	2019	2020	2021
Wheat and meslin	1000838	1043450	1133123	845768	1542108
Barley	216058	235742	185355	215138	422251
Maize	743834	876500	1242381	1083645	1640525

Graphic 6. Export value (th. euro)

Source: National Institute of Statistics data processing

Particularities specific to the grain industry:

a. Cereals are field plants grown for seeds;

b. The most widespread cereals are wheat, corn, barley, oats;

c. Cereal grains are used in human nutrition, animal feed and as a raw material in industry;

d. Cereals are the most important agricultural products subject to international trade;

e. The cereal supply chain can be studied both from the point of view of their economic and nutritional importance, it continues with production, transport, storage, processing, distribution and last but not least, consumption;

f. The grain market is distinguished from other marketing subsystems because of the dynamic relationship between supply and demand.

g. The grain market can be an indication of the pulse of the market, which can anticipate changes and directions of action for the companies in its sphere of influence, but also on the commercial environment.

CONCLUSIONS

The most significant cultivated area was recorded by the grain maize crop in 2019 with a total of 2678504 ha, followed by wheat 21750277 ha (2021) and barley 333007 ha (2021).

The largest agricultural production at the national level in the period 2016-2020 was recorded in the maize crop with a value of 18,663,939 tons (2018), followed by wheat 10,433,751 (2021) and barley 1,593,802 (2021).

Regarding the average annual consumption per inhabitant (kilograms) in the category of cereals and cereal products (grains), we have a maximum recorded in 2016 of 208.4 kilograms and a minimum of 204.2 kilograms in 2019. In the rye wheat category (grains) a maximum of 163.2

kilograms was recorded in 2017 and a minimum of 160.5 kilograms in 2020. In the grain corn category we have a maximum of 40.4 kilograms in the analyzed period and a minimum of 38, 8 kilograms in 2020. In the category of cereals and cereal products (flour), the maximum recorded was in 2016 with a total of 157.6 kilograms and a minimum of 154.3 kilograms in 2019. The average annual consumption per inhabitant in the category of wheat, rye (flour) recorded a maximum of 122.4 kilograms in 2017 and a minimum of 120.4 kilograms in 2020. A maximum of 30.3 kilograms in 2017 was recorded in the maize equivalent category and a minimum of 29 kilograms in 2019.

In terms of price, a maximum of 0.96 lei/kg was recorded in 2021 for wheat and a minimum of 0.65 in 2017. For barley, the maximum value recorded was 0.87 lei/kg in 2021 and the minimum was 0.58 lei/kg in 2017. Grain corn recorded a maximum value of 0.90 lei/kg in 2021 and the minimum was 0.60 lei/kg.

The value of imports at the national level for wheat and meslin recorded a maximum in 2021 with a value of 242702 thousand euros and a minimum of 120020 thousand euros in 2018. For barley, the maximum import value is 114343 thousand euros in 2020 and the minimum had a value of 25742 thousand euros in 2019. For corn, the maximum import value was recorded in 320767 thousand euros in 2020 and a minimum of 120776 thousand euros in 2018.

The export value at the national level for wheat and meslin reached a maximum of 1542108 thousand euros in 2021 and a minimum of 845768 thousand euros in 2020. For barley, the maximum export value was 422251 thousand euros in 2021 and the minimum of had a value of 185355 thousand euros in 2019. In the corn category, the highest export value was recorded in 2021 with a total of 1640525 thousand euros and the lowest value was recorded in 2017 with a total of 743834 thousand euro.

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THE EVOLUTION OF THE ROMANIAN VEGETABLE TRADE IN THE WORLD CONTEXT

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Abstract: *The paper aims to study the reaction of the Romanian vegetable sector to the disruption of trade flows due to the Covid-19 pandemic, analysing the evolution of the trade of the main vegetable products in the last decade in Romania and making comparisons with the most important vegetable producing countries both within the EU and outside the EU. The study also makes a brief analysis of world trade, in which the main trends, its size and perspectives are analysed at global level. Short-term global forecasts anticipate a further increase in vegetable consumption, but at the same time signal many uncertainties related to the evolution of energy and gas prices, as well as the increasingly manifestation of a new actor, namely climate change. In this context, the results reveal that Romania remains a net importer of vegetables. The negative trade balance deepened continuously during the analysed period, the deficit increasing and exceeding 400 million euros in 2019.*

Keywords: *trade context, Romanian vegetable sector*

JEL classification: Q11, Q 17

INTRODUCTION

The change in the way of consumption such as the exponential growth of online deliveries, the difficulties of securing raw material in the processing sector, the limited and restricted operation of the HORECA system, the partial transition of the education system to online system are the major problems generated by the Covid-19 pandemic in the vegetable sector. To these issues from the last years, one can recently notice the significant increase in energy and gas prices, which ultimately led to an increase in the prices of vegetable production.

In the last two years, these important changes have occurred not only in Romania, but also at the level of global food chains. The current situation makes it almost impossible to make short-term forecasts regarding the evolution of this market. In this unfavourable context, it is worth noting the appearance of a new actor on the scene: climate change. The current uncertainty is accentuated by climate change which, by making climate less predictable, prevents the realization of realistic production plans. Since the spring of 2020, the price of oil has increased by 200%, while that of gas by up to 30% only in the second quarter of 2021. Rising energy and gas costs have consequences on both processed output and production costs. This leads to important uncertainties related to the choice of species to be cultivated and the method of cultivation. The experience of some European countries in recent years shows that the organization of agricultural production through producer organizations as well as through interprofessional organizations in certain areas represents an important factor in the stability of primary production, its processing and prices.

MATERIALS AND METHODS

The objective of this paper is to analyse the role of trade in addressing global challenges related to food security and the opportunities to increase vegetable production in Romania.The main indicators used were trade balance, import, export, vegetable production, the degree of coverage of consumption by vegetable species. The data used cover the period 2010-2019 and come from the databases of the National Institute of Statistics, tempo on line and Eurostat.

The paper also reviews the main trends and perspectives of the global trade in vegetables, against the background of the current disruptions generated by the Covid-19 pandemic and the problems caused by the increase in energy prices.

RESULTS AND DISCUSSIONS

Trade can be an important tool in reducing food insecurity and increasing food security at country level. Through imports, trade increases access to a wider variety of food other than that of the local supply, and stabilizes the domestic market by overcoming the shortage or supplementing the domestic supply. Through exports, trade generates income and foreign exchange for exporting countries, improving consumer purchasing power and ability to pay for food imports. On the other hand, trade can expose importing countries to risks from various external shocks, as food price spikes in 2008 and 2012 showed (Morrison and Sarris 2016). The emergence of the COVID-19 virus, the spread of the pandemic around the world and the disruptive consequences on food security, such as the temporary closure of borders, has again illustrated how internationally connected food value chains can be vulnerable (Swinnen and McDermott 2020).

At the same time, trade can exacerbate environmental challenges associated with food production, land use and climate change by promoting intensive production methods (Balogh and Jámbor 2020).

Vegetables play a key role in reducing malnutrition problems through their contribution to improving the nutritional value of the diet (Willett, Rockström et al. 2019). The data show that the level of current vegetable production in many low- and middle-income countries, including Romania, does not cover the consumption needs and it is based on imports. Demand for vegetables is expected to increase in the future as a result of continued population and income growth and increased demand for a more diverse diet (FAO 2020; de Steenhuijsen Piters, Dijkxhoorn et al. 2021). Increased demand indicates production opportunities in countries that already have comparative advantages in vegetable production, but may increase the import dependence of those countries that lack these advantages. There are many studies showing that international trade does indeed promote economic growth, as it allows countries to use their resources more efficiently by specializing in the products and services they can produce most competitively (e.g. Brooks and Matthews 2015; OECD, 2020).

Trade plays a key role in balancing international food surpluses and deficits, trade improves food security (by reducing seasonal effects on food availability) and makes local markets less prone to economic/political or weather shocks. The specialized literature cited above highlights the advantages of trade, and the current analysis aims to analyse to what extent Romania's vegetable trade contributes to the achievement of the objectives presented above: food security, food diversification, source of income and foreign exchange.

The pandemic has led to an increase in the consumption of tomato products throughout Europe. On the other hand, the collapse of available stocks after 2020 caused an increase in imports in the months immediately preceding 2021, but the production of 2021 was sufficient to restore the balance under the conditions of a normal consumption trend. According to market representatives, there is still no indication of how vegetable consumption will reposition itself after the pandemic, as the production of the world's major producers may be sufficient to guarantee adequate coverage of global stocks.

The situation in Romania reveals that the current moment is full of uncertainties. The Romanian vegetable market has actually been a market of uncertainties for more than 30 years, primarily due to the poor organization of producers. 2021 was a good year for Romanian vegetable production, but a large part of this production was not sold because the prices of certain vegetable species were very low, farmers preferring to throw away their production due to the lack of commitments regarding production contracting. Weak organization of vegetable producers and trade relations along the supply chain are the main factors contributing to an unpredictable reaction of this market, and a very reduced ability to adapt/operate according to the European model of market organization. Thus, in Romania, there are only 5 producer organizations that implement Operational Programs (in which less than 1% of vegetable producers are part) and that could have mitigated these disruptions through the implemented market measures.

International vegetable trade, context and forecasts

According to a study by Market Research, the global fruit and vegetable market was estimated at USD 265.6 billion in 2017 and is expected to reach USD 373.5 billion in 2022. The vegetable market can be segmented as follows: fresh produce segment, dried, frozen and processed segments. The processed vegetable products segment accounts for an average of 35% of total revenue and is expected to have the fastest growth in 2018-2023 at 8.3%. Market growth is driven by the important role that vegetables play in the diet as a rich source of vitamins and minerals.

According to the same study, the world's richest countries report that the global market generated a total value of USD 72.8 billion in 2017. The United States is considered to be the world's largest importer of fruit and vegetables, with 13.7% of global imports, followed by Germany with 9.2% and the United Kingdom with 4.2%. China was the world's largest exporter of fruits and vegetables, accounting for 15.3% of global exports, followed by the Netherlands with 10.4% and Spain with 9.3%. China is a major supplier to neighbouring countries such as Vietnam, Thailand, Indonesia, the Philippines and Hong Kong and is known as a major exporter of garlic, grapes, citrus fruits and onions. Important quantities of garlic are exported from China to Romania as well.

Europe holds the largest fruit and vegetable market due to high consumption. Recently, the importance of the frozen segment has increased on the European market. Forecasts by Market Research claim that the Asia-Pacific region will witness the fastest growing fruit and vegetable market in the period 2020-2025, with a growth rate of 4.9%. Mordor Intelligence reports that rising production in China, Japan and India is driving market growth. The same study estimates that more than half of the vegetables consumed worldwide are produced in China. There is a growing demand for the frozen segment and the busy urban lifestyle in the Asia-Pacific region is leading consumers to discourage cooking in favour of quick and easy diets.

Romanian vegetable trade

In the last decade, the total areas cultivated with vegetables decreased from 263 thousand ha in 2010 to 228 thousand ha in 2019 (-14%), the same negative trend being registered by the total production of vegetables, which decreased from 3864 thousand tons to 3529 thousand tons (-18%). The main causes are the reduced ability of farmers to associate, (less than 1% of vegetable producers are part of a farmers' cooperative or a producer group) and meteorological changes, with recent evolution trends towards extreme weather conditions.

Romania's trade in vegetables is negatively influenced by the evolution of the indicators presented above. The negative trade balance continued to increase, with imports increasing annually while exports remain at modest levels. This situation makes it difficult for the processing factories that fail to get raw material from Romania on the one hand, and on the other hand the consumption of the population is not sufficiently covered, which creates a certain vulnerability of food security for this sector. On the other hand, the negative trade balance damages Romania's balance of payments, and although trade can apparently become a source of income and foreign exchange, in the case of Romania's vegetable trade, this does not happen.

Romania's total vegetable imports have increased since 2010 (tomatoes and the so-called "various vegetables" group, which includes, among others, cucumbers, peppers and eggplants, had the largest share, with approximately 22% each). Weak capacity to organize the sector and a fragmented supply chain, higher prices and lower yields compared to the main competitors, as well as the proximity of large producers such as Turkey, have contributed to the increase in the trade deficit in this sector.

Romania is a net importer of vegetables. The negative trade balance has continuously deepened in the period 2010-2019. Although the level of investment and farm support has increased and the areas under protected crops (greenhouses and plastic tunnels) have increased, the national impact in terms of total vegetable production and yields remains low. The competitiveness of the sector, measured by the trade balance indicator did not improve in the period 2010-2019, while the deficit increased and exceeded 400 million euros in 2019 (Figure 1).

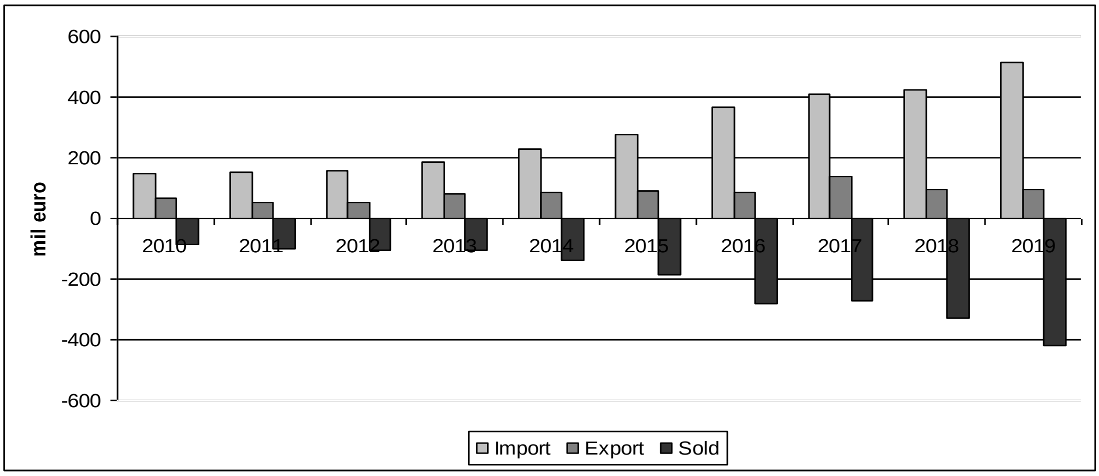

Figure 1. Evolution of the balance of trade in vegetables

Source: calculations on the basis of NIS data, tempo on line

In 2019, according to data provided by the National Institute of Statistics, the largest deficit came from the so-called "various vegetables" group, which includes, among others, peppers and eggplants, (representing about 22% of the deficit), closely followed by tomatoes (21%), cabbages, cauliflowers and collard greens (14%), group 0703 "onions, shallots, garlic, leeks and other allied vegetables, fresh or chilled" with 11%, and group 0707 cucumbers, fresh or chilled , with 7%.

In the period 2010-2019, the value of the total intra-EU import of vegetables increased four times, and the value of total extra-EU imports increased twice. The intra-EU export value is 50%

higher, while the extra-EU export increased by 88%. The deficit of the trade balance deteriorated continuously, reaching -301 million euros in the intra-EU trade relationship and -120 million euros in the extra-EU trade relationship. At the level of 2019, Romania reached a historical maximum of the deterioration of the trade balance for total EU and non-EU, this being -421 million euros (figure 1).

Tomatoes

Import of tomatoes from the EU increased in value terms, by 691% in 2019 compared to the base year 2010, but remained almost constant on the extra-Community relationship (+0.5%). The value of tomato exports to the EU decreased by 50% between 2019 and 2010, but increased by 61% in the extra-EU area. Overall, Romania imported very large quantities of tomatoes mainly from the EU; in 2019 the value of tomato imports from the EU was 55 million euros, and the value of tomato imports from the extra-EU area was 38.3 million euros, which led to a negative balance of 93.3 million euros. As regards exports, they are very modest both in terms of quantity and value.

According to calculations based on statistical data provided by Eurostat, in 2019, in value terms, the main EU states supplying tomatoes to Romania were the Netherlands and Spain (with 23% each) and Italy (with 14%). It can be mentioned that the export structure underwent significant changes in the period 2010-2019, in the sense that, while in 2010 the share of exports in the EU area prevailed, it decreased significantly in 2019, but the share to extra-Community destinations increased.

From the non-EU area, Romania imports 88% of the amount of tomatoes from Turkey, whose value share represents 92%.

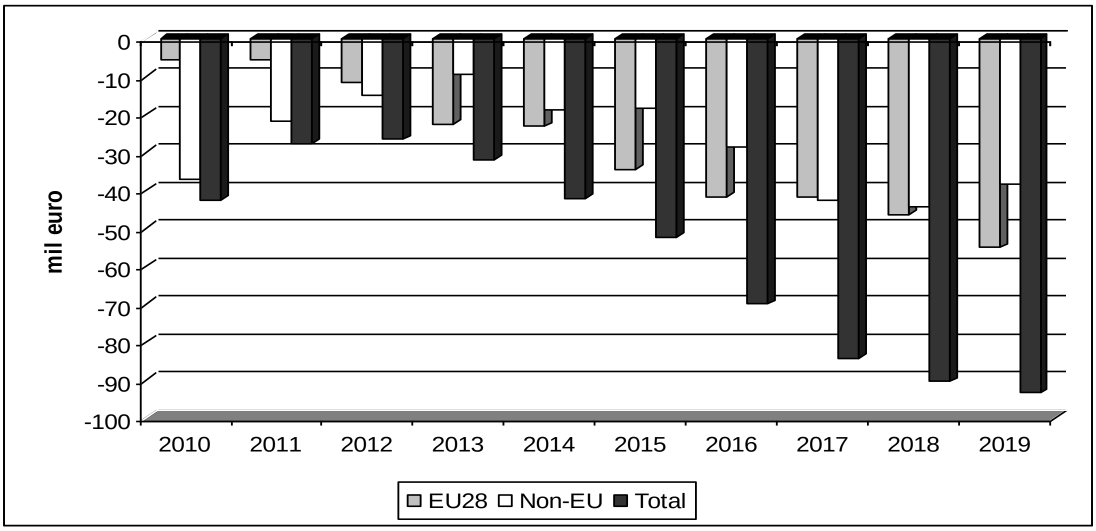

Figure 2. Balance of trade in tomatoes per total EU and non-EU, mil. euros

Source: calculations based on Eurostat data, 2021

Various vegetables

The group of various vegetables includes the following species: peppers, cucumbers, eggplants, cauliflowers. In the period 2010-2019, the value of the EU import of species belonging to the "various vegetables" group increased by almost five times, and the extra-Community import by almost seven times. The intra-EU export value increased by 55% in 2019 compared to 2010, while the extra-EU export increased by 357%. It is worth noting a reorientation of the export of various vegetables to destinations outside the EU, while imports have increased massively from both areas, both from the EU and non-EU areas. The trade deficit increased continuously, reaching -25.3 million euros with EU countries and -31.6 million euros with extra-EU countries. In 2019, Romania reached the largest trade balance deficit for EU and non-EU total, respectively -56.9 million euros.

The largest imports of vegetables belonging to the "various vegetables" group from the intra-community space came from Spain (30%), Poland and the Netherlands (18% each), Germany (16%). As far as the extra-EU area is concerned, over 90% of imports came from Turkey.

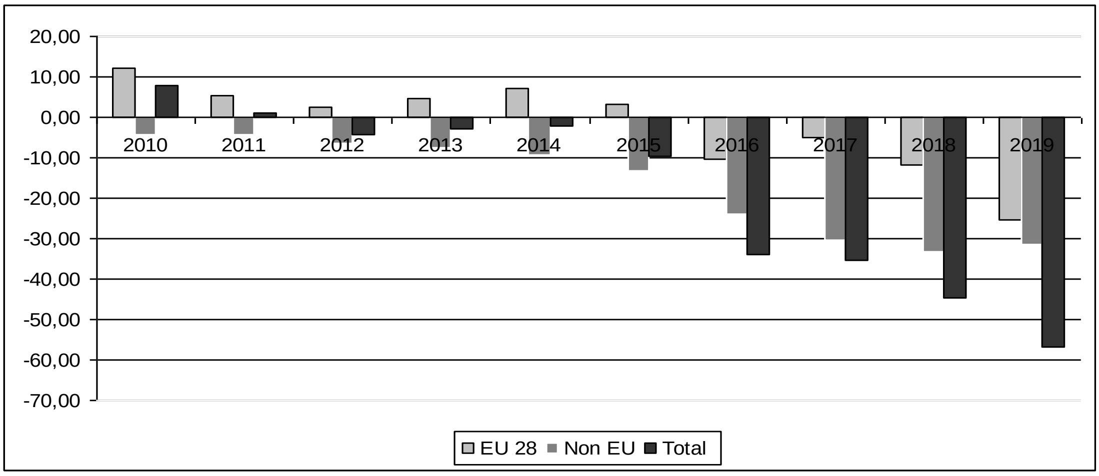

Figure 3. Balance of trade in the group of various vegetables, mil. euros

Source: calculations based on Eurostat data, 2021

The trade balance in the group of various vegetables was negative throughout the investigated period. This reached a historical high in 2019, at almost 60 million euros.

Regarding the cucumbers, an important deterioration of the trade balance occurred in 2017, when Romania's cucumber imports from the EU totalled of over 13 million euros, and 5.3 million euros from non-EU countries, while total exports reached 6.9 million euros, which led to a deficit of -11.9 million euros. In 2019, the trade deficit decreased slightly, to reach -9.8 million euros (Figure 4).

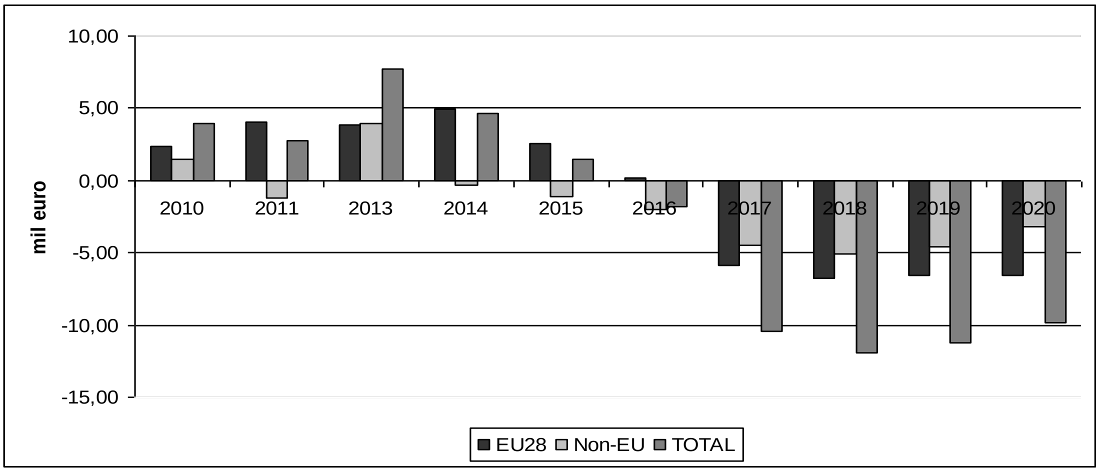

Figure 4. Balance of trade in cucumbers, mil. euros

Source: calculations based on Eurostat data, 2021

The highest share of imports in value terms came from Spain, Greece and Germany. From the non-EU area, over 80% of imports came from Turkey.

CONCLUSIONS

The world market of vegetables has recently experienced a significant growth, on the one hand due to the change in the population's diet, and on the other hand due to the increase in the population's income. Short-term global forecasts anticipate a further increase in vegetable consumption, but at the same time signal out many uncertainties related to the evolution of energy and gas prices, and the increasingly manifestation of a new actor on the scene, namely the climate change.

Although the specialized literature supports the role of trade as a generator of income and economic growth, Romania's trade in vegetables is far from being a generator of income and currency for increasing the country's commercial power. Romania imports significant quantities of vegetables, which causes the worsening of the trade balance. However, imports ensure the coverage of consumption needs and contribute to ensuring a certain food security. However, it must be stated that in light of the latest global events, such as the Covid-19 pandemic, more recently the war in Ukraine, and the increase in energy and gas prices, turning to imports is not a feasible long-term solution.Romania is a net importer of vegetables. The negative trade balance deepened continuously in the investigated period, the deficit increasing and exceeding 400 million euros in 2019.

Regarding the intra-EU import of tomatoes, this increased in value terms, by 691% for the entire analysed period, but remained almost constant in the extra-Community relationship (+0.5%). The largest imports of vegetables belonging to the "various vegetables" group from the intra-EU area came from Spain (30%), Poland and the Netherlands (with 18% each). The evolution of the trade balance in cucumbers was negative during the entire analysed period.

The lack of organization of vegetable producers and the weak production contracting are the main factors that contribute to an unpredictable reaction of this market to various disturbances; therefore, it is necessary to increase the capacity of decision-makers to help organize the market, as well as of farmers to adapt to the European model of market organization. Producer organizations and associations have decisively contributed to the relatively good functioning of this market at European level in this period of crisis.

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AREA AND PRODUCTION ESTIMATES FOR VINEYARDS

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Abstract: *Viticulture is an important activity in Romania, with a tradition since ancient times, it is ideal to cultivate especially for its geographical position and pedo-climatic conditions. In Romania, the area under vines is decreasing between 2015 and 2021, while total grape production is increasing considerably during this period. At EU level, Romania ranks 5th in terms of vineyard area and 6th in terms of total grape production, behind countries such as Italy, Germany, France, Portugal and Spain. Using the Forecast method, it is estimated that in 2030 the area under vines will reach 149 thousand hectares, the optimistic scenario shows that the area will reach 156 thousand hectares and the pessimistic scenario shows that the area will reach 99 thousand hectares. In the case of total grape production, it is estimated that in 2030, Romania will produce 99 thousand tonnes, according to the pessimistic scenario it will reach 1.42 million tonnes, and according to the pessimistic scenario it will reach 400 thousand tonnes.*

Keywords: *estimates, viticulture, Romania*.

JEL classification: Q10, L66, C13.

INTRODUCTION

Romania is suitable for vine growing due to its climate, soil composition and hilly and lowland areas which are suitable for viticulture. This activity dates back to ancient times and is one of the most precious natural riches (Tudor, 2022, Dumitru, 2021).

Viticulture is important for the national economy because vines can be grown on sloping land with sandy, eroded and poorly solidified soil, on which other crops cannot be grown. Grapes are mainly used for making wine and wine distillates, but they are also used in the food industry for making jams, compotes, preserves, juice, raisins, while pips are used for making oil (Lădaru, 2015; Chiurciu, 2020).

A country's wine trade shows the level of competitiveness that can be improved by increasing wine exports and/or the average unit price. From this point of view, Romania is unspecialised in wine exports and measures are needed to propel Romania on the international wine market (Ștefan, 2017; Antoce, 2017).

European funds have played and continue to play an important role in the development of various agricultural sectors, a benefit brought by the accession to the European Union (Sterie, 2021).

As regards measures dedicated to the wine sector, in the period 2009-2013, investments were made for this sector, but only through rural development programmes, and in the period 2014-2018, Romania will adopt measures exclusively for the development of this sector. Among the objectives they have pursued, these have focused on restructuring and respectively transforming vineyards and planting new varieties of higher quality to be certified (Iancu, 2022; Micu 2022).

Climate change plays a key role in the production of wine grapes, their quality is directly influenced and varieties that produce high quality grapes are sensitive to these pedo-climatic changes. Rising temperatures have direct effects on the duration of vegetative development, forced ripening which alters the characteristics of the berries (Micu, 2022; Iancu, 2022).

MATERIALS AND METHODS

The research is based on data provided by the National Institute of Statistics and Eurostat on the area under vines and total grape production in Romania and by development region. The main statistical indicators were calculated on the basis of the data:

- Standard deviation

$$\partial = \sqrt{\frac{\sum(xi - \overline{x})^2}{n-1}}$$

- Coefficient of variation

$$C = \frac{\partial}{\overline{X}} * 100$$

- Growth rate

$$\overline{R} = (I \times 100) - 100$$

Using the FORECAST method in Excel, a forecast was made for the area of vines under vines and total grape production for the next 9 years, based on data recorded from 2000 to 2021. The aim of the work is to identify the annual growth rate and to determine forecasts for the area under vines and total grape production in Romania for the period 2021-2030.

RESULTS AND DISCUSSION

The area under vines in Romania fluctuates between 2015 and 2020, so in 2015 an area of 178.12 thousand hectares was recorded, reaching 165.29 thousand hectares in 2020, showing a decrease of about 2%. The area of vines under vines shows a negative annual rate, 1.21%, and according to the coefficient of variation (3.21%), the data series shows a small variation (Table 1).

Table 1. Area under vines and total grape production 2015-2021

Year	2015	2016	2017	2018	2019	2020	2021	Average	Standard deviation	Coef. of var. (%)	Growth Rate %
Surface (thousands of hectares)	178.12	178.15	177.26	177.50	178.23	167.35	165.55	174.59	6	3.21	-1.21
Total production (thousand tons)	798.77	736.89	1,067.12	1,144.31	977.81	935.96	1,009.19	952.86	144	15.10	3.97

Source: processing based on INS data

As regards the total production of grapes in Romania, an increase of 26.34% can be observed in 2021 (1009.19 thousand tons) compared to the production of vines on the vine recorded in 2015 (798.77 thousand tons). The annual rate in the case of total production is positive (3.97%) and the data series shows a medium variation, according to the coefficient of variation (15.1%) (Table 1).

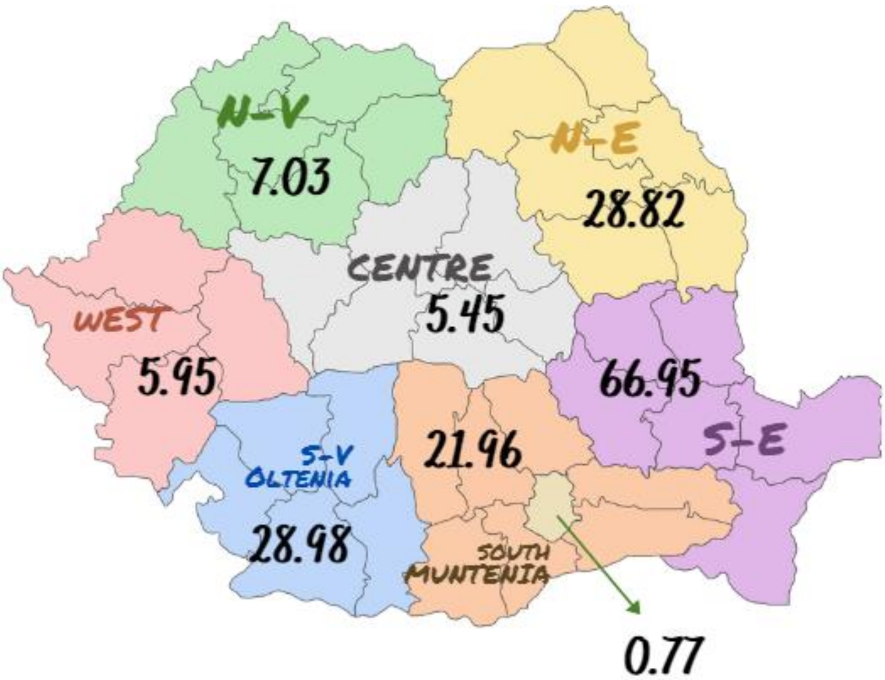

Figure 1. Area under vines by development region in 2021 (thousand hectares)

Source: processing based on INS data

According to the data provided by the National Institute of Statistics, the regions with the largest areas of vines in bearing in 2021 are the South-East with 66.95 thousand hectares, followed by South-West-Oltenia with 28.98 thousand hectares and North-East with 28.82 thousand hectares.

Among the regions with the lowest areas under vines are the West (5.95 thousand hectares), Centre (5.45 thousand hectares), Bucharest-Ilfov (0.77 thousand hectares) (Figure 1).

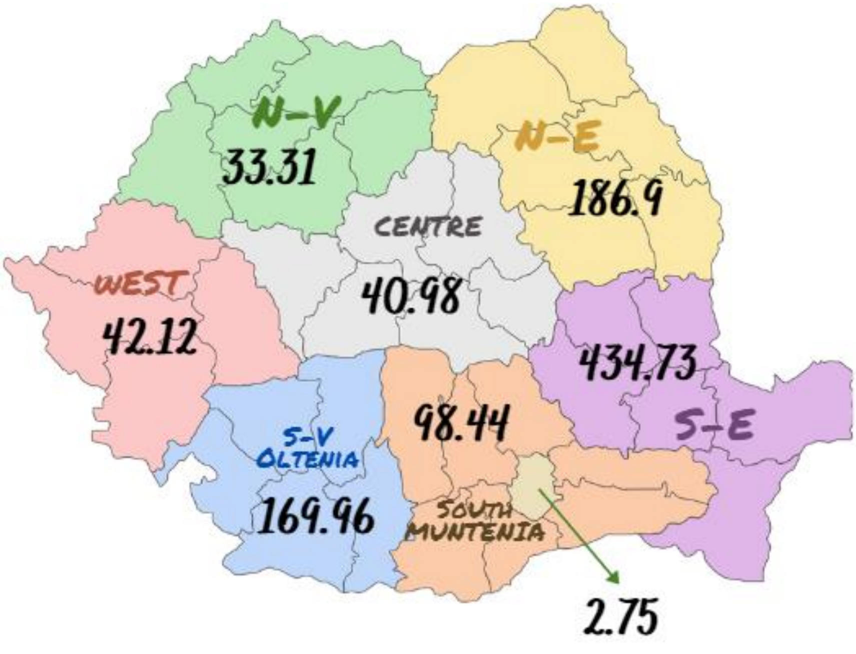

Figure 2. Total grape production by development region in 2021 (thousand tonnes)

Source: processing based on INS data

In the case of total grape production in Romania in 2021, the highest production was recorded in the South-East Region with 434.73 thousand tonnes, followed by the North-East Region with 186.9 thousand tonnes and South-West-Oltenia with 169.96 thousand tonnes (Figure 2).

In 2021, Romania ranked 5th in terms of the area under wine grapes, being overtaken by Spain, which cultivated an area of 912.43 thousand hectares, followed by France (750.39 thousand hectares), Italy (651.28 thousand hectares), Portugal (1763.39 thousand hectares) (Figure 3).

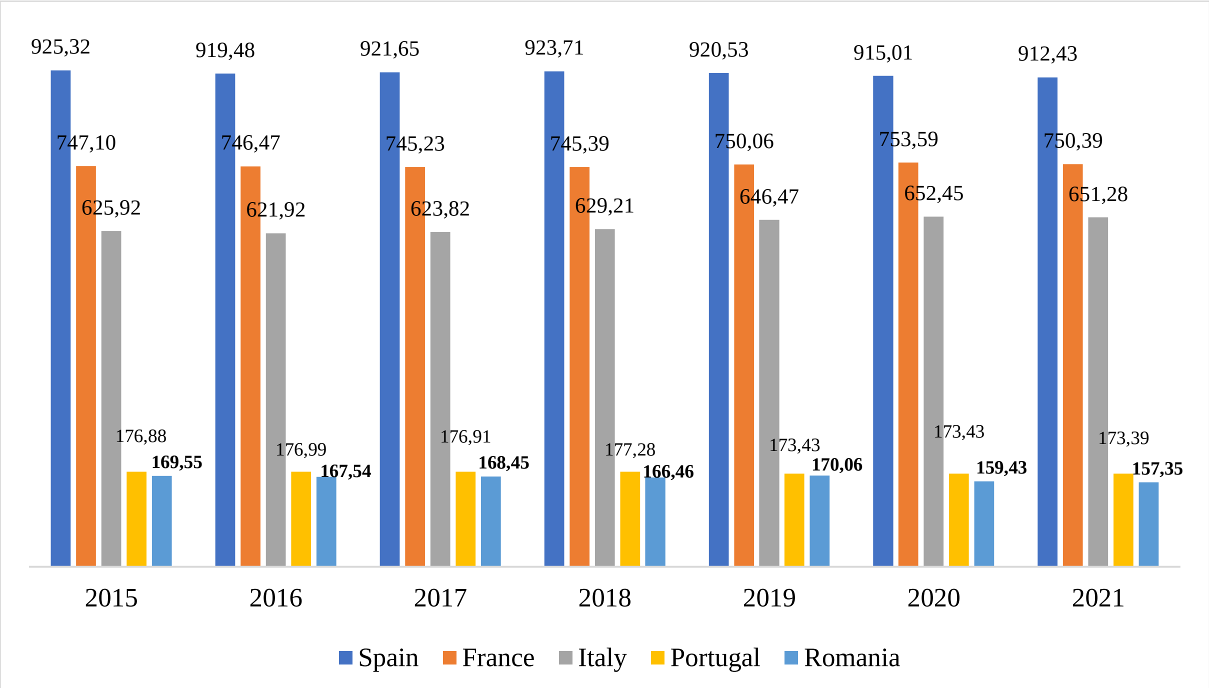

Figure 3. Main countries with the largest area under wine grapes in the EU level (thousands of hectares)

Source: processing based on EUROSTAT data

At the European Union level in the period 2015-2021, Spain ranks at the top of the largest areas cultivated with grapes, with an area of 925.32 thousand hectares in 2015, reaching 912.43 thousand hectares in 2021, showing a slight decrease of 1.4%.

A slight increase of 0.44% and 4%, respectively, compared to the area recorded in 2015 for the two countries is noted for France (750.39 thousand hectares) and Italy (651.28 thousand hectares) in 2021 (Figure 3).

In terms of total wine grape production in 2021, Romania ranks 6th with a total production of 0.95 million tonnes, topped by Italy with a production of 7.11 million tonnes, followed by countries such as Spain with 5.78 million tonnes, France with 4.46 million tonnes , Germany with 1.15 million tonnes and Portugal with 0.96 million tonnes.

Although in the period 2015-2021, the first place in the area under vines on the vine is occupied by Spain, in the case of wine grape production, the first place is occupied by Italy, which in 2015 produced 6.84 million tonnes, reaching in 2021 to produce 7.11 million tonnes, an increase of about 4%. In the case of Germany, although it ranks 6th in terms of area under grapes, in terms of production it ranks 4th in the period 2015-2021, showing a decrease of 4% in 2021 (1.15 million tonnes) compared to 2015 (1.2 million tonnes) (Figure 4).

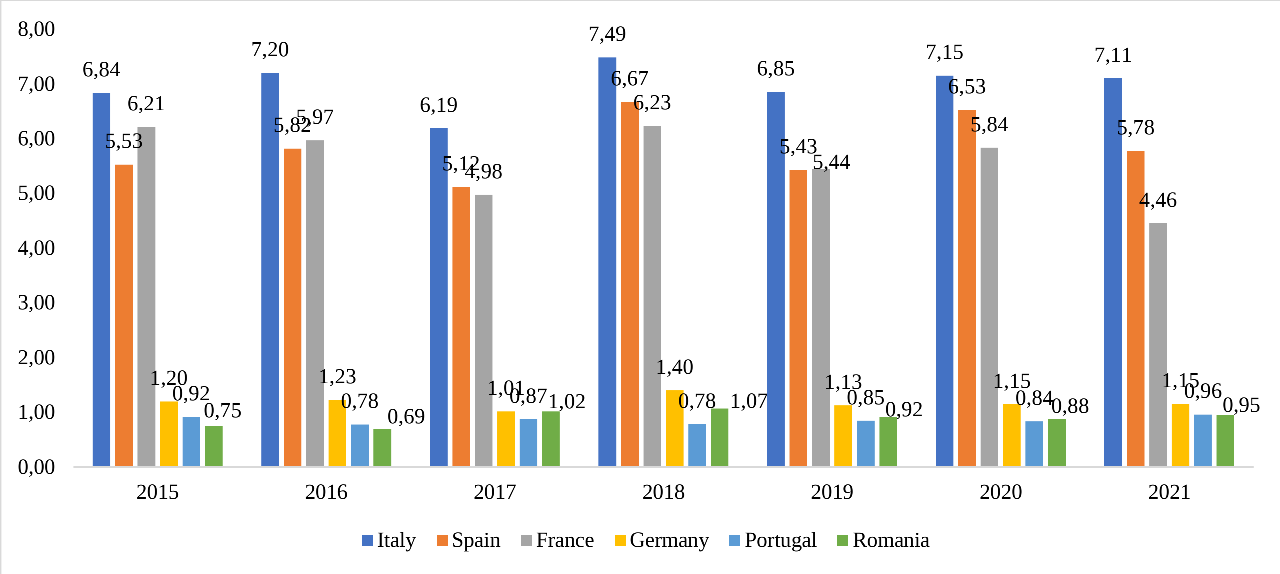

Figure 4. Main countries with the highest production of wine grapes at EU level (million tonnes)

Source: processing based on EUROSTAT data

Using data taken from the INS, a forecast of the area under vines in Romania up to the year 2030 was made. In 2000, an area of 247.5 thousand hectares was recorded, reaching an area of 165.5 thousand hectares in 2021. According to the estimates, the area under vines will reach an area of 149 thousand hectares, and according to the optimistic scenario it will increase to 156 thousand hectares, while the pessimistic scenario will decrease to 99 thousand hectares (Figure 5).

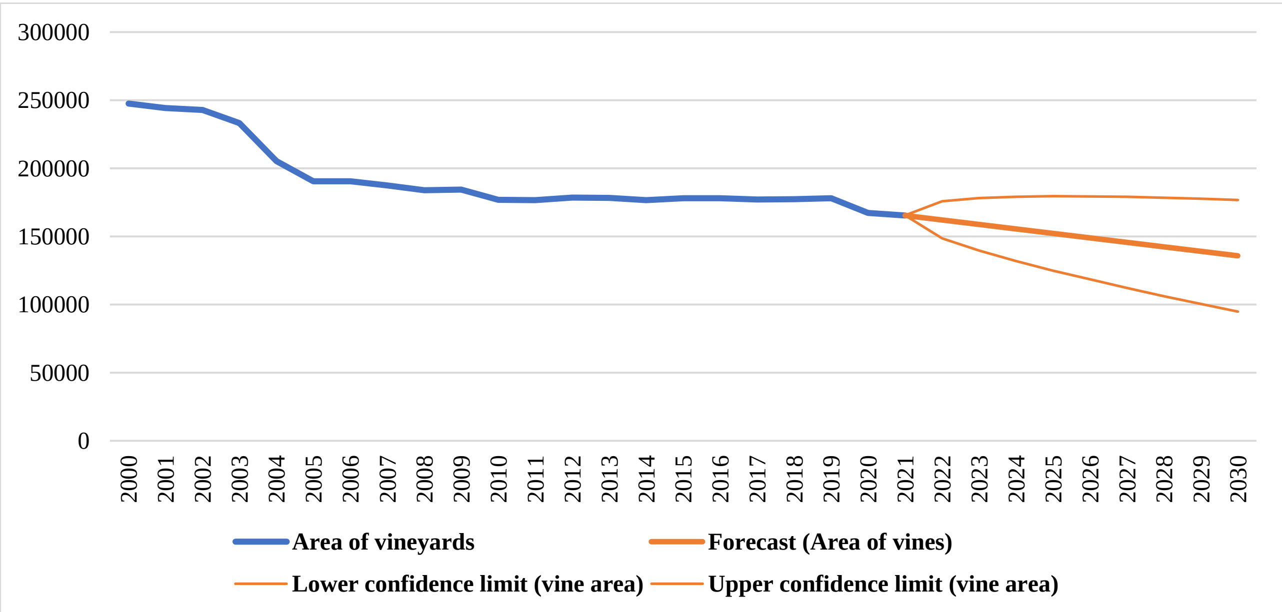

Figure 5. Forecast area under vines in Romania (hectares)

Source: processing based on INS data

In the case of total grape production, Romania produced 1.3 million tonnes of grapes in 2000, reaching a production of just over one million grapes in 2021. According to estimates, in 2030, grape production will reach 99 thousand tonnes, and under the optimistic scenario, 1.42 million tonnes will be produced, and under the pessimistic scenario, just over 400 thousand tonnes of grapes will be produced (Figure 6).

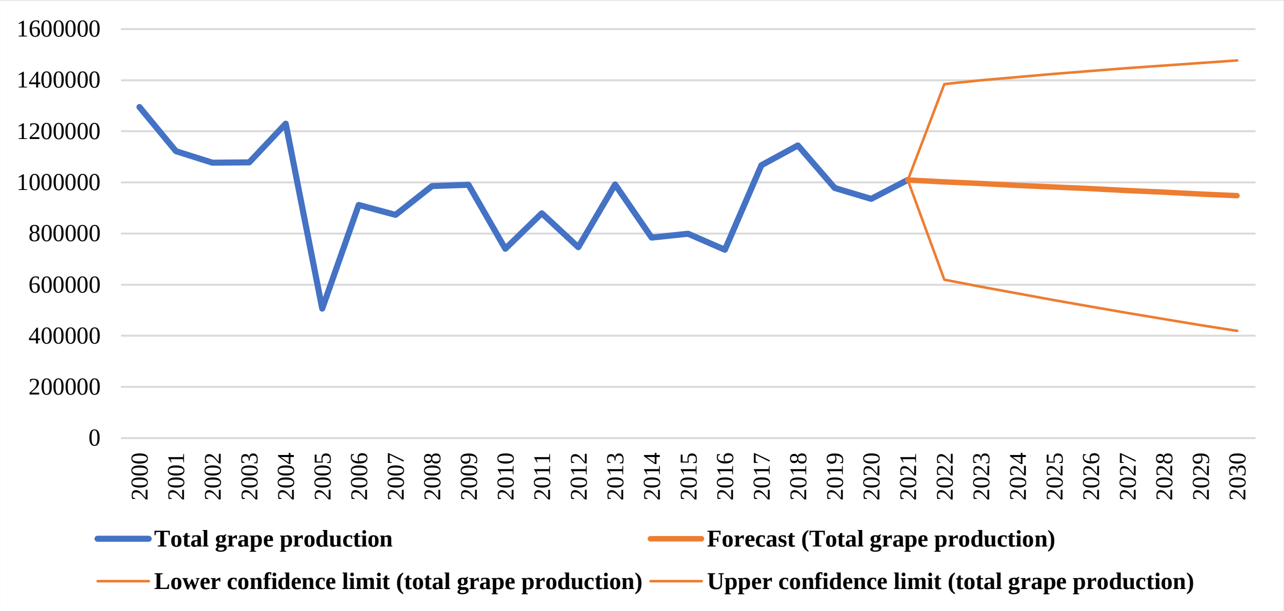

Figure 6. Forecast total grape production in Romania (hectares)

Source: processing based on INS data

CONCLUSIONS

Romania recorded a 2% decrease in the area under vines in 2021 (165.55 thousand hectares) compared to the area recorded in 2015 (178.12 thousand hectares), while total grape production increased by 26% in 2021 (1009.86 thousand tonnes) compared to the production recorded in 2015 (789.77 thousand tonnes). In the case of the development regions, South-East, North-East and South-West-Oltenia cultivated the largest areas under vines and recorded the highest total grape production. At the opposite end of the scale are the West, Centre and Bucharest-Ilfov regions in terms of areas and grape production.

Romania ranks 5th in the European Union in terms of vineyard area, with 157.35 thousand hectares, behind Spain (912.43 thousand hectares), France (750.39 thousand hectares), Italy (651.28 thousand hectares) and Portugal (1763.39 thousand hectares). In terms of total grape production, Romania ranks 6th with a production of 0.95 million tonnes, the first places being occupied by Italy with a production of 7.11 million tonnes, followed by Spain with 5.78 million tonnes, France with 4.46 million tonnes, Germany with 1.15 million tonnes and Portugal with 0.96 million tonnes.

According to estimates made over a period of 21 years, the area under vines in Romania will reach 149 thousand hectares in 2030, while under the optimistic scenario it will rise to 156 thousand hectares and the pessimistic scenario will drop to 99 thousand hectares. In the case of production, 99 thousand tonnes will be produced in 2030, and under the optimistic scenario, 1.42 million tonnes will be produced, while under the pessimistic scenario just over 400 thousand tonnes of grapes will be produced.

The development of the wine sector and the increase in wine sales can be achieved by using new technologies based on innovation. Promotion also plays a very important role in increasing the image of wineries and the varieties that produce high-quality wine, contributing to economic growth.

An opportunity to increase farmers' incomes is wine tourism, which, thanks to the vineyard landscapes and the quality of Romanian wines, has a high potential for winemakers.

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STUDY ON THE PRODUCTION AND MARKETING OF SUNFLOWER SEEDS WORLDWIDE IN THE PERIOD 2015-2020

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Abstract: *This study highlights important aspects regarding the production and marketing of sunflower seeds worldwide for the period 2015-2020. In order to achieve this study, a series of indicators specific to the sector of production and marketing of sunflower seeds were analyzed, such as: the area cultivated worldwide with sunflower; the production of sunflower seeds achieved worldwide; the average production per hectare of sunflower; the imports and exports of sunflower seeds worldwide. Sunflowers are cultivated on all continents, but on different surfaces. Europe is the leader of the ranking at continental level, regarding, on the one hand, the areas cultivated with sunflower, and on the other hand, the production obtained for sunflower seeds. Sunflower seeds have a number of uses, which places them in the area of the most important oilseeds crops. Nowadays, worldwide, the production and marketing of sunflower seeds is given a special importance. The statistical data presented and analyzed in the study were taken from the FAOSTAT website.*

Keywords: *areas cultivated with sunflower; average production per hectare of sunflower; imports and exports of sunflower seeds worldwide*

JEL classification*:* Q11, Q13, Q17

INTRODUCTION

According to the specialized literature, the sunflower (Helianthus annuus L) is classified in the family Compositae. The sunflower comes from Central and North America, being spread across the globe. In general, sunflower is used to obtain oil (https://www.agro.basf.ro/ro/stiri/basf-in-camp/cultura-de-floarea-soarelui-toate-informatiile-de-care-ai-nevoie.html, Popescu et al., 2019, Sher et al., 2022).

It is well known that sunflower oil is obtained by industrialization, and the remaining part that is represented by the pellets which are used for animal feeding. Unlike other oil plants, according to the studies conducted, the sunflower is able to provide a maximum of oil per unit area (https://www.agro.basf.ro/ro/stiri/basf-in-camp/cultura-de-floarea-soarelui-toate-informatiile-de-care-ai-nevoie.html).

According to reports Mordor Intelligence, sunflower represents one of the most significant oilseed crops in the world, because it has a number of uses, such as: for bird feeding; for industry and for the growing snack market (https://nuseed.com/ro/cererea-mondiala-si-de-diversificare-de-floarea-soarelui-creeaza-oportunitati/, Medelete et al., 2019).

It is necessary to specify that sunflower seeds have a high nutritional value, because they contain a significant amount of: protein; polysaturated fats, monounsaturated fats and vitamin E (Cuzino, 2022, https://www.industryarc.com/Research/Global-Sunflower-Seeds-Market-Research-513241, https://www.gminsights.com/industry-analysis/sunflower-seeds-market).

Another characteristic of sunflower seeds is that they have a high content of magnesium, a mineral that is involved in over 300 different physical functions. Sunflower seeds, as well as other categories of seeds show a significant combination of healthy fats, vitamins, fiber, minerals and phytonutrients, which recommends them for their inclusion in the human diet (https://www.eva.ro/dietafitness/nutritie/cat-de-sanatoase-sunt-semintele-de-floarea-soarelui-articol-195269.html).

Currently, the sunflower seed market is a market that is of particular importance, on the one hand for farmers, because some of them secure their income from the sale of sunflower seeds, and on the other hand, for consumers who use sunflower oil, but also other products based on sunflower seeds. The world market for sunflower seeds is projected to reach $2,599 million by 2027 (https://www.industryarc.com/Research/Global-Sunflower-Seeds-Market-Research-513241).

Photo 1. Sunflower field

Source: (http://www.gradinamea.ro/P-camp_cu_floarea_soarelui-988-4096.html)

MATERIALS AND METHODS

The study presents a series of trends regarding the production and marketing of sunflower seeds worldwide for the period 2015-2020. In the paper were highlighted and analyzed a number of representative indicators, such as: the area cultivated with sunflower worldwide; global production of sunflower seeds; average production per hectare of sunflower recorded worldwide; imports and exports of sunflower seeds worldwide. Faostat website was the main provider of statistical data underlying the achievement of this study. It is necessary to specify that the results of the analysis were presented in graphic form.

RESULTS AND DISCUSSION

Between 2015 and 2020, a number of changes were highlighted worldwide regarding the sector of production and marketing for sunflower seeds. During the period under analysis, the surface cultivated with sunflowers recorded a series of variations. From the data published by Faostat it can be seen that, in 2020, the largest surface cultivated with sunflower was registered worldwide, of 27,874,284 ha (see Fig. 1).

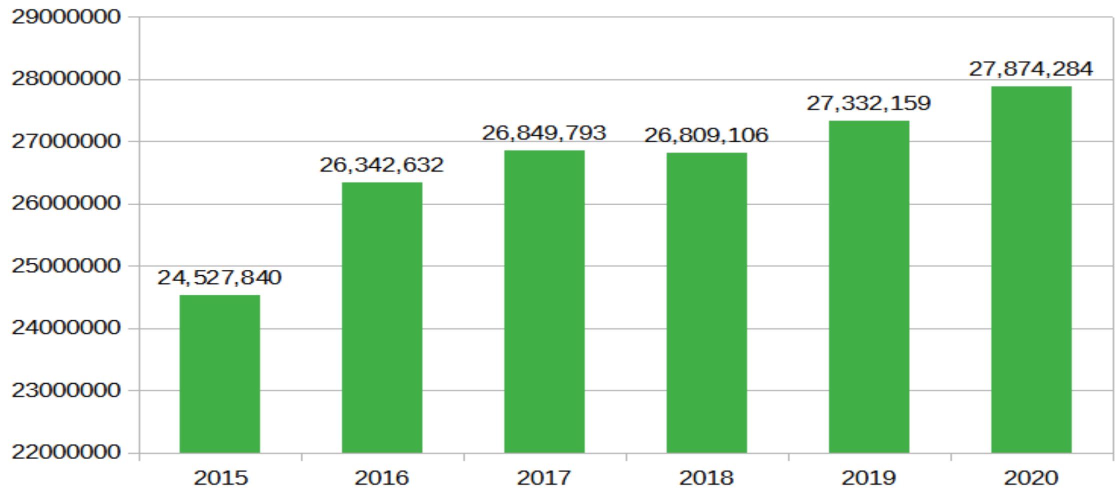

Figure 1. Sunflower area cultivated worldwide, in the period 2015-2020 (ha)

Source: Own design based on FAOSTAT database 2022

In 2015, the smallest surface of only 24,527,840 ha of sunflower was cultivated worldwide. The surface cultivated with sunflowers worldwide increased in 2020, by 3,346,444 ha, respectively 13.64%, compared to 2015. At the continental level there were significant differences in terms of areas cultivated with sunflowers.

In 2015, Europe cultivated the largest surface with sunflowers, of 16,399,991 ha, approximately 67% of the world's registered surface. At the opposite pole, the lowest surface cultivated with sunflowers in 2015 was attributed to Oceania, with 25,390 ha, respectively 0.1% of the area cultivated worldwide.

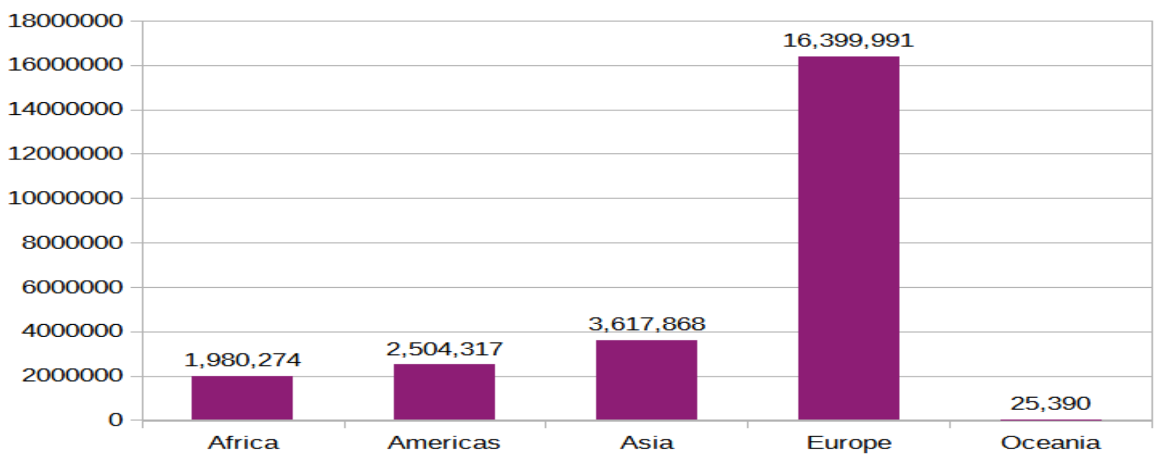

Figure 2. Sunflower area cultivated at continental level in 2015 (ha)

Source: Own design based on FAOSTAT database 2022

In 2020, at the continental level, it is found that the same ranking was maintained regarding the areas cultivated with sunflower. The data presented shows the following:

➢ Europe is the leader of the ranking, with an area of 19,928,887 ha, respectively 71.49% of the area cultivated worldwide in 2020;

➢ Asia is on the second position, with a cultivated area of only 3,204,706 ha, respectively 11.49% of the cultivated area worldwide;

➢ Americas occupies the third place, with an area of 2,482,142 ha, respectively 8.90% of the area cultivated worldwide;

➢ Africa occupies the 4th position, with an area of 2,250,013 ha, respectively 8.07% of the area cultivated worldwide;

➢ Oceania is on the 5th position, with the smallest area of 8,536 ha.

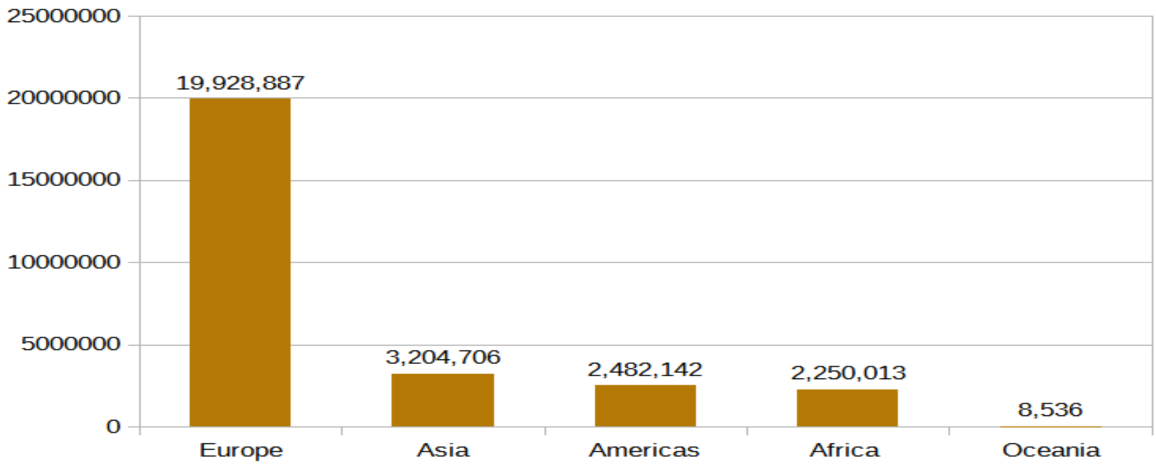

Figure 3. Sunflower area cultivated at continental level in 2020 (ha)

Source: Own design based on FAOSTAT database 2022

In 2020, the surface cultivated with sunflowers in Europe increased by 21.18% compared to 2015. In Oceania, a situation was highlighted diametrically opposite to that in Europe, because the surface cultivated with sunflowers in 2020, decreased by 66.39% compared to 2015.

The production of sunflower seeds is firmly linked to the cultivated area on the one hand, and to the average yield per hectare achieved for this crop on the other hand. In the period 2015-2020, the total production of sunflower seeds worldwide recorded a number of changes (see Figure 4). From the statistical data regarding the production of sunflower seeds achieved worldwide, it can be seen that the most significant production was made in 2019 (56,020,665 tons).

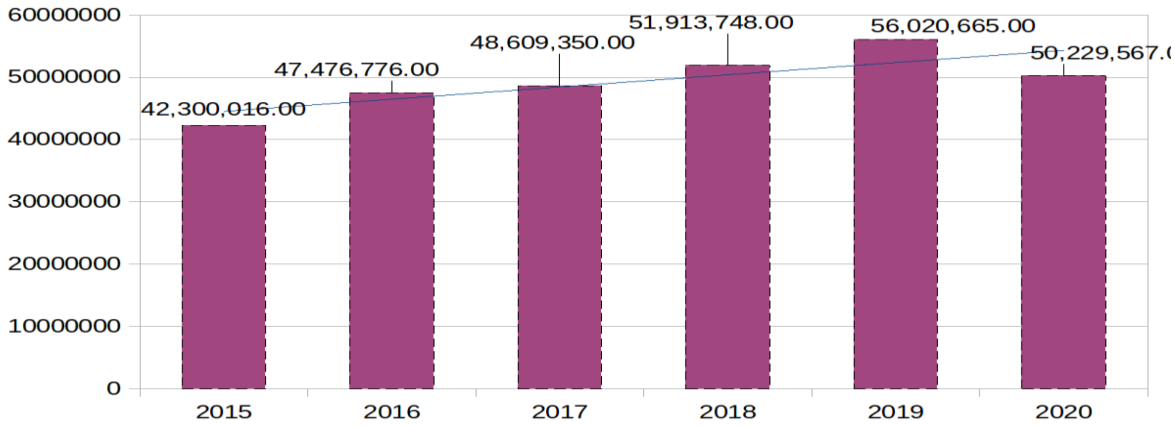

Figure 4. Total production of sunflower seeds worldwide, in the period 2015-2020 (tons)

Source: Own design based on FAOSTAT database 2022

The world's smallest production of sunflower seeds was of 42,300,016 tons in 2015. In 2015, there was a strong correlation between the total surface cultivated with sunflower and the total production of sunflower seeds obtained. In 2020, the production of sunflower seeds increased by 18.74% compared to 2015. At continental level, the production of sunflower seeds has recorded oscillations from one year to another and from one region to another.

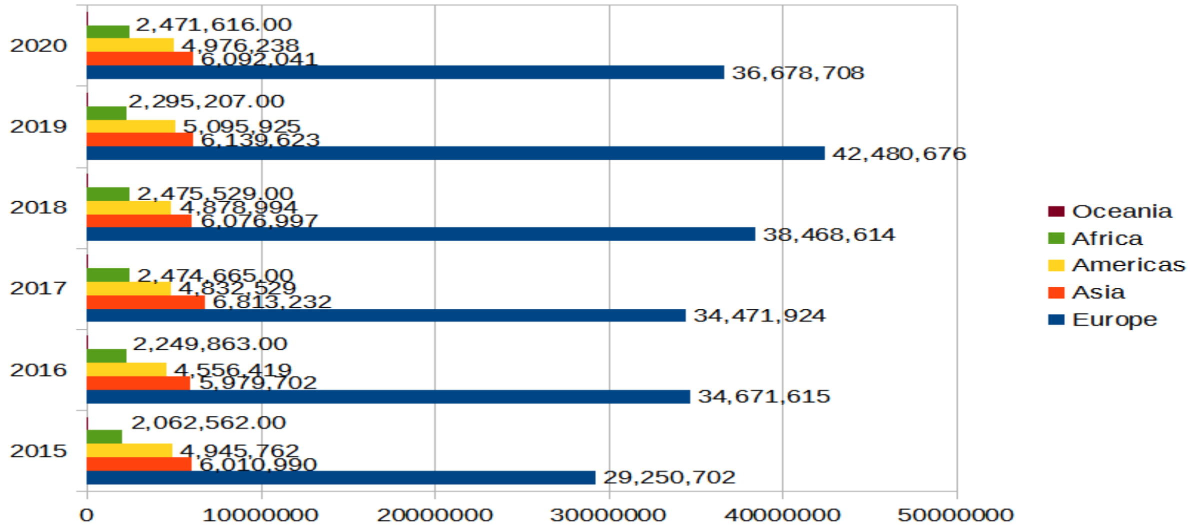

Figure 5. Total production of sunflower seeds achieved in the continental area, in the period 2015-2020 (tons)

Source: Own design based on FAOSTAT database 2022

As expected, Europe is the leader of the continental classification regarding the production of sunflower seeds. The most significant production of sunflower seeds was achieved in 2019 (42,480,676 tons), and the lowest production was recorded in 2015 (29,250,702 tons). In 2020, in Europe, the production of sunflower seeds increased by 25.39%, compared to 2015. Europe accounted for 73.00% of the world's production of sunflower seeds in 2020. Asia is on the second position of the ranking with the highest production of sunflower seeds, of 6,813,232 tons (2017). In 2020, the production here increased by 1.34% compared to 2015. Asia accounted for 12.10% of the world's sunflower seed production in 2020. America occupies the 3rd position in the ranking of the production of sunflower seeds obtained at continental level. In 2019, it obtained the highest production of sunflower seeds, of 5,095,925 tons. In 2020, Americas accounted for 9.90% of worldwide production. Americas. In 2020, the production of sunflower seeds increased insignificantly by only 0.6%, compared to 2015.

Photo nr.2. Sunflower seeds

Source:(https://www.eva.ro/dietafitness/nutritie/cat-de-sanatoase-sunt-semintele-de-floarea-soarelui-articol-195269.html)

Africa is on the 4th position, with the highest production of sunflower seeds in 2018, of 2,475,529 tons. In 2020, Africa accounted for 4.90% of the worldwide production of sunflower seeds. The production of sunflower seeds in Africa increased by 19.83% in 2020 compared to 2015. Oceania ranks 5th in this ranking, with the most significant production made in 2015 (30,000 tons).

In 2020, Oceania achieved only 0.02% of the worldwide production of sunflower seeds. At the continental level, Oceania was the only one to record in 2020 a decrease in the production of sunflower seeds, by 63.46% compared to 2015.

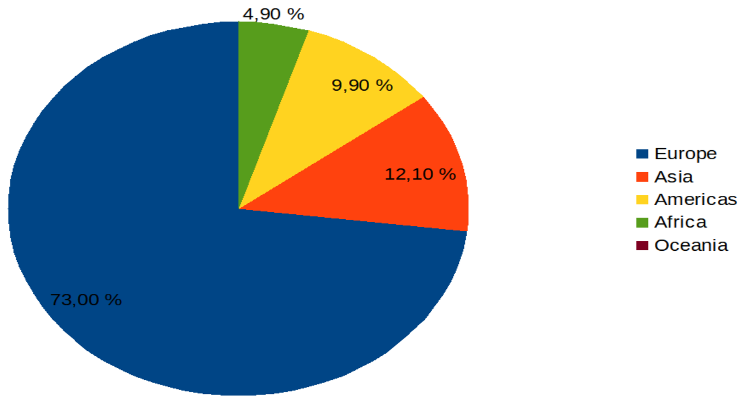

Figure 6. Production share of sunflower seeds at regional level in 2020 (%)

Source: Own design based on FAOSTAT database 2022

In 2020, according to the statistical data published, the first position in the top of the most significant producers of sunflower seeds was the Russian Federation, with a production of sunflower seeds of 13,314,418 tons, respectively 26.50% of the total world production obtained for this category. The second position is occupied by Ukraine with a production of 13,110,430 tons, respectively 26.10% of the world production achieved. The 3rd place is occupied by Argentina, with 3, 232,649 tons, at a significant distance from the Russian Federation and Ukraine. It achieved in 2020, representing 6.43% of the world production of sunflower seeds. Position 4 is held by China with 2,375,000 tons, namely 4.72% of the world's production of sunflower seeds. The 5th place is occupied by Romania with 2,198,670 tons, namely 4.37% of the world production of sunflower seeds.

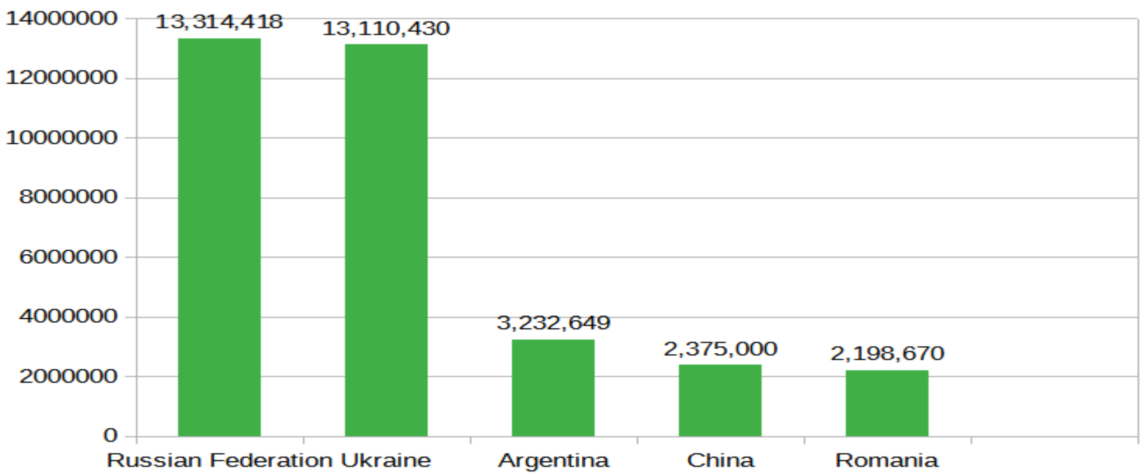

Figure 7. Top 5 largest producers of sunflower seeds in the world, in 2020 (tons)

Source: Own design based on FAOSTAT database 2022

The average production of sunflower seeds per hectare worldwide varied from one year to the other in the analyzed period. From the data presented it can be easily observed that the most significant average production per hectare was of 2,050 kg/ha (2019), and the lowest was in 2015 (1,724 kg/ha). In 2020, the average production of sunflower seeds per hectare worldwide increased by 4.52% compared to 2015, but decreased compared to 2019, by 12.10%.

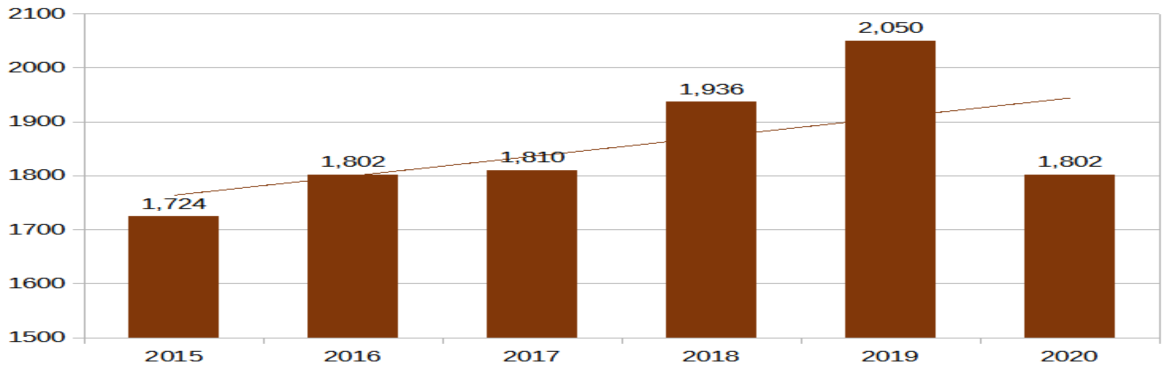

Figure 8. Average production of sunflower seeds per hectare worldwide, in the period 2015-2020 (kg/ha)

Source: Own design based on FAOSTAT database 2022

The quantitative exports of sunflower seeds worldwide recorded variations from one year to the next during the period under analysis. The most significant quantitative exports were recorded in 2019 (7,279,843 tons), and the smallest were in 2015 (4,370, 298 tons). In 2020, the quantitative exports of sunflower seeds worldwide increased by 58.97% compared to 2015, but decreased by 4.57% compared to 2019.

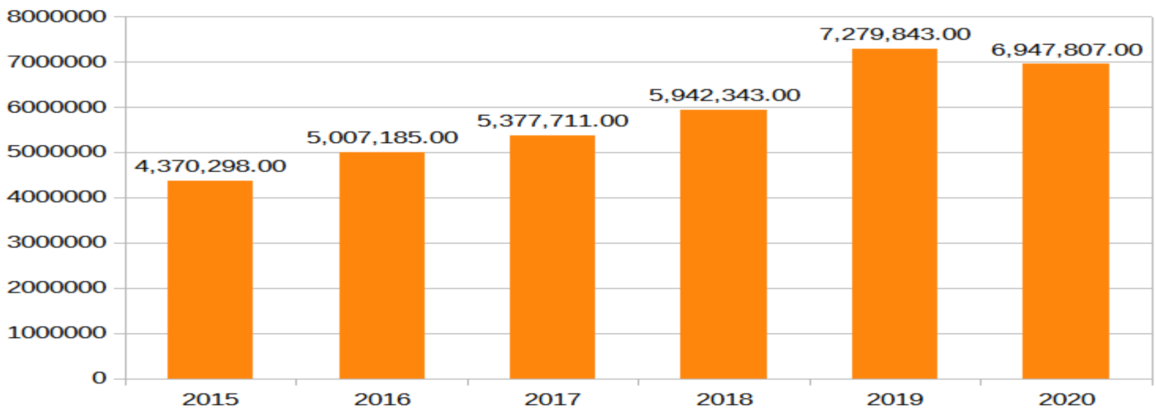

Figure 9. Quantitative exports of sunflower seeds worldwide, in the period 2015-2020 (tons)

Source: Own design based on FAOSTAT database 2022

In 2020, a number of exporters of sunflower seeds were noticed worldwide, and among them the presentation of the first 5 was required, as follows:

- Romania -1,482,504 tons, respectively 21.33% of the total quantitative exports achieved worldwide;
- Russian Federation -1,369,907 tons, respectively 19.71% of the total quantitative exports achieved worldwide;

- Bulgaria -818,258 tons, respectively 11.77% of the total quantitative exports achieved worldwide;
- China -508,002 tons, respectively 7.31% total quantitative exports achieved worldwide;
- France -423,547 tons, i.e. 6.09% of total worldwide quantitative exports.

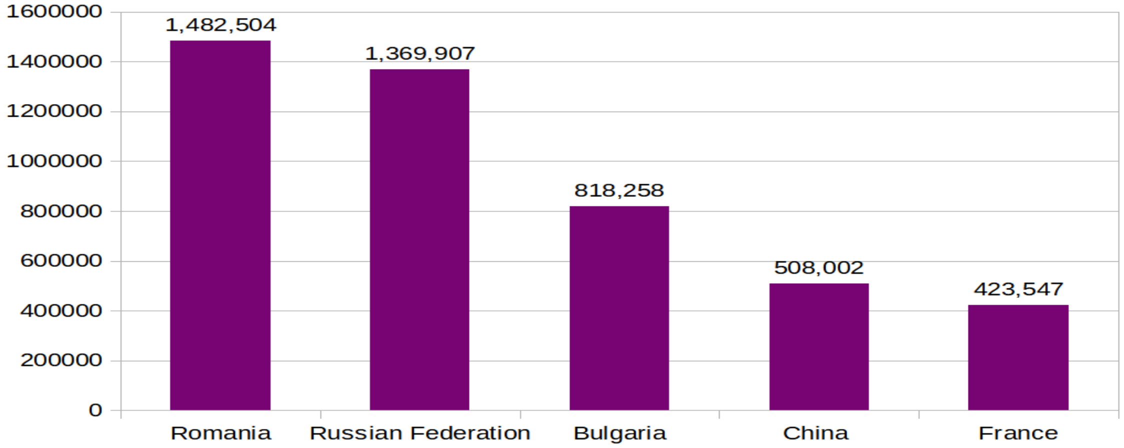

Figure 10. Top 5 exporters of sunflower seeds worldwide, in 2020 (tons)

Source: Own design based on FAOSTAT database 2022

Regarding the quantitative imports of sunflowers, they recorded changes in the analyzed period. The largest quantitative imports were obtained in 2019 (7,167,930 tons), and the lowest were in 2015 (4,306,931 tons). In 2020, the quantitative imports of sunflower seeds worldwide increased by 63.14% compared to 2015, but decreased by 1.98% compared to 2019.

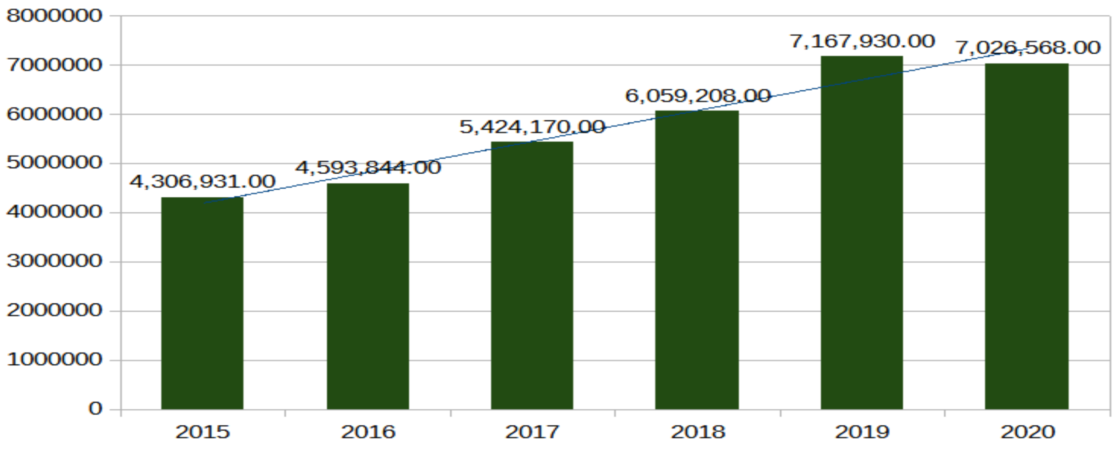

Figure 11. Quantitative imports of sunflower seeds worldwide, in the period 2015-2020 (tons)

Source: Own design based on FAOSTAT database 2022

According to the worldwide statistical data, several importers of sunflower seeds were highlighted in 2020, and the first 5 are the following:

- Turkey -1,206,590 tons, respectively 17.17% of the total quantitative imports recorded worldwide;
- Bulgaria -1,020,754 tons, respectively 14.52 % of the total quantitative imports recorded worldwide;

- Netherlands -768,104 tons, respectively 10.93% of the total quantitative imports recorded worldwide;
- Spain -402,351 tons, namely 5.72% of the total quantitative imports recorded worldwide;
- Germany-389,116 tons, namely 5.53% of the total quantitative imports recorded worldwide;

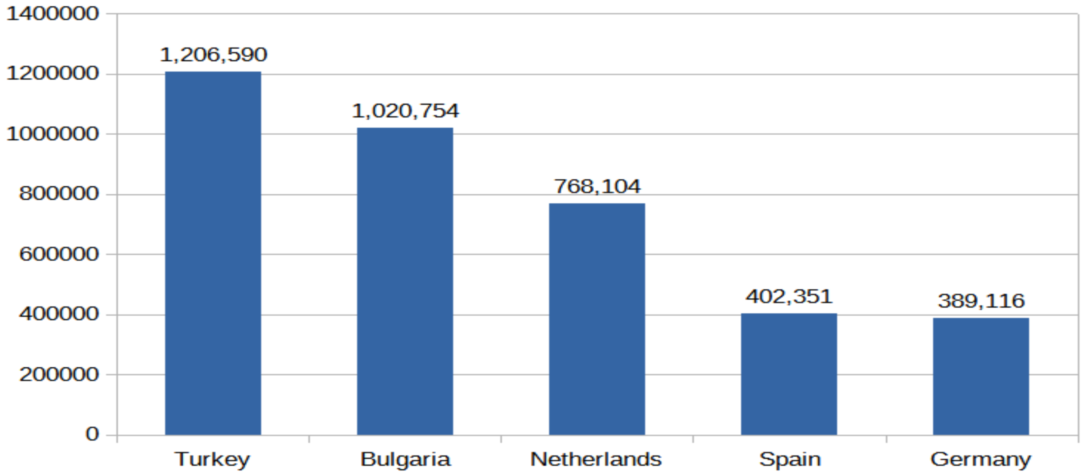

Figure 12. Top 5 importers of sunflower seeds worldwide, in 2020 (tons)
Source: Own design based on FAOSTAT database 2022

In the coming years the top of importers and exporters of sunflower seeds may change depending on the economic interests of each country.

CONCLUSIONS

Following the analysis of the main indicators related to the sector of production and marketing of sunflower seeds worldwide for the period 2015-2020, the following results emerged:

- The significant surface cultivated with sunflowers was highlighted in 2020 (27,874,284 ha);
- At continental level, the most significant surface with sunflowers was cultivated in Europe, and increased from 16,399,991 ha (2015) to 19,928,887 ha (2020);
- In 2019, the largest production of sunflower seeds was achieved worldwide, of 56,020,665 tons;
- Europe has achieved the highest sunflower production recorded at continental level, reaching a maximum production in 2019 (42,480,676 tons);
- The largest quantitative exports of sunflower seeds recorded worldwide were of 7,279,843 tons (2019);
- In 2020, Romania was the most representative exporter of sunflower seeds with 1,482,504 tons;
- In 2019, the highest quantitative imports of sunflower seeds were of 7,167,930 tons;
- In 2020, Turkey stood out as the first importer of sunflower seeds recorded worldwide, with 1,206,590 tons;

In the medium and long term, the sunflower seed production sector will remain one of the important sectors related to agriculture worldwide, because on the one hand, sunflower seeds are a significant raw material for industry, and on the other hand, they are an important source in animal nutrition.

ACKNOWLEDGEMENTS

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ECONOMIC PERFORMANCE AND COMPETITIVENESS IN AGRICULTURE. THEORETICAL APPROACHES

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Abstract: *In agricultural activity, the performance and competitiveness concepts are interest targets for decision-makers, regardless of their representation level (production unit and / or product level, activity sector and / or national and / or international level). The way of materializing these two concepts of performance and competitiveness, in the agricultural activity is accomplished through the indicators system used.*

Key words: *performance, competitiveness, indicators*

Clasificare JEL: Q10; Q18

INTRODUCTION

The comparing idea of the performance in the same activity sector, in this case, in agriculture and food industry sector, within the states member of European Union, intersects with the competitiveness idea, because these two notions are interconnected, performance and/or competitiveness of one of this mentioned could affect the other and vice versa. The performance notion complexity implies the use of several indicators, because this is the only way in order to capture, on the one hand, as many aspects as possible about a phenomenon, process, organization, sector of activity and, on the other hand, in order to track the degree of fulfillment of some parameters and functionalities.

Regarding the concept, there are different approaches in specialized literature. For example, W. Edward Deming (1900-1993) is the Deming System of Deep Knowledge creator, which is based on the four principles application: Planning - Execution - Control - Action. W. E. Deming considers defining these principles for the commercial achievement performance, the prosperity of a society, as well as peace. Association Française de Gestion Industrielle (AFGI) and International Organization for Standardization propose the most complete definition, according to which "a performance indicator is a quantifiable date, which measures the total or partial effectiveness and/or efficiency of a process or system (real or simulated), in relation with a norm, a plan or an objective determined and accepted within the enterprise strategic framework".

In the present paper, the economic performance and competitiveness, in agriculture, is addressed through the indicator systems perspective, defined in the specialized literature.

MATERIALS AND METHODS

Starting from the premise that determining the perception of performance and/or competitiveness will facilitate the processes of strategic decision, through the substantiation sub-indicators rethinking, possible tools are created for: establishing resource allocation priorities; introducing corrections even during the development of some projects; facilitating the establishment of the destination of the results / of the agricultural productions obtained, we proposed the different approaches inventory, in terms of performance and competitiveness in the agricultural sector, through the analysis of the existing specialized literature in the field of interest.

RESULTS AND DISCUSSION

From the specialized literature's information's analysis, regarding the performance measurement (Biton, 1990), it can be synthesized the following characteristics:

a. Performance measurement, for any of the directions of its use (planning - execution - control - action), must be carried out at the same level (production unit and / or product level, activity sector and / or at national and/or international level) to which the present (ongoing) or future objectives/actions of interest refers.

b. Ensuring the consistency between the performance indicators and the objectives/actions of interest is mandatory.

c. The objectives/actions of interest for which the performance indicators are achieved/tracked must be clearly and concisely formulated.

d. In performance measurement of interest objectives or actions, the following requirements must be respected: the performance measurement to be carried out according to the direction/level of use decision; performance measurement must follow the evaluation frequency required by the objectives/actions of interest; performance measurement must be able to be validated.

e. The optimal conditions for validating the performance indicators must be ensured by the persons/institutions to which they are intended.

f. The performance measurement for the objectives / actions of interest can be analyzed in order to be updated periodically.

g. The databases that include the indicators used to evaluate the performance of some activities, systems, phenomena, processes, policies, etc. (in the case of the current work on the PAC policy) are those that can ensure the creation of synergies, which in turn allow obtaining new dimensions of the analyzed systems' performance.

h. The standardization of the indicators used to evaluate the performance of CAP policy has the role of ensuring the collected data interoperability and/or received and transmitted by all partners, respectively EU's[1] MS.

Regarding the EU budget, the framework performance is a prerequisite for all EU programs, including those to support the CAP, because all of them (European programs) are oriented to towards results that must be well known and managed. The EU programs performance levels, including those for supporting the CAP, is emphasized that in the Multiannual Financial Framework 2014-2020 performance is a prerequisite for the financing by the Commission of all European programs / projects, this being considered as representing a new mandatory characteristic. At the same time, through this decision, it was aimed to achieve a greater concentration on the results (from the EU budget), which required the establishment of clear and measurable objectives and indicators, as well as the assumption of specific and firm arrangements for monitoring, reporting and evaluation. In this way, the performance indicators of EU programs for the future programming period, together with other sources of qualitative and quantitative performance information (such as evaluations), will be likely to provide a solid basis for auditing the programs performance and the progress made in achieving the agreed objectives. Also, the indicators provided by the "performance requirements" of

[1] Provided in Art.95 of EC Regulation 966/2012.

the related EU programs and the current programming period allows the anticipation and operative resolution of some problems only when they appear during their development (European programs / projects). A relevant example regarding the functionality of the performance levels of EU programs, including those for supporting the CAP, from the Multiannual Financial Framework 2014-2020, is represented by the European Structural and Investment Funds (ESIF), which are strongly oriented towards performance, and which have applied the "backup performance mechanism", launched in 2019. The backup performance mechanism materialized for those programs, which did not reach their goal. In their case, after performance evaluation, the related resources were reallocated to other priorities. The new feature, mandatory for Commission's offered funding through the CFMA 2014-2020, namely the performance levels of the EU programs, including those to support the CAP, also has the role of contributing both to improving the performance of the programs and to the efficiency and effectiveness of operations, of the management systems and procedures of the bodies and institutions involved in the management of EU funds. At the same time, the audit reports of the European Court of Auditors, after the introduction of the mandatory performance levels of EU programs, highlighted effects worthy of consideration, such as:

- Recommendations formulation regarding the annual activity reports preparation of the European funds beneficiaries.
- Paying more attention to encountered challenges in running programs with European funds, with a greater focus on data reliability and quality.
- The realization by the European funds beneficiaries of some notifications and clearer explanations of how data and information on the performance of programs with European funds were used to register real improvements in the reference indicators (in the present case of performance indicators).
- Areas where also clarified, both now or in the future programming period, and it will be needed reforms to fully use the potential of the EU budget, such as: focusing decision-makers' attention on the added value of programs initiated with European funds; rationalizing the budget, as well as exploiting the synergies between the programs; simplification and better financial management of public allocations with European funds; promoting the flexibility and capacity of management authorities to respond to crises; focus on achieving programmed performance levels; greater coherence with the main political issues, objectives and existing values at the level of each user, responsible for the program financed by EU funds; improving the overall performance framework (for example, by rationalizing the number of programs initiated, improving the way they "work" together, greater flexibility, as well as by using fewer but higher quality indicators for program performance monitoring and reporting activities), etc.

The agriculture's competitiveness concept. In general, the concept of competitiveness, intensively used in developing and analyzing economic policies process, does not have a precise definition, most of times adapted, to the analyzes for which it is used purpose. Thus, there is a diversity of understandings competitiveness concept, of which the most important are the following:

- Competitiveness is synonymous with comparative advantage, although Siggel (2006) believes that "... this approach is not complete, as it depends on the treatment level / perspective - micro or macroeconomic, national or international...".
- Competitiveness refers to the annual evolution calculation of trade indices and prices in order to assess the economic entities, sectors and / or countries and / or regions performance.

- The competitiveness concept is used by analysts to identify the comparative advantage achievement. The concept of pursuing a level of comparative advantage was theorized by M. Porter (1990). Based on the Porter method use of comparative advantage, some authors have indirect calculated performance indicators, such as, for example: the costs of internal resources; the social cost-benefit ratio; production costs.
- Measuring competitive advantage involves "...the assessment of competitiveness indirectly, taking into account the competitive position of a company or sector or technology or product or service on the international or national or regional or local market, as well as the performance achieved in a certain period of time...". For such evaluations (measurement of competitive advantage) various commercial indicators were used, thus allowing the comparison of different countries (or companies or products or services) and/or time series data. In this case, the indicators used are, most of the time, ex-post indicators. The specialized literature considers that the use of ex-post indicators is useful to demonstrate the performance (competitiveness) of a country, but they fail to define the "source of the advantage". Other models of competitiveness measurement indicators that are present in the specialized literature requires the formulation of numerous and various working hypotheses, precisely in order to fix the problem.

Currently, for the competitiveness of economic policies development, the competitiveness index is used, which has the merit of giving an overall, synthetic picture of the analysis objects. For example, in case of international comparisons by using the competitiveness index, the aim is to highlight the gain and/or loss of competitiveness. In addition, by using some of the indicators that are the basis of its calculation (the competitiveness index), analyzes can also be carried out regarding the competitive performance from various points of view of a phenomenon, process, system, activity, objective.

It is unanimously recognized by specialists that the competitiveness determination is assimilated to one of the characteristics of the actors operating (competing) in market conditions. In this context, is mentioned the proposed definition of competitiveness formulated by the World Economic Forum (WEF) from Lausanne, Switzerland, in 1994: "competitiveness is the ability of a country or a company to create wealth greater than competitors on the world market" (World Competitiveness Report 1994). According to this definition, competitiveness is approached both as a process of comparison between rival actors and as a premise to achieve cooperation (partnerships) between business partners.

Competitiveness level evaluation. In general, the evaluation of the level of competitiveness of a phenomenon, process, system, entities, of an action, objective, etc. it consists in comparing the actual results with the expected ones of different interest groups. There are specialists who consider competitiveness as an expression of economic performance (OECD, 1992). At the same time, there are other experts who consider competitiveness to be an inappropriate concept and an obsession (Krugman, 1994). In this context, at least the following characteristics can be identified:

- The competitiveness system depends on the generation degree and knowledge distribution at a certain time in a society or community. Thus, increasing competitiveness "engines" can be: certain technologies adoption and use; education level; innovation degree, etc.
- The competitiveness limits are not necessarily sectoral, regional, national or global, but they depend on the chosen reference and on the general level of socio-economic development reached at a given time.

Depending on how the competitiveness characteristics are perceived by different interest groups, in the specialized literature three categories of competitiveness are nominated (after Stankiewicz, 2009):

a. Normal competitiveness – which manifests itself when the specific interactions results are equal to the participating stakeholders expectations.

b. Lower than normal competitiveness – if actual results do not meet expectations. In such situations, the interested parties take measures to withdraw from the interaction with the entities that register results superior to them, and in the next stage, most often, are formulated more attractive decisions.

c. Higher than normal competitiveness - when the actual results are higher than expected by the reference entities. In these cases, the interested parties try to strengthen their relationship with the entity that has a higher than normal competitiveness.

The competitiveness evaluation level of a phenomenon, process, system, action, objective, etc. from the components that can be taken into account point of view, it can be registered in two typologies:

- Production factors competitiveness. The competitiveness influencing factors are those that determine the ability of the entities involved to act, such as: they have a quick response to changes on the market; skillfully utilizes own resources or other factors friendly or not; aim to strengthen the competitiveness of the reference entity in the long term.
- Competitiveness related to results. The level of competitiveness of a phenomenon, process, system, action, objective, etc. determines the results of the competition, found in indicators, such as: market share; the share of sales of products with scientific value and financial performance of the reference entity to the leaders.

In the specialized literature, there are also opinions related to the adoption of the concept of defining competitiveness only through prices (costs). We believe that such an approach induces the risk of reaching simplistic conclusions. For example, if wages, taxes or energy costs are reduced, the immediate effect is to increase competitiveness. However, the option for such a path, - known as the "short path" of competitiveness, is identified with a narrow understanding of competitiveness, which is applied in the analyzes dedicated to the subject being a practice addressed in the case of developing countries.

In the case of highly developed economies countries, the competitiveness definition both includes the evolution over time perspective (thus defining long-term competitiveness growth) and the socio-economic system references, which in turn is based on three pillars (the of increasing incomes; the social pillar; the ecological pillar). Through this complex understanding of the definition of competitiveness, the aim is to support the transition towards a new way of developing society, in general, this being considered the "extended way" of approaching competitiveness. At the same time, such a treatment also has the advantage of including the components of well-being (social and ecological), in the resulting evaluations it is likely to allow the connection with the measures that influence the economic policy[1]. In this case, (of approach / extended analysis of competitiveness) specific indicators of each of the three mentioned pillars (income growth pillar; social pillar; ecological pillar) are taken into account, as follows:

[1] This understanding is the result of research carried out by the OECD, CE and WEF within the project "WWW forEurope". See: Karl Aiginger (WIFO), Susanne Bärenthaler-Sieber (WIFO), Johanna Vogel (WIFO). 2013. "Competitiveness under New Perspectives", OECD Working Paper no 44.

The growth income pillar – starts by considering the GDP level, but also includes the income available for household consumption and consumer spending.

The social pillar - summarizes the indicators that reflect the results of the socio-economic system of a country, region, sector, such as: the risk of poverty; inequality; youth unemployment,

The ecological pillar - evaluates the recorded results in the environmental protection and climate change mitigation field among the evaluation indicators (resource productivity; intensity of greenhouse gas emissions; energy intensity; share of electricity produced from renewable energy sources, etc.).

It is currently found that, the extended long-term competitiveness definition, adopted as an idea in the countries with highly developed economies case and based on the consideration of the specific indicators of the three pillars, respectively of three sets of indicators that individualize the approaches, is likely to change even some of the rankings already considered immutable.

CONCLUSIONS

Finally, considering the presented paper, we can state that the general factors that contribute competitiveness definition refer to the following aspects:

- price competitiveness, which focuses on factor costs and productivity,
- quality competitiveness, which is a more important factor for high incomes industrialized countries and which aims at the transition to competitiveness in a broad sense with the inclusion of elements of a socio-ecological nature,
- the involved actors competitiveness level,
- based on it, four groups can be distinguished: shareholders; customers; buyers; employees (Stankiewicz, 2009).

Each of these involved actors groups, in defining competitiveness process, evaluates the activities of various entities of interest / enterprises using a diversity of criteria (expression of some interests), such as for example: the owners, who are mainly interested in the revenues that can be obtained from holding some shares; customers, who are interested not so much in the value of the company, but in the value of its offer; employees, who are mainly interested in working conditions and wages; suppliers, who are interested in the volume and growth of business activity (Zelga, Kamila, 2017).

In general, the competitiveness question, as can be clearly seen from the various points of view and classification, is very complicated. However, to fully realize the extent of this complexity, it must be considered the unit reference size for determining competitiveness, respectively of the competition, because it is appreciated that in the last wo decades interested in this topic has rapidly increased.

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THE EVOLUTION OF TRADE WITH MEAT AND ORGANS IN THE PERIOD 2010-2020, IN ROMANIA

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Abstract: *This paper aims to analyze the evolution over time of the trade with meat and organs, in Romania, important foods for a balanced diet. Statistical data indicate that, although Romania has large productions, it is deficient in terms of ensuring meat consumption, especially with pork, which occupies the first position on the list of imports of agri-food products. The analysis was carried out with the help of statistical indicators: the evolution of imports and exports for the period 2010-2020 and the trade balance. The conclusions resulting from this work underline the importance of the livestock sector development, constituting an essential element for ensuring food security.*

Keywords: *import, export, meat, trade balance, Romania*

Classification JEL: Q17, Q02, Q13

INTRODUCTION

Animal husbandry plays an important role in rebalancing trade with agri-food products in Romania (Business Microcredit, accessed 2022). After Romania's accession to the EU, meat production decreased, which is due to the disappearance of many animal slaughtering units that did not comply with European standards. Only units operating at high performance levels remained on the market (MADR, 2015). Also, market fluctuations and changes in consumer preferences have led, over time, to fluctuations in livestock and production (Lumea satului, 2021).

Romania, 20 years ago, was a large producer of meat, but for several years our country has become a net importer of meat and organs. As indicated by specialist studies, the balance of trade balance sheet with meat and meat products has been on a downside for a long time, with imports rising to a level that is difficult to reach by the exports made by our country. Instead, there is a surplus of the trade balance in the category of live animals, Romania being an exporter of primary, unprocessed products (Ilie Stoian, 2013). The value of the trade balance with live animals in the 11 years studied (2010-2020) reaches 1.96 billion euros (exports of 3.68 billion and imports of 1.72 billion).

The main partners with whom Romania carries out commercial exchanges are the European countries, in recent years reaching a weight of approx. 88-89% of the total imports or exports (Simion Mihaela Aurelia, 2020).

MATERIAL AND METHOD

The study is based on Trade Map statistical data on international demand for goods. In this study, the indicators that characterize Romania's foreign trade were used: Romania's export and import of meat and organs and the share of the main partner countries.

The analysis was carried out with the help of statistical indicators regarding the evolution of the value of imports and exports of meat and organs of Romania, as well as the trade balance for the period 2010-2020: average, standard deviation, coefficient of variation, and growth rate.

RESULTS AND DISCUSSIONS

Statistical data (Trade Map) regarding Romania's foreign trade in meat and organs indicate that the highest value of imports was recorded in 2019, when it reached 940.3 million euros. In 2020, imports with a volume of 912.5 million euros, registered a decrease of 3% compared to 2019, but compared to 2010, it was higher by 83.8%.

Table 1. The evolution of the value of imports of meat and organs in Romania, in the period 2010-2020

Countries	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Average	C.var.*	Annual rate	2020/ 2010	2020/ 2015	2020/ 2019
	Euro thousand												%	%	%	%	%
Total import Romania	496585	440069	478192	489680	545575	568661	643710	766528	817588	940316	912484	645398.9	28.4	6.3	183.8	160.5	97.0
Spain	34386	25643	27415	35309	50103	60989	101231	129000	164720	182017	176176	89726.3	70.2	17.7	512.3	288.9	96.8
Germany	116694	116124	114960	121562	145503	158091	151817	176706	174225	174586	174943	147746.5	17.7	4.1	149.9	110.7	100.2
Hungary	87282	84823	130950	142467	114615	113819	126791	135071	149656	196535	170092	132009.2	25.0	6.9	194.9	149.4	86.5
Poland	16763	14518	20595	21188	43771	60205	66320	85282	84360	106753	121551	58300.5	65.3	21.9	725.1	201.9	113.9
Netherlands	54787	47974	56028	53393	70737	59758	58847	77131	73228	84848	82130	65351.0	19.4	4.1	149.9	137.4	96.8
Belgium	28130	24100	15387	16074	19087	18078	15321	20292	21567	35219	42799	23277.6	38.0	4.3	152.1	236.7	121.5
Italy	25374	28446	27687	22956	22208	22988	38285	45382	38286	40794	32609	31365.0	26.0	2.5	128.5	141.9	79.9
Denmark	19948	12768	13705	17231	12905	15207	11531	19270	18304	19571	26378	16983.5	25.6	2.8	132.2	173.5	134.8
United Kingdom	5134	2216	2825	3504	4747	8232	9839	14351	12402	13385	15765	8400.0	59.5	11.9	307.1	191.5	117.8
Austria	33231	21359	22583	13467	17384	11303	15278	16496	17651	16710	10896	17850.7	35.1	-10.6	32.8	96.4	65.2
Lithuania	0	0	116	85	591	983	926	690	5967	9209	9818	2580.5	148.2	-	-	998.8	106.6
Estonia	145	158	1085	1099	1997	5014	8988	8231	4649	9224	8993	4507.5	84.2	51.1	6202.1	179.4	97.5
Bulgaria	29457	20824	14809	13832	13305	11586	10819	6261	8795	7827	8880	13308.6	50.3	-11.3	30.1	76.6	113.5
France	25163	19089	14345	12288	13083	8836	10480	11187	12388	13252	8287	13490.7	35.9	-10.5	32.9	93.8	62.5
Cyprus	4716	7904	2067	7452	5929	4079	4343	4938	6624	7971	5743	5615.1	32.4	2.0	121.8	140.8	72.0

Source: Own calculation based on TRADE MAP data

Regarding the evolution of the value of imports of meat and organs, an increase in imports from Poland can be observed throughout the analyzed period with an annual rate of 21.9%. At the same time, compared to 2019, the value of imports from this country has increased significantly by approximately 14% in 2020. It can also be observed that imports from the Netherlands, in 2020 compared to 2010, recorded almost 50% higher values, but compared to 2019 they decreased by 3.2%.

The main suppliers of meat and organs to Romania during the entire analyzed period are: Spain, Germany and Hungary.

Spain in 2020 had a share of 19% of the total, with a value of 176.1 million euros (five times higher than the value reported in 2010), having a share of 7%. It is closely followed by Germany with a share of approx. 19%. Even if the value of imports from Germany increased in 2020 to 174.6 million euros (+49.9% compared to 2010), their share in total imports decreased compared to 2010 (23%) or 2015 (28%), when it represented the main supplier of meat and organs in our country.

In third place is Hungary, which in 2020 has a share of 19% of the total imports of meat and organs. The value of meat and organ imports from the Hungarian market exceeded 170 million euros, being almost double compared to 2010 and +49.4% compared to 2015.

And the Netherlands represents an important supplier of meat and organs for Romania with a value of 81.1 million euros in 2020 (+49.9% compared to 2010) as well as Poland which reached a value 7 times higher in 2020 compared with 2010.

France is among the last in the ranking with a value of meat and organ exports to Romania of 8287 thousand euros in 2020, down 67.1% compared to 2010.

The 10 countries presented in figure 1, provided in 2010 over 91.5%, respectively 93.5% (in 2015, 2020) of the total meat imported into Romania.

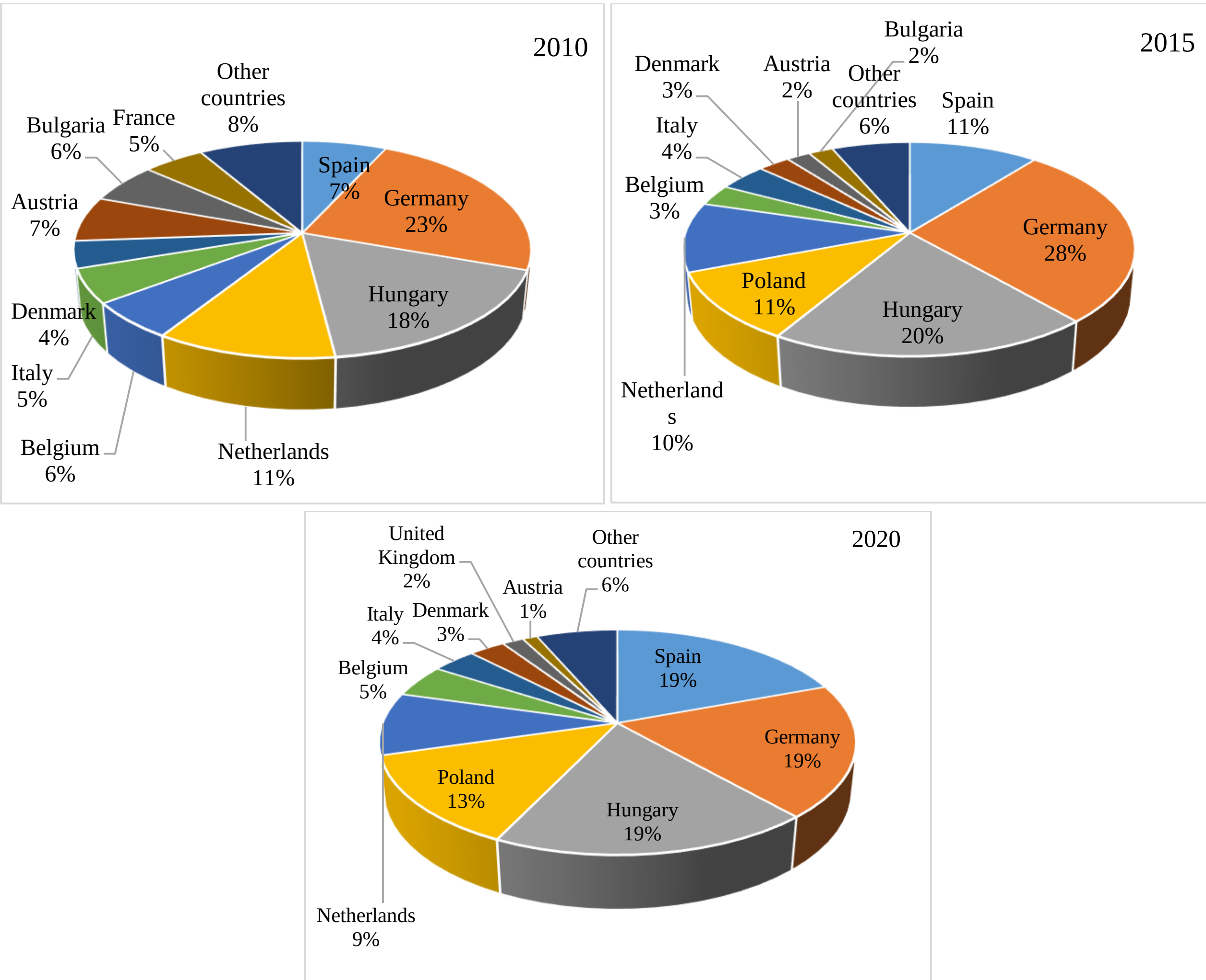

Figure 1. The structure of Romania's meat and organ imports by the main supplying countries, in 2010, 2015 and 2020.

Source: Own calculation based on TRADE MAP data

Regarding the value of the export of meat and organs, according to statistical data (Trade Map) in the period 2010-2020, Romania reaches a maximum value in 2017 exceeding 281 million euros. In the following period, a substantial decrease is noted, reaching in 2020 a value of 195.1

million euros. Compared to 2010, the value of meat and organ exports increased by 55.1%, but compared to 2019, it decreased by 18.1% (table no. 2).

Table 2. The evolution of the value of exports of meat and organs in Romania, in the period 2010-2020

Countries	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Average	C.var.*	Annual rate	2020/ 2010	2020/ 2015	2020/ 2019
	Euro thousand												%	%	%	%	%
Total export Romania	125824	212917	262072	227194	212570	247863	237078	281002	263703	238213	195107	227594.8	18.5	4.5	155.1	78.7	81.9
United Kingdom	2415	7679	12082	18728	22896	39790	43917	42287	45048	37904	27354	27281.8	56.9	27.5	1132.7	68.7	72.2
Italy	10231	11200	8125	7112	12634	15686	15730	20576	29686	26842	23861	16516.6	46.6	8.8	233.2	152.1	88.9
Hungary	17471	29986	32944	45157	30495	18015	16448	17257	20325	21236	25130	24951.3	35.8	3.7	143.8	139.5	118.3
Bulgaria	48110	94255	97138	28342	25021	30666	27800	34179	31807	25014	26190	42592.9	63.5	-5.9	54.4	85.4	104.7
France	1969	3696	6273	14332	22996	29261	26049	24947	22417	26515	18828	17934.8	54.9	25.3	956.2	64.3	71.0
Netherlands	5211	12567	31644	30201	10363	10082	7719	19652	12066	10771	9581	14532.5	60.9	6.3	183.9	95.0	89.0
Belgium	5772	5107	5080	5300	5409	6115	4620	6636	6762	7558	6349	5882.5	15.0	1.0	110.0	103.8	84.0
Greece	3529	10259	19608	16378	17741	21854	21781	18115	12883	11394	6437	14543.5	42.2	6.2	182.4	29.5	56.5
Slovakia	5006	3173	2882	6359	6346	2489	610	1758	2500	3771	3966	3532.7	51.2	-2.3	79.2	159.3	105.2
USA	0	0	0	0	0	0	0	0	91	1804	4032	538.8	237.1	-	-	-	223.5
Germany	2729	7035	9281	12964	13362	12205	7214	5983	7672	5268	3914	7966.1	45.3	3.7	143.4	32.1	74.3
Austria	890	2557	5283	4638	3136	4177	4337	4103	4001	4545	3258	3720.5	192.0	-	-	-	186.0
Czech Republic	2169	1448	397	126	628	634	1629	3741	5007	4992	2651	2129.3	73.2	-7.4	46.1	23.6	31.2
Kuwait	0	0	0	0	0	0	0	423	703	2009	3737	624.7	56.9	27.5	1132.7	68.7	72.2
Jordan	8062	5899	229	2529	2276	15734	5580	16658	12033	11906	3719	7693.2	46.6	8.8	233.2	152.1	88.9

Source: own calculation based on TRADE MAP data

In 2010, Romania exported meat and organs mainly to Bulgaria worth 48.1 million euros (with a share of 38%), Hungary and Italy, with values of 17.5 million euros (14%) and 10.2 respectively million euros (8%). In 2015, the main market for Romanian meat was England with a value of 39.8 million euros (with a share of 16% of total exports), followed by Bulgaria with 30.7 million euros (13%) and France with 29.3 million euros (12%).

At the level of 2020, England ranks first as the main importer of meat and organs, with a value of 27,354 thousand euros (14%), followed by Bulgaria and Hungary with values of 26.2 million euros (14%) and respectively 25.1 million euros (13%).

It should be noted that since 2017, respectively 2018, Romania exports meat and organs to Kuwait and the USA in the amount of 3.7 - 4 million euros.

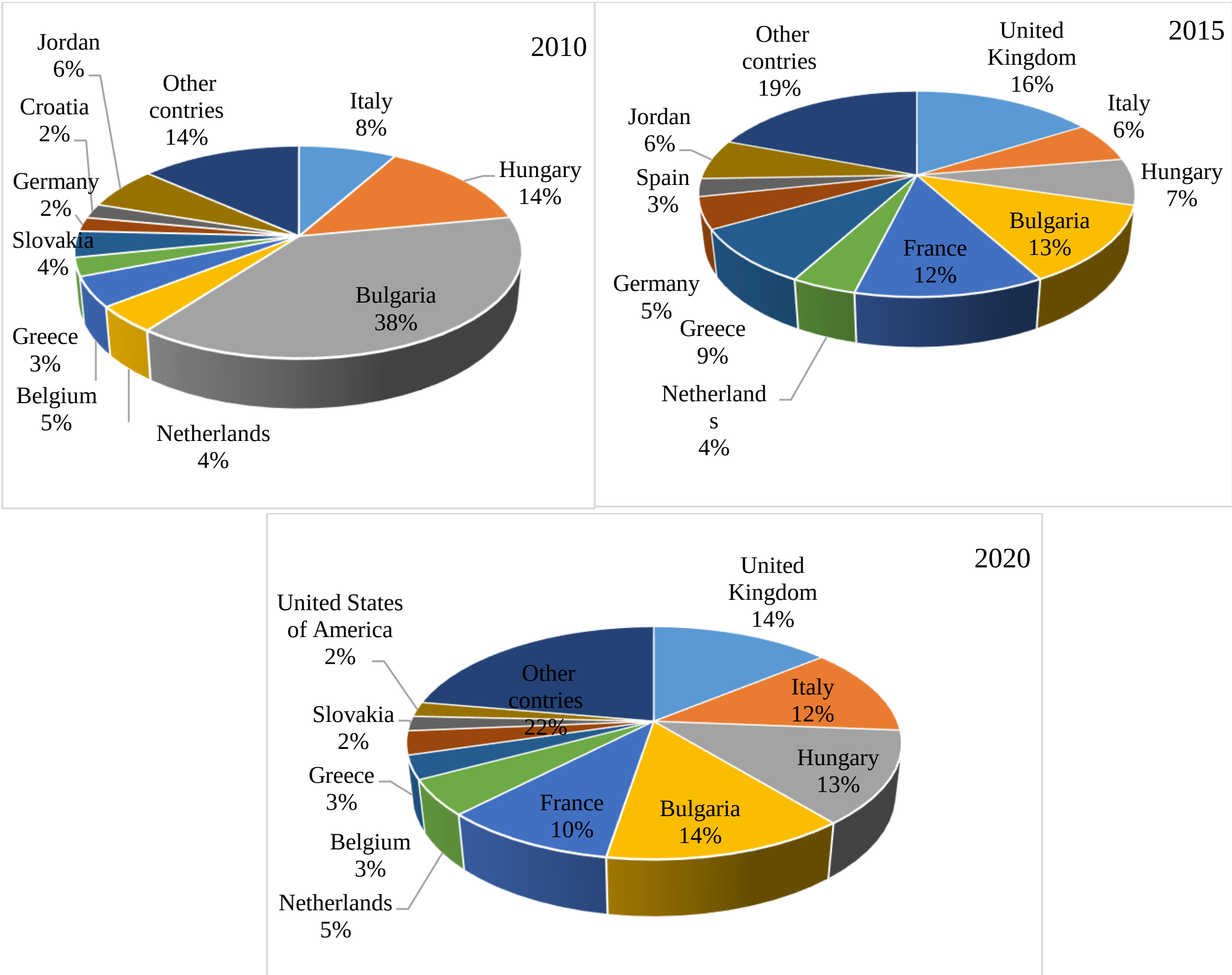

Figure 2. The structure of Romania's meat and organ exports to the main importing countries, in 2010, 2015 and 2020.

Source: Own calculation based on TRADE MAP data

Regarding the trade balance with meat and organs, a deficit can be observed throughout the analyzed period, the lowest being in 2012, of -216.1 million euros, and the most accentuated in 2020 of 717.3 million euros. (fig. 3)

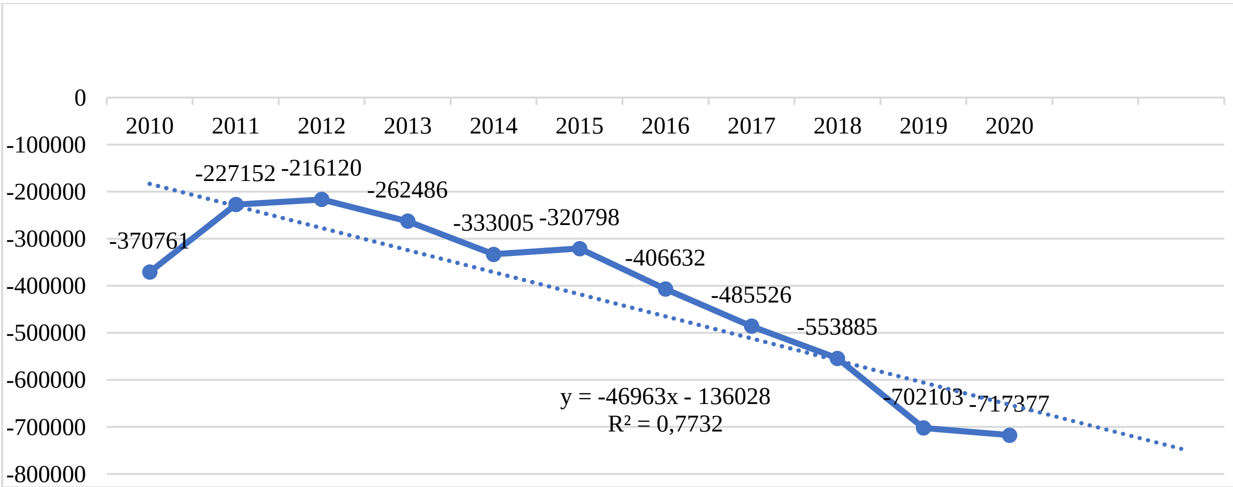

Figure 3. Evolution of the trade balance with meat and organs, in the period 2010-2020, th. euro

Source: processing based on TRADE MAP data

CONCLUSIONS

The animal breeding sector has undergone great transformations in recent years. Animal breeding is a tradition in our country, Romanians being big consumers of meat, especially pork. However, livestock numbers have decreased in recent years, with the exception of sheep and goats, which have increased. To cover this deficit and ensure meat consumption, Romania relies on massive imports.

The rate of evolution of Romania's export and import of meat and organs has determined a significant deepening of the deficit in these products, by 2.2% (15.3 million euros) in 2020, compared to 2019, and compared to 2010 it has increased with 93.5% (345.6 million euros).

The Covid-19 pandemic determined a lower economic activity, a fact that negatively influenced Romania's meat and organ trade, decreasing both external demand and domestic production.

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STUDY ON MEAT CONSUMPTION IN ROMANIA IN THE PERIOD 2010-2020

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Abstract: *When we talk about the consumption of a food, we must take into account its importance for a balanced human diet, its production capacity, consumer preferences for that food and, last but not least, retail prices. Taking into account the current challenges regarding the provision of food for the entire population of the globe and its access to healthy food, the periodic analysis of these indicators is necessary to be able to develop policies and strategies at the global, regional and/or the national level. The purpose of the paper is to analyze meat consumption in Romania in the period 2010-2020, starting from the data provided by the National Institute of Statistics, in order to estimate the trend in a future time horizon.*

Keywords: *consumption, meat, urban, rural*

JEL classification: I31, O11

INTRODUCTION

The challenge of this century is to ensure the food needs for the entire population of the globe in continuous growth, while also ensuring access to healthy food (Beia S.I. et al., 2017). Another challenge is the preservation of biodiversity and combating climate change, bearing in mind that in the European Union, agriculture is responsible for producing 10% of greenhouse gas emissions. In this context, farmers in today's agriculture must produce more with less money and protect the environment. Part of the European Green Deal, the Farm to Fork Strategy provides long-term development opportunities so that farmers become champions in the fight against climate change. The "Farm to Fork" strategy must offer the possibility of strengthening the position of farmers in the food chain. This strategy must be seen as a whole, because the circular economy, bioeconomy, forestry and energy policy are closely related to the food system. (Elsi Katainen, 2020).

In the narrow sense of the terms, from the "Farm to Fork" Strategy, for a producer, the road from the farm to the fork should be as short as possible, as if we were taking the food from the plate directly to the mouth. The need for food under the conditions of compliance with food security and safety rules, makes the road "From Farm to Fork" longer, more expensive and with many restrictions for all "actors" (producers, intermediaries, consumers).

Among the products of animal origin, meat is in the first place, due to its high content in protein substances, high digestibility and adaptability to various culinary products. It is the main source of high quality protein. Its nutritional value depends primarily on its chemical composition, so on the species.

The balanced consumption of meat ensures the essential amino acids, which play a role in the formation of nucleo-proteins and enzymes that activate the vital functions and processes of the human body. From the amount of protein derived from meat, the protein provided by pork currently has the largest share, followed by beef, a fact also proven by the large shares they hold in multi-year productions (approximately 40% pork , cattle approximately 25%).

Within the livestock sector, meat represents the main production in terms of protein, quantity and value. Due to its nutritional value and its organoleptic properties, meat is a highly demanded product in the international trade of basic foods, being an important indicator of the standard of living in a country. From a trophic-biological point of view, meat is the main food with an energetic role in the human diet. Meat proteins, regardless of the species, have a high content of essential and non-essential amino acids that participate in the formation of hemoglobin, while the organs are a source of iron, the complex of B vitamins and vitamin PP, with a hematopoietic role. Meat consumption increases the resistance of the human body to infections and toxic substances, stimulates the activity of the CNS. Meat fats, consumed in moderation, serve to transport fat-soluble vitamins (A, D, E, K) (V. Sârbulescu, V. Stănescu, I. Văcaru-Opriș, Cornelia Vintilă, 1983).

MATERIAL AND METHOD

The analysis is based on statistical data provided by the INS regarding meat consumption in Romania in the period 2010-2020, calculating the statistical indicators: arithmetic mean, standard deviation, coefficient of variation, annual growth rate and linear trend equation. The formulas used to calculate these indicators are presented below:

1. For the arithmetic mean:

$$\overline{x} = \frac{\sum_{i=1}^{N} x_i}{N}$$

Where: X = arithmetic mean;
Xi = value of production/consumption per number of years (i);
N = number of years

2. For the standard deviation ( ) it is calculated as a square mean of the deviations of all elements of the series from their arithmetic mean (Dănciulescu Daniela):

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

The root mean square deviation is a basic indicator, which is used in the analysis of variation, in the estimation of selection errors in the correlation calculation.

3. For the coefficient of variation (ν) it is calculated as a ratio between the mean squared deviation and the arithmetic mean. It is expressed as a percentage:

$$\nu = \frac{\sigma}{\overline{x}} \cdot 100$$

Meaning. The closer the value of v is to zero, the weaker the variation, the more homogeneous the community, the average having a high degree of representativeness. The higher the value of v, the greater the variation, the more heterogeneous the community, and the lower the significance of the mean. It is appreciated that at a coefficient above 35-40%, the average is no longer representative and the data must be separated into series of components, by groups, depending on the variation of another grouping characteristic.

1. The annual rate of growth = $r2010-2020 = 11\sqrt{\prod\left(\frac{p1}{p0}\right) - 1}$;

Where : ∏p1/po = the product of the indicators in the chain for the analyzed period (*Anghelache Constantin, Manole Alexandru , 2012*).

2. Linear regression: Y(x) = ax + b

Where: a, b = coefficients or parameters of the equation;

a = the parameter of the explanatory or factorial variable defining the linear increase/decrease;

b = the free term or constant;

x = the exogenous chronological variable or time expressed in years (*Necula, R., Stoian, M. and Drăghici, M., 2016*).

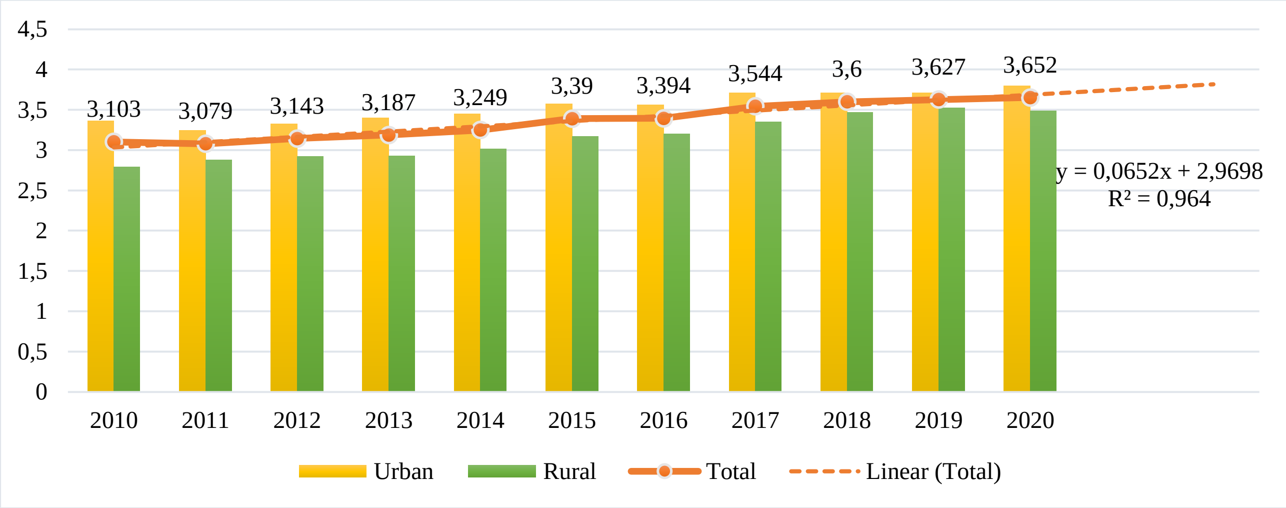
RESULTS AND DISCUSSIONS

According to statistical data, in Romania, the total production of meat in the period 2010-2020 recorded small variations (C. var= 5.6%), standing around the average of 1,305.26 thousand live weight tons. The lowest production was reported in 2013, being 1,299.53 thousand live weight tons, and the highest in 2019, being 1,494.89 thousand tons. In 2020, meat production was 11.7% higher than in 2010, but 2.5% lower than in 2019. In Romania, the average monthly consumption is approx. 3.4 kg of fresh meat, the consumption trend during the analyzed period being increasing from 3.103 kg/person/month in 2010 to 3.652 kg/person/month in 2020, the increase being 17.7%. Adjustment with the help of linear regression indicates that this consumption growth trend is maintained in 2021, reaching 3.752 kg/person/month (figure 1).

Depending on the residence environments, we observe that larger amounts are consumed in the urban environment compared to the rural environment. Thus, in 2010, in urban areas a person consumed 3.362 kg of meat monthly, and in rural areas by 0.572 kg less. Consumption increased in both residence environments, but in 2020, consumption in urban areas continued to increase compared to previous years reaching 3,793 kg/person, while in urban areas it decreased by 1.1% compared to 2019 (figure 1).

Poultry takes first place in consumer preferences, due to its more affordable price and its high digestibility at any age. In 2010, an average of 1.52 kg of poultry meat/person/month was consumed. This indicator increased during the analyzed period, 2010-2020 reaching the end of the interval at 1.629 kg/person/month (table 1).

Figure 1 Evolution of meat consumption, monthly average per person, by residence, in the period 2010-2020



Source: National Institute of Statistics of Romania

On the second place in the preferences of Romanian consumers are meat dishes, being more and more sought after, so that from an average consumption of 1.068 kg/person/month, in 2010, it increased to 4.406 kg/person/month in 2020, the increase being significant of 31.6% (table 1).

Table no.1 Evolution of average monthly meat consumption per person in Romania during 2010-2020

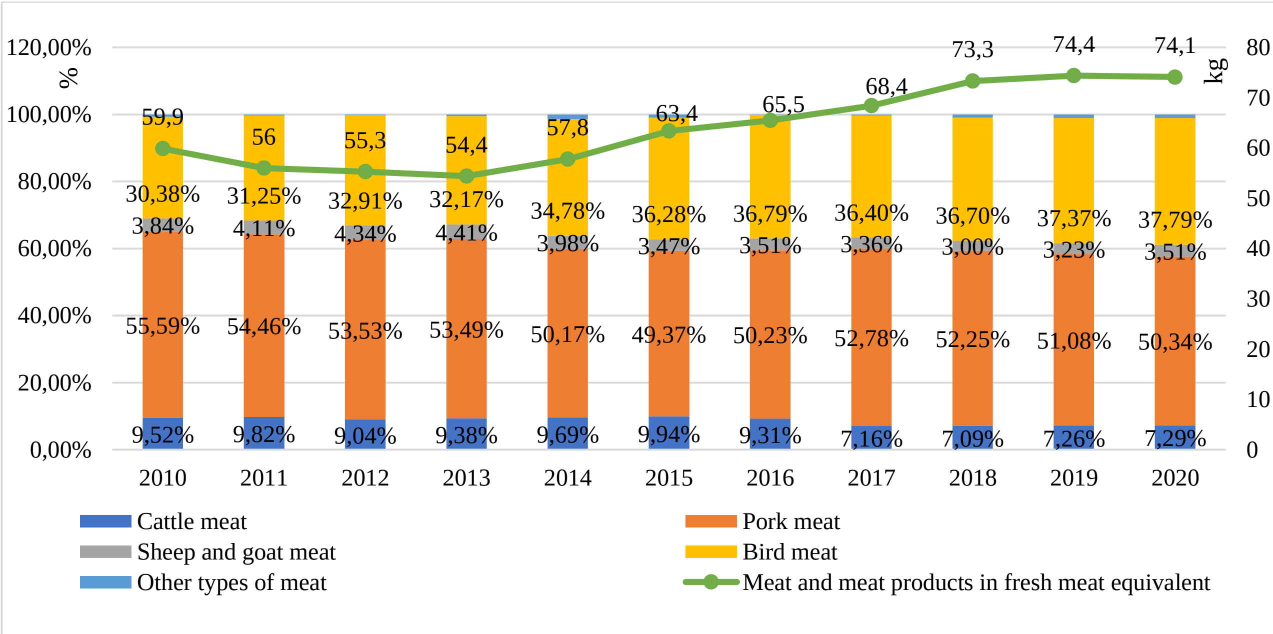
Products	2010	2011	2013	2015	2017	2019	2020	Average	Standard deviation	C.var.*	Annual rate	2020/ 2010	2020/ 2015	2020/ 2019
Fresh meat, total (kg)	Kg/person/month									%	%	%	%	%
	3.103	3.079	3.187	3.39	3.544	3.627	3.652	3.4	0.2	6.5	1.6	117.7	107.7	100.7
Beef	0.325	0.28	0.274	0.301	0.331	0.32	0.322	0.3	0.0	8.2	-0.1	99.1	107.0	100.6
Pork meat	0.904	0.939	0.989	1.161	1.257	1.317	1.352	1.1	0.2	14.4	4.1	149.6	116.5	102.7
Bird meat	1.52	1.522	1.58	1.591	1.593	1.615	1.629	1.6	0.0	2.3	0.7	107.2	102.4	100.9
Meat preparations (kg)	1.068	1.023	1.031	1.101	1.202	1.238	1.406	1.1	0.1	10.7	2.8	131.6	127.7	113.6

Source: National Institute of Statistics of Romania

The consumption of pork increased the most. so that in 2020. approximately 50% more pork was consumed compared to 2010 and 2.7% more compared to 2019. The least common assortment on the Romanians' meal is represented by beef. they consume on average only 0.3 kg/person per month. The explanation for this fact is related to the high prices of this assortment and the low purchasing power. In the period 2010-2014 beef consumption decreased from 0.325 kg/person to 0.28 kg/person. then until 2018 it increased to 0.341 kg/person. and in recent years it decreased again to 0.32 kg /the person.

Regarding the average annual consumption of meat and meat products. it can be observed that in the first years of the period the trend was one of reduction. but starting from 2014. it starts to increase. reaching a maximum of 74.4 kg/inhabitant in 2019 In the following year. the consumption of meat and its products is slightly reduced by 0.3%. still remaining at a fairly high level of 74.1 kg/inhabitant.

Figure 2 Evolution of annual meat consumption per inhabitant and the share of different types of meat. in the period 2010-2020



Source: National Institute of Statistics of Romania

According to the data of the National Institute of Statistics. pork meat is consumed in the first place. with an annual average of 37.3 kg/inhabitant. so that in 2020. it exceeds the consumption of 2010 by 12%. More than 50% of the total annual meat consumption is represented by the consumption of pork and only in 2015 it decreased to 49.7%. a fact due to the increase in the consumption of beef and poultry. The consumption of poultry meat increased a lot. so that in 2020. an inhabitant consumed an average of 28 kg annually which represents an increase of 53.8% compared to 2010. As a share of the total average annual meat consumption. poultry meat occupied in 2010. 30.38%. and with small variations it reaches 37.79% in 2020.

Table no. 2. The evolution of the average annual meat consumption per inhabitant in Romania in the period 2010-2020

Products	2010	2011	2013	2015	2017	2019	2020	Average	Standard deviation	C.var.*	Annual rate	2020/ 2010	2020/ 2015	2020/ 2019
	Kg/person/year									%	%	%	%	%
Meat and meat products in fresh meat equivalent	59.9	56	54.4	63.4	68.4	74.4	74.1	63.9	7.8	12.2	2.2	123.7	116.9	99.6
Beef	5.7	5.5	5.1	6.3	4.9	5.4	5.4	5.5	0.4	8.0	-0.5	94.7	85.7	100.0
Pork meat	33.3	30.5	29.1	31.3	36.1	38	37.3	33.2	3.6	11.0	1.1	112.0	119.2	98.2
Sheep meat goats	2.3	2.3	2.4	2.2	2.3	2.4	2.6	2.3	0.1	4.8	1.2	113.0	118.2	108.3
Bird meat	18.2	17.5	17.5	23	24.9	27.8	28	22.4	4.2	18.9	4.4	153.8	121.7	100.7
Other types of meat	0.4	0.2	0.3	0.6	0.2	0.8	0.8	0.5	0.3	64.0	7.2	200.0	133.3	100.0

Source: National Institute of Statistics of Romania

Beef is poorly represented, in 2020 the average annual consumption is 5.4 kg/inhabitant (-5.3% compared to 2010) and has a share in the total meat consumption of only 7.29%. Consumption of mutton and goat meat, although it increased by 13% in 2020 compared to 2010, it remains at a low level, an inhabitant consuming on average 2.6 kg annually, which represents approximately 3.7% of total meat consumption. As we have already mentioned, retail prices, different for each category and for each assortment, have been on the rise in the last decade, the causes being multiple: the increase in inflation and the decrease in purchasing power, the increase in the price of energy, fuel and/or power for work. So, the purchase price of pork, at the level of Romania, has increased quite a lot in the period 2010-2020, from 4.93 lei/kg live in 2010 to 6.72 lei/kg live in 2020, representing an increase of 36.3%.

In 2020, beef was purchased at a price of 7.88 lei/kg live. There is an increase of 62.5% compared to the price of 2010 and 9.3% compared to 2019. The purchase price for sheep meat, in Romania during 2010-2020, it varied a lot with values from 5.38 lei/kg live in 2010 to 9.56 lei/kg live in 2020. For poultry meat, the purchase price started from 3.2 lei/kg live in 2010, It rose to 4.32 lei/kg live in 2013, but it decreases until 2018 to 3.56 lei/kg live. In 2020, the price for poultry meat rose to 3.81 lei/kg live, 3.8% higher compared to the previous year and 19.1% compared to 2010.

CONCLUSIONS

One of the most current problems of the economy is the appreciation and valorization of animals according to quality, seeking to harmonize existing differences between the breeders, the sellers and the processors of animals. The evaluation and valorization of animals according to carcass quality based on scientifically based criteria and methods is more recent, using meat quality assessment and coding systems.

Meat contains about 1% mineral salts, their structure varying depending on the species and its anatomical part. So, meat contains: potassium, sodium, calcium, magnesium, iron but also cobalt, aluminum or selenium. In addition to minerals, in meat we find a series of vitamins from the B complex (B1, B2, B3, B6, C and PP) and enzymes (glycolytic, phosphorylases, phosphatases, etc.). Ideally, we should consume 100 grams of red meat per day, 2 times a week and 150 g a day of white meat to bring the body's intake of minerals, necessary vitamins and enzymes. The consumption needs of the body of an adult who performs daily physical activities of medium intensity would translate into an average monthly consumption of 3.8 kg of meat, a single serving per day. It follows that it is not fully covered, average consumption in 2020 being approximately 3.65 kg.

Quality and assortment determine the selling prices. Combined with the average income of the population and its consumption preferences, with the ages of the consumers, they create an image of meat consumption in Romania in the last 10 years. In recent years, the average annual consumption of meat has increased, reaching a record level in 2019, of 74.4 kg/inhabitant. This evolution was supported by the increase in revenues and the reduction of the VAT rate (starting in 2015). Meat production in Romania exceeded 1.4 million tons in 2015, reaching a maximum level in 2019 of almost 1,495 million tons.

According to estimates, consumption exceeded Romania's production level, resorting to imports, which led to the intensification of the meat trade balance deficit. Almost 90% of meat consumption is represented by pork and poultry. Although there has been a slight increase in recent years, the consumption of sheep and goat meat is kept at a fairly low level. On the other hand, beef consumption showed a downward trend. According to studies, over 90% of Romanians consume meat at least once a week, and almost 50% almost daily. The young people preferring chicken meat, but people over 45 prefer pork. Beef is preferred by a certain category of people, being a high quality meat, more expensive than the other two. A top quality meat involves higher production costs, which is reflected in the shelf price.

The trend of recent years is to eat fresh meat, coming from the private farms or private sources with which a relationship of trust is created over time. This openness towards rural farms is also recognized by the authorities who come to the aid of farmers by establishing policies to support the sector, especially due to the fact that a decrease in the production and consumption of meat is expected in the coming years. This decrease is attributed to the decrease in purchasing power as well as changes in consumer preferences towards meat.

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THE ECONOMIC EFFICIENCY OF USING HEIFERPLUS SEMEN IN DAIRY FARMS

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Abstract: *This work aims to increase the economic efficiency of dairy farms by improving the fecundity indicators and increasing the number of cows obtained. The research was carried out in the context in which the slaughter age of cows has decreased to 2.8 lactations, and the herds of dairy cows in our country are in a proportion of 93% held in holdings of up to 5 heads, which endangers the sustainability of these farms. In the context where 0.8% of cattle/year are obtained from a cow, of which only 0.6% are viable and according to the ratio between the sexes, only 0.3% of cattle are born and the exchange of generations in this species is high, 4.8 years , the use of new semen processing technologies is required. One of these technologies is HeiferPlus. This technology uses conventional sperm enhanced with certain enzymes that capacitate spermatozoa carrying X or Y chromosomes depending on the desired direction. The work was carried out at the Research and Development Institute for Bovine Balotesti, on a herd of 89 heads, cows of the Romanian Black Spoted breed, where the efficiency of the use of HeiferPlus semen was analyzed. From the analyzed data, an increase in fecundity was found by 4.03% and the proportion of females obtained was 57.5%. In these conditions, the use of HeiferPlus sperm is recommended because by increasing fecundity, production costs decrease by reducing calving intervals and obtaining more cattle ensures the maintenance/increase of existing herds.*

Keywords: *economic efficiency, cows, HeiferPlus semen*

JEL classification: Q01, Q19,Q55

INTRODUCTION

This work aims to increase the economic efficiency of dairy farms by improving the fecundity indicators and increasing the number of cows obtained. The research was carried out in the context in which the slaughter age of cows has decreased to 2.8 lactations, and the herds of dairy cows in our country are in a proportion of 93% held in holdings of up to 5 heads, which endangers the sustainability of these farms. In the context where 0.8% of cattle/year are obtained from a cow, of which only 0.6% are viable and according to the ratio between the sexes, only 0.3% of cattle are born and the exchange of generations in this species is high, 4.8 years, the use of new semen processing technologies is required. One of these technologies is HeiferPlus. This technology uses conventional sperm enhanced with certain enzymes that capacitate spermatozoa carrying X or Y chromosomes depending on the desired direction.

MATERIAL AND METHOD

The work was carried out at the Research and Development Institute for the Breeding Cattle of Balotesti, between May 2020 and December 2021, on a herd of 89 cows of the Romanian Black Spoted breed that belong to the Institute. The analyzed cows were divided into two batches: the first batch consisted of 39 heads and the second one of 50 heads. The batch of 39 cows was artificially inseminated with conventional frozen semen and the batch of 50 cows was artificially inseminated with frozen semen obtained through HeiferPlus technology.

The frozen semen used in the experiment came from the Semtest Craiova resort and the amount of sperm used was collected from the Amadeo bull owned by Semtest. The gloves used for artificial insemination (AI) and the transrectal examination of cows as well as the sequins used for the torch during artificial insemination were purchased from the same Semtest.

The artificial insemination of the cows from the two experimental groups was carried out on a normal heat cycle by the bimanual method. The pregnancy diagnosis was performed 30 days after the artificial insemination. The gender diagnosis was performed 40 days after the confirmation of the pregnancy, respectively 70 days after the artificial insemination. Pregnancy control and gender diagnosis were carried out by specialists from the Institute with the help of a portable ultrasound machine through transrectal examination.

The obtained data were processed statistically with the help of the Microsoft Excel program.

RESULTS AN DISCUSION

Table number 1 shows the fecundity analysis of cows from the two experimental groups. Fecundity represents the ability of animals to reproduce. This is achieved by the union and fusion of the two cells, the ovule and the sperm. In both females and males, fecundity is a hereditary characteristic influenced by many factors such as: the morphofunctional state of the genital system, the quality of the gametes, age, climatic factors, the use regime of the breeders, etc. Fecundity is assessed by the number of females that remained pregnant or by the number of artificial inseminations required to obtain a fertilization. The ideal fecundity in this species requires obtaining one calf/year (Jill Peine, 2022).

Table 1.Fecundity analysis and number of artificial insemination / gestation

Bull name/ frozen semen used	AMADEO HeiferPlus	AMADEO conventional	Frozen semen HeiferPlus/ Frozen semen conventional
n	50	39	
% FECUNDITY I IA	66	51,3	28,65%
% FECUNDITY II IA	78	74,3	4,97%
% FECUNDITY III IA	80	76,9	4,03%
No AI/G	1.8	2	
Fecundity semen HeiferPlus ~ fecundity semen conventional			0,340936 (p>0.05)

Table 1 shows that the fecundity obtained at the first insemination in the group of cows artificially inseminated with m.s.c. HeiferPlus was 66% which represents good fecundity (Cheryl Waldner 2022). This increased fecundity may be due to the higher movement speed of HeiferPlus spermatozoa (Heather R Ruemke 2022). The fecundity analysis of the group of cows inseminated with conventional semen shows that the fecundity obtained at the first insemination was 51.3%, which equates to low fecundity. The fecundity difference between the two groups analyzed at the first artificial insemination was approximately 29% higher in the group inseminated with HeiferPlus sperm. The results obtained at the second insemination show that in both batches of cows, fecundity exceeded 70%, which equates to good fecundity. The difference in fecundity between the two batches at the second artificial insemination was approximately 5% higher in favor of the HeiferPlus sperm.

From the fecundity analysis obtained at the third artificial insemination, it is found that in the batch of cows where HeiferPlus frozen semen was used, this was 80%, which equates to a very good fecundity according to the specialized literature. The fecundity recorded in the group of cows where conventional frozen semen was used was somewhat lower, at 76.9%. The fecundity difference between the two batches was 4.03% higher in favor of the group of cows inseminated with HeiferPlus semen. If we relate this difference to what the manufacturer claims, namely that this sperm increases by 5-15% the chances of obtaining a pregnancy, we find that the result obtained in this experiment is close to the minimum threshold of progress ensured by the manufacturer. The analysis of the coitus index shows that in the group of cows artificially inseminated with HeiferPlus semen, the AI/G number was 1.8, which equates to good fecundity. In the batch of cows artificially inseminated with conventional semen, 2 inseminations were necessary to obtain a pregnancy, which equates to good fecundity. When the fecundity is greater than 2 AI/G, it is intervened (Ioan Hutu 2019).

Fisher's test analysis (p=0.340936) shows that there are no significant differences between the two groups of cows ($p \geq 0.05$). Even if from a statistical point of view no significant differences were found in the two batches of cows, from a percentage point of view differences in fecundity existed. Thus, during the second artificial insemination, the farmer spent 28.65% more conventional sperm, more gloves for the transrectal examination, more protective sequins and napkins in an attempt to achieve a pregnancy compared to HeiferPlus sperm. In the 3rd AI the expenses were 4.93% higher in the group of cows inseminated with conventional sperm compared to the group of cows inseminated with frozen semen HeiferPlus.

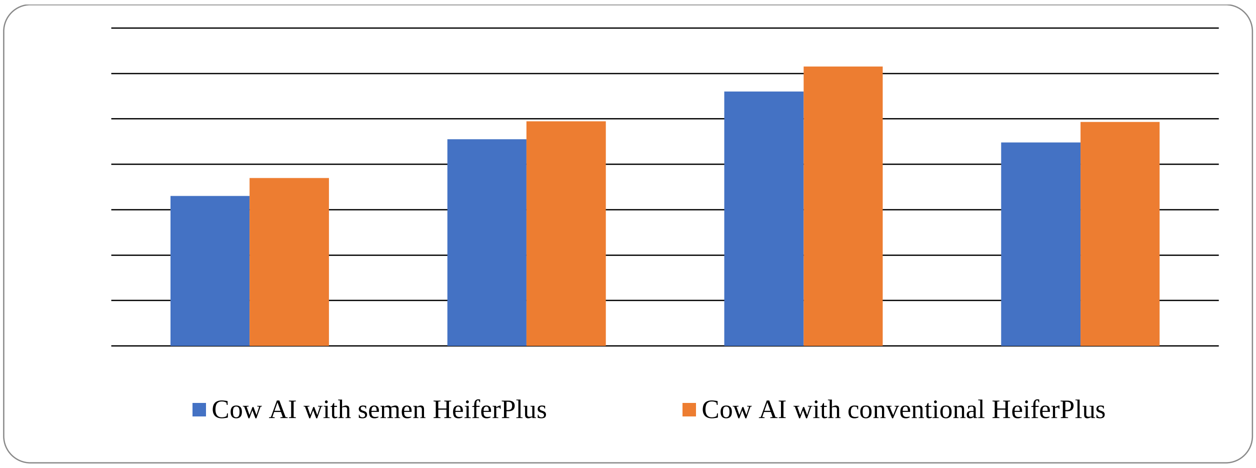

Figure 1. Analysis of the service period for the two batches of cow

From the graphic image above, it can be seen that the average time elapsed from calving to the first insemination, in cows inseminated with HeiferPlus semen, was approximately 66 days and in cows inseminated with conventional semen, it was approximately 74 days. This shows that there are no significant differences between the two groups. The duration of the estrous cycle between the first and the second IA was on average approximately 25 days, in both batches, which shows that some cows had longer or irregular cycles. This puts the insemination operator at a disadvantage, because he uses the reproduction calendar and based on this he must capture the optimal time window for artificial insemination. As the duration of the estrous cycle in cows has an average of 21 days, these long and irregular cycles have as a consequence, in most cases, the loss of the optimal period for artificial insemination, which leads to an increase in the duration of service period. Service period represents the mobile component of the calving interval. The average duration of srvice period in cows must be 80 days according to specialized literature. From the analyzed data, it can be seen that the duration of service period in the two groups was 89.7 days, in cows inseminated with HeiferPlus semen and 98.90 days in cows inseminated with conventional semen. This score leads to a decrease in income by increasing expenses. Moreover, the analysis of the service period shows that between the two batches there was a percentage difference of 10.25% in favor of the batch of cows artificially inseminated with HeiferPlus semen. This shows that productivity losses are much lower in cows artificially inseminated with HeiferPlus semen than in those artificially inseminated with conventional semen.

After performing the pregnancy diagnosis, 30 days after insemination, the cows are examined to perform the sex diagnosis. It is carried out with the help of the ultrasound machine between 55-90 days after insemination, respectively 25-60 days after the diagnosis of the pregnancy. Normally, in cows artificially inseminated with conventional sperm, 50% males and 50% females are born. New reproduction technologies have made it possible for this ratio to change in the desired direction. Thus, in farms that have herds specialized for milk production, the aim is to obtain females, and in feedlots and farms specialized in the sale of sperm, the obtaining of males. Today, according to specialized literature, up to 85% - 90% of cattle with the desired sex can be obtained.

The HeiferPlus technology, according to those who sell it, allows obtaining 60% - 70% of cattle of the desired sex with relatively low costs and with a better fecundity by approximately 5% - 15%. (https://www.semtestcraiova.ro/#facilities)

Table 2 shows the ratio between the sexes obtained in the two groups analyzis

Table 2 The analysis of the ratio between the sexes carried out in the two experimental groups

n = 40 gestation semen HeiferPlus	Sex ratio semen HeiferPlus		Sex ratio with conventional semen	
n= 30 gestation with conventional semen	Males	Females	Males	Females
% sex ratio	42.5	57.5	53	47
Percentage difference between males and females	35.29		12.76	
Ftest sex ratio semen HeiferPlus ~ conventional semen	p=0.484476			
CHITEST sex ratio semen HeiferPlus 60% females	p=0,609834			
CHITEST sex ratio semen HeiferPlus 70% females	p=0,006377			
CHITEST sex ratio conventional semen	0,548506			

The sex diagnosis was carried out on the 70th day after insemination, respectively 40 days after the diagnosis of pregnancy and was carried out with the help of the ultrasound machine. The analysis of the gender ratio shows that in the group of cows inseminated with semen HeiferPlus, the percentage of females obtained was 57.5% and that of males was 42.5%. Similar results were obtained by Gaffari Turk and colleagues . The difference between the number of males and females was 35.29% higher in favor of females. This favors the farmer, breeder of milk cows, because in the next period the number of replacement females will increase, which will allow a better selection among the reformed cows. It is known that in dairy farms the biggest expenses are recorded with the purchase of the piggery material. Or in the context where the age of reformation of the cows is approximately 2.8 lactations, the farmer receives the insurance of the replacement female youth.

In the batch of cows AI with conventionally sperm, the percentage of males obtained was 53%, (G. Turk1 2015), 12.76% higher than the number of registered females. The large number of males obtained has the advantage that, in the short term, the farm will benefit from immediate financial resources by selling them, but it has the disadvantage that in the medium and long term, the rigor of the selection will decrease in order not to make the existing herd vulnerable. As the change of generations in cows is high, for 4.8 years, it is preferable that the percentage of females born over a period of time is at least 50% of the products so that this change can be carried out in optimal conditions.

Fisher's test analysis ($p = 0.484476$) shows that there are no significant differences ($p>0.05$) between the two groups regarding the gender ratio obtained. Even if from a statistical point of view these differences are insignificant, percentage-wise there are differences between the two batches which admit that the use of HeiferPlus semen is a viable solution for obtaining a larger number of cattle of the desired sex.

The analysis of the CHITEST indicator was carried out to highlight the differences between the number of cattle with the desired sex obtained and the expected one. Thus, in the group that used conventional sperm, the gender ratio was 53% male - 47% female. As from this sperm it was expected that the gender ratio would be 50% male - 50% female (J.R.Roche 2006), the CHITEST indicator showed that in this batch there were no significant differences ($p = 0.548506$) between the gender ratio obtained and the expected one ($p >0.05$). Even if from a statistical point of view it is found that there are no significant differences between the two sexes obtained, from a percentage point of view they exist and were in favor of males. This, in the long term, does not favor the farmer. In small and medium farms, up to 50 heads, where the profit margin is smaller, these percentage differences can tip the balance decisively between stagnation and progress. In the batch of cows artificially inseminated with HeiferPlus semen, it was found that the percentage of females obtained was 57.5% and that of males 42.5%.

From this batch, according to the estimates provided by the producer, the percentage of cattle obtained varies between 60% and 70%. From the analysis of the CHITEST indicator, it is found that if we compare the values obtained by us to the minimum value of cattle estimated by the producer (60%), there are no significant differences ($p=0.609834$); ($p>0.05$). However, if we report the results obtained by us to the maximum value (70% cattle) estimated by the producer, the CHITEST analysis shows that there are significant differences between the obtained and estimated values ($p=0.006377$); ($p\leq0.001$). By reporting the result obtained by us to the normal one of 50% male - 50% female, it is found that there are no significant differences between the two results ($p=0.133614$); ($p>0.05$).

If we compare the performances obtained by the two batches, namely: cows inseminated with conventional sperm 47% females and 53% males and cows inseminated with semen HeiferPlus 57.5% females and 42.5% males, it is found that between the two batches there are significant differences in terms of the ratio between the sexes of the products of conception obtained ($p=0.035397$); ($p<0.05$).

In order to be able to establish the economic efficiency of the use of HeiferPlus semen, the costs were calculated and the cost price was established. The cost price included: the purchase price of the dose with frozen semen and the price of the gloves for examination/artificial insemination. The price of the sequins for the insemination torch was not included because they come in the package with the frozen semen. In order to be able to make a comparison with the expenses recorded for performing the artificial insemination procedure with the conventional semen, the same costs were taken into account as with the semen HeiferPlus.

In table number 3, the economic analysis of the use of HeiferPlus semen is presented.

Table 3. Economic efficiency of using semen HeiferPlus compared to conventional semen

Bulls	n=	Sperm dose price	No. AI/G	Gloves ETR (lei)	Sex diagnosis 70 days of gestation	
Amadeo HeiferPlus	40	21 Lei	1,8	3.9	17♂	23♀
Amadeo conventional	30	16 Lei	2	4.32	16♂	14♀
The cost of calves obtained from semen HeiferPlus	Females		41.7 Lei		41.7/23*21=38.07 Lei	
	Males				41.7/17*21=51.51 Lei	
The cost of calves obtained from conventional semen	Females		36.32 Lei		36.32/14*16=41.50lei	
	Males				36.32/16*16=36.32lei	
Percentage difference in yield between females obtained with heifer plus and those with conventional semen						9
Percentage difference in yield between males obtained with heifer plus and those with conventional semen						41.82
Percentage difference in yield between calves obtained with heifer plus and those with conventional semen						15.11
Ftest semen HeiferPlus ~ conventional semen						p=0,298049
Correl price semen HeiferPlus/calves						0.546479
Correl price conventional semen/calves						0.612965

From table number 3, it can be seen that the price with which the HeiferPlus was purchased was 21 lei/dose (approximately 4.3 euros). Since 1.8 doses of frozen sperm were used to obtain a pregnancy and 3 ETR shoulder gloves were consumed (0.72 lei/glove), we realize that the price for obtaining a fertilization was 41.7 lei (approximately 8.51 euros). Gloves were used as follows: first for artificial insemination; the second at the pregnancy test and the third at the gender diagnosis. From the data obtained, it was found that the distribution of costs was different between the two sexes registered and this was influenced by the number of products of the same sex obtained. Because of the 40 gestations obtained, 23 were female, resulting in a cost of 38.07 lei (approximately 7.76 euros) for obtaining a cow. From the analysis of the expenses for obtaining a male, it was found that the price was higher, approximately 51.51 lei (approximately 10.51 euros). The percentage cost difference between obtaining females and males in the batch artificially inseminated with semen HeiferPlus was 35.30% in favor of the females. The low cost of obtaining a cow compensates to a small extent the maintenance costs that the farmer has with the cow until it becomes primiparous. The higher cost of obtaining a male will negatively influence its selling price.

From the analysis of the costs of the batch inseminated with conventional semen, it was found that the price for obtaining a female was 38.21 lei and for obtaining a male it was 33.44 lei. The percentage difference in cost between females and males obtained with conventional semen was 14.26% in favor of males.

From the comparative analysis of the costs between heifers bred with HeiferPlus sperm and heifers obtained with conventional sperm, it is found that 9% more was spent to obtain a heifer with conventional material. From the comparative analysis of the costs for obtaining a male, it was found that in the lot inseminated with HeiferPlus the costs were 42% higher. From the analysis of the costs for obtaining a calf, it is found that in the group of cows where HeiferPlus sperm was used, the costs were 15.11% higher compared to the group inseminated with conventional material. As the farm of the Research and Development Institute for the Breeding Cattle of Balotesti owns specialized cows for milk production, so it is concerned with raising replacement female youth, it is found that the use of semen HeiferPlus is more profitable from an economic point of view than the use of conventional frozen semen .

The cost analysis using the Fisher test shows that there are no significant differences between the two batches (p=0.298049); (p>0.05). Even if from a statistical point of view these differences do not exist, percentage differences were found that can decisively influence the farmer's decision to use, in the future, the desired type of sperm for the artificial insemination of the cows in the herd.

The analysis of the correlation between the cost price and the cattle obtained in the lot artificially inseminated with semen HeiferPlus shows that there is a positive correlation between the two (0.546479). Similar results were also obtained from the analysis of the correlation coefficient in the group of cows where the conventional sperm was used (0.612965). This shows that if the costs will be higher, the number of cattle obtained will be higher. For a cow farm, this type of correlation is undesirable. In general, farmers prefer obtaining negative correlations in order to reduce their production costs and increase their benefits.

CONCLUSIONS

- Fecundity in the group of cows artificially inseminated with semen HeiferPlus was higher by 4.03% than in the group of cows artificially inseminated with conventional semen.
- Fecundity at I AI was 28.65% higher in favor of HeiferPlus. This favors the increase of income by decreasing expenses.
- The sex ratio in the group artificially inseminated with semen HeiferPlus was 1.15 in favor of females compared to the group artificially inseminated with conventional semen where the ratio between sexes was 1.06 in favor of males.
- Reproduction indicator no. AI/G shows that in the batch of cows artificially inseminated with semen HeiferPlus, the efficiency was better.

The costs for obtaining a cow were 9% lower in the batch of cows inseminated with semen HeiferPlus, even though the cost of purchasing a dose of frozen semen was +31.25% higher.

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RESEARCH ON THE BREAKEVEN POINT IN MILK AND MEAT PRODUCTION AT RUMINANTS

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Abstract: *Profitability in animal production is at the forefront of approaches and activities continuity, and the breakeven point, or equilibrium point from which profit generation begins, must be reached in the shortest possible time. In the present paper, the breakeven point is analyzed for cow's, sheep's, goat's and buffalo's milk, as well as for beef and sheep meat. The study is based on a total of 197 case studies conducted in ruminant farms of the aforementioned species, with average data for 3 consecutive years: 2017-2019, or 2018-2020. It turned out that the breakeven point synthesizes in its structure the levels of important technical-economic indicators of the activity, such as: the level of production and its capitalization price, which give the value of production, as well as variable and fixed costs. Thus, for the threshold of profitability in physical expression, the following average values were highlighted: for cow's milk 5,506.3 l / head, for beef 378.1 kg / head, for buffalo milk 801 l / head, for sheep milk 153.4 l / head, for sheep meat 17.9 kg / head, for goat's milk 216.1 l / head.*

Keywords: *breakeven point, production, milk, meat, costs*

JEL Classification: Q01, Q12, Q13

INTRODUCTION

Break-even point analysis is an economic tool, used to determine the cost structure of a unit or an activity, or to determine the number/quantity of products that must be sold to cover costs. Breakeven is a circumstance where a farm makes neither profit nor loss, but recovers all the money spent. Break-even point analysis is used to examine the relationship between fixed cost, variable cost and revenue. It calculates the minimum number of units to sell and the sales volume needed to cover all expenses before turning a profit.

In the course of agricultural activities, farmers must use this indicator as a decision-making and planning tool, due to its impact, efficiency and accuracy regarding the optimal use of resources, but also as a mean of control (Alnasser, N., Shaban, O. S., & Al-Zubi, Z., 2014).

Break-even point analysis provides information on, on the one hand, the volume of production sold at a certain price, to cover the costs involved, especially the fixed ones (Sintha, L., 2020), and on the other hand, it calculates the price required for a certain level of production, which covers all costs (Gutierrez, P. H., & Dalsted, N. L., 1990).

Kucharski, R., & Wywiał, J. L. (2019) appreciates the fact that break-even analysis is a classic management accounting tool. The changes that take place in the conduct of activities, such as the physical volume of production, the quantification of the impact of a higher turnover, the application of modernization programs constitute economic decisions, the basis of which is based on the knowledge of the level of the critical point (Iacob, S. V., 2014).

MATERIAL AND METHOD

The present paper performs a comparative analysis of the physical and value break-even point for cow, sheep, goat and buffalo milk, as well as beef and sheep meat, based on the results of 197 case studies carried out in farms of ruminants of the previously mentioned species. The data represent the averages for the years 2017, 2018 and 2019 for sheep milk, goat milk and sheep meat and for the years 2018, 2019 and 2020 for cow milk, buffalo milk and beef.

RESULTS AND DISCUSSIONS

Break-even point for sheep's milk

For sheep's milk, this indicator was calculated based on data from 47 case studies - sheep farms from all over Romania. The average milk production was between 29.33 - 146.67 liters/head, as an average of the years 2017-2019.

The physical profitability threshold had an average of 153.35 liters/head, with a minimum of 58.82 liters/head, a maximum of 626.37 liters/head, the standard deviation of 86.73 liters, and the coefficient of variability of 0.57 (Chart 1).

For sheep's milk, this indicator was calculated based on data from 47 case studies - sheep farms from all over Romania. The average milk production was between 29.33 - 146.67 liters/head, as an average of the years 2017-2019.

The physical profitability threshold had an average of 153.35 liters/head, with a minimum of 58.82 liters/head, a maximum of 626.37 liters/head, the standard deviation of 86.73 liters, and the coefficient of variability of 0.57 (Figure 1).

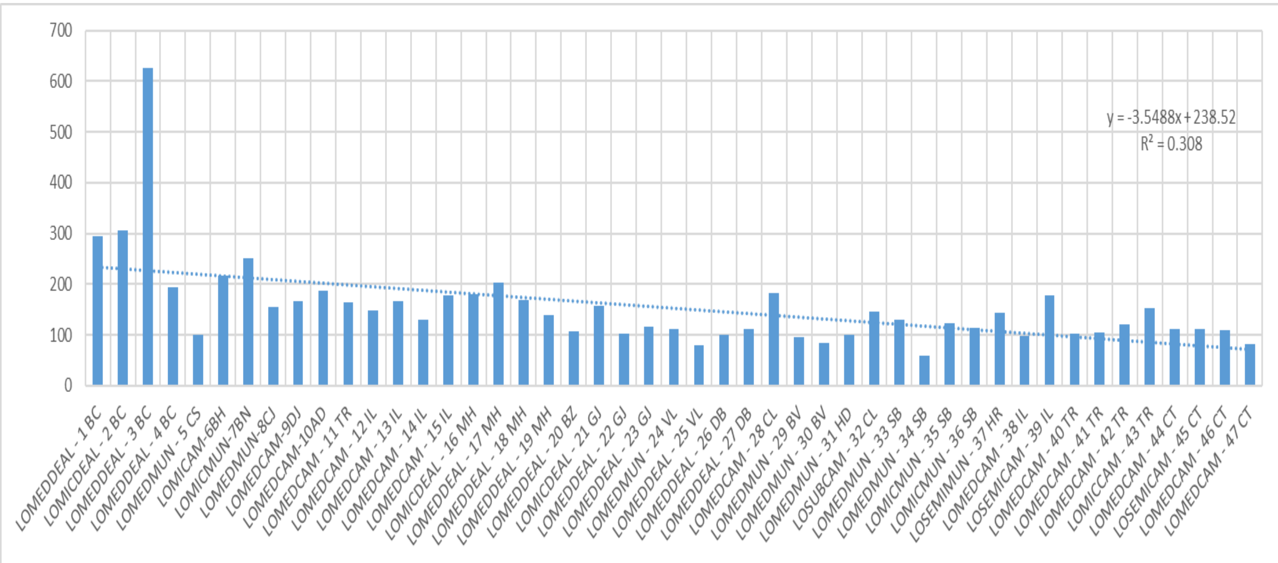

Figure 1 – Break-even point in physical units for sheep's milk

Source: Own calculations

The value profitability threshold was, on average, 490.24 lei/head, with a minimum of 283.07 lei/head, a maximum of 1586.81 lei/head, the standard deviation of 199.45 lei/head and the coefficient of variability of 0.41. The best values of the break-even point were obtained in farms with advantageous delivery prices, with high herds, with low fixed expenses (Figure 2). The milk recovery prices were between 2.47 - 5.01 lei/liter.

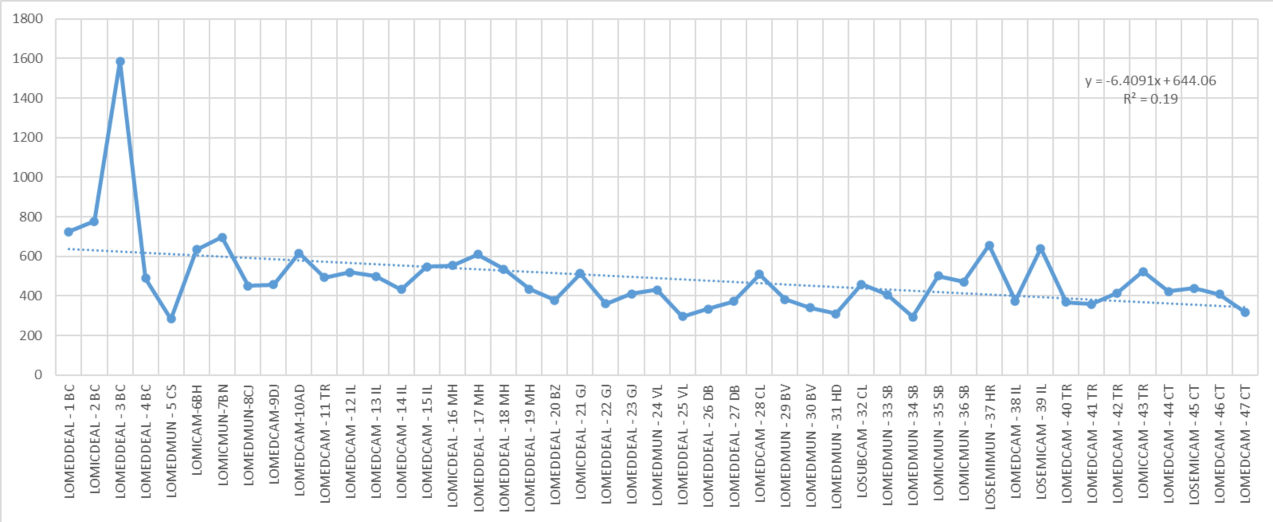

Figure 2 – Break-even point in value units for sheep's milk

Source: Own calculations

The break-even point is a key tool for planning and managing the economic-financial results of a farm, especially in the first years of activity (Rambo, C. M., 2013), it is the point at which farm is able to produce a higher yield than the average cost of productions (Ubal, N. P., 2020).

Break-even point for sheep meat

For sheep meat, break-even point was calculated based on data from 15 case studies. The average production was between 31.67 – 50.0 kg live weight/head, with an average of 38.38 kg live weight/head. The physical break-even point averaged 17.85 kg live weight/head, with a minimum of 7.67 kg live weight/head and a maximum of 31.29 kg live weight/head (Figure 3).

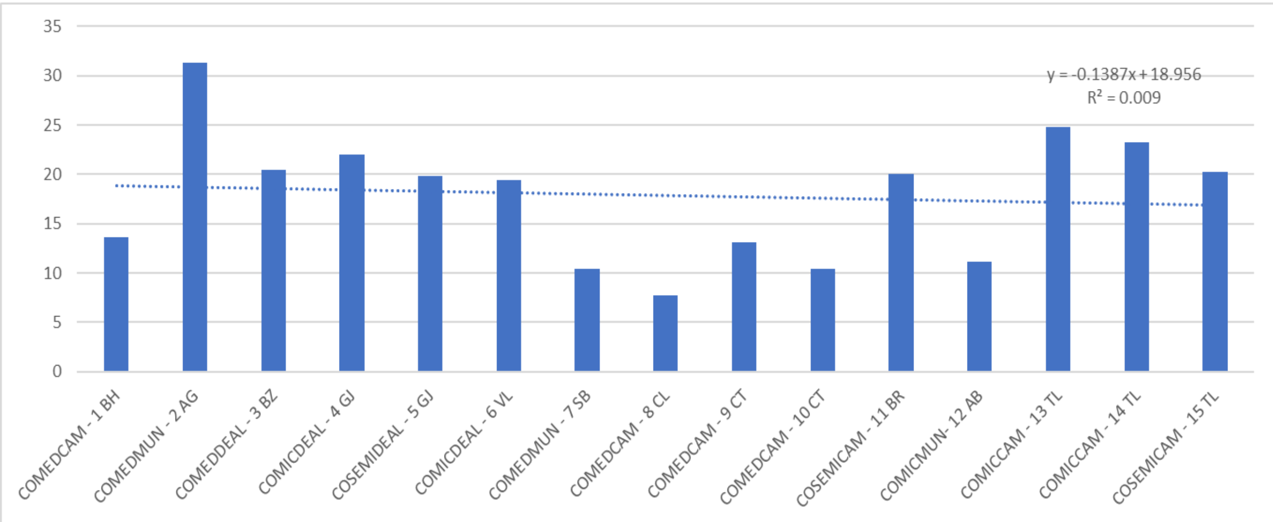

Figure 3 – Break-even point in physical units for sheep meat

Source: Own calculations

The value profitability threshold was, on average, 159.67 lei/head, with a minimum of 67.95 lei/head and a maximum of 322.51 lei/head (Figure 4). Prices for fattened sheep youth, for the period under study, were between 8.19 - 10.31 lei/kg live weight.

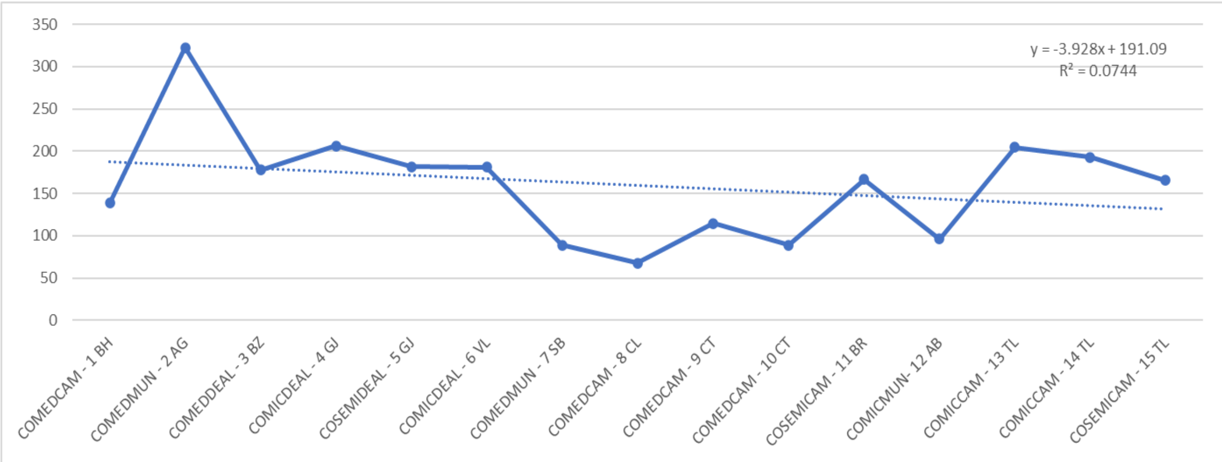

Figure 4 – Break-even point in value units for sheep meat
Source: Own calculations

Break-even analysis is an economic tool used to determine the cost structure of farm activity and to examine the relations between variable, fixed expenses and income earned (Vagner, I., 2020).

Break-even point for goats milk

For goats milk, the break-even point was calculated based on data from 33 case studies. The average milk production was 340.25 liters/head, being between 100.0 and 901.67 liters/head.

Physical break-even point averaged 216.14 liters/head, with a minimum of 99.49 liters/head and a maximum of 377.01 liters/head (Figure 5).

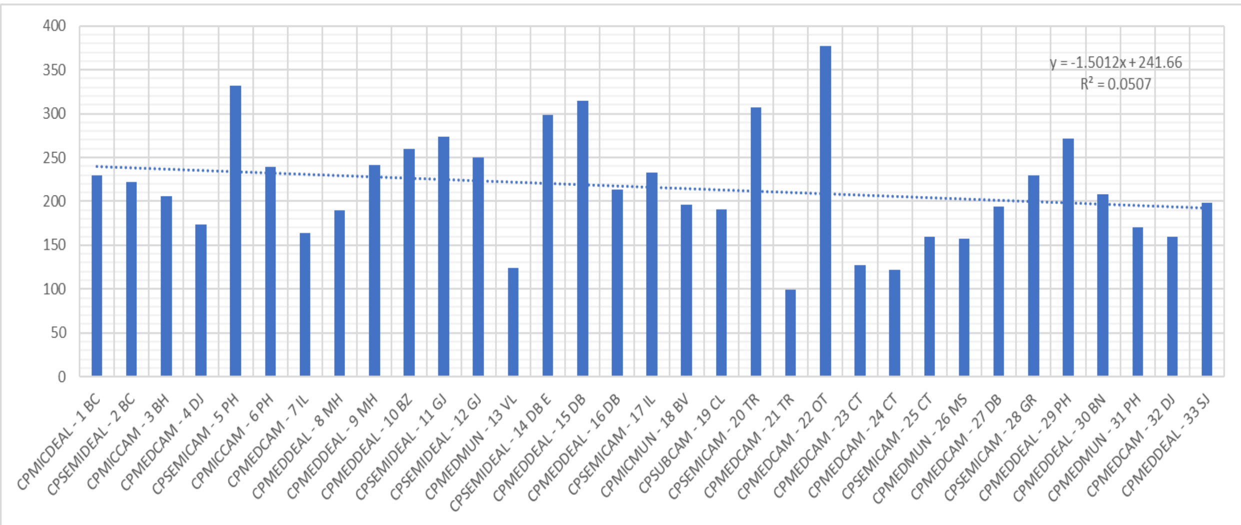

Figure 5 – Break-even point in physical units for goats milk
Source: Own calculations

The value profitability threshold was, on average, 628.08 lei/head, with a minimum of 323.23 lei/head and a maximum of 1102.42 lei/head (Chart 6). The milk recovery prices were between 2.40 - 4.08 lei/liter.

Break-even point in value units was, on average, 628.08 lei/head, with a minimum of 323.23 lei/head and a maximum of 1102.42 lei/head (Figure 6). The milk prices were between 2.40 - 4.08 lei/liter.

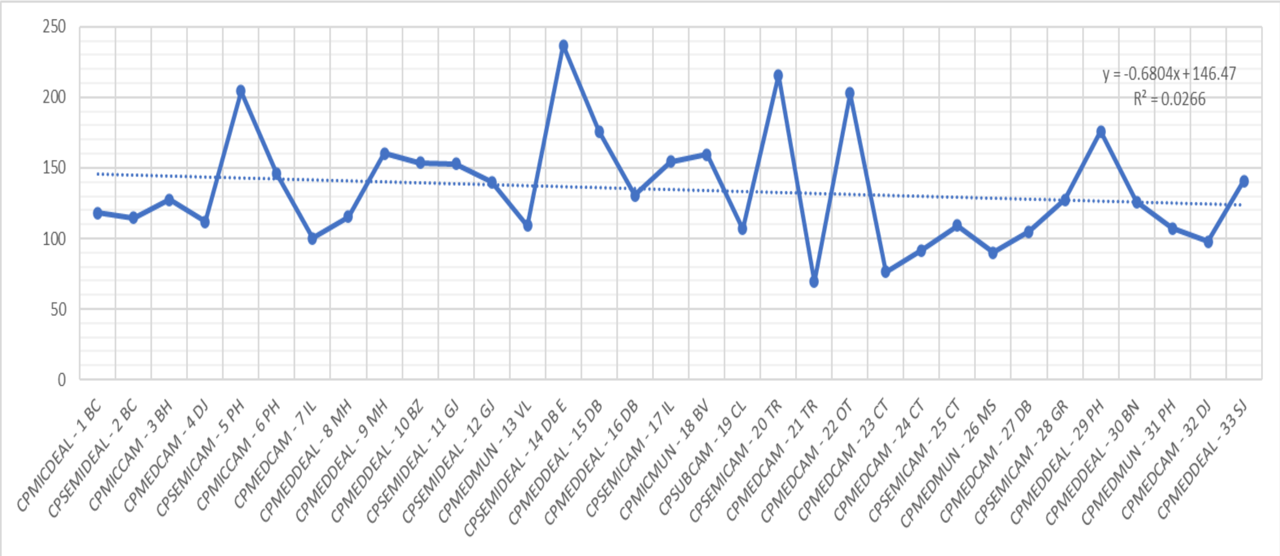

Figure 6 – Break-even point in value units for goats milk

Source: Own calculations

In making managerial decisions of the farm, determining the use of the critical capacity and the minimum acceptable profit is a major objective of the activity and provides a clear picture about the solvency of the farm, based on the fact that the value of the profit and the certainty of its realization are important information, which lead to a successful management (Potkany, M., & Krajcirova, L., 2015).

Break-even point for cow's milk

For cow's milk, break-even point was calculated based on data from 54 case studies. The average milk production was 4554.94 liters/head, being between 2600.0 and 9633.3 liters/head.

The physical break-even point averaged 5506.29 litres/head, with a minimum of 2338.42 litres/head and a calculated maximum of 20401.52 litres/head (Figure 7).

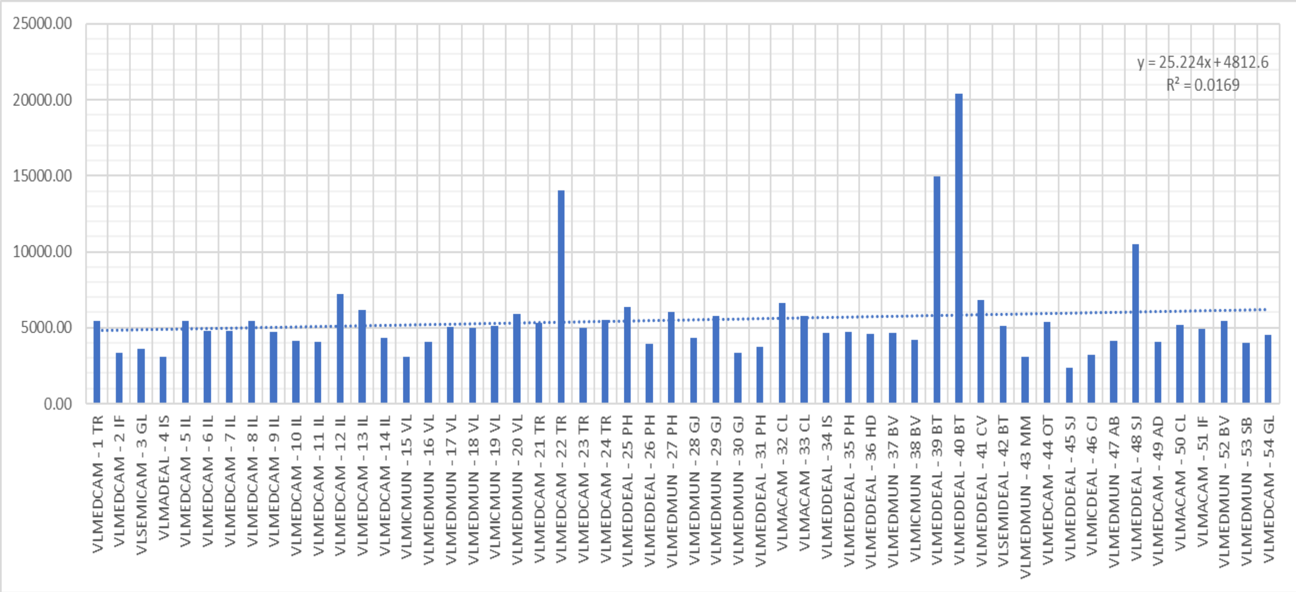

Figure 7 – Break-even point in physical units for cows milk

Source: Own calculations

The value profitability threshold was, on average, 8024.83 lei/head, with a minimum of 5268.66 lei/head and a maximum of 22429.82 lei/head (Figure 8). The milk prices were between 1.10 - 3.67 lei/liter.

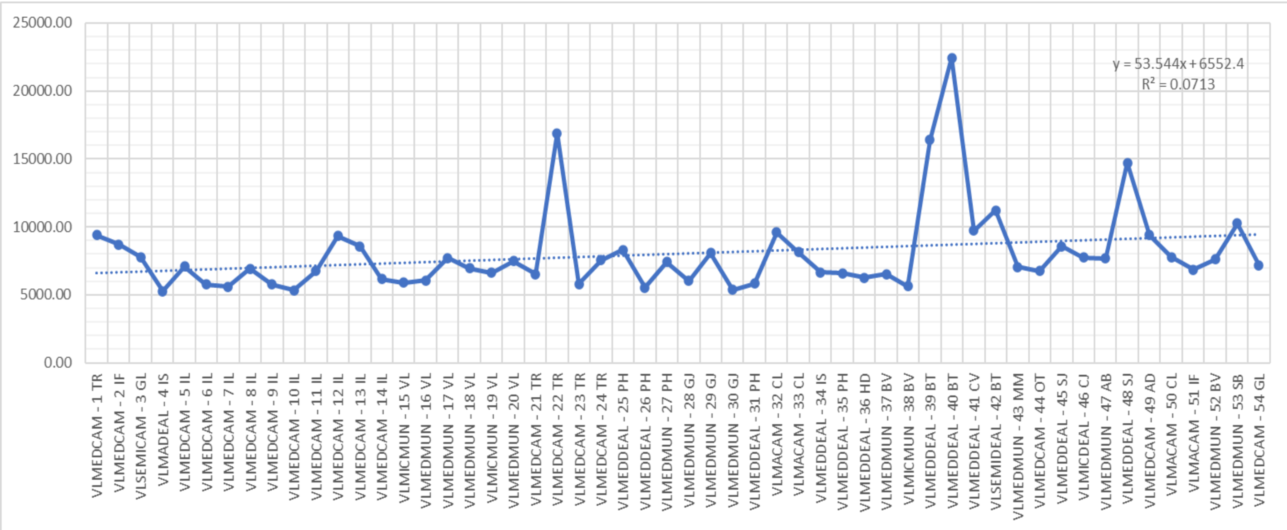

Figure 8 – Break-even point in value units for cows milk

Source: Own calculations

Break-even point for beef

For beef, break-even point was calculated based on data from 30 case studies. Average production was between 340.52 – 684.8 kg live weight/head, with an average of 509.06 kg live weight/head. The physical break-even point averaged 378.14 kg live weight/head, with a minimum of 148.94 kg live weight/head and a maximum of 1070.69 kg live weight/head (Figure 9).

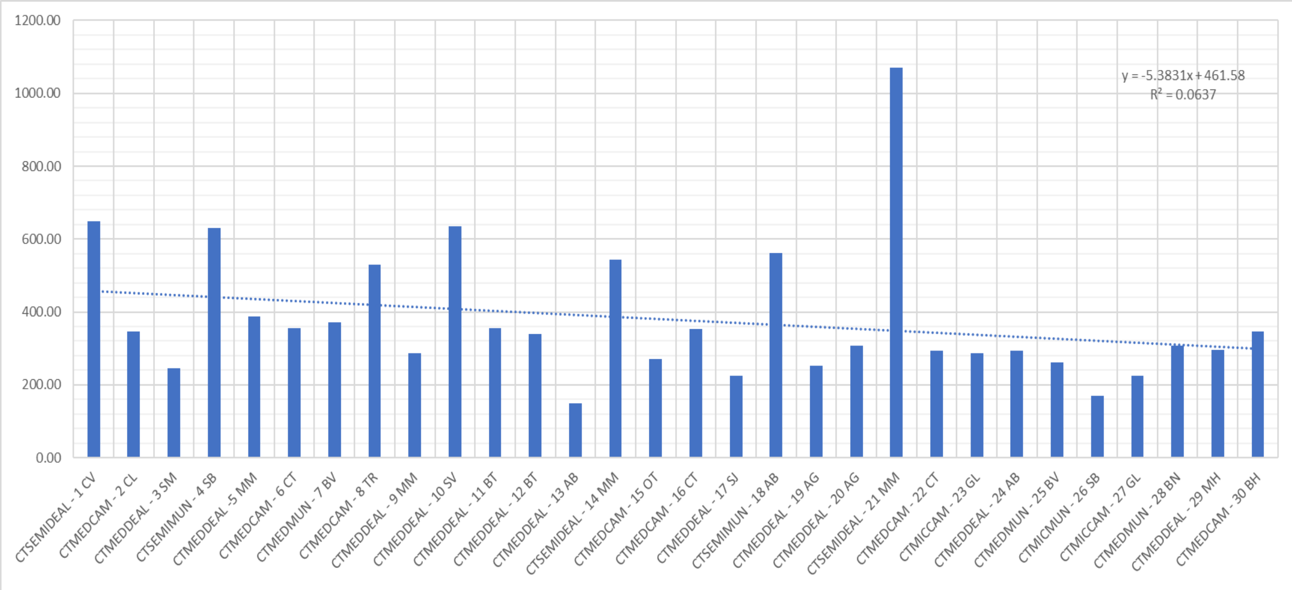

Figure 9 – Break-even point in physical units for beef

Source: Own calculations

The value profitability threshold was, on average, 4151.04 lei/head, with a minimum of 1769 lei/head and a maximum of 8950.94 lei/head (Figure 10). The prices of fattened young cattle, for the period under study, were between 7.67 - 15.43 lei/kg live weight.

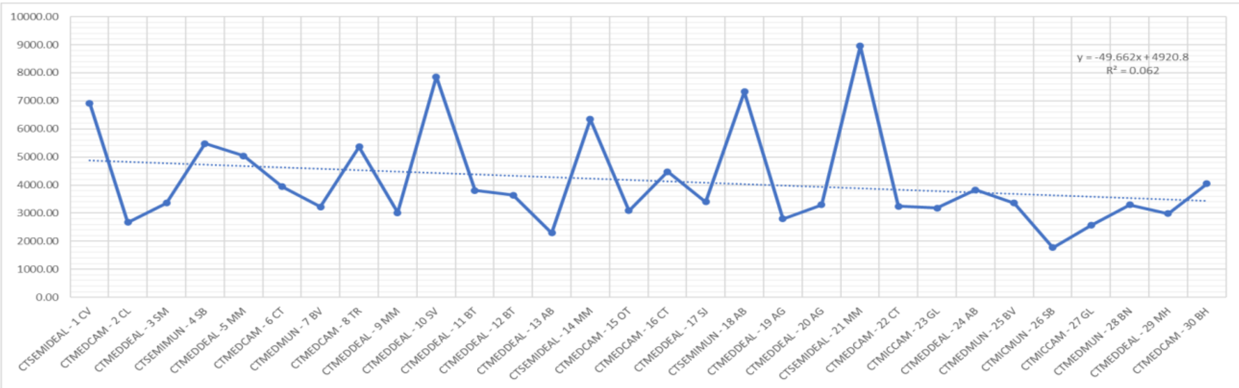

Figure 10 – Break-even point in value units for beef

Source: Own calculations

Break-even point for buffalo milk

The break-even point for buffalo milk was calculated based on data from 23 case studies. The average milk production was 1306.09 liters/head, ranging from 933.3 to 1750 liters/head.

Physical break-even averaged 801 litres/head, with a minimum of 456.12 litres/head and a calculated maximum of 1071.72 litres/head (Figure 11).

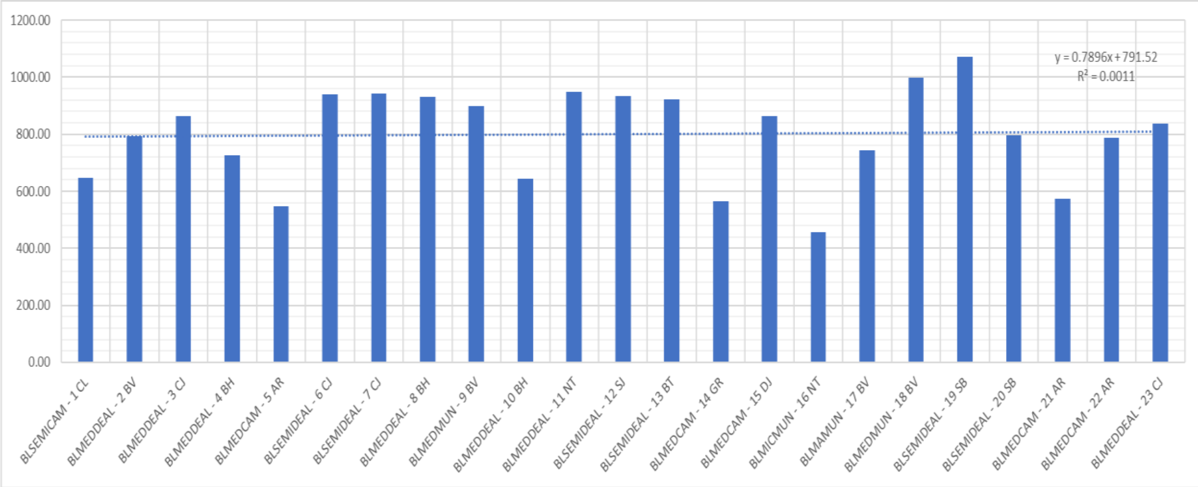

Figure 11 – Break-even point in physical units for buffalo milk

Source: Own calculations

The value profitability threshold was, on average, 3302.51 lei/head, with a minimum of 1987.4 lei/head and a maximum of 4226.81 lei/head (Figure 12). The milk prices were between 3.31 - 5.05 lei/liter.

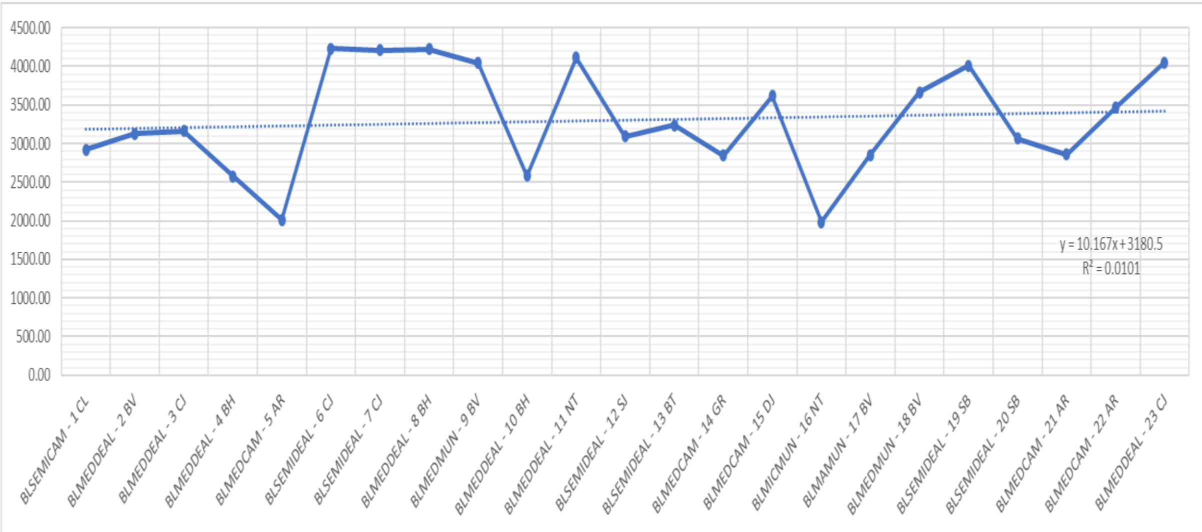

Figure 12 – Break-even point in value units for buffalo milk

Source: Own calculations

CONCLUSIONS

Break-even values for ruminant milk and meat production varied, depending on production levels, prices, farm size, and level of various expenditure categories. Generally, larger farms have lower profitability thresholds, higher security indices, even production level is not very high. They are more flexible, more adaptable to fluctuations in the economic environment, and the farmer can use the various levers of economic recovery, in due time. In the case of small farms, the risk of finalizing activity with a negative result is higher, especially if there are not high productions. This complex indicator gives managers the opportunity to make timely decisions to return to the equilibrium point.

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STUDY ON THE MILK MARKET IN THE PERIOD 2017-2021

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Abstract: *This article presents the milk market in the period 2017-2021 highlighting aspects regarding the evolution of the herd (cows), milk production, price, consumption, import, export, market characteristics, the main dairy producers in Romania, but also a series of conclusions that are the basis of this study. The research method used in the study is statistical data processing and economic analysis of data. Cow's milk is composed of 3.5 percent fat, 9 percent milk solids and 87.5 percent water. The main protein (80 percent) is casein. The milk of certain mammals, including cows, sheep, goats, buffaloes and yaks, is collected for human consumption, either directly, usually after pasteurization, or processed into dairy products such as cream, butter, yoghurt, ice cream or cheese. Milk is a complete food that contains all the nutrients that the human body needs. Cow's milk is the most appreciated by the consumer and the most accessible in terms of price, which are the main reasons why I chose to study this segment.*

Keywords: *cow milk, price, consumption, evolution*

JEL Classification: Q11; Q13;L11

INTRODUCTION

In this paper, I set out to analyze the statistical data on the cow's milk market, at the national level, highlighting aspects such as milk production, cow herds, price, consumption, import, export, the most important dairy producers in Romania but also a series of conclusions that are the basis of this study. At the national level, approximately 33% of Romanians consume milk daily or almost daily, it has many health benefits, being rich in calcium, proteins and vitamins for the body. given the pandemic caused by Covid-19, consumer behavior has changed a lot in terms of a healthier lifestyle, especially in terms of food. People have started to pay more attention to everything they consume for their health.

MATERIAL AND METHOD

The research method used in the study is the statistical processing and economic analysis of official statistical data such as INS, MADR but also websites, specialized magazines. Based on these data, comparative analyzes of the milk market at the national level were carried out.

RESULTS AND DISCUSSION

At the national level, the total value of the herds of cows and buffaloes decreased by a percentage of 7.94 percent in 2021 compared to 2017. The possible causes that influenced this decrease could be the aging of the population that can no longer effectively take care of themselves of animal husbandry. Another possible cause could be the very low price of milk that cannot even cover production costs, which makes farmers give up. In addition to these two problems, we can also add the lack of pastures that discourage farmers from - multiply the number of cows.

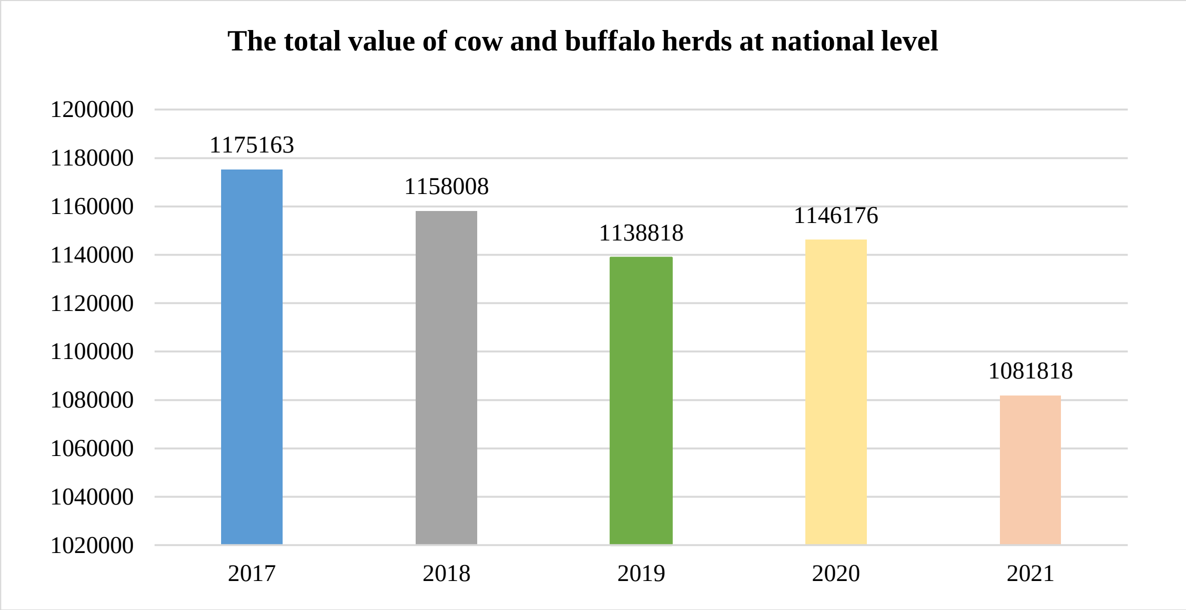

Figure 1. Total number of cows

Source:NIS

Figure 2 shows the total production of cow and buffalo milk at the national level, which decreased by 4.24% in 2021 compared to 2020. A cause of this decrease could be determined by the drastic decrease in herds of cattle.

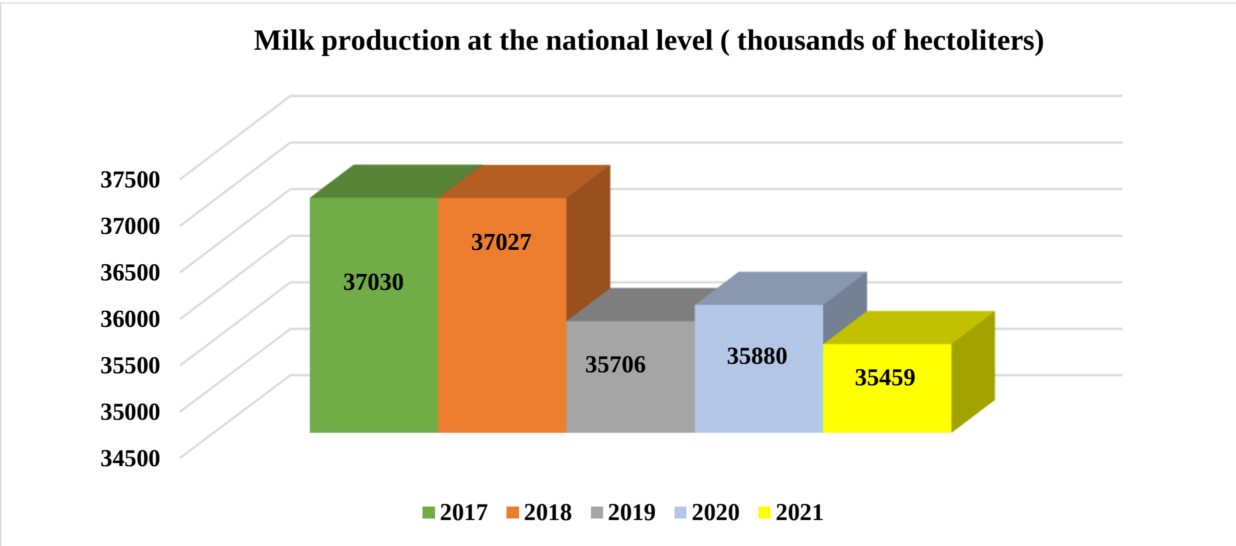

Figure 2. Milk production

Source:NIS

In figure 3, the average prices of cow's milk between December 2018 and June 2022 are highlighted. As can be seen in the graph, it increased in June 2022 by 50% compared to 2018, from 2.74 lei/l to 4.11 lei/l. The main reason for this increase is the increase in production costs. Farmers complain about the high price of fodder, diesel but also the very low subsidies that do not even cover a third of the costs.

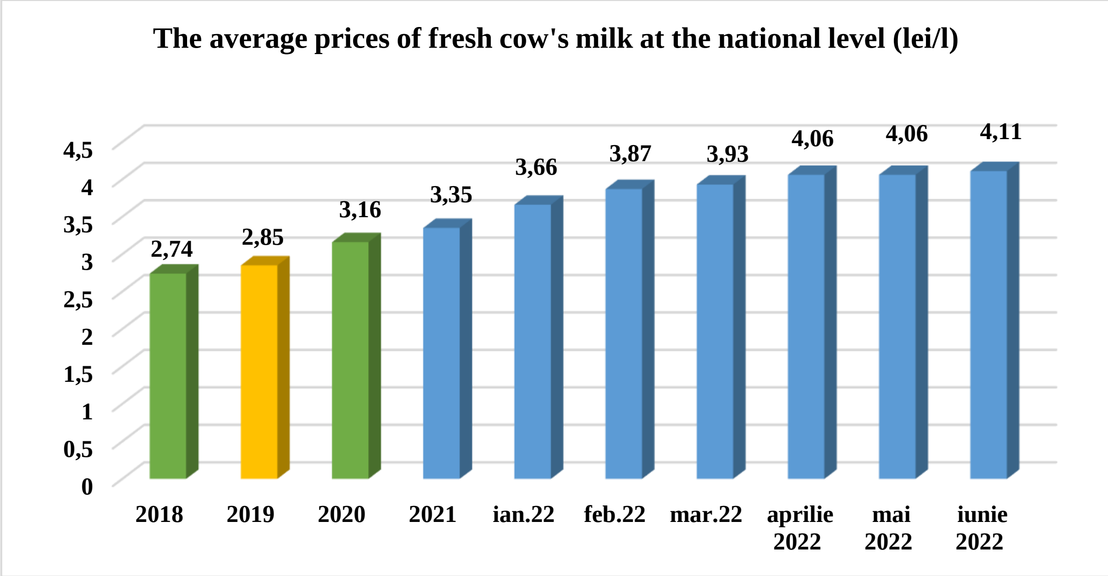

Figure 3. The price of milk

Source:NIS

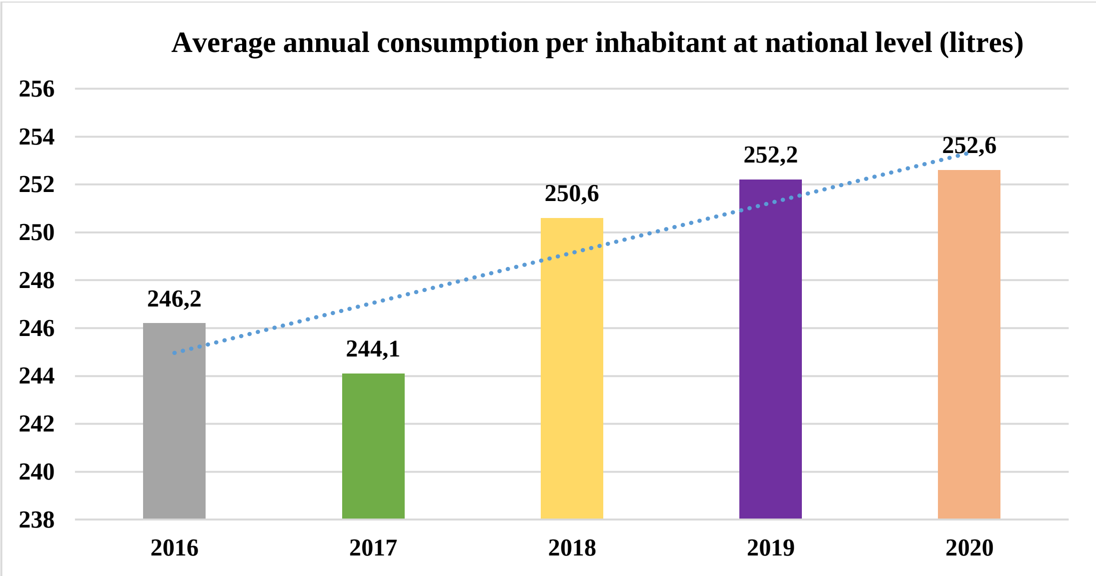

Figure 4. Average consumption

Source:NIS

Figure 4 shows the average annual consumption at the national level in the period 2016-2020. As can be seen in the graph, comparing the first year with the last study, there was an increase of 2,6 percent, which indicates that Romanians have approached a healthier way of life during the pandemic, they appreciated the beneficial effects of milk, starting to consume more, but also staying at home made consumers stock up to decrease the frequency of supply.

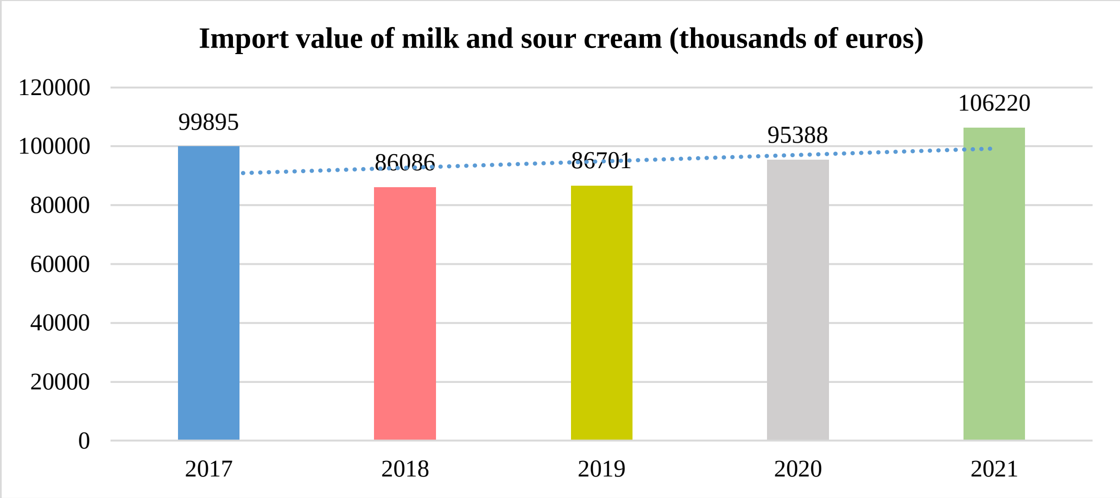

Figure 5. The value of the import

Source:NIS

According to the statistical data of the National Institute of Statistics, the value of the import of milk and milk cream increased in 2021 by 6.33 percent compared to 2017. This increase is due to the drastic decrease in the number of cows that caused milk production to decrease resulting in an increase in imports.

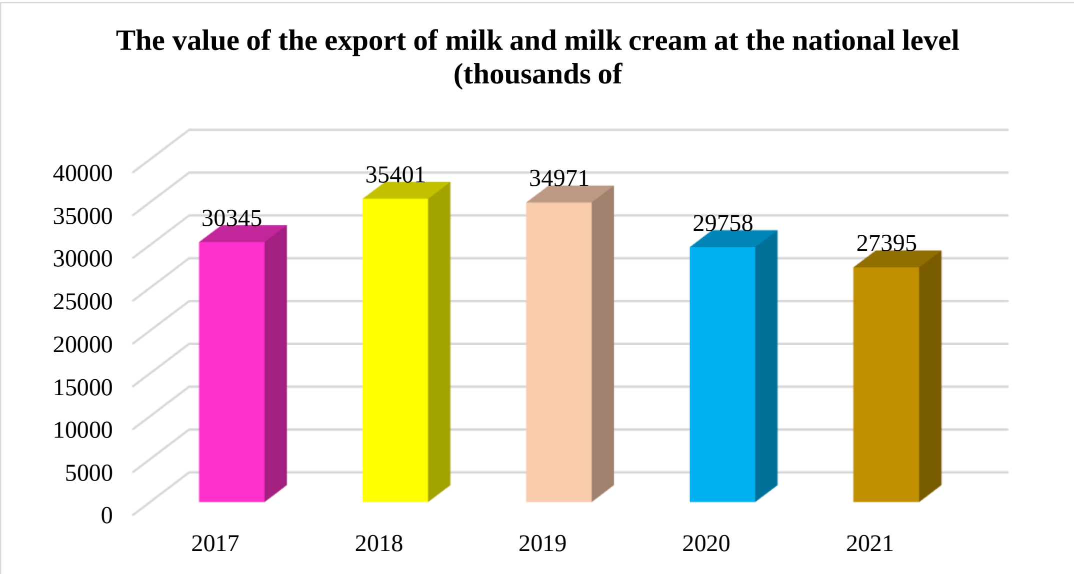

Figure 6. Export value

Source:NIS

Figure 6 shows the export value over a period of 5 years. At the end of 2021, the export value decreased by 9.72 percent, reaching 27395 thousand euros.

The main dairy producers in Romania

According to the profile websites, the strongest entrepreneurial businesses are represented by Albalact S.A, Danone Romania, FrieslandCampina Romania, the Brașov dairy and Hochland Romania.

Albalact SA was established in 1971, privatized in 1999, with the Ciurtin family acquiring the majority of the shares, which they later sold to the French from Lactalis for approximately 72 million euros, including the campaigns that came under the manufacturer's name, these being Rarăul and Albalact Logistic. In 2017, Lactalis delisted the company's shares from the stock exchange.

Since 2016, Danone ranks second in the list of the most important milk producers, with a turnover of 633 million lei in 2020 from 612 million lei in 2019.

Friesland Campina Romania is the producer of the Romanian brand Napolact, representing, according to the latest data, more than 70% of the company's turnover. It has 3 factories locally, in Baciu, Târgu Mureș and Țaga (Cluj county). In the last mentioned factory cheeses are produced in collaboration with the Transilvania Cheese Factory.

The Brașov dairy (Olympus) is a leader in collecting milk from Romanian farmers with a maximum reception capacity of 48,000 liters of milk per hour, which is then processed on the production lines.

Thus, the company can produce 16,000 liters of milk for consumption (PET bottle) and 10,500 liters of UHT milk (TetraPak packaging) per hour, 150 tons of yogurt and 120 tons of cheeses per day. All Olympus brand products benefit from a state-of-the-art technology called TetraPak.

Hochland entered the Romanian market in 1993 through the company Whiteland, which imports and sells processed cheese, triangles and slices in stores. in new equipment, which will allow production to increase, in order to consolidate its leading position on the market and increase the amount exported. Hochland Romania owns two factories, one in Sighisoara where in 1999 it produced the first Mixtett processed cheese and the second being in Sovata where the cheese is produced.

CONCLUSIONS

The cow's milk market can certainly be characterized as an uncertain market, being often unpredictable, especially in the last period when, due to the pandemic caused by Covid-19, there have been considerable changes that can also be seen in the statistical data.

Regarding the evolution of the herds of cows and buffaloes at the national level, a decrease was recorded from 1175163 heads in 2017 to 1081818 heads in 2021.

Milk production also decreased from 37030 thousand hectoliters in 2017 to 35459 thousand hectoliters in 2021.

Cow's milk registered a 50% increase in June 2022 compared to 2018, where a total price of 2.74 lei/l was recorded.

Annual milk consumption recorded a minimum in 2017 of 244.1 liters per inhabitant/year and the maximum was recorded in 2020 with a value of 252.6 l/inhabitant, with an increase of 3.48%.

The import of milk at the national level registered a minimum of 86,086 thousand euros in 2018, and a maximum of 106,220 thousand euros in 2021, resulting in an increase of 23.39% in the last year of study.

Milk export recorded a maximum of 35,401 thousand euros in 2018 and a minimum of 27,395 thousand euros, resulting in a decrease of 22.62%.

The Covid-19 pandemic certainly had a negative impact on the entire economy not only at the national level but also at the world level. Unfortunately, many farmers had to give up cows because they cannot support the expenses due to the increase in the price of fodder, electricity, fuel but also of very small subsidies that do not even cover production costs, farmers complaining that the government is not interested in this sector and even more so does not support them in this regard.

In conclusion, the milk market was considerably affected by the Covid-19 pandemic, by the expenses incurred by many processors to close the factory doors, to give up employees, sending them into unemployment.

Certainly the European institutions will use all the means at their disposal to make this market stable again from all points of view.

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THE EFFICIENCY OF USING THE BODY CONDITION INDEX FOR IMPROVING MANAGEMENT IN DAIRY FARMS

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Abstract: *The present work was carried out for the economic efficiency of dairy cow farms by using the body condition index. The body condition index is a subjective indicator that evaluates the subcutaneous fat deposits of dairy cows. For its interpretation, a scale from 1 to 5 with fragmentation from 0.5 points to 0.5 points is used. With the help of this indicator, the maintenance condition of the cows is monitored and the fodder ration is made more efficient so that there are no cachectic or obese animals in the herd. The present research was carried out at the Research and Development Institute for the Breeding Cattle of Balotesti, on a herd of 72, cows of the Romanian Black Spoted breed. This work was carried out to correct the production and reproduction deficiencies with the help of the maintenance condition of the cows. The body condition index was reported both to the reproductive indicators: the number of IA/G, service-period and the calving interval, as well as to the production indicators: milk production on the control day and milk production/lactation. From the analyzed data, it was found that by using this indicator, the economic efficiency of the farm increased by improving the production and reproduction performances.*

Keywords: *body condition score, cow, index production and reproduction*

Clasification: JEL: Q01,Q18

INTRODUCTION

The body condition represents a relative new concept introduced in our country and analyzes the state of maintenance and exploitation of dairy cows. This appreciation indicator was taken to help nutritional and reproductive management in farms, because it corrects technological mistakes and makes considerable contributions in improving production and reproduction performances. The evaluation system used to assess body condition uses grades from 1 to 5 (Carissa M. Truman, 2005), with a difference of 0.5 points, to assess subcutaneous fat deposits.

MATERIAL AND METHOD

The present work was carried out at the Research and Development Institute for the Breeding of Balotesti Cattle, on a herd of 72 heads, cows of the Romanian Black Spoted breed. The analyzed data captured the activity on the farm in the period 01.01.2020 - 31.12.2021. The milk production was obtained from the personnel performing the Official Control of Milk Production and the reproduction data were extracted from the reproduction program Taurine.exe. which belongs to the Institute. The evaluation of the physical condition was carried out by specialists from the institute. The statistical interpretation of the obtained data was carried out with the help of the Microsoft Excel program.

RESULTS AND DISCUSSION

In the graphic image below, we have analyzed the state of maintenance of the cows in relation to the score obtained on the body condition index

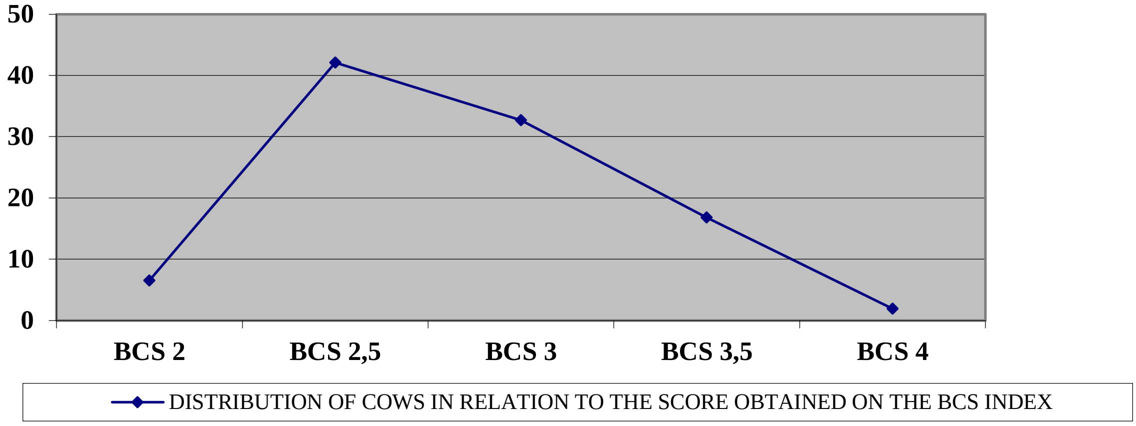

Figure 1. Distribution of the batch of cows according to the score obtained on the BCS index

From figure 1, it can be seen that the largest share of the analyzed batch has the cows that obtained a score of 2.5 on the body condition index, approximately 42.1%. In second place were the cows that obtained grade 3 in the body condition index, approximately 32.7%. Overweight cows ranked 3rd with a weight of 16.8% and cachectic cows ranked last with a weight of 6.5% and obese cows with a weight of 1.9%. From the data presented above, it can be seen that the analyzed batch of cows has a good state of maintenance, in which the largest share is occupied by cows that received scores between 2.5 and 3.5 on the body condition index.

Dairy farms operate according to the principle of profitability. Thus, if the animals are productive, they will be kept in the herd. In any other conditions, they will be reformed. Starting from this principle, we analyzed the productivity of the cows according to the score obtained on the body condition index.The graphic image below shows the average milk production obtained by the cows in the monitored group according to the grade obtained for the body condition indicator.

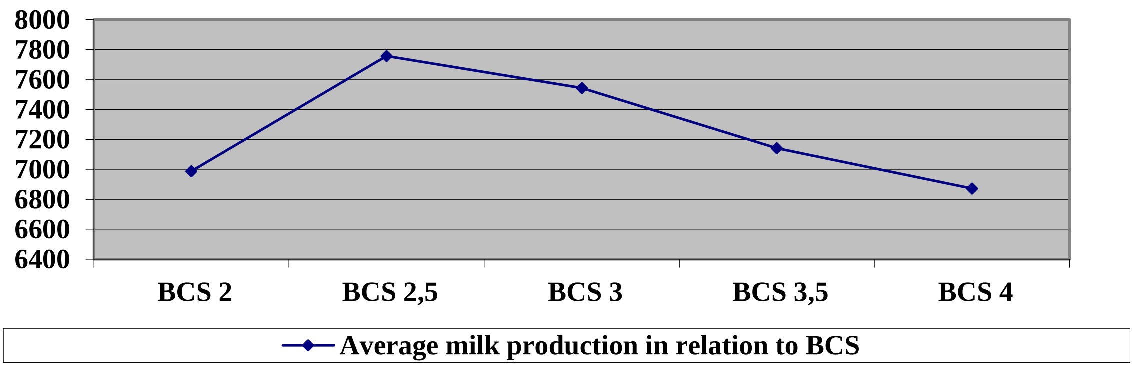

Figure 2. Distribution of cows' productivity according to the score obtained on the BCS index

From figure 2, it can be seen that the highest average milk production was obtained from the cows that received a score of 2.5 on the body condition index, approximately 7756 kg. In second place were the cows that received a score of 3 on the body condition index. The average milk production obtained from them was 7543.5 kg. The difference in productivity between the first two ranked was 2.81% in favor of the first. The cows that received a score of 3.5 on the body condition index, with a production of 7142.3 kg, ranked third. The difference in productivity between the leading group and them was 8.59%. Lean cows with an average milk production of 6987.5 kg were ranked 4th. The difference in productivity between the first place and them was 10.99%. Fat animals ranked last. From these, an average milk production of 6871 kg was obtained. The productivity difference between the first and the last place was 12.88%. From the above results, it can be seen that the highest milk productions were obtained from cows with good maintenance. They made the best use of the fodder ration, having the best conversion ratio of fodder into milk. The lowest productions were obtained from the lots with cachectic and fat cows (J J Domecq 1997).

For there to be milk production, there must be reproduction. The better the reproductive activity in a farm, the higher the income and the lower the economic losses. The main indicators that analyze the reproductive activity in dairy farms are: fecundity, fertility, service period and calving interval.

Fecundity represents the physiological process through which the spermatozoon and the ovule merge and form the zygote. The higher the fecundity, the higher the economic efficiency. The specialized literature appreciates that a farm has a high fecundity when 80% of the herd is represented by pregnant animals.

The table below shows the fecundity analysis according to the grade obtained on the body condition index.

Table 1. Analysis of fecundity of cows from the experimental group

FECUNDITY	BODY COBDITION SCORE					Total
BCS	2	2,5	3	3,5	4	
COWS AI	5	28	24	12	3	72
PREGNANT COWS	3	20	21	9	1	54
% GESTATION	60	71,42	87,5	75	33,3	75
AI PERFORMED	10	36	30	17	4	97

From table 2 it can be seen that in the analyzed time interval 72 cows were inseminated from which 54 pregnancies were obtained, which is equivalent to a fecundity percentage of 75%. The best fecundity, of 87.5%, was obtained from the group of cows that obtained grade 3 on the body condition index. On the II and III places were the batches of cows that received marks of 3.5 and 2.5 respectively on the BCS index. In these groups, the fecundity was 75% and 71% respectively. Cachectic and obese cows ranked last (López-Gatius F. 2003). The fertility in these batches was 60% and 33%, respectively. This low fecundity recorded in obese animals is caused by fat deposits in the ovaries that prevent their normal functioning. The low fecundity recorded in weak animals is caused by the lack of subcutaneous energy deposits. A weak cow, at the beginning of lactation, when the energy balance is negative (Butler WR,2005), cannot support the vital functions, high milk production and good functioning of the reproductive system from the ingested energy. Following the results obtained, it can be stated that for increasing fecundity in dairy farms, it is preferable to avoid animals having a BCS index score lower than 2.5 and higher than 3.5.

From the analysis of indicator no. AI/G states that the fewest artificial inseminations/gestations, 1.42, were carried out in the group of cows that obtained grade three on the

BCS index. Moreover, this score equates to a very good fecundity. The cows that obtained marks of 2.5 and 3.5 on the BCS index were ranked next. For these batches, 1.8 AI/G and 1.9 AI/G were required. The scores obtained by these groups of cows equate to good fecundity. The lowest scores were recorded in the groups of obese and cachectic cows. These required 4 AI/G and 3.33 AI/G respectively. These results equate to low fecundity. From the analysis of the AI/G number indicator, it is found that the most effective from the point of view of fecundity are the cows with a good state of maintenance and the economic losses are produced by thin and obese cows due to the large amount of frozen semen used. Once the pregnancy is established, the fertility of the cows is monitored. This represents the ability of an animal to obtain viable offspring. Specialized literature appreciates that fertility is good when it is 60% of the herd in operation.Table 2 shows the fertility of the cows in the analyzed batch.

Table 2. Fertility analysis of cows from the experimental group

FERTILITY	BODY COBDITION SCORE					Total
BCS	2	2,5	3	3,5	4	
PREGNANT COWS	3	20	21	9	1	54
CALVES OBTAINED	1	17	19	8	1	46
Embryonic mortality/abortion	1	2	2	1	0	6
NON VIABLE CALVES	1	1	0	0	0	2
VIABLE CALVES	1	17	19	8	1	46
% fertility	33,33	85	90,47	88,88	100	85,18
% mortality	66,33	15	9,53	11,12	0	14,82

From the data presented in table 2, it can be seen that 46 calvings were obtained from the cows in the experimental group, which equates to a fertility of 63.88%. The most offspring, 19, were obtained from cows that received a score of 3 on the body condition index. In second place were the cows that received a grade of 2.5 on the BCS index. 17 cattle were obtained from them. In third place was the batch of cows that received a grade of 3.5 on the BCS indicator. 8 cows resulted from these. The fewest calvings were recorded in the groups of cows that received marks of 2 and 4 respectively for the same indicator.

The analysis of the fertility of cows through the lens of the number of viable offspring obtained shows that the best fertility was recorded in fat animals. In second place were the cows that received grade 3 on the BCS index (O Markusfeld, 1997). The fertility recorded in this lot was 90.47%, which equates to good fertility. In third place were the cows that received a score of 3.5 in the body condition index. Fertility in this lot was 88.88%, which equates to good fertility. On the 4th place were the cows that obtained a fertility percentage of 85% according to the BCS index, which equates to good fertility. The group of thin cows ranked last. For them, the fertility was 33.33%, which equates to low fertility. Moreover, the specialized literature appreciates that a farm under normal operating conditions and with cows in an optimal state of maintenance has a fecundity of 80% and a fertility of 60%. This shows that in specialized literature, fecundity losses of up to 20% are considered acceptable for a farm to be economically viable. From the data obtained by us and reported in the specialized literature, it is found that except for the group of weak cows, the other batches had acceptable losses of fecundity.

The analysis of reproductive indicators, service-period and the calving interval shows both the time elapsed from calving to the fertile mount and the time elapsed between two calvings. As service period represents the mobile component of the calving interval, it is preferable that it does not exceed 80 days and the calving interval should be 365 days for a farm to be economically efficient.

Figure 3 will show the duration of service-period indicators and the calving interval in relation to the grade obtained on the body condition index.

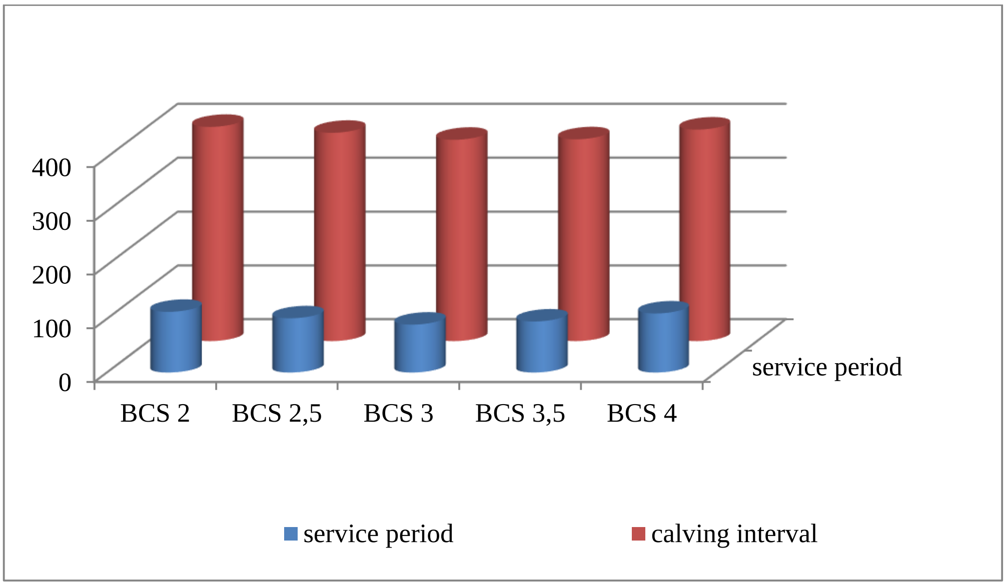

Figure 3. Analysis of service-period and calving interval indicators in relation to the grade obtained on the BCS index

From figure 3 it can be seen that the best scores were recorded for the group of cows that received grade 3 for the body condition index. In this group of cows, service period was approximately 89 days and the calving interval was approximately 374 days. In second place were the cows that scored 3.5 on the body condition index. In this group of cows, the duration of the reproductive indicators analyzed was 95 days and 375 days, respectively. The reduction of the calving interval in this group is due to the duration of the pregnancy, which had a somewhat shorter average of 280 days. In 3rd place were the cows that obtained a grade of 2.5 at the BCS. In these, the duration of service period was approximately 101 days and the calving interval had an average of 387 days. Weak cows ranked last with an average of 113 days of service period and 398 days calving interval (Virginia A. Ishler 2018). The Fisher test analysis shows that there are no significant differences between the analyzed groups ($p>0.05$). From the resulting data, it can be seen that cows with good maintenance are the most efficient from the point of view of the reproductive indicators analyzed (Mareike Maak 2018). In any farm, the longer the distance between the fronts, the lower the economic efficiency. This is explained by the relationship between production and reproduction. Since the duration of lactation is 305 days and the breast rest is 60 days, it is ideal that the calving interval is 365 days. An increase of it is accepted only in the case of cows with high productions, which can justify the low score recorded by the cows that received a grade of 2.5 on the BCS index.

Increasing the calving interval represents a sufficient argument for the reformation of cows. In recent years, the age of reformation, worldwide, has dropped to 2.8 lactations. As the growth of replacement youth represents the largest share of a farmer's expenses, it is preferable to increase the period of exploitation of cows in order to increase income. The reformation of young cows can make small farmers who have holdings of up to 5 cows vulnerable. Besides, they own the largest share of the cow herds in our country, according to MADR, approximately 93%. Thus, increasing the longevity of cows is a priority to ensure the maintenance and growth of existing herds.

The graphic image below shows the longevity of cows in relation to their maintenance status.

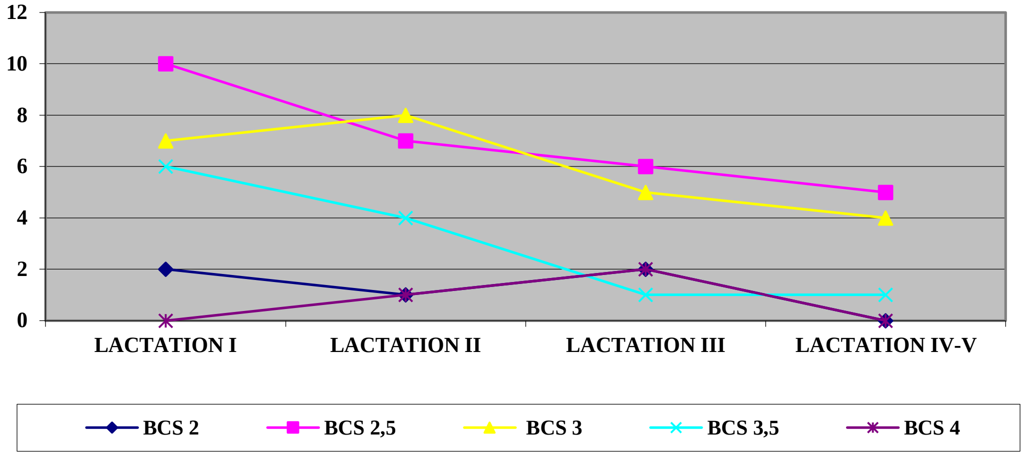

Figure 4. Analysis of longevity in relation to the BCS index

From fig. no. 4 it is found that the cows that received a grade of 2.5 on the body condition index have the greatest ability to delay their reformation. On the next position are the cows that received grade 3 at BCS. Overweight and obese cows have the lowest share among the cows in the analyzed group, which proves that they had the least productive arguments to be kept in the herd. It should be noted that among the animals that have reached the IV and V lactations, there is no cachectic or obese cow, which shows that these animals are poorly productive and it is not an advantage to maintain them in the herd. These differences show that the longevity of cows can be increased by adjusting body condition.

In graphic image no. 5 shows the conditions associated with infertility in relation to the grade obtained on the body condition index.

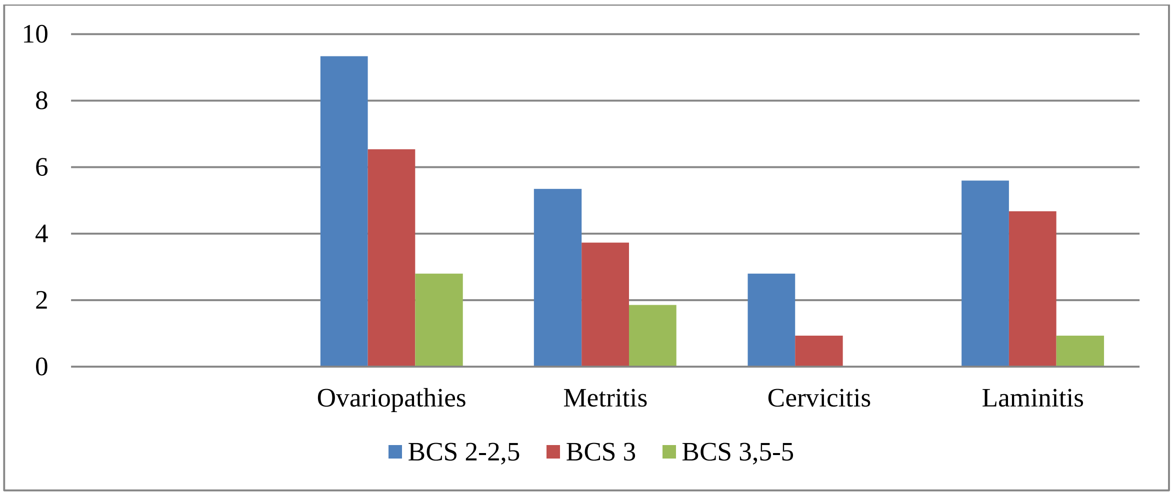

Figure 5. The incidence of pathology associated with infertility in relation to the BCS index

From graphic image number 3, it can be seen that the most reproductive disorders were registered in the group of cows that received marks of 2 and 2.5 respectively at BCS (Wissal

Souissi2019). In these groups, the most common conditions were ovariopathies. Of this group of diseases, the most common were ovarian hypotrophy and ovarian cyst disease. In second place from the point of view of pathology associated with infertility, cows with foot diseases were ranked. From this group of diseases, the most common was infectious bulbar necrosis. In third place were the cows that presented metritis. From this group of diseases, the most common was endometritis.
Cows that received grade 3 at BCS were ranked II in terms of case history associated with reproductive disorders. From the graphic image above, we can see a decrease in reproductive disorders compared to the cows that received grade 2 at BCS. This decrease in the number of cases is due to subcutaneous fat deposits that provide the energy needed to support production and reproduction activities and favor better utilization of feed, thus preventing the occurrence of ruminal imbalances that can contribute to the installation of foot ailments.

The fewest diseases were recorded in overweight cows. It seems that the popular saying 'the more a cow eats, the cheaper it eats' is valid for this group of cows

CONCLUSIONS:

The highest milk production was obtained from cows that scored 2.5 on the BCS index (+12.88%)

The best fecundity of 87.5% was recorded in cows that obtained grade 3 on the BCS index (+16.66% compared to the average of the analyzed batch)

The longest-lived are cows with good maintenance

The fewest reproductive disorders were recorded in cows with good maintenance.

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ANALYSIS OF GAME MEAT PRODUCTION

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Abstract: *Game meat (wild meat) is constantly present in the European meat market, but a limited number of consumers are interested in its consumption, given the unique characteristics of meat from wild animals. Game meat production in Europe decreased almost 9 times in 2020, reaching a total production of about 13.5 thousand tons, while nationally there was a growing trend until 2017 when it recorded production of 4,544 tons, an increase of 12% compared to 2005. The purpose of this paper is to analyze the total production of game meat in national, European, and EU countries, as well as the analysis of the import and export of game meat from Romania, Europe, and the EU. The data used are provided by the International Food and Agriculture Organization (FAO) database, on the basis of which the mentioned indicators were analyzed.*

Keywords: *Game meat, Romania, Total Production, Import, Export*

JEL classification: C10, Q10, Q23

INTRODUCTION

Game meat, according to the publication Food Safety magazine, represents that category of meat that "*is from non-domesticated, free-ranging wild animals and birds that are either legally hunted for personal consumption or reared, slaughtered, and commercially left for food."(*Food Safety Magazine, 2014)

Meat flavor is a very important attribute that contributes to the sensory quality of meat and meat products, although the sensory quality of meat includes aroma, taste, and ortho-nasal and retro-nasal appearance, as well as juiciness and other textural attributes, with emphasis on the first row put on flavor. Species, age, gender, anatomical location of muscles, diet, harvesting conditions, packaging and storage, as well as cooking affect the flavor of venison. Very little research is available on the factors that influence the flavor of wild and free-range meat. Factors that determine the overall quality of meat include its microbiological safety, production practices (animal welfare), in addition to health status (intramuscular lipid content and composition), and sensory profile (aroma, taste, and overall quality of the animal's diet) (Barendse, W., 2014).

However, many consumers will still prefer meat products from domestic animals. However, consumers judge the quality of game meat based on criteria similar to those established for commercial meat products derived from domestic species (Hoffman, L. C., & Wiklund, E., 2006). In addition, consumer’s expectations of game meat quality may be affected by their personalities, beliefs, attitudes, experiences, and past exposures. These expectations influence how consumers actually perceive the quality of game meat and, consequently, their experience of eating game meat (Jesus S. M, et al., 2018). Game meat and meat products are often perceived as having a very dark color. Consumers regularly perceive darker meat as lower quality because they prefer meat that is not extremely dark (Jeremiah, L. E, et al. 2000).

In recent years, there has been a notable increase in the popularity of wild game meat among consumers. This has led to the emergence of a growing number of emerging markets for this type of meat in many developed countries, including Europe. However, the expansion of these markets is often hindered by the lack of a well-developed supply chain. The profitability of a supply chain would depend on the willingness of consumers to buy these products (Maria E. M., et al. 2019). Most of the existing literature on game meat consumption is primarily descriptive and focuses on non-European countries such as Africa and Australia.

Consumer health consciousness has led to greater demand for leaner and lower-cholesterol meats, in turn sparking new interest in suitable alternatives to traditionally farmed meat products. Game meat could meet the needs of today's consumers as an alternative to meat from domestic animals, because it is characterized by very good chemical composition, with a low-fat content (an optimal ratio of unsaturated and saturated fats), high protein content, and protein composition as well as a distinctive taste and aroma (Neethling J., et al., 2016). In general, from the available scientific evidence, it can be concluded that there is a higher level of protein in game meat, being a low-fat alternative to chicken, beef, or pork.

MATERIALS AND METHODS

In the present paper, the production of game meat was analyzed. The quantitative analysis of the data related to the total production as well as the import and export of game meat both worldwide and at the level of Europe and the European Union, data obtained from the Food and Agriculture Organization (FAO) was carried out.

In addition, based on the data provided by the Food and Agriculture Organization (FAO), a forecast of game meat production in Romania was made, for the next period, until 2025, with the help of the SPSS software, through the Forecasting function and the Expert Modeler method.

RESULTS AND DISSCUSION

In countries with deep-rooted hunting traditions and environmental conditions favorable to hunting, game meat could become an alternative to meat produced by intensive animal husbandry.

In most European countries, game meat is mainly derived from red deer, roe deer, wild boar, wild rabbit, and wild birds of various species. A common trait that characterizes meat from wild animals is represented by a series of characteristics that have a positive impact on the health and functioning of the human body, being the result of its nutritional composition (proteins, unsaturated fatty acids, vitamins, macro, and microelements) in comparison with meat from domestic animals (Strazdina, V. et al., 2013). Game meat is perceived as a prestigious and sophisticated food, and the game market is still a niche, difficult for consumers to reach.

Although the high nutritional value of hunting meat has been documented, its consumption in Europe remains at a low level (Meltzer H.M et al., 2013). In Europe, the production of hunting meat has decreased almost 9 times in 2020, reaching a total production of about 13.5 thousand tons, compared to the first year analyzed, 2005 when there was a production of 129 thousand tons (Table 1). However, the consumption of game meat is very unequal among populations, in general, in Europe, only 2-4% of the population regularly consumes this type of meat (Meltzer H.M et al., 2013).

Worldwide, however, an upward tendency in hunting meat production between 2005-2010 is observed, followed by a considerable decrease in the next 3 years. In 2020, there was an amount of 1,950 thousand tons of meat, about 5% less than in 2017, when the maximum period was registered. (Table 1).

Table 1 - Total production of game meat (thousands of tons)

Year \ Region	World	Europe	UE
2005	1717.75	129.00	114.29
2006	1768.85	129.91	116.17
2007	1804.26	138.06	124.20
2008	1860.98	140.83	126.58
2009	1890.56	140.95	126.99
2010	1895.44	139.54	125.40
2011	1959.15	138.97	125.10
2012	1975.82	137.23	123.90
2013	1986.75	135.36	121.89
2014	1999.75	130.01	116.82
2015	2043.32	117.46	104.47
2016	2042.40	125.92	113.36
2017	2049.55	123.65	110.19
2018	1948.68	13.33	-
2019	1945.32	13.60	-
2020	1950.40	13.56	-

Source: www.FAO. Org (Accessed on 20.09.2022)

At the level of the European Union, no data were found for the period 2018-2020, but follows the same trend, descending production, since 2005, when about 114.2 thousand tons of meat occurred, decreasing by 4% in 2020 recording about 110 thousand tons (Table 1).

Its organoleptic characteristics could be a reason for the reduced consumption of game meat, as well as its hygiene conditions, sometimes the hygienic-sanitary conditions required are difficult to maintain.

Table 2 - Total game meat production at EU level (tons)

Country	An												
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017*
Germany	60000	65000	67000	70000	70000	70839	69456	67361	66983	62963	51691	60546	58400
Sweden	16116	14382	15180	16242	16726	16871	18317	18309	18050	17098	16331	16381	16062
Poland	10000	11000	13000	13000	13000	10000	10000	9863	9192	8894	8759	8351	8103
Spain	7061	7000	7500	7448	7372	7250	7200	7200	7200	7053	6801	6819	6786
Austria	6700	5700	6500	6400	6200	6500	6200	7100	6400	6400	6600	6900	6700
Romania	4074	4200	4300	4217	4189	4100	4100	4233	4390	4456	4506	4508	4544
Portugal	4240	4242	4250	4235	4191	4212	4205	4198	4191	4181	4157	4169	4164
Denmark	3100	3000	3000	3000	3629	3530	3523	3500	3456	3594	3454	3404	3404
Czechia	2000	900	1100	1151	900	1122	1100	1200	1220	1196	1197	1200	1200
Luxembourg	447	408	435	494	392	400	350	363	307	402	397	395	400
Cyprus	440	236	336	292	289	473	548	473	401	473	481	591	327
Lithuania	115	97	98	105	102	100	100	100	100	110	100	100	100

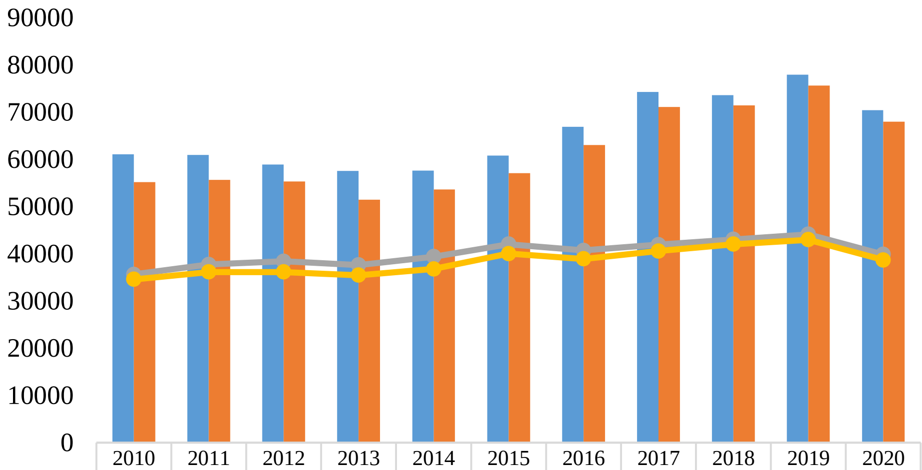
Source: www.FAO. Org, (Accessed on 20.09.2022), *The latest data on meat production at the level of EU countries.

According to FAO data, in 2017 at the head of the ranking in terms of hunting meat, Germany is found, with a total quantity of 58 400 tons, followed by Sweden with 16 062 tons, and Romania in 6th place with a production of 4 544 tons (Table 2). According to a study published by the German Federal Institute for Risk Assessment (BfR), it is claimed that in Germany, on average, people enjoy one to two meals containing 200 to 400 grams of the game every year. The meat is mainly from wild boar, deer, deer, and deer. However, intense consumers of hunting meat, such as hunter families and acquaintances, eat up to 60 and more meals containing game meat every year Bundesinstitut für Risikobewertung, 2018). All the analyzed states register decreases in the production of hunting meat, but the highest decreases are recorded in the Czech Republic and in Cyprus, so that from 2000 tonnes and 440 tonnes respectively in 2005 a production of 1200 tonnes and 327 respectively. tons in 2017, representing a decrease of 40% and 26% respectively (table 2). In the case of Poland, there is also a reduction of the herds in 2017, by 19% compared to 2005.

In Romania, a tendency of growth is observed until 2017, when there was a production of 4 544 tonnes, represent the maximum of the analyzed period, being an increase of 12% compared to 2005. Of the total production obtained at the European Union level. The product obtained in Romania represents only 4% (Table 2).

At the level of Europe, the import of hunting meat presents a downward trend, as a whole, registering a small decrease in 2020 when the value of imports was 297.07 thousand dollars, 24% less, compared to 2019. It is observed that The value of the import of hunting meat from 2020 is 43% lower than the one registered in 2010 (Figure 1).

From a quantitative point of view, the import of hunting meat, at the level of Europe, recorded an upward trend, with a small amount of quantity in 2020, when 70.4 thousand tonnes imported, about 10% less Compared to the previous year, 2019. Regarding, as a whole, the imported quantity was 15% more compared to 2010. (Figure 1).



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Europe- Import	61072	60966	58935	57564	57658	60798	66925	74334	73618	77980	70416
European Union (27) - Import	55228	55676	55358	51511	53662	57131	63026	71097	71439	75680	68028
Europe- Export	35660	37761	38439	37660	39407	42046	40718	41961	43074	44148	39870
European Union (27) - Export	34588	36155	36153	35465	36793	40049	38949	40585	42064	42993	38705

Figure 1 – Evolution of import and export of game meat (tons)

Source: www.FAO.Org

The export of game meat, at the level of Europe, shows an upward trend, as a whole, registering a small decrease in 2020 when the value of exports was 23,004 thousand dollars, 25.7% less, compared to 2019. It is observed that the value of game meat imports in 2020 is approximately 27% times lower than that recorded in 2010. From a quantitative point of view, the highest value was recorded in 2019, approximately 44148 tons, by 10.7% more than in 2020.

At the EU-27 level, the import of game meat shows an upward trend, as a whole, registering a small decrease in this case as well in 2020 when the value of imports was 286.32 thousand dollars, 24% less, compared to the year 2019. It is observed that the value of the import of game meat in 2020 is 36% lower than that recorded in 2010. From a quantitative point of view, the import of game meat, at the level of Europe, registered an upward trend, as a whole, with a slight decrease in the amount in 2020, when 68.02 thousand tons were imported, about 10.1% less than the previous year, 2019. The largest amount of game meat imported to the EU level in 2019 was 75,680 thousand tons, equivalent to 378.6 thousand dollars.

Regarding the export of game meat from the EU-27, an upward trend can be observed, from a quantitative point of view, in 2020, a total of 38.7 thousand tons were exported, 12% more than the first year analyzed, 2010 From a value point of view, the situation is a little different, that is, an oscillating train is recorded, but in 2020 game meat was exported in the total value of 224.6 thousand dollars, which represents a decrease of 26.1% compared to the previous year, when it was exported in the amount of 304.3 thousand dollars.

Starting from an increase in the domestic production of game meat correlated with an increase in quantities, the forecast of the total production of game meat in Romania until the year 2025 was realized. In the year 2000, approximately 3780 tons of game meat were produced.

Therefore, observing the upward trend of the evolution of total game meat production, a model was created in which its evolution was predicted in the following period, until the year 2025. According to the model, in the year 2025, Romania could produce up to 4904 tons of game meat, which would mean 29.7% more compared to the year 2000 (Figure 2).

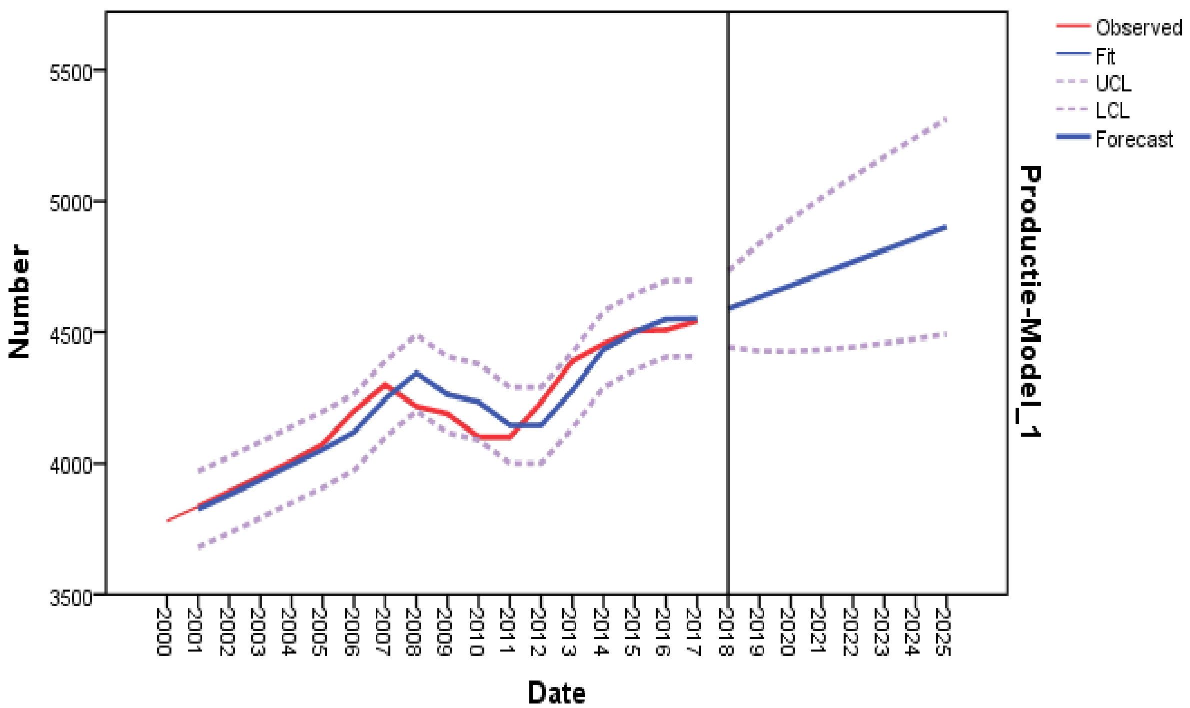


Figure 2 - Forecasting of the total production of game meat in Romania, until 2025 (tons)
Source: own representation in SPSS

It is known that game meat differs from the other types of meat available on the market due to its specific taste (Hutchison, C.L. et al., 2010). As game meat is largely derived from wild animals, it is difficult to maintain a stable level of meat parameters, because the taste and nutrient composition of the game meat is mainly influenced by the species, age, gender, state of health, and the animal's diet (Hoffman, L.C., et. al., 2007).

CONCLUSION

Following the results obtained, it can be concluded that the world production of game meat shows a slightly upward trend during the analyzed period, while at the European level a slight decrease is recorded. However, venison is still perceived as a sophisticated food and the venison market is still a niche, difficult for consumers to reach.

Regarding the production of game meat obtained at the level of the European Union, Germany is at the top of the ranking, followed by Sweden and Poland. At the national level, there was an upward trend, registering an increase of 12% in 2017 compared to 2005. Of the total production obtained at the level of the European Union, the production obtained in Romania represents only 4%.

Analyzing the evolution of imports at the European level, it is concluded that the import of game meat in 2020 is 15% higher than that recorded in 2010, while the amount exported is 11% higher in 2020. Finally, starting from on the premise of increasing the domestic production of game meat, following the forecast made with the help of the SPSS application, it is concluded that in 2025 Romania could produce up to 4904 tons of game meat, which would mean 29.7% more compared with the year 2000.

In the context of a limited number of studies related to the subject of game meat, further research should be carried out in the field of demand for this type of meat, with special attention paid to the quality of game meat. Given that food safety is very important to consumers, there is a need for extensive information activities to reduce their concerns about game meat. This may contribute to the increase in demand for this type of meat as an alternative to frequently consumed meat.

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HONEY MARKET– ACTUALITY AND PERSPECTIVES

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Abstract: *Apiculture as a branch of agriculture bases on bee's instinct to store food supplies over consumption need. supplies that are used by the beekeeper. From the technical-scientific and socio-economic evolution point of view. it caused the increase of food and the diversity of its range. Apiculture has a very important role in the distribution of honey. but also as a vector of increasing the apiculture production by pollinating the entomophile crops. Currently. Romania situates among the countries that have a well-developed apiculture. this situation being a consequence of the large number of bee families at our disposal. of the quantity of honey that was obtained. of the diversity in apiculture production and of the results from scientific research activities and training specialists. This study presents the evolution of the main indicators regarding the evolution of the number of bee families. production and honey consumption. as well as a forecast until 2027.*

Key words: *bee family. honey. apiculture products*

JEL Ranking: Q10. Q12

INTRODUCTION

The economic importance of apiculture is given by the value and the capitalization of direct apiculture that men harvest from bee: honey. propolis. pollen grains. royal jelly. venom. caps. bee bread and wax. but also those from agricultural products that are obtained from cultivated and wild plants through pollination.

From an alimentary and sanitary point of view. honey shall be understood as the food extracted from honeycombs. when they have been capped by bees on at least ¾ of their surface. so that it avoids the penetration of larvae (brood). bee bread. bee cadavers. pieces of wax or other impurities (Bulancea. M. 2002).

Honey has been used for consumption. as well as for medicinal purposes since ancient times. However. natural honey consumption had a decline throughout some periods. especially after the Industrial Revolution (Pocol.2013).

This last aspect has been strongly influenced in a positive way on the food market due to the increase of consumer's interest in a healthy lifestyle. namely „healthy eating habits". Moreover. numerous parents choose and search for natural products in order to provide healthy food for their children (Mărghitaş L..2008).

Besides the positive impact on health that honey has as a natural product. one of the reasons that contributed to the increase of honey consumption consists in information procured by the consumer regarding its nutritional value.

So. from a nutritional point of view honey is a natural product with a high caloric value: 320 - 330 kcal per 100 g. Regarding calories it was determined that the equivalent of 1.000 kg of honey can be the equivalent of: 1.450 kg of bread; 2.370 kg of beef; 3.930 kg of fish meat; 4.700 l of cow's milk or 6.000 kg of apples (Dezmirean D. S..2010).

Regarding Romanian population. consumers see honey as a product with multiple benefits for human health and as a part of a healthy lifestyle. This attention that honey has been paid not only locally or nationally. but also globally can be explained due to the fact that it's presented as a natural product and as part of alternative medicine. According to Pocol and collab. (2018) 1/3 consumers eat honey once a week or once a month.

MATERIAL AND METHOD

This study conducts an analysis of the honey market. the data that are used in the study present a market retrospective. because it analyses the number of bee families. productions. consumption and average purchase prices so that. by processing the series of chronological data with the help of different statistic indicators: arithmetic mean. standard deviation. variation coefficient and annual rate. those being determined with the help of the following formulas:

- arithmetic mean: $\overline{X} = \frac{\sum_{i=1}^{n} x_i}{n}$. where x_i- observed values; n-number of observed values

- standard deviation: $S = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{N-1}}$. where x_i- observed values; N-number of observed values. $\bar{x}$ – average of observed values

-variation coefficient: $CV = \frac{S}{\overline{X}}$. where S – standard deviation. $\overline{X}$– arithmetic mean

- average annual rate: *R= [radical of the order n-1 from (x_n / x_0)] - 1 * 100. where x_n.x_0 – current year – previous year value.*

Using *FORECAST* function. it was possible to present predictions of the honey market from Romania and by Regions of Development (2010-2027) in order to show it tendency.

FORECAST function predicts a value based on existing values across a linear tendency. FORECAST calculates the predictions of the future value using linear regression and can be used to predict numeric values such as sales. stocks. expenses. measurements etc.

In statistics. linear regression is an approach to shape the relation between a dependent variable (y values) and an independent variable (x values). FORECAST uses this approach to calculate the y value for a certain x value based on existing x and y values. In other words. for a given x value. FORECAST returns an estimated value based on the relation of linear regression between x values and y values.

RESULTS AND DISCUTIONS

Analyzing the evolution of the number of bee families in Romania. we can see an increase tendency between 2010-2020 when it has been registered a maximum number of 1879611 bee families in 2020 and a minimum of 1249610 bee families in 2011. This evolution of the number of bee families has increased in 2020 compared to 2010 by 147.4% and had an annual growth rate of 4.0%. (table nr.1)

The increase of the number of bee families is dues to accessing funds from national programs by purchasing biologic material necessary to repopulate apiculture livestock. which led to the growth and /or substitution of bee families following apicultural practice and implicitly to obtaining larger. healthier and more productive apiaries.

Per Development Regions we can see that at the top. with the largest number of bee families is the South-East Region with a number of 333.218 in 2020. with a difference of 180.959 bee families compared to 2010. registering an annual growth rate of 8.1%.

In the following places. in 2020 places the North-West Regions with a number of 308.674 bee families. the South-West Region Oltenia with a number of 290.283 bee families. followed by the South Region - Muntenia with 265.044 bee families and on the last place is the Bucharest – Ilfov Region with a number of 15.943 bee families.

Table 1. Evolution of the number of bee families in Romania. by Development Regions between 2010-2020

Specification	2010	2011	2013	2015	2017	2019	2020	Average (nr)	Stand. Dev. (%)	Var C.* (%)	Annual rate (%)
TOTAL	**1274917**	**1249610**	**1354218**	**1392846**	**1602453**	**1843026**	**1879611**	**1484419.3**	**231995.2**	**15.6**	**4.0**
NORTH-WEST Region	170269	162294	170933	171194	209867	294620	308674	203616.5	52855.3	26.0	6.1
CENTRAL Region	184046	185463	195713	202168	204403	223199	225822	201451.7	14244.7	7.1	2.1
NORTH-EAST Region	178685	170837	195333	198724	215535	238612	248639	202.693.0	25733.2	12.7	3.4
SOUTH-EAST Region	152529	150510	138325	138285	252914	323671	333218	199711.1	80750.9	40.4	8.1
SOUTH Region -MUNTENIA	193084	184822	192110	197903	227126	249359	265044	212184.2	27284.6	12.9	3.2
BUCHAREST – ILFOV Region	19207	17752	18248	13841	14092	16018	15943	16290.8	2010.2	12.3	-1.8
SOUTH-WEST Region OLTENIA	197052	209892	270707	298033	312789	311516	290283	272968.4	44530.4	16.3	3.9
WEST Region	180045	168040	172849	172698	165727	186031	191988	175503.5	8056.6	4.6	0.6

Source: own calculations based on INSSE data. *Variation coefficient: <10 = small; 10-20 = average; >20 = large.

Using *Forecast* function we can see the future tendencies of the total number of bee families from Romania as follows:

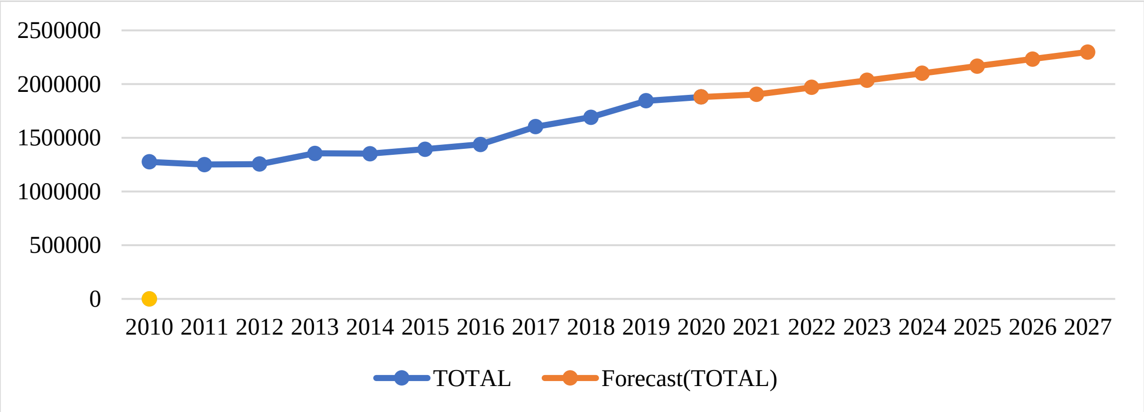

Figure 1. Tendency of total number of bee families from Romania. 2010-2027

Source: authors calculations

According to estimations it is expected for the number of bee families to increase by 2027 if this trend that has been analyzed between 2010-2020 is maintained.

The largest growth percent was held by the South-East Region in 2020 compared to 2010 and 2015 with a variation coefficient of 40.4%.

Increases with a more accelerated rate have been noticed also in the North-West Development Regions. South-West Region Oltenia respectively 26.0% and 16.3%.

In 2020 compared to previous year there have been registered increases by a number of 15685 bee families in South Region - Muntenia. 10.027 bee families in North-East Region and in the West Region 5.957 bee families. At a national level the significant increase has been in 2020 compared to 2010 of 47.4% decreasing up to 32.3% compared to 2015 and 0.2% compared to 2019.

The main trait of the Romanian market is the fact that the largest part of production lies with small private producers. some of them being under the protecting umbrella of some processors or trade associations or having supplying contracts with them. Currently. in our country the production of extracted honey during the analyzed period had an ascending trend with an annual rate of 3.3% (table 2) so that in 2020 the production of extracted honey increased by 8492 tons compared to 2010.

The largest honey production belongs to South-West Region Oltenia supplying between 2010-2020 an average of 4327 tons and a maximum of 5299 tons in 2017.

In the North-West Region a production maximum is registered in 2020 respectively 4345 tons and a minimum of 2771 tons in 2010 representing 38.2% with an annual rate of 3.3%. The Central Region between 2010-2020 maintains a linear trend supplying in average 3472 tons with an annual rate of 3.0%. In the North-East Region it’s registered an increase in 2015 of 4081 thousand tons respectively 4.8% and a maximum of 4342 thousand tons in 2020 with an annual rate of 1.1% throughout the analyzed period.

South-East Region places first in 2020 registering a production of 5662 tons with a difference compared to 2010 of 3002 tons and an annual rate of 7.9%.

South Region-Muntenia registers increases between 2013-2017 with an average of 3613 tons only to decrease in the following period (2019-2020). registering an average of 3520 tons and a negative annual rate of 0.1%.

Placing last is the Bucharest-Ilfov Region with a period average of 266 tons and an annual rate of 3.8% having a small increase towards the end of the analyzed period.

Table 2. Analysis of honey production extracted in Romania. by Development Regions between 2010-2020 (tons)

Development Region	2010	2011	2013	2015	2017	2019	2020	Average	Deviation (%)	Var C* (%)	Annual rate (%)
TOTAL	**22222**	**24127**	**26678**	**27893**	**30177**	**25269**	**30714**	**25322.4**	**4024.8**	**15.9**	**3.3**
NORTH-WEST	2771	3159	3117	3568	4031	3263	4345	3320.5	657.9	19.8	4.6
CENTRAL	2891	3466	3958	4269	3829	3408	3877	3472.3	502.7	14.5	3.0
NORTH-EAST	3894	3692	3433	4081	3917	3691	4342	3654.3	455.3	12.5	1.1
SOUTH-EAST	2650	2728	3130	3271	5201	4333	5652	3553.5	1212.7	34.1	7.9
SOUTH -MUNTENIA	3592	3318	4152	4058	4049	3078	3546	3541.3	476.7	13.5	-0.1
BUCHAREST – ILFOV	225	215	379	277	261	314	328	266.0	67.8	25.5	3.8
SOUTH-WEST OLTENIA	3409	4037	4491	4657	5299	4712	5278	4326.7	855.7	19.8	4.5
WEST	2790	3512	4018	3712	3590	2470	3346	3187.9	491.0	15.4	1.8

Source: own calculations based on INSSE data. *Variation coefficient: <10 = small; 10-20 = average; >20 = large.

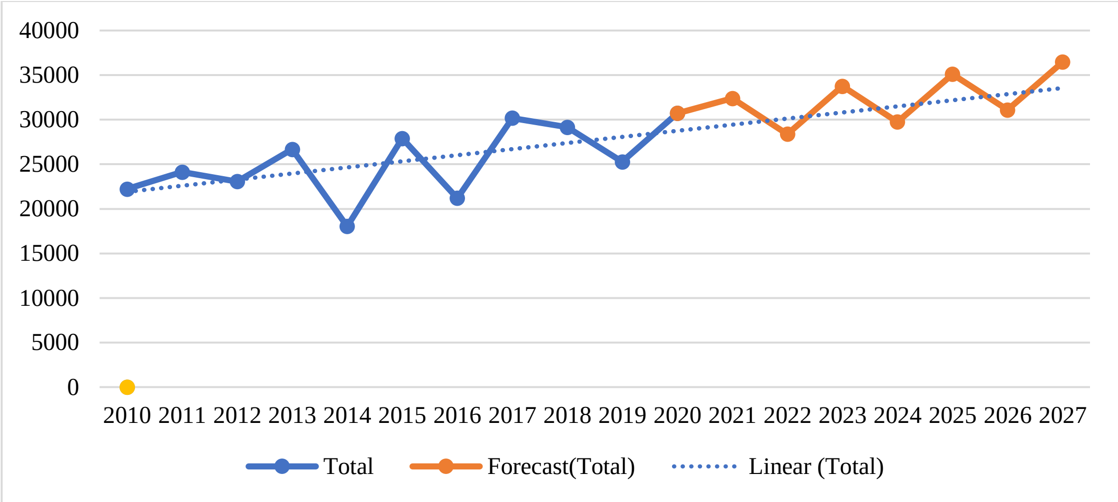

Figure 2. Tendency of honey production in Romania

Source: authors calculations

According to estimations it's expected for honey production to increase by 2027 if this trend that has been analyzed between 2010-2020 is maintained.

Regarding honey consumption. Romania is among the countries with the lowest consumption in Europe although an increase was registered in the last years.

Table 3. Analysis of the monthly average consumption of honey per person. per social categories and per residence (Kg). between 2010-2020

Specification	UM	2010	2011	2013	2015	2017	2019	2020	Average	Deviation	Var. C.*	Annual Rate
Total	Total	0.057	0.058	0.061	0.072	0.083	0.092	0.092	0.073	0.014	19.1	4.9
	Urban	0.72	0.073	0.073	0.087	0.1	0.108	0.104	0.146	0.191	130.9	-17.6
	Rural	0.039	0.039	0.046	0.055	0.063	0.073	0.078	0.056	0.014	25.0	7.2
Employees	Total	0.067	0.07	0.071	0.08	0.091	0.099	0.099	0.082	0.012	15.0	4.0
	Urban	0.074	0.078	0.079	0.087	0.101	0.11	0.105	0.090	0.013	14.4	3.6
	Rural	0.046	0.045	0.05	0.064	0.07	0.078	0.087	0.063	0.014	22.7	6.6
Self-employed in nonagricultural activities	Total	0.047	0.046	0.043	0.059	0.068	0.072	0.074	0.057	0.012	20.7	4.6
	Urban	0.063	0.067	0.052	0.081	0.092	0.089	0.077	0.070	0.014	19.6	2.0
	Rural	0.035	0.031	0.035	0.045	0.053	0.063	0.072	0.047	0.015	31.5	7.5
Farmers	Total	0.024	0.023	0.035	0.038	0.05	0.046	0.05	0.038	0.010	26.8	7.6
	Urban	0.04	0.023	0.047	0.083	0.077	0.039	0.04	0.047	0.023	47.9	0.0
	Rural	0.023	0.023	0.034	0.034	0.048	0.047	0.05	0.037	0.010	26.8	8.1
Unemployed people	Total	0.04	0.034	0.035	0.053	0.047	0.065	0.066	0.045	0.012	25.6	5.1
	Urban	0.049	0.037	0.037	0.059	0.055	0.075	0.074	0.053	0.013	24.4	4.2
	Rural	0.022	0.028	0.032	0.046	0.037	0.055	0.054	0.034	0.013	37.7	9.4
Retired people	Total	0.06	0.06	0.063	0.077	0.086	0.098	0.097	0.077	0.015	19.7	4.9
	Urban	0.076	0.074	0.075	0.093	0.104	0.114	0.11	0.091	0.016	17.4	3.8
	Rural	0.046	0.047	0.052	0.062	0.068	0.082	0.083	0.063	0.014	22.1	6.1

Source: own calculations based on INSSE data. *Variation coefficient: <10 = small; 10-20 = average; >20 = large.

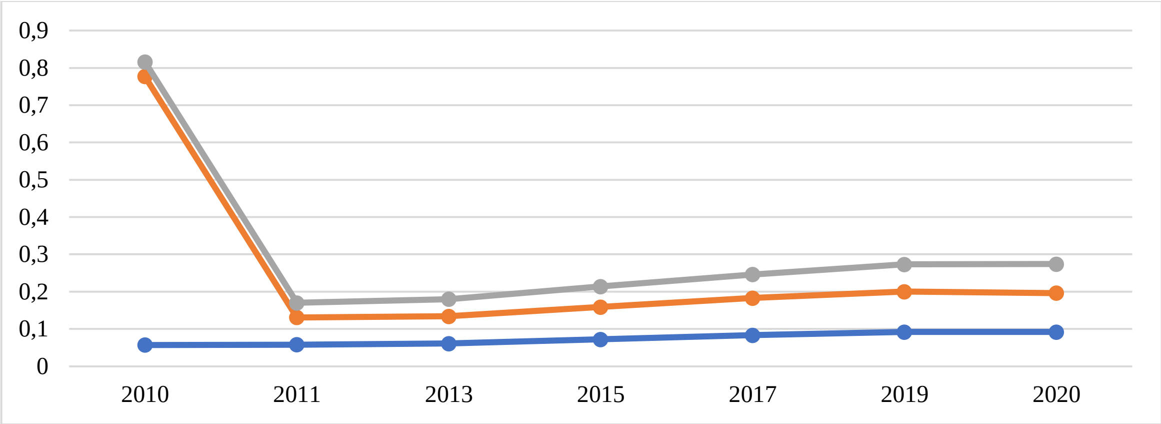

Figure.3. Evolution of honey consumption in Romania. 2010-2020

Source: authors calculations

Regarding the monthly average consumption of honey per person. per social categories and per residence we can notice that it has an ascending trend in the analyzed period. so that in 2020 it was of 0.092 kg/person representing an increase of 61% compared to 2010 but compared to previous year it maintained the same value. (table nr.3). The social category that consumes the largest quantity is employees of urban residence with an annual average of 0.090 kg/person compared to the ones of rural residence that have an average consumption of 0.063 kg/person. For the self-employed in nonagricultural activities. we can observe an oscillating trend of honey consumption. the average being of 0.057 kg/person. A maximum for the studied period is registered in 2020 with 0.074 kg/person and a minimum in 2013 of 0.043 kg/person. Regarding this category we can say that the biggest consumers remain the ones of urban residence with a difference of 0.005 kg/person compared to the ones of rural residence. The retired people category is the largest consumer of honey. followed by the categories of unemployed and farmers. The retired people are the ones that consume in average 0.077 kg/person. unemployed people 0.045 kg/person and farmers 0.038 kg/person.

According to statistic data. in the analyzed period the price for honey had important increases. accelerated even. registering throughout the analyzed period an annual rate of 6.7%. At the level of 2020 it registers the highest value of 16.86 lei/kg, respectively by 192% compared to 2010.

Also. we can see in the table below that at a regional level in 2020. the North-East Region registers the highest value. respectively 21.7 lei/kg with an annual rate of 9.7%. followed by the Central Region with 18.28 lei/kg. the South Region-Muntenia with a value of 16.97 lei/kg. the last place being held by the South-West Region Oltenia with 12.3 lei/kg.

Table nr. 4. Analysis of the average purchasing prices for honey. per country total and per Regions of Development between 2010-2020 (lei/kg)

Products	Development Regions	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Average	Deviation (%)	Var. C.* (%)	Annual Rate (%)
Honey	**TOTAL**	**8.79**	**9.99**	**10.04**	**11.46**	**13.83**	**14.62**	**15.11**	**16.13**	**16.68**	**16.66**	**16.86**	**13.7**	**3.0**	**22.3**	**6.7**
	NORTH-EAST	8.59	9.32	9.15	11.5	14.5	13.39	14.33	17.07	20.68	20.52	21.7	14.6	4.8	33.1	9.7
	SOUTH-EAST	8.51	9.14	9.07	10.68	13.32	19.61	14.17	13.23	13.74	14.57	15.82	12.9	3.3	25.9	6.4
	SOUTH - MUNTENIA	8.82	9.48	8.18	10.81	11.81	11.51	12.49	15.63	21.28	20.05	16.97	13.4	4.5	33.6	6.8

Products	**Development Regions**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**Average**	**Deviation (%)**	**Var. C.* (%)**	**Annual Rate (%)**
	SOUTH-WEST OLTENIA	8.59	9.37	9.5	11.04	13.49	12.9	14.92	15.56	12.2	11.16	12.3	11.9	2.3	18.9	3.7
	WEST	8.45	10.41	10.64	11.69	14.58	18.8	17.42	16.54	15.52	14.93	14.33	13.9	3.2	23.3	5.4
	NORTH-WEST	-	-	-	-	-	-	20.33	16.8	15.66	-	-	17.6	2.4	13.8	-
	CENTRAL	9.2	10.72	11.31	12.25	14.48	15.24	14.92	17.59	17.57	17.88	18.28	14.5	3.2	22.1	7.1

Source: processed INSSE data

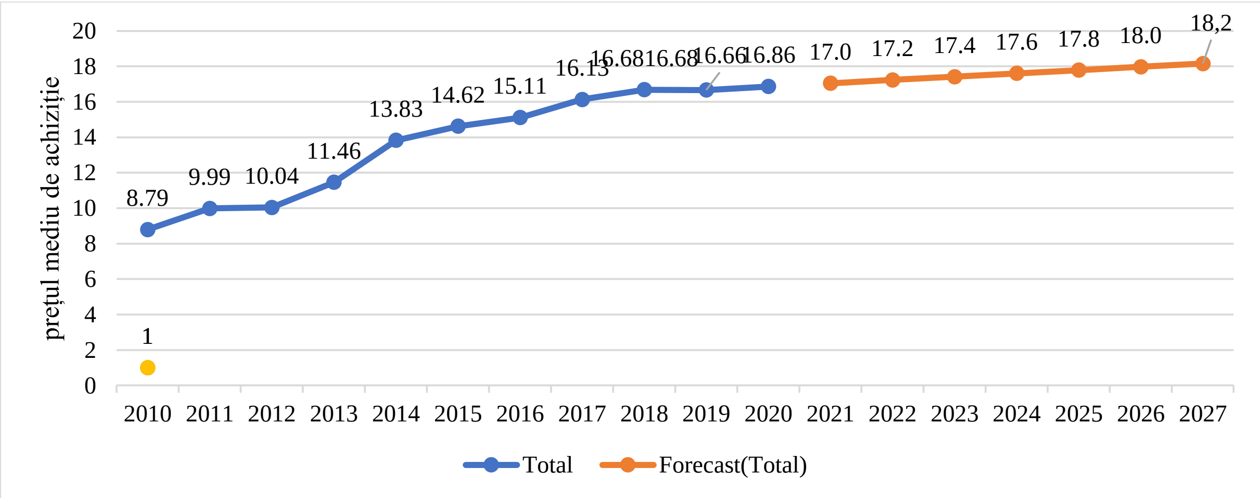

Chart nr. 4. Tendency of the average purchasing price for honey

Source: authors calculations

We can see, according to estimations that the tendency for the average purchasing price is a relatively constant one. that will reach in 2027 the value of 18.2 lei/kg.

CONCLUSIONS

The prices of the apiculture products are influenced in a higher or smaller proportion depending on the characteristics of the chosen distribution channels (length. width and depth).

Although Romania places 4th regarding honey production in Europe. Romanian beekeepers being recognized for the quality of produced honey. the price obtained by beekeepers is extremely low.Currently. the EU supports the apiculture sector. including the one from Romania. within common agricultural policy (CAP). mainly through national apiculture programs. These programs contain eight measures concentrated clearly on the improvement of general conditions of production and marketing of apiculture products. such as technical assistance for beekeepers. monitoring the market and combating beehive invaders and diseases.

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ECONOMIC IMPACT OF RISING FERTILIZER PRICES ON THE CEREALS BUDGET

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Abstract: *This paper aims to assess the impact on the budget of the main cereal crops in Romania, following the disruptions in the fertilizer market that led to accelerated price increases for this category of inputs. The income and expenditure budgets will be studied, both for the technological framework developed in 2021 and for the one developed in 2022, in the framework of the ADER 23.1.1 project of the Research Institute for Agriculture Economy and Rural Development, and finally the data will be quantitatively analysed, determining the absolute and relative differences related to the main cost elements, as well as the weight of the financial effort made for the application of fertilizers in the different cost structures for the crops: wheat, barley and maize.*

Keywords: *chemical fertilizer price, impact, cereals, Romania, budget.*

JEL classification: Q11, Q12.

INTRODUCTION

This paper aims to analyze the economic impact of the increase in the price of chemical fertilizers on the income and especially on the expenditure budget for the main cereal crops in Romania.

This accelerated increase in fertilizer prices has several causes, such as the increase in inflation in the last year, according to data and forecasts of the National Bank of Romania (2022), due to the increase in the cost of natural gas and energy sources, according to the European Council (2022), and these causes have led to the limitation of production or even the closure of certain fertilizer factories in Romania, an example would be the Azomures factory (Econmedia, 2021). Thus, a low supply of fertilizers at an increasingly high cost has been exponentially felt in the increase in prices for these products, given the observed demand for fertilizers for Romanian households, both small and especially competitive.

This is the main context from which the research question arose, i.e. what is the influence of these price increases on the expenditure budget for the main cereal crops, and the research hypothesis, given the constant level of production and thus the required quantities of active substance on fertilizers, is that the increase in fertilizer costs will be directly proportional to the price increase.

The importance of fertilizers can be found in any literature in the field, Iliev (2016) states that „*fertilisers contribute to the growth and development of plant mass, root system and other organs. Due to the plant's anatomical structure and developmental characteristics, it easily absorbs and efficiently uses the nutrients administered, resulting in increased production and improved quality*.”.

Ciochina (2017) confirms in his paper that „*the application of scientifically supported chemical fertiliser rates to autumn wheat contributes substantially to increasing yield and quality*.”

MATERIALS AND METHODS

This paper aims to determine the economic impact of the sharp increase in the price of chemical fertilizers on the income and expenditure budget for cereal crops in Romania. For this purpose, data on the technological estimates for the year 2021, taken from the publications of the Research Institute for Agricultural Economics and Rural Development, within the framework of the ADER 23.1.1 project, were used, and for the year 2022, technological estimates were elaborated and implicitly calculated the income and expenditure budgets for these crops. In the study, the following cereal crops were analysed, according to the share of cultivated areas in Romania, according to the National Institute of Statistics (2022): wheat, barley and maize. In order to determine the impact of the increase in fertiliser prices, the cost elements of the income and expenditure budgets were analysed, determining the absolute and relative differences between the values of the two agricultural years analysed, as well as the shares of fertiliser costs in total inputs.

RESULTS AND DISSCUSION

In order to determine the economic impact that may occur in cereal crops as a result of the increase in fertiliser prices, the data in the Income and Expenditure Budgets (IEB), calculated on the basis of the estimated technological estimates for each crop per unit area of one hectare, were analysed. Therefore, the current year 2022 and the previous year 2021 will be taken into account in order to identify the absolute and relative cost differences and the contribution of fertiliser costs to the various forms of expenditure per hectare.

Table 1. Determination of absolute and relative differences within IEBs for wheat crop

Crt. No.	Indicatori	Unit*	2021		2022		Abs. Diff.		Rel. Diff.
			lei	euro	lei	euro	lei	euro	%
1	A. VALUE OF PRODUCTION	c.u.	4215	852	5966	1206	1751	354	41.6%
2	D (-)TOTAL EXPENDITURE	c.u.	3794	767	5419	1095	1625	328	42.8%
3	I. VARIABLE EXPENSES	c.u.	3470	701	4993	1009	1523	308	43.9%
4	1. Expenditure on materials	c.u.	1476	298	2718	549	1242	251	84.2%
5	- Seed and planting material	c.u.	460	93	460	93	0	0	0.0%
6	- Chemical fertilisers	c.u.	793	160	2023	409	1230	249	155.1%
7	- Pesticide	c.u.	224	45	235	48	11	2	4.9%
8	2. Expenditure on mechanised works	c.u.	1862	376	2069	418	207	42	11.1%
9	3. Irrigation expenditure	c.u.	x	x	x	x	x	x	x
10	4. Supply costs	c.u.	44	9	82	16	38	8	85.3%
11	6. Insurance	c.u.	87	18	125	25	38	8	43.6%
12	II. FIXED COSTS	c.u.	324	65	426	86	102	21	31.4%
13	PRODUCTION COST	c.u./to	862	174	1220	247	358	72	41.6%

Source: calculations based on ADER 23.1.1 project data.* currency units

As regards wheat cultivation, the calculations in Table 1 were made for a wheat production level of 4,400 kg/ha in the lowland area with an average potential level for both periods analysed. Given the increase in inflation in the current year, there are increases in the expenditure items in the

Income and Expenditure Budget for this crop for most items, except for seed and planting material, the cost of which has remained constant.

Analysing the level of total expenditure, it increased in 2022 compared to the previous year by €328 per hectare, an increase of 42.8%. Analysed by the two main components, there is an increase in variable expenditure of 308 euros per hectare, i.e. 43.9%, and an increase in fixed expenditure of 21 euros per hectare, i.e. 31.4%.

Although the cost level recorded for planting material has remained constant, the largest increase in the variable expenditure items is recorded in the expenditure on raw materials and materials (inputs), given the increase in the cost of chemical fertilisers for this crop at this level of production in a non-irrigated system, the costs being higher by 249 euros per hectare, i.e. by 155.1%, in other words the fertiliser expenditure in this case has increased by 2.55 times.

Therefore, adding these additional costs to the volume of production obtained results in a cost per unit of product (tonne) of 247 euros, which is 72 euros per tonne higher than the previous year, i.e. 41.6% higher. This percentage is therefore also recorded in the value of production, given that the level of productivity is the same the recovery price should maintain the same rate of increase as the cost in order to cover the economic effort made in the wheat production process.

Table 2. Determination of the share of fertiliser costs in wheat crop expenditure

Indicators	U.M.	2021	2022	Diff. p.p
Share of fertiliser cost in expenditure on raw materials and materials	%	53.7%	74.4%	20.7 p.p.
Share of fertiliser cost in variable expenditure	%	22.9%	40.5%	17.7 p.p.
Share of fertiliser costs in total expenditure	%	20.9%	37.3%	16.4 p.p.

Source: own calculations

Analysing the share of the cost of fertilisers used in the technological estimate for the wheat crop in the various cost levels for both 2021 and 2022, but also analysing the dynamics, the following can be seen.

Analysing the share of the cost of fertilisers in the category to which it belongs, i.e. in the total costs of raw materials and materials (inputs), in 2021, fertilisers had a contribution of 53.7% and in the following year, this contribution increased to 74.4%, i.e. by 20.7 percentage points.

Looking at the share of fertiliser cost in total variable (direct crop) expenditure, in 2021 the fertiliser cost had a contribution of 22.9% and in 2022 this contribution increased by 17.7 percentage points to 40.5%.

Finally, analysing the share of fertiliser costs in total expenditure for the crop under study, it can be seen that in 2021, 20.9% of total expenditure represented fertiliser costs, and in 2022, these costs increased to 37.3%, i.e. an increase of 16.4 percentage points.

Table 3. Determination of absolute and relative differences within IEBs for barley crop

Crt. No.	Indicatori	Unit*	2021		2022		Abs. Diff.		Rel. Diff.
			lei	euro	lei	euro	lei	euro	%
1	A. VALUE OF PRODUCTION	c.u.	4062	821	5580	1128	1518	307	37.4%
2	D (-)TOTAL EXPENDITURE	c.u.	3655	739	4955	1002	1300	263	35.6%
3	I. VARIABLE EXPENSES	c.u.	3344	676	4560	922	1216	246	36.4%

Crt. No.	Indicatori	Unit*	2021		2022		Abs. Diff.		Rel. Diff.
			lei	euro	lei	euro	lei	euro	%
4	1. Expenditure on materials	c.u.	1378	279	2363	478	985	199	71.5%
5	- Seed and planting material	c.u.	426	86	360	73	-66	-13	-15.5%
6	- Chemical fertilisers	c.u.	729	147	1770	358	1041	210	142.8%
7	- Pesticide	c.u.	224	45	233	47	9	2	4.1%
8	2. Expenditure on mechanised works	c.u.	1840	372	2011	407	171	35	9.3%
9	3. Irrigation expenditure	c.u.	x	x	x	x	x	x	x
10	4. Supply costs	c.u.	41	8	71	14	30	6	72.9%
11	6. Insurance	c.u.	84	17	114	23	30	6	36.0%
12	II. FIXED COSTS	c.u.	312	63	396	80	84	17	26.8%
13	PRODUCTION COST	c.u./to	812	164	1116	226	304	61	37.4%

Source: calculations based on ADER 23.1.1 project data.* currency units

As regards barley, the calculations in Table 3 were made for a wheat production level of 4,500 kg/ha in the lowland area, with a medium potential level, in a non-irrigated system for both periods analysed. Given the increase in inflation in the current year, there are increases in the expenditure items in the Income and Expenditure Budget for this crop for most items, except for seed and planting material, the cost of which has decreased.

Analysing the level of total expenditure, it increased in 2022 compared to the previous year by € 263 per hectare, an increase of 35.6%. Analysed by the two main components, there is an increase in variable expenditure of 246 euros per hectare, i.e. 36.4%, and an increase in fixed expenditure of 17 euros per hectare, i.e. 26.8%.

Although the level of cost recorded for planting material has decreased, the largest increase in the variable expenditure items is recorded in the expenditure on raw materials and materials (inputs), given the increase in the cost of chemical fertilisers for this crop at this level of production in a non-irrigated system, the costs being higher by 210 euros per hectare, i.e. by 142.8%, in other words fertiliser expenditure in this case has increased 2.43 times.

Therefore, adding these additional costs to the volume of production obtained results in a cost per unit of product (tonne) of 304 euros, which is 61 euros per tonne or 37.4% higher than the previous year. This percentage is therefore also recorded in the value of production, given that the level of productivity is the same it was necessary for the recovery price to maintain the same rate of increase as the cost in order to cover the economic effort made in the barley production process.

Table 4. Determination of the share of fertiliser costs in barley crop expenditure

Indicators	U.M.	2021	2022	Diff. p.p
Share of fertiliser cost in expenditure on raw materials and materials	%	52.9%	74.9%	22.0 p.p.
Share of fertiliser cost in variable expenditure	%	21.8%	38.8%	17.0 p.p.
Share of fertiliser costs in total expenditure	%	19.9%	35.7%	15.8 p.p.

Source: own calculations

Analysing what is the share of the cost of fertilizers used in the technological estimate for the barley crop in the different cost levels for both 2021 and 2022, but also analysing the dynamics, the following can be observed.

Analysing the share of the cost of fertilisers in the category to which it belongs, i.e. in the total costs of raw materials and materials (inputs), in 2021, fertilisers had a contribution of 52.9% and in the following year, this contribution increased to 74.9%, i.e. by 22 percentage points.

Looking at the share of fertiliser cost in total variable (direct crop) expenditure, in 2021 the fertiliser cost had a contribution of 21.8% and in 2022 this contribution increased by 17 percentage points to 38.8%.

Finally, analysing the share of fertiliser costs in total expenditure for the crop under study, it can be seen that in 2021, 19.9% of total expenditure represented fertiliser costs, while in 2022, these costs increased to 35.7%, i.e. an increase of 15.8 percentage points.

Table 5. Determination of absolute and relative differences within IEBs for maize crop

Crt. No.	Indicatori	Unit*	2021		2022		Abs. Diff.		Rel. Diff.
			lei	euro	lei	euro	lei	euro	%
1	A. VALUE OF PRODUCTION	c.u.	4677	945	5638	1139	961	194	20.5%
2	D (-)TOTAL EXPENDITURE	c.u.	4210	851	5535	1119	1325	268	31.5%
3	I. VARIABLE EXPENSES	c.u.	3514	710	5147	1040	1633	330	46.5%
4	1. Expenditure on materials	c.u.	1218	246	2623	530	1405	284	115.4%
5	- Seed and planting material	c.u.	344	70	375	76	31	6	9.0%
6	- Chemical fertilisers	c.u.	773	156	2139	432	1366	276	176.7%
7	- Pesticide	c.u.	101	20	109	22	8	2	8.3%
8	2. Expenditure on mechanised works	c.u.	2162	437	2317	468	155	31	7.2%
9	3. Irrigation expenditure	c.u.	x	x	x	x	x	x	x
10	4. Supply costs	c.u.	37	7	79	16	42	8	112.7%
11	6. Insurance	c.u.	97	20	128	26	31	6	31.5%
12	II. FIXED COSTS	c.u.	696	141	388	78	-308	-62	-44.3%
13	PRODUCTION COST	c.u./to	765	155	922	186	157	32	20.6%

Source: calculations based on ADER 23.1.1 project data.* currency units

As regards maize, the calculations in Table 5 were made for a wheat production level of 5,500 kg/ha in the lowland area, with a medium potential level, in a non-irrigated system for both periods analysed. Given the increase in inflation in the current year, there are increases in the expenditure items in the Income and Expenditure Budget for this crop for most items, except for fixed costs, the level of which has decreased, given that in 2022 the manual work of hoeing between plants in turns has been eliminated due to labour issues and increased tariffs.

Analysing the level of total expenditure, it increased in 2022 compared to the previous year by €268 per hectare, representing an increase of 31.5%. Analysed by the two main components, there is an increase in variable expenditure of 330 euros per hectare, i.e. 46.5%, and a decrease in fixed expenditure of 62 euros per hectare, i.e. 44.3%.

The largest increase in the variable expenditure items is recorded in the expenditure on raw materials and materials (inputs), given the increase in the cost of chemical fertilisers for this crop at this level of non-irrigated production, the costs being higher by 276 euros per hectare, i.e. by 176.7%, in other words the fertiliser expenditure in this case increased by 2.77 times.

Therefore, adding these additional costs to the volume of production obtained results in a cost per unit of product (tonne) of €186, i.e. €32 per tonne higher than the previous year, i.e. 20.6% higher. This percentage is therefore also recorded in the value of production, given that the level of productivity is the same it was necessary for the recovery price to maintain the same rate of increase as the cost in order to cover the economic effort made in the maize production process.

Table 6. Determination of the share of fertiliser costs in maize crop expenditure

Indicators	U.M.	2021	2022	Diff. p.p
Share of fertiliser cost in expenditure on raw materials and materials	%	63.5%	81.5%	18.1 p.p.
Share of fertiliser cost in variable expenditure	%	22.0%	41.6%	19.6 p.p.
Share of fertiliser costs in total expenditure	%	18.4%	38.6%	20.3 p.p.

Source: own calculations

Analysing the share of the cost of fertilisers used in the technological estimate for maize in the various cost levels for both 2021 and 2022, but also analysing the dynamics, the following can be seen.

Analysing the share of the cost of fertilisers in the category to which it belongs, i.e. in the total costs of raw materials and materials (inputs), in 2021, fertilisers had a contribution of 63.5%, and in the following year, this contribution increased to 81.5%, i.e. by 18.1 percentage points.

Looking at the share of fertiliser cost in total variable (direct crop) expenditure, in 2021 the fertiliser cost had a contribution of 22% and in 2022 this contribution increased by 19.6 percentage points to 41.6%.

Looking at the share of fertiliser cost in total variable (direct crop) expenditure, in 2021 the fertiliser cost had a contribution of 22% and in 2022 this contribution increased by 19.6 percentage points to 41.6%.

CONCLUSIONS

The aim of the study was to assess the impact of the recent increase in fertiliser prices on cereal crop budgets. Thus, the income and expenditure budgets for the years 2021 and 2022 were analysed for the crops: wheat, barley and maize, in a non-irrigated system, in a lowland area with average potential.

Given the high level of inflation in 2022, most of the cost items for the three cereal crops have seen increases over the previous year, but by far the largest increases have been for the input category, fertiliser.

Clearly each crop has its own technical and technological peculiarities, but nevertheless, the increase in the cost of fertiliser application for the three crops ranged from +210 euros/hectare to +276 euros/hectare, resulting in a relative difference of between +142.8% and +176.7%, or in other words, the cost of chemical fertilisers increased by 2.43 to 2.77 times. In this case, of the three main cereal crops, the most affected was maize, due to its technological specificity, but the differences with the other crops in terms of costs were not large.

Each cost increase in the cost elements ultimately led to an increase in the cost per unit of product, ranging from +20.6% (maize crop) to +41.6% (wheat crop), and obviously the price of these products had to keep pace with the increase in costs in order to break even.

An analysis of the share of fertiliser costs in the various categories of expenditure shows an increase of between 15.8 and 22 percentage points.

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METHODS AND TECHNIQUES FOR EVALUATING NON-MARKETABLE ECOSYSTEM SERVICES

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Abstract: *Ecosystems provide a range of goods and services vital to the well-being of humans and other living things, as well as to the development of society. Along with natural resources, tangible and tradable in the market, they provide a series of intangible, non-marketable services that translate into health, cultural, social and scientific benefits. Human activities, especially after industrialization, have created unprecedented pressures on natural ecosystems and led to their constant degradation, resource depletion, global warming and loss of biodiversity. This is also because non-marketable services are underestimated by the majority of the population, being perceived as inexhaustible and free. The health of ecosystems has a direct impact on the quality of life of people and other living things, a fact that has led to the development of a series of methods and techniques for evaluating all services, including non-marketable ones, so that their value can be taken into account at all relevant levels of the decision-making process. In this paper, a state-of-the-art of methods and techniques for evaluating non-marketable services provided by ecosystems is presented, the results of studies to calculate the Total Economic Value of ecosystem services are presented, as well as their importance in the process of public policy development.*

Keywords: *ecosystem services, global warming, biodiversity, evaluation methods, public policies.*

JEL classification: Q51.

INTRODUCTION

Currently, part of these resources, such as UNESCO heritage sites, Natura 2000, natural areas or protected species, benefit from protection, by legislating restrictions on human activities that can be carried out in the respective areas. One such example is the granting of financial compensation for loss of income, as is the case with forest land owners who enter into voluntary commitments. For example, in Romania, through NPRD 2014-2020, under Measure 15 – Agri-environmental services, compensatory payment packages were provided for forest owners who enter into commitments for at least 5 years, in the amount of €25/ha/ year for the areas dedicated to the provision of quiet areas, respectively €103/ha/year for the use of hitches for the collection of wood from thinnings, in the case of forest areas between 100-500 ha. For areas larger than 500 ha, a degressive financial support is applied, motivated by the fact that, in this case, the amount of income ensured by the utilization of the harvestable wood mass increases progressively, and the profitability of the forest exploitation is also improved (NPRD, 2014).

MATERIAL AND METHOD

The objective of the research is to present methods and techniques for evaluating non-marketable services provided by ecosystems, their advantages or disadvantages and limitations, identified in the specialized literature, as well as in specific national and international legislation. Also, as an example, the results of some studies will be presented that have focused on the calculation of VET in the USA, Spain, Italy and the Republic of Moldova. For this purpose, scientific articles published on the scientific platforms researchgate and google academic were analyzed, as well as national and international specialized legislation such as: resolutions, regulations, decisions, directives, PNDR 2014-2020, guides related to the specified measures. The research methods used in carrying out the work were the following: the desk-research method through the study of previous research carried out by different authors and their systematic and comparative analysis, as well as of the studied legislation.

RESULTS AND DISCUSSION

In the last 70 years, especially after industrialization, human activities have created unprecedented pressures on natural ecosystems that have caused changes within them faster and more than in any other period of mankind, and led to their constant degradation, global warming and biodiversity loss. Between 1960 and 2000, the demand for ecosystem services increased exponentially as the world population doubled to 6 billion people and the global economy grew more than sixfold (MEA, 2005).

At the global level, the importance of protecting ecosystems and their sustainable management has been recognized through a series of documents adopted by the UN, such as the Framework Convention on Climate Change (2016), the Convention on Biological Diversity (1992), or the Convention to Combat Desertification (2019). Also, at the European level, a series of European conventions or regulations have been adopted by which the member countries undertake to promote appropriate legislative and administrative measures for the protection and conservation of natural habitats. Among them we list: Bern Convention on the Conservation of Wild Life and Natural Habitats in Europe (1979), Bonn Convention on the Conservation of Migratory Species of Wild Animals (1979), EU Council Directive 92/43/EEC on the Conservation of Natural Habitats and species of wild fauna and flora (1992), Directive 2009/147/EC on the conservation of wild birds (Birds Directive, 2009) or the EU Biodiversity Strategy for 2030 (2020). The UN Millennium Ecosystem Assessment report classifies ecosystem services into: supply services (food, water, wood, etc.); regulation services (which regulate the climate, water quality, provide control of floods, epizootics and zoonoses, ensure the absorption of carbon emissions and other gases); cultural services (recreational, aesthetic, cultural, spiritual benefits), and support services (soil formation, photosynthesis, nutrient cycle).

VET assessment of ecosystem services has been and still is a challenge for scientists, specialists, experts, promoters and decision-makers of public policies globally.

Concerns in the field have led over time to the development of various techniques and methods for conducting these assessments, from mapping and modeling the demand and supply of ecosystem services to determine their economic and non-economic value, to social and ecological assessment techniques.

If for the evaluation of marketable ecosystem goods and services there are already associated values related to their use, resulting from trading on the market, the challenges arise when the question arises of the evaluation of non-marketable services, associated with non-use values, such as benefits in terms of health, biodiversity, society, science, expectations about the future.

The natural resources provided by ecosystems are unique and limited, and their depreciation or degradation entails costs to society. From an economic point of view, when a resource is limited, the opportunity cost appears, representing the value of the best of the sacrificed chances, i.e. the one that is given up when a choice is made. However, the difficulty of carrying out a VET evaluation of ecosystems is given by the fact that the changes produced on them are irreversible or reversible but at a prohibitive cost.

The VET assessment methodology developed in 2010 in the TEEB Report (TEEB, 2010) identifies two main components of the VET of ecosystem services: use value and non-use value.

Use value is composed of actual use value and potential use value while non-use value is made up of preservation value and intrinsic value. Specifically, use value comes from direct services provided by ecosystems: animals, fish, plant products, recreation, well-being, spiritual fulfillment, education, research, or indirect: clean air, purified water, soil fertility, pollination, pest control, And so on

Non-use value includes philanthropic and altruistic values, namely the desire that the services offered by ecosystems can be enjoyed by other people and future generations, as well as the desire that the species that make up the ecosystem continue to exist. These values are the most difficult to evaluate in financial terms, considering that they refer to moral, aesthetic, religious principles, for which there is no proper trading market.

The TEEB report identifies and classifies VET assessment methods into 3 categories:

I. Direct market valuation approaches: price-based method, cost-based method, production function-based method.

I.1) The price-based method is most often used to calculate the value of goods and services provided. These being traded on the market, their value is relatively easy to calculate: for example, the value of selling wood, honey, the value of tourist services.

I.2) Cost-based methods. Within this category there are several techniques, such as: the method of avoided costs (which evaluates the costs that would have occurred in the absence of the existence ecosystem), the replacement cost method (estimates the costs of replacing ecosystem services with artificial technologies), the restoration cost method (which evaluates the costs of counteracting the effects of ecosystem loss or restoring them).

I.3) The method based on production functions estimates how much of the non-market services provided by an ecosystem contribute to another service or good traded on the market, respectively how much it contributes to the increase in productivity or the price of that good or service.

II. Approaches to consumer preferences: Travel cost method, Hedonic pricing method.

II.1) Travel cost method – the method mainly relevant for determining the value of recreational services associated with biodiversity and ecosystem services. The method is based on the principle that recreational experiences can be associated with a cost, consisting of direct costs and opportunity cost. In the case of tourism, changing ecosystem biodiversity can influence the demand to visit that location.

II.2) The hedonic price method – it is based on the added value that a landscape, or the location near a forest can bring to the real estate market, for example. In this case, the change in the biodiversity of an ecosystem can lead to a change in the market value of the respective property.

The limitations of these approaches are given by the fact that a large amount of data and complex statistics are needed, the methods being expensive and time-consuming. In addition, being methods that are based on direct observation of buyers, they can provide a picture of the current moment.

III. Value simulation approaches: Contingent valuation method, Deliberative choice method, Group valuation method. III. 1) The contingent valuation method consists in the use of questionnaires through which the respondents provide information regarding the amount they would be willing to pay to protect ecosystem services, respectively how much they would be willing to pay to accept their loss or degradation.

III. 2) The deliberative choice method focuses on trying to model human behavior in a given context, starting from the premise that, as a rule, people have to choose from two or more alternatives when making a decision, one of which is the money.

III. 3) The group evaluation method combines the techniques of gathering information through questionnaires, with elements of the deliberative process from political sciences, this being increasingly used to collect values such as: the uniqueness of ecosystems, social justice, altruism towards other people, face by future generations, compared to the species that are part of the ecosystem,

One of the first significant economic evaluations of VET was carried out in 1997 by Robert Costanza in the work entitled "The value of the world's ecosystem services and natural capital" (Costanza, 1997). The premises from which the evaluation of eco-systemic services was started were those that they provide, through their functions and components, benefits to the population, i.e. services. Ecosystems are unique, irreplaceable, which makes their value inestimable. Starting from these premises, the author grouped ecosystem services into categories and calculated their unit value, using evaluation techniques based mainly on "people's willingness to pay". The resulting values were then multiplied by the area occupied by all ecosystems in the US, calculating a total of $33 billion per year, more than double the annual GDP, estimated at $16 billion, at the time.

The study entitled Socio-Cultural and Economic Valuation of Ecosystem Services Provided by Mediterranean Mountain Agroecosystems (Bernués, 2014), carried out in the Natural Park "Sierra y Cañones de Guara" from Spain, in which deliberative methods were applied to evaluate the services provided by Mediterranean mountain ecosystems, leading to the conclusion that a level of compensatory payments three times higher than that applicable at the time of the study (121 euros/person /year, compared to 45 euros/person/year) would correctly reflect the VET of the studied area.

In the framework of the study Socio-economic valuation of abandonment and intensification of Alpine agroecosystems and associated ecosystems services (Faccioni, 2018), carried out in the Italian Alps - Povincia Trento, a VET of 150.30 euros/person/year resulted.

The study Practical considerations in the complex economic evaluation of forest resources managed by the "Moldsilva" agency (Țurcanu, 2014), concluded that about 83.65% of VET is represented by regulatory, cultural and assistance services.

The results obtained from the study will be presented in a logical order to enable the reader to interpret the data correctly.

CONCLUSIONS

Ecosystems provide a range of marketable and non-marketable services, such as food, genetic material, medicinal plants, pollination, air filtration and cleaning, soil and carbon dioxide absorption. People's perception of ecosystem services is different and often underestimated.

Calculating VET in a comprehensive and relevant manner is challenging due to the fact that natural, historical and cultural resources are not traded like any other goods and services and do not have an explicit monetary value, making them difficult to quantify monetarily. Biodiversity is one of the non-use values for which society and people must decide whether they want to pay to maintain and preserve it.

Despite the increase in the number of scientific communications presenting the valuation of ecosystem services and valuation methods and techniques based on non-monetary methods, it has not been possible to formalize a relatively unified methodology to date.

Challenges identified in the methodologies developed to date are: broad, confusing and contested terminology, unclear boundaries/boundaries and contextual specificities.

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USE OF SOIL AMENDMENTS - IMPORTANT MEASURE TO INCREASE YIELD IN SUGAR BEET

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Abstract: *The research where executed in 2021, at the Turda Agricultural Development Research Station, using the Vangelis sugar beet cultivar and followed the influence of Terracalco [95] soil amendments on physiological parameters and production at different stages of crop development. The granular soil amendment was applied in two doses of 500 and 1000 kg/ha^{-1}, during the vegetation period (beginning of root formation, 75 days after emergence, 105 days after emergence and 135 days after emergence), quantifying certain physiological parameters. Physiological parameters were monitored with the CIRAS-3 foliar gas analyzer, simultaneously determining: reference carbon dioxide (CO2r- µmolm-s^{-1}), assimilation (A- µmol m^{-2}s^{-1}), transpiration rate (E- mmolm^{-2}s^{-1}), leaf water deficit (VPD- kPa) and leaf temperature (Tfr. °C). By applying the granulated soil amendment, the absorption of nutrients is maximized, in most cases stimulating the analyzed physiological parameters, obtaining in the variant that applied 1000 kg/ha^{-1}an increase in production of over 950 kg/ha^{-1}.*

Key words: *soil amendment, assimilation, sugar beet, yield*

Clasificare JEL: Q 01, Q 15, Q 16

INTRODUCTION

Sugar beet is a crop of particular economic importance, being the only plant that provides the raw material for sugar production, in the temperate continental climate, especially in European countries (Muntean et al., 2014). The long duration of sunshine of at least 850 hours during the growing season in August, September, October qualifies it as a long-day plant and leads to the provision of large amounts of sugar (Velican, 1965).

In sugar beet culture, an important role is played by photosynthesis, a process by which the first organic compounds are synthesized from inorganic substances (carbon dioxide, water and mineral salts) in the presence of light radiation captured by assimilating pigments (especially chlorophyll), in after which oxygen is released (Delian Elena, 2010).

By applying Terracalco [95], the structure of the soil is improved and the absorption of nutrients from the soil by plants is maximized, creating an environment favorable to biological activity, it sets the cycle of living things and microorganisms in motion, it raises the pH and last but not least, it increases production. (Chețan Felicia, 2021).

The product Terracalco [95] is administered with the machine for spreading chemical fertilizers, on the stubble and is incorporated into the soil through the basic works (ploughing, scarification, etc.) or it can be incorporated superficially into the soil through disc works followed by plowing.

The research looked at the influence of Terracalco [95] soil amendment in the sugar beet crop on physiological and environmental parameters, yield and quality.

MATERIALS AND METHODS

In the experiment, the sugar beet cultivar Vangelis Strube Dieckmann was used, which shows tolerance to cercosporiosis and rhizomania, the culture being included in a rotation with a 4-year rotation: corn - soybean - winter wheat - sugar beet.

The studies were carried out on a vertic clay-iluvial chernozem type soil, with a pH of 7.0 - 7.2, with a humus content at the depth of 0 - 30 cm between 2.14 - 3.12% and of clay between 51.8 - 55.5 % (clay texture), the preceding plant being winter wheat. After harvesting the wheat in the variants in which Terracalco ^{95} was used, it was applied by spreading, after plowing at a depth of 30 cm on the entire surface, already in the fall in the third decade of September.The leveling was executed with the rotary harrow since autumn to achieve better water management.

The basic fertilization was realized with 700 kg/ha NPK 16:16:16 in the third decade of March for all variants and an additional fertilization on the vegetation with 150 kg/ha N.

Herbicide where administrated pre-emergent on the ground at the end of March with the products Venzar 1.2 l/ha + Spectrum 1.0 l/ha, being incorporated at a depth of 3-4 cm, with the combiner.

Sowing was done at the end of March at 45 cm distance between rows and 18 cm between grains/row. The quantity of seed/ha being 1.4 UG (140000 b.g).

After sowing, the land was rolled with the ring roller for a better contact of the seed with the soil, and after about 21 days after sowing, the emergence of the crop took place.

The treatments on vegetation to combat weeds, diseases and pests were executed as follows: treatment I was applied in the first decade of May, with the products Powertwin (2.0 l/ha) and Cloe (0.25 l/ha) ; treatment II was applied at the beginning of the second decade of May, with Safari 50 WG (30 g/ha) and Sherpa (0.2 l/ha); treatment III was aplied at the beginning of the third decade of May, with the herbicides Safari (30 g/ha) and Agil (1.5 l/ha) + Lithovit (1.0 kg/ha) (foliar fertilizer) + Mospilan (0 .2 l/ha) (systemic insecticide); treatments IV and V were aplied in the first decades of July and August with Sfera (0.35 l/ha) (fungicide) + Dafcobor (2.0 l/ha) (foliar fertilizer) + Aphis (0.15 l /ha) (systemic insecticide) and Yamato (1.5 l/ha) (fungicide) + Aphis (0.15 l/ha) (systemic insecticide).

The harvest took place at the end of the second decade of October.

The measurement of the physiological parameters were executed in three phases of development, the root formation phase, 75 days after emergence, which corresponds to the first decade of July, the root thickening phase, in the first decade of August, at 105 days from emergence and the root maturity phase, 135 days after emergence, in the first decade of September. The research method used was non-destructive (the leaves were not detached from the plant) and was based on the use of the leaf gas analyzer CIRAS-3, (PP System USA,-2014), the determinations being realized under semi- controlled conditions for normal CO2 (390 μmolm-s^{-1}). It simultaneously reads several physiological and environmental parameters such as: reference carbon dioxide (CO2 r-μmolm-s^{-1}), assimilation (A- μmol m^{-2}s^{-1}), transpiration rate (E- mmolm^{-2}s^{-1}), water deficit in the leaf (VPD-kPa), active photosynthetic internal radiation (PARi- μmolm^{-2}s^{-1}) and leaf temperature (Tfr. - ^{o}C), (table 2).

The beet sugar percentage was determined using the KRUSS DR201-95-OE dual-scale portable refractometer, which reads in degrees brix 0 – 95% for invert sugar (for glucose, fructose, invert sugar).

RESULTS AND DISCUSSIONS

During the vegetation period (March - October) in sugar beet, the rate of growth, development and accumulation of sugar are influenced by environmental conditions, temperature and precipitation.

Temperature is a particularly important factor, so that Radke and Bauer (1969) found that the rate of root growth intensifies between the temperature limits of 10-20°C, becomes stagnant in the limits of 20-30°C and decreases at temperatures exceeding 30°C. Also, leaf formation is slower at temperatures below 15°C, has maximum values between 15 and 30°C and decreases greatly in intensity at temperatures above 30°C (Thorne, 1967).

Regarding the meteorological conditions in 2021 for the sugar beet crop, during the vegetation period (March - October) it can be observed that the average temperature was 14.6°C, and the amount of precipitation fell was 418 mm.

The thermal regime during the vegetation period (March - October) was cooler in the months of March-April-May, the deviations being negative, which led to a slower development of the beet in the first phases.

The highest temperatures were recorded in June and July, with a deviation from the multiannual average of +1.9°C and +3.0°C respectively, and the months of August, September and October had normal monthly average values compared to the multiannual average, sugar beet having normal development and sugar accumulation (Figure 1).

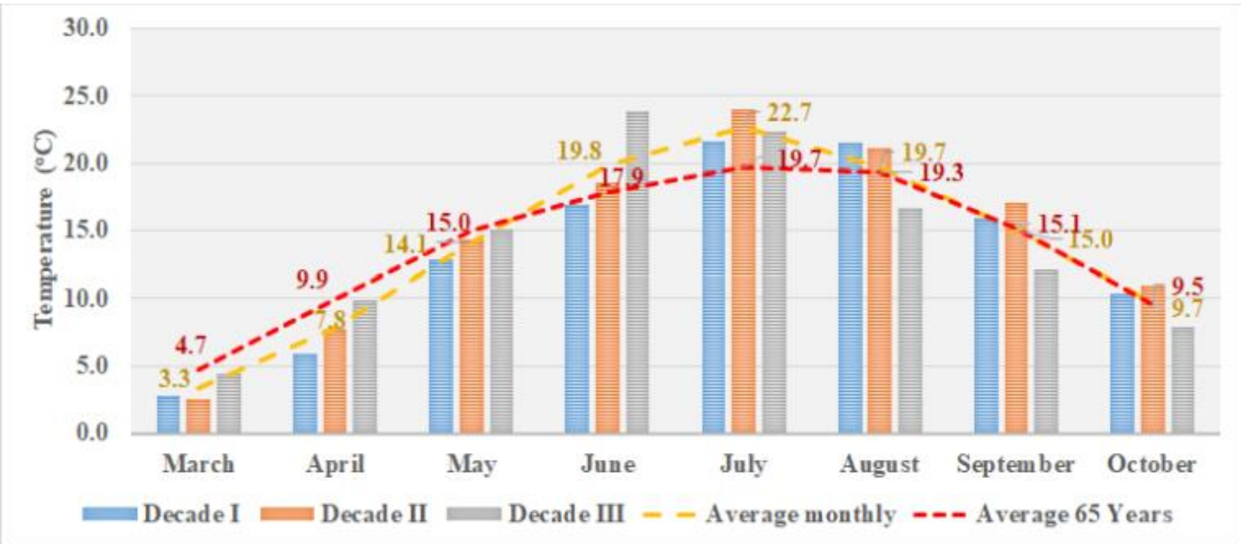

Figure 1. The average monthly temperature recorded during March 1st, - October 31st, 2021
Primary data source: meteorological station Turda (longitude: 23° 47' latitude 46° 35')

Regarding the rainfall regime during the beet vegetation period, it recorded an amount of 418.3 mm, the deviation from the multi-annual average being -16.4 mm. Precipitation in the spring months ranged from a little rainy in March, during the sowing period, to a little dry during the emergence period, and to a little rainy in the phase of the beginning of root formation.

Precipitation in the summer months ranged from excessively dry in June with a deviation of -39.8 mm, to excessively rainy in July with a deviation of +46 mm, then to normal in August.

In September the rainfall was near to normal, so the sugar beet was able to develop normally and accumulate reserve substances. For this crop, the 2021 agricultural year was favorable according to temperature, but dry for precipitation (this is where the lack of precipitation in April, June and October left its mark) (Figure 2). But sugar beet tolerates long periods of drought quite well and can quickly recover water after a rainy period, with the maximum water requirements being in early July and mid-August, a fact also highlighted by Burzo et al. in 1999.

At the beginning of the vegetation period, the growth rate of the leaves is slower, after which their development intensifies in July and reaches its maximum in August, gradually decreasing during the months of September and October (Demazure et al. 1992).

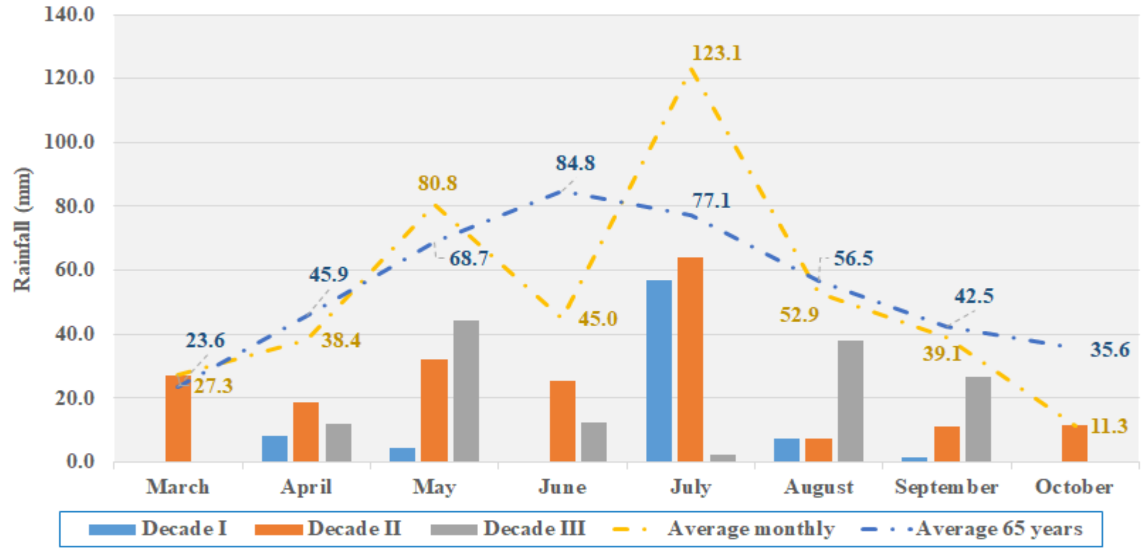

Figure 2. The average monthly rainfall recorded during March 1st, - October 31st, 2021
Source of primary data: Turda meteorological station (longitude: 23 ° 47 'latitude 46 ° 35');

In the sugar beet cultivar Vangelis, assimilation (A) was more intense in all development phases, where the Terracalco^{95} amendment was applied, in all three temperature ranges I1 (24-27°C), I2 (27-30°C) and I3 (30-33°C), as can be seen from table 1.We can note that where 1000 kg/ha Terracalco ^{95} was used the differences compared to the control are statistically ensured at different thresholds (table 1).

Table 1 The influence of the Terracalco ^{95} amendment on assimilation in sugar beet

	Temperature (°C)	**July (75 days after germination)**			**August (105 days after germination)**			**September (135 days after germination)**		
	Variant	V_1	V_2	V_3	V_1	V_2	V_3	V_1	V_2	V_3
Assimilation (A-μmolm^{-2}s^{-1})	24-27°C	20.4	21,2	22.8	23,8	23,6	24,7	19.9	20,5	21.8
	Significant	Cv.	ns	***	Cv.	ns	*	Cv.	*	***
	27-30°C	21,5	22,3	23,2	23,7	24,4	24,9	21,4	22,4	23,2
	Significant	Cv	ns	***	Cv.	ns	**	Cv	*	***
	30-33°C	23,3	23,3	24,4	24,2	24,9	25,3	21,9	22,7	23,1
	Significant	Cv	ns	**	Cv.	ns	*	Cv.	ns	**
LDS (p 5%)-0,84; LDS (p 1%)-1,13; LDS (p 0,1%) - 1,52;										

, * = Significant at 1% and 0.1% probability levels, positive values; Cv. = control variant: ns= not significant

Transpiration at leaf level has oscillating values in the climatic conditions of the experimental year 2021 (Figure 3) with grouped values, and the regression curve obtained indicates a decrease in potential yield from values of 58500 kg/ha^{-1} to a transpiration level of 2.2 mmol^{-2} s^{-1} CO2 up to values of 58000 kg/ha going down to 57500 kg/ha^{-1} under transpiration conditions of 3.0 mmol^{-2} s^{-1} CO_2 and 3.8 mmol^{-2} s^{-1} CO_2. Superior yields are obtained in the range of these transpiration values in the Vangelis sugar beet cultivar (Figure 3)

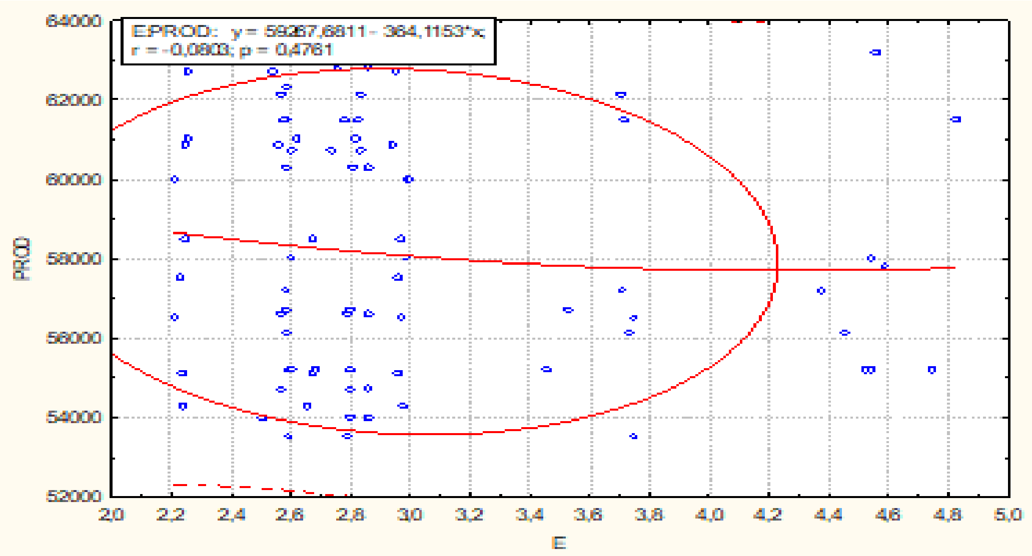

Figure 3. Interaction between yield (kg/ha^{-1}) and transpiration (mmolm^{-2}s^{-1})

As it presented in figure 4, the water deficit in the leaf is closely connected with the climate of the year 2021, the regression line indicating an increase in potential production from the range of 58200 to 58500 kg/ha^{-1}, at values of the water vapor pressure deficit of leaf (VPD) from 0.8 to 1.2 kPa (optimum year), after which it decreases to 56000 kg/ha^{-1} at a deficit of water vapor pressure from 1.8 to 2.0 kPa (climatic stress).

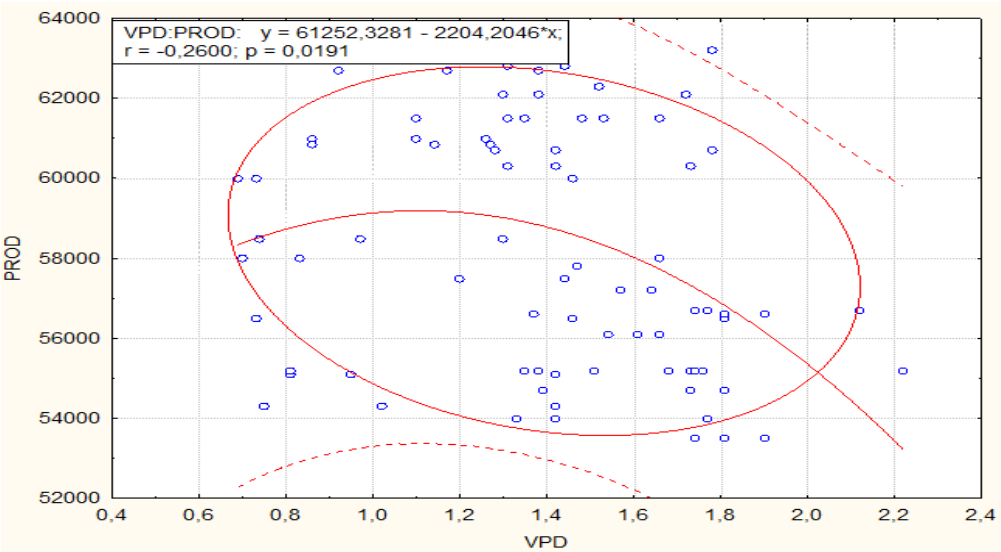

Figure 4. Interaction between production (kg/ha^{-1}) and leaf vapor pressure deficit (kPa)

The interaction between leaf transpiration (Evap - mmolm^{-2}s^{-1}) and the sugar beet development period was more intense in the first two phases of root formation and thickening (July and August) in the V3 variant where 1000 kg/ha of Terracalco 95 was applied the values obtained being statistically very significantly positive compared to the control treated only with basic fertilization (table 2).

The interaction of leaf water vapor pressure deficit (VPD) and plant development period was lower in July and August from 0.79 to 0.99 kPa when plants had the fastest growth and leaf development rate.higher, being statistically assured compared to the control as can be seen from table 4.

Malnou et al. 2006 and Jaradat and Riske 2012 point out that newer genotypes have a higher capacity to cover the soil with leaves of up to 90% to make maximum use of solar radiation. With the beginning of September, the active photosynthetic radiation of the leaf drops below 1000 μmolm^{-2}s^{-1} and the temperature of 26.7^{o}C, sugar beet roots reaching the maturity phase when the number of leaves decreases and the accumulation of sugar in the root is quite high (table 2).

Table 2 The influence of the amendment on physiological parameters in sugar beet

Physiological parameters	July (75 days after germination)			August (105 days after germination)			September (135 days after germination)		
	V_1	V_2	V_3	V_1	V_2	V_3	V_1	V_2	V_3
reference CO_2 r (μmolm-s^{-1})	390	390	390	390	390	390	390	390	390
Transpiration at leaf level (mmolm^{-2}s^{-1})	2,85	3,48	3,46	2,98	3,25	3,43	2,47	2,48	2,46
Significant	Cv.	***	***	Cv.	*	***	Cv.	ns	ns
LDS (p 5%)-0,22; LDS (p 1%)-0,31; LDS (p 0,1%) - 0,44;									
Leaf vapor pressure deficit (VPD – kPa)	1,35	1,17	1,16	1,66	1,18	1,32	1,58	1,50	1,63
Significant	Cv.	0	00	Cv.	000	000	Cv.	ns	ns
LDS (p 5%)-0,13; LDS (p 1%)-1,19; LDS (p 0,1%) - 0,26;									

**,*** = Significant at 1% and 0.1% probability levels, positive values; ^{000} = Significant at 0.1% probability levels, negative values;Cv = control variant: ns= not significant

The yield obtained in the Vangelis sugar beet cultivar increased slightly by applying 1000 kg/ha of Terracalco^{95} granulated fertilizer, the increase in yield being over 950 kg/ha^{-1}, the differences obtained being statistically very significantly positive compared to the control treated only with the fertilization of base (table 3)..

Not signifiant differences in yield were obtained but, the application of this soil amendment (a granular fertilizer) contributes to a very easy absorption, loosening and improvement of the soil. It also makes agricultural work more efficient, allowing water, oxygen and carbon dioxide to circulate freely in the soil, and improving its microbial activity.

The increase in yield in the variant where 1000 kg/ha^{-1} of Terracalco^{95} was applied was followed by a decrease in the sugar content from 19.5% to 18.7%, the differences compared to the control being very significant. Even though the application of the Terracalco 95 soil amendment reduced the percentage of sugar, still the yield of sugar per hectare increases.

Table 3 Influence of Terracalco ^{95} application on yield and sugar concentration.

Granular soil amendment, Terracalco ^{95}	Yield (kg/ha^{-1})	Difference (kg/ha^{-1})	Significant
V_1-control variant	57754	0,00	Cv
V_2- 500 kg/ha Terracalco ^{95}	58150	396	ns
V_3- 1000 kg/ha Terracalco ^{95}	58712	958	***
LDS (p 5%) 397,0; LDS (p 1%) 557,3; LDS (p 0,1%) 786,8			

Granular soil amendment, Terracalco 95	Sugar concentration (%)	Difference (%)	Significant
V_1-control variant	19,50	0,00	Cv
V_2- 500 kg/ha^{-1}Terracalco 95	19,22	-0,28	0
V_3- 1000 kg/ha^{-1}Terracalco 95	18,69	-0,81	000
LDS (p 5%) 0,28; LDS (p 1%) 0,39 ; LDS (p 0,1%) 0,55.			

**,*** = Significant at 1% and 0.1% probability levels, positive values; ^{000} = Significant at 0.1% probability levels, negative values; Cv = control variant: ns= not significant

CONCLUSIONS

In the sugar beet cultivar Vangelis, by applying the Terracalco 95 soil amendment in the phases of root formation 75 days after emergence, and root thickening 105 days after emergence, the physiological parameters had more positive values high, except for the leaf vapor pressure deficit (VPD), which is inversely proportional, registering negative values.

Following the application of the amendment, the absorption of nutrients by plants increases, achieving higher yields, over 58150 kg/ha, and a higher amount of sugar. per unit area

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ANALYSIS OF THE ECOLOGICAL AGRICULTURE SECTOR IN THE REPUBLIC OF MOLDOVA

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Abstract: *The general purpose of this article is the analysis of the organic agriculture sector in the Republic of Moldova, determining the place of this sector in the national economy, as well as highlighting the advantages and disadvantages of this sector. In the process of developing this article, such research methods as statistical analysis of existing data, comparative analysis, synthesis of existing information, deduction method, and SWOT analysis were applied. Following the use of research methods, quantitative parameters were established that define the place of organic agriculture in the economy of the Republic of Moldova, the importance of organic agriculture in particular in the current conditions of agricultural development that involve such factors as: climate change, environmental pollution, inefficient use and abuse of natural resources, etc. The industrial model of agricultural intensification widely used in the last decades did not ensure a sustainable development of the agricultural sector. As a result, organic agriculture is gaining more and more importance and demonstrates dynamic development trends. The practice of organic farming is dictated by market demand, with consumers increasingly demanding healthy, organic, naturally grown agricultural and food products.*

Keywords: *ecological agriculture, ecological agricultural product, economic analysis*

JEL classification: Q10, Q13, Q15

INTRODUCTION

Organic farming offers a number of advantages compared to conventional farming. These advantages can benefit both agricultural producers and consumers of these products, as well as all participants in the food chain that mediates production and consumption. Among the main advantages, the following can be mentioned: a) a higher level of income compared to conventional agriculture, caused by a lower consumption of agricultural inputs; respectively and b) a lower level of dependence on input imports, mainly chemical fertilizers and protection means. This results in a less polluted environment, greater biodiversity and an increase in the amount of humus in the soil. Organic production is healthier for human consumption and ensures a higher level of sustainability compared to conventional production. At the same time, organic production in the Republic of Moldova faces certain problems and difficulties that prevent or do not allow a more massive development in this sector with a high development potential. The analysis of the organic agriculture sector made in this article makes an attempt to highlight these advantages and disadvantages including the main actors in the organic agricultural production chain. In the article, a brief presentation of the inspection and certification bodies operating in the Republic of Moldova was made. The SWOT analysis presents the results of these analyses in a more concise and visible way. The respective conclusions and recommendations aim to provide a more applicable character to the materials presented in the given article.

MATERIAL AND METHOD

In the process of developing this article, such research methods as statistical analysis of existing data, comparative analysis, synthesis of existing information, deduction method, and SWOT analysis were applied. Data for analysis were collected from the open secondary sources accessed via the INTERNET. Data analysis was performed using the standard functions available in the Excel program.

RESULTS AND DISCUSSIONS

Organic agriculture - is a relatively new field, but also quite interesting and attractive for agricultural producers in the Republic of Moldova. The first attempts at ecological agricultural production date back to 2003. In the meantime, these areas have expanded so that in 2020 they reach already about 29 thousand hectares, according to the data presented by MAIA[1]. The unusual jump in the areas occupied by ecological agricultural production in 2017 is due to dishonest manipulations by some certification companies carried out in collaboration with certain economic agents and possibly with responsible persons from the Republic of Moldova. But, the analysis of these manipulations is not the subject of this article and will be analysed in another paper.

At the same time, using international publications in the field as a source of information, we can observe some quite significant discrepancies between the figures provided by MAIA and those provided by FIBL[2] regarding the areas occupied by organic agricultural crops in the Republic of Moldova. These discrepancies are quite small, of the order of 1 hundred hectares in 2016 and up to about 45.6 thousand ha in 2017 (see figure 1).

This makes the estimates regarding the surfaces occupied by organic crops to be made much more rigorously and thoroughly in order to avoid mechanical errors. There are also differences regarding the dynamics of the areas occupied by organic agricultural crops in the FIBL and MAIA version.

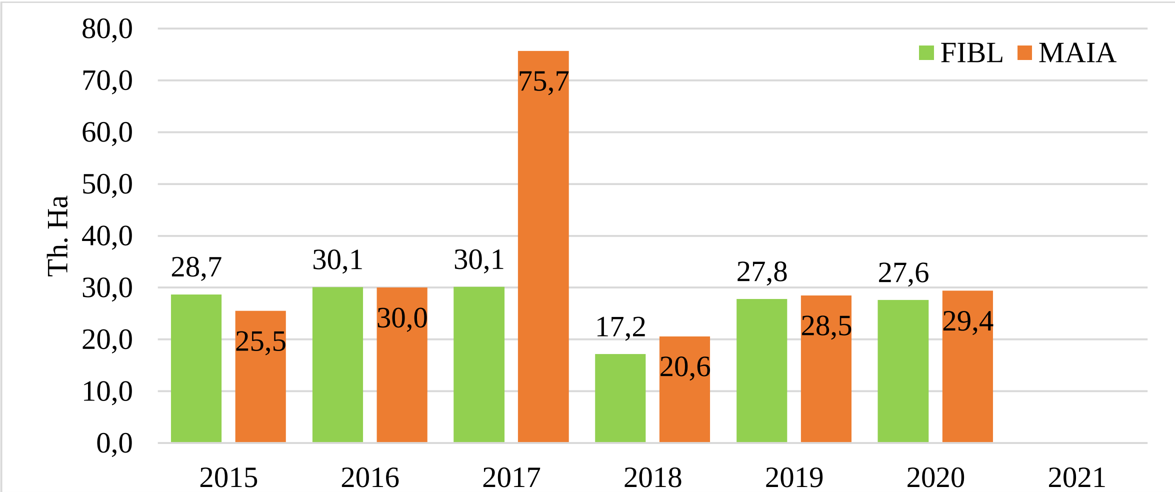

Figure 1. Areas occupied by organic production in the Republic of Moldova according to MAIA and FIBL data, 2015-2020, thousand ha.

Source: Prepared by the authors based on MAIA (2022) and FIBL (2017-2022) data

[1] Ministry of Agriculture and Food Industry of the Republic of Moldova
[2] Forschungsinstitut für biologischen Landbau / Research Institute of Organic Agriculture, Switzerland

All these divergences make the estimation of the areas occupied by organic crops in the Republic of Moldova a little more confusing.

The share of areas occupied by ecological agriculture in the total volume of agricultural land in the Republic of Moldova is quite small and varied between 2015-2020 around 1.7% according to MAIA data and around 1.3% according to FIBL. More than that, according to MAIA data, the areas occupied by ecological agriculture increased during this period by about 15%, but according to FIBL data, these areas decreased by about 4% (see table 1).

Table 1. Dynamics of the share of ecological agricultural production areas in the Republic of Moldova according to MAIA and FIBL data, 2015-2020, ha, %

	2015	2016	2017	2018	2019	2020	2020/2015, %	Average 2015-2020
The total agricultural area of the Republic of Moldova (thousand ha)	2026.5	2028.3	2039.8	2041.6	2073.0	2092.0	102.5	2050.2
The area occupied by organic agriculture, according to MAIA (thousand ha)	25.5	30.0	75.7	20.6	28.5	29.4	115.3	35.0
Share, %	**1.26**	**1.48**	**3.71**	**1.01**	**1.37**	**1.41**	**139.3**	**1.7**
The area occupied by organic agriculture, according to FIBL (thousand ha)	28.7	30.1	30.1	17.2	27.8	27.6	96.2	26.9
Share, %	**1.42**	**1.48**	**1.48**	**0.84**	**1.34**	**1.32**	**93.2**	**1.3**

Source: developed by the authors based on data from the State Cadastre, FIBL and MAIA

Comparing the share of the areas occupied by organic agriculture in the Republic of Moldova with the same indicator at the global level, it can be observed that it lags behind the global trends. Thus, at the global level, the share of the areas occupied by agricultural production increased by about 33% in the period 2015-2020, while in the Republic of Moldova this indicator indicated a stagnation in the same period. It becomes even more obvious that the Republic of Moldova is lagging behind in the field of organic production when we compare it with the indicators in Europe, in the EU countries, or with certain countries in Europe, where this sector of agriculture has experienced a much more impressive development. According to the situation in 2020, the average share of the land occupied by organic agriculture on the European continent was 3.4%, registering an increase of about 126% compared to 2016. This indicator is even more impressive in EU countries, where the share of the land occupied by organic agriculture was of 9.2% in 2020, increasing by about 41% compared to 2016.

Among the most advanced countries in Europe in the field of organic production, one can mention Austria, Estonia, Switzerland, the Czech Republic, Latvia, Slovenia, Germany and Spain, where the share of land involved in the organic circuit varied in 2020 between 10.0% (Spain) and 26.5% (Austria).

The growth rate of the share of land involved in the organic circuit was particularly impressive in Romania, where it increased more than twice in the period 2015-2020, in France by 60%, in Germany by 36% and in the Czech Republic by 33%.

Against this impressive background, the results of the Republic of Moldova with a share of land occupied by ecological agriculture of 1.2% and with zero growth in the period 2015-2020 look very unimpressive, a fact that demonstrates the attitude towards this sector both at the micro level and at the macro level (see table 2).

Table 2. The dynamics of the share of organic agricultural production areas globally, and in selected European countries. 2016-2020, %

	2016	2017	2018	2019	2020	2020/2016, %	Average, 2016-2020
Globally	1.2	1.4	1.5	1.5	1.6	133.3	1.4
Europe	2.7	2.9	3.1	3.3	3.4	125.9	3.1
EU, total	6.5	7.2	7.4	8.1	9.2	141.5	7.7
Austria	21.9	24.0	26.7	26.1	26.5	121.0	25.0
Estonia	18.9	20.5	21.6	22.3	22.4	118.5	21.1
Switzerland	13.5	14.4	15.4	16.5	17.0	125.9	15.4
Czech Republic	11.5	12.2	12.8	15.4	15.3	133.0	13.4
Latvia	14.3	14.8	15.4	14.8	14.8	103.5	14.8
Slovenia	9.0	9.5	9.9	10.3	10.8	120.0	9.9
Germany	7.5	8.2	9.1	9.7	10.2	136.0	8.9
Spain	8.7	8.9	9.6	9.7	10.0	114.9	9.4
France	5.5	6.3	7.3	7.7	8.8	160.0	7.1
Lithuania	7.6	8.1	8.3	8.1	8.0	105.3	8.0
Romania	1.7	2.0	2.5	2.9	3.5	205.9	2.5
Montenegro	1.5	1.2	1.9	1.8	1.9	126.7	1.7
Moldova	**1.2**	**1.2**	**0.7**	**1.2**	**1.2**	**100.0**	**1.1**
Ukraine	0.9	0.7	0.7	1.1	1.1	122.2	0.9
Azerbaijan	0.8	0.8	0.8	0.8	0.8	100.0	0.8
Georgia	0.1	nd	0.1	0.1	0.1	100.0	0.1

Source: developed by the authors based on FIBL data

The analysis of the areas occupied by organic crops in the profile of the development regions demonstrates that the largest areas are located in the Central region with about 14.5 thousand ha in 2020. This is followed by the North region with about 10.6 thousand ha and the South region with 4, 2 thousand ha. Subsequently, regarding the situation in 2020, about 51% of the organic agricultural areas were concentrated in the Central region, 37% in the Northern region and about 15% in the Southern region.

Compared to 2019, these areas have undergone certain changes, so in the Central region, these areas have decreased by about 16%. In the same period, the areas of organically cultivated crops increased in the North region by about 11%, and in the South region by about 2.5 times (see figure 2).

The distribution of the areas occupied by crops grown according to organic standards in different districts of the Republic of Moldova is quite unclear and inhomogeneous. While some districts have registered several thousand hectares of such crops, others do not have at all or do not report on the presence of organic producers on the territory of the respective administrative units. Thus, several groups of districts can be highlighted according to the size of these areas. In the first group can be included the districts (administrative units) where from one thousand to about 7000 thousand hectares of organic agricultural crops were registered. These are the districts: Bender, Soroca, Chisinau, Cahul, Sangerei, Hâncești, and Glodeni. The average area per district in this group is about 3000 ha., with deviations from about 1000 ha in Glodeni district to about 6700 ha in Bender district. At the same time, certain questions arise regarding the large fluctuations in the 2019-2020 period of these areas in the districts of Chisinau, Cahul, Sângerei, which can only partially be explained either by the fact that certain areas were only in the conversion period or that the certification period has already it expired.

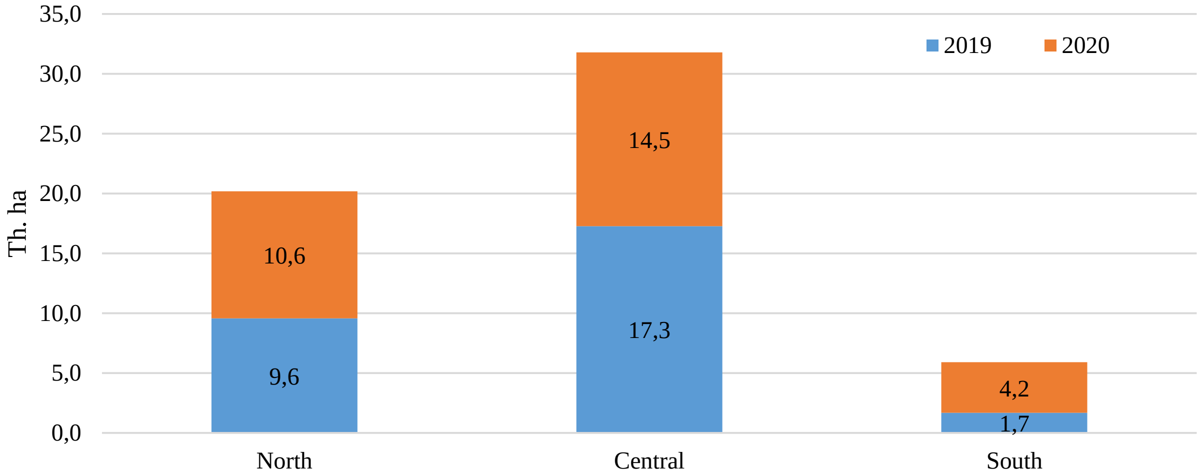

Figure 2. Areas occupied by organic production by development regions, 2019-2020, Ha.
Source: Developed by authors based on Ecovisio data (2022)

The second group of districts are those that have from a few tens to a thousand hectares of organically cultivated land. This is the largest group and includes 24 districts: Anenii Noi, Basarabeasca, Briceni, Călărași, Cantemir, Căușeni, Criuleni, Dondușeni, Drochia, Dubăsari, Edineți, Fălești, Florești, Ialoveni, Leova, Orhei, Rezina, Râșcani, Soldănești, Stefan Voda, Telenesti, UTA[1] Transnistria, Ungheni and UTA Gagauzia. The average area per district in this group is about 300 ha., with deviations from about 10 ha in the Cantemir district to about 700 ha in the Dondușeni district.

And the last group consists of 6 districts, namely: Bălti, Cimișlia, Nisporeni, Ocnița, Străseni and Taraclia, which either do not have land cultivated in organic regime, or do not report such data (Ecovisio, 2022).

In 2020, most of the land occupied by organic production (about 75%) was already certified according to organic production standards, compared to about 79% in 2019. In absolute numbers, the areas of already certified organic constituted about 22.5 thousand Ha in 2019 and about 22.1 thousand ha in 2020, registering a slight decrease of about 1.7% in 2020 compared to 2019. About 5% of the organic fields were in the first year of conversion in 2020, compared to about 9% in 2019 About 19% were in the II year of conversion in 2020 compared to about 12% in 2019 and only about 1% were in the III year of conversion in 2020. Thus it can be seen that a share of about 25% of the land cultivated organically in 2020 was in different phases of conversion, which creates a significant potential for the increase of organically certified areas in the following years (see figure 3).

[1] UTA – Autonomous Territorial Unit

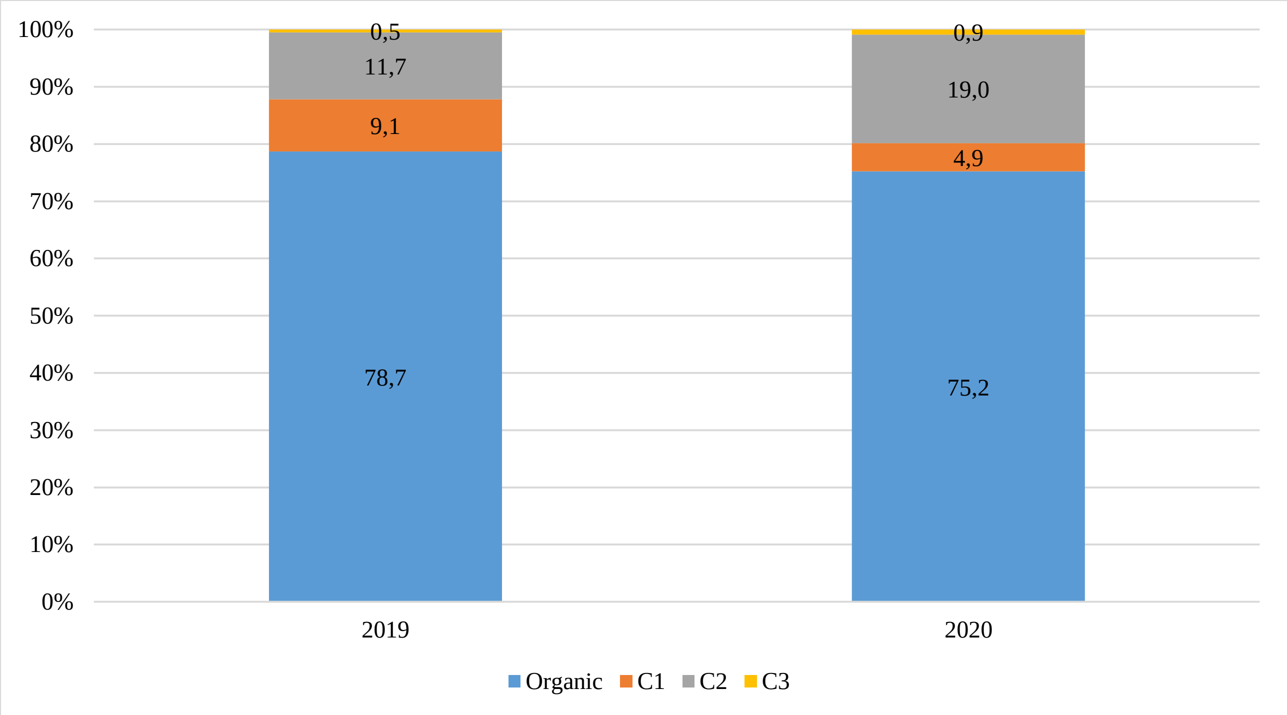

Figure 3. Structure of cultivated areas by status, 2019-2020, %

Source: Developed by authors based on Ecovisio data (2022)

The main crops grown organically in the Republic of Moldova are cereals and oilseeds, which in 2020 occupied about 42% and 32% of the total areas occupied by organic agriculture, respectively. It should be noted that during the period 2016-2020, the areas occupied by ecologically cultivated cereal crops decreased by about 42%. In the same period, the areas cultivated ecologically with oil crops increased by about 2.1 times, those occupied by leguminous crops by about 2.9 times, those by fruits by about 2.2 times, and the areas occupied by organically grown grapes by about 5.9 times (see table 3).

Table 3. The dynamics of the areas occupied by different crops in an ecological regime, 2016-2020, ha

	2016	**2017**	**2018**	**2019**	**2020**	**2020/2016, %**	**Share in 2020, %**
Cereals	20097	20097	3541	11401	11607	57.8	42.1
Oil crops	4183	4183	3720	9192	8852	211.6	32.1
Leguminous	515	515	1133	1658	1490	289.3	5.4
Fruits	279	279	177	656	619	221.9	2.2
Grapes	7	7	5	18	41	585.7	0.1
Vegetables	109	109	6	18	2	1.8	0.0
Other crops	4910	8910	8618	3757	4989	101.6	18.1
Total	**30100**	**34100**	**17200**	**26700**	**27600**	91.7	100.0

Source: Developed by authors based on FIBL data (2017-2022)

In the period 2019-2020, 10 inspection and certification bodies activated in the Republic of Moldova, namely: A Cert, AGRECO, Bio Inspecta, CERES, Certificat ECO, Control Union Dnjestr (CUD), Ecocert, KIWA BCS, Organic Standard and STC. Most organic farms were certified by

Control Union Dnjestr (41 units in 2020) and ECO Certificate (42 units in 2020). They are followed at some distance by AGRECO (28 units in 2020) and KIWA BCS (10 units in 2020). The other inspection and certification bodies certified a considerably smaller number of organic farms (see figure 5).

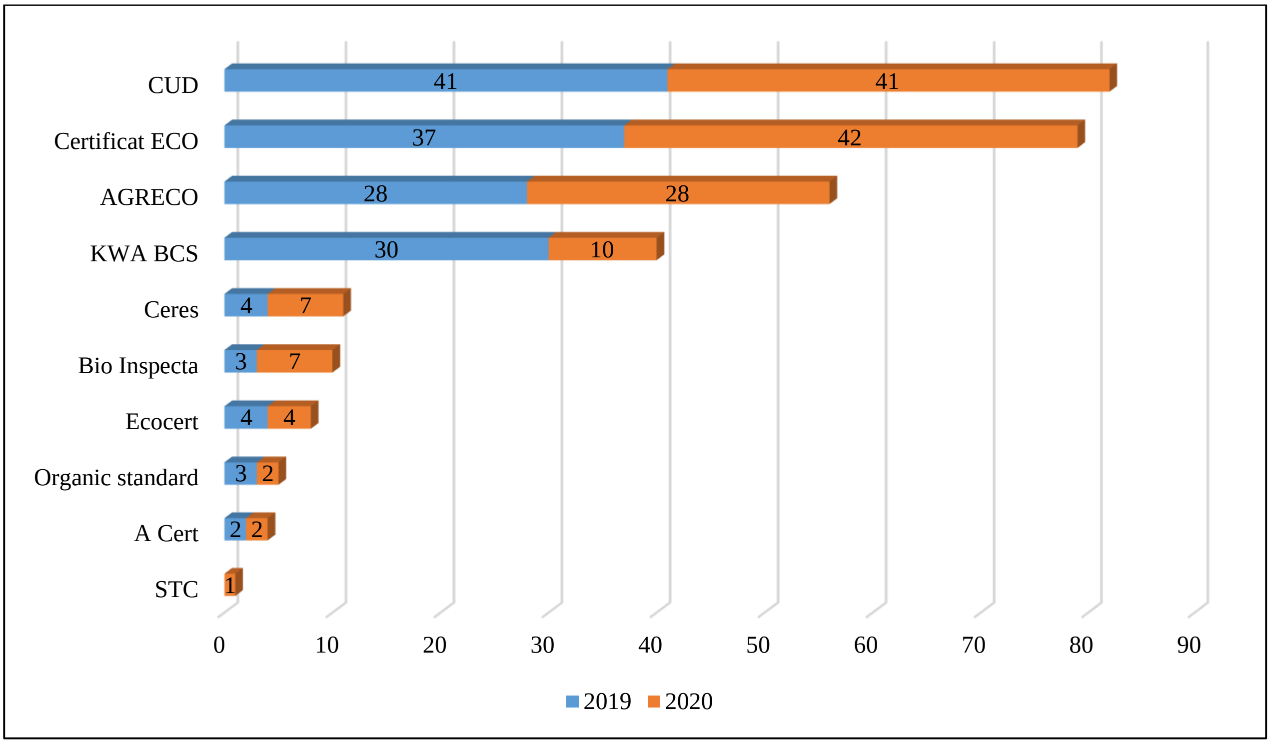

Figure 4. Accredited certification institutions by the number of certified agricultural holdings in the Republic of Moldova, 2019-2020.

Source: Developed by authors based on Ecovisio data (2022)

The biggest problem in the activity of these inspection and certification bodies lies in the fact that according to the legislation in force, only organic farms certified by the national authorities can benefit from the subsidies offered by the Agency for Interventions and Payments in Agriculture, but these institutions are not recognized abroad of the Republic of Moldova. At the same time, in order to be able to export ecological products, importers request the certification of producers by a recognized entity, from abroad of the Republic of Moldova. But certification by these international bodies is not recognized by the Agency for Interventions and Payments in Agriculture as valid for applying to subsidies for organic production. Thus, organic agricultural producers face a problem with several unknowns: either they export the organic products, but are not accepted for the subsidy program, or vice versa - they accept the subsidies but cannot export, or the last option - be certified by a local body and an international one, which implicitly raises the certification costs.

Following the analysis of the materials presented in the given article, the identification of the strong and weak parts of the risks and opportunities of ecological agricultural production in the Republic of Moldova was carried out. They are briefly presented in the table below.

Table 4. SWOT analysis of organic production in the Republic of Moldova

STRONG PARTS	WEAK PARTS
• Soil and climatic conditions favourable to organic agricultural production • Rich experience in agriculture with great potential to develop organic production skills • Transport, storage and processing infrastructure available for use in the organic circuit • Proximity to several markets in Europe with significant potential for procurement of organic agri-food products • Local demand not covered by ecological agri-food products of domestic origin	• The low level of ecological culture of the population • The insufficiency of informative, educational and ecological culture promotion programs starting with primary education and ending with higher educational levels • Lack of official statistical information regarding production, logistics, internal and external trade of organic agri-food production
RISKS	**OPPORTUNITIES**
• The massive depopulation of the Republic of Moldova, which leads on the one hand to the chronic shortage of labour in agriculture, including the organic one, and on the other hand reduces the mass of potential customers who consume organic agri-food products • The intense erosion of agricultural lands resulting in the permanent elimination of considerable agricultural areas from the agricultural circuit and implicitly from the organic one • Other risks related to the supply on time and at economically advantageous prices with various agricultural inputs specific to organic production	Penetration of domestic agri-food production on EU markets following the process of legislative, normative and political rapprochement with the EU • Identification, development, implementation and continuous improvement of informative, educational and ecological culture promotion programs starting with primary education and ending with higher educational levels • Monitoring and reporting to the National Bureau of Statistics data related to production, logistics, internal and external trade of organic agri-food production with the annual and quarterly publication of official data with reference to organic agri-food production

Source: developed by the authors

CONCLUSIONS

1. The Republic of Moldova has an untapped potential in terms of ecological agricultural production.

2. Analysis of the organic production sector is extremely important to accumulate the relevant information needed to estimate production volumes and trends in this prospective market.

3. The lack and/or insufficiency of official data regarding the production, logistics, export, import and consumption of organic products makes it difficult to analyse this sector and develop truthful forecasts of development, as well as sector policies.

4. The lack of conformity between national and EU legislation makes the certification procedure of organic producers confusing and duplicitous and creates problems in the development of this sector.

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THE IMPACT OF PESTICIDES AND DRY RESIDUAL BIOMASS ON THE ECOLOGICAL FOOTPRINTS IN OECD COUNTRIES

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Abstract: *The present study explores the impacts of pesticide usage and burned biomass on the ecological footprints in OECD countries. Based on 500 panel observations from 25 sample OECD countries during the period of 2000 to 2019, the study applies panel data regression approch. The panel data regression models are estimated by pooled OLS method in one way and fixed effects with Driscoll-Kraay standard errors method in other way. The latter method is a robust method of capturing heteroskesedasticity and autocorrelation. In both estimations, the results find that pesticide usage and burned biomass have positive and significant impacts on the ecological footprints of OECD countries but in particular pesticide usage has stronger effect in Driscoll-Kraay standard errors approach and less in pooled OLS method. This means that both variables increase the PM2.5 concentration in OECD countries and cause climate change. Therefore, organic pest-resistant techniques and the use of residual biomass as feedstock could be the possible solutions to improve ecological footprints in OECD countries.*

Keywords: *Climate change, Ecological footprints, Pesticide usage , Bio mass burning , OECD*

JEL Classification: Q2, Q5, P42, Q580

INTRODUCTION

Pest management for crops has existed for as long as human civilization. Since the prehistoric age, people have tried to protect their food production using various crude methods. Despite the significant human effort, the development of the various plant protection methods has been noticeably slowed down as they become ineffective with the passage of time. However, during the sixteen century, chemicals were exposed to the crops for pest control (Polyrakis, 2009). However, agriculture's industrial revolution and pesticide usage positively increase crop productivity (Duttagupta et al., 2020). On the other hand, pesticide usage appears to be harmful to the environment and causes climate change (Ukhurebor et al., 2020). The massive use of pesticides in agriculture increases airborne bone particulate matter (Yera, & Vasconcellos, 2021; Year et al., 2020; Nascimento et al., 2018). Similarly, on the other hand, its use adversely affects public health (Guberman VerPloeg et al., 2019; Ghorab & Khalil, 2015).

Likewise, in recent periods, urban expansion and deforestation have caused climate change worldwide (Andrée et al., 2019). Moreover, urbanization's rapid industrialization harms the environment by increasing the carbon emission in the air (Cherniwchan, J. (2012; Patnaik, R. (2018, March). However, besides pesticides, biomass combustion also harms the environment by increasing the concentration of carbon emissions in the air (Chuvieco et al., 2021). In terms of empirical research, Zhao et al. (2017) statistically analyzed the impact of agricultural biomass burning on the environment in 10 stations in Changchun by NASA Earth Observatory's Active Fire Data. They concluded that biomass burning increases the concentration of PM 2.5 before the harvesting period. Li et al. (2010) also confirmed a similar find in their empirical research in which Aerosol particle data were collected in urban Beijing from 12 to 30 June 2007. They conclude that one of the key factors which cause the high concentration of haze in urban Beijing is the burning of agricultural biomass in fields around Beijing. Numerous other studies also indicate a high concentration of carbon-related particles in the air caused by agricultural biomass burning (Tian et al., 2017; Favez et al., 2009).

Recent literature indicates that environmental sustainability is a heavily debatable topic among researchers, environmental practitioners and policymakers. However, literature indicates that there are numerous factors which harm our environment during the economic growth process, such as industrialization (Pan, & Dong, 2021), urbanization (Wei et al., 2021), fossil fuels consumption (Hassan et al., 2021) and agricultural activities (Cheng et al., 2021). Developed countries transferred their industrial sector towards sustainable production and consumption pattern; however, climate change heavily impacts daily activities in developing countries (Krec et al., 2022). Non-seasonal rains, floods and droughts in developing countries are major issues raised by climate change. All these issues further impact agricultural production and consumption (Das, 2022). Besides that, unsustainable agricultural methods, massive use of pesticides, and excessive fertilizer usage harm the environment and cause concentration of air pollutant particles. Considering that environmental sustainability is not only an issue of developing countries but also it becomes a major issue for developed countries, where sustainable production and consumption patterns are usually highly regulated and adopted.

Therefore, the present study questions the dynamics of relationship among the pesticide usage, agriculture biomass burning and environmental sustainability by presenting empirical discoveries. To inject some new insights in the empirical literature, this study empirically investigates the impact of chemical use as pesticides and the burning of residual agricultural biomass on air pollution. To probe the discourse, a panel of 25 OECD countries during the period from 2000 to 2019, three variables such as fine particulate Matter (PM 2.5), Pesticide usage and agricultural dry residual biomass burned are analysed. The results of this empirical investigation offer a new fresh inside for interpreting the nexus between agricultural factors and environmental sustainability for developed countries which is further used for environmental policymaking in the agriculture sector.

The rest of paper is organised as research framework (section 2), methodology (section 3), analysis of results and discussion (section 4) and conclusion (section 5).

Research Framework

The study mainly highlights the nexus among fine particulate matter, pesticides usage and dry residual of biomass burned indices in the panel of 25 OECD countries. Undoubtedly, dry residual biomass burning and massive use of pesticides harm the environmental sustainability. Therefore, the study investigates the impact on pesticide usage and residual bio mass burning on ecological foot prints. The following figure represents a research framework of the present study.

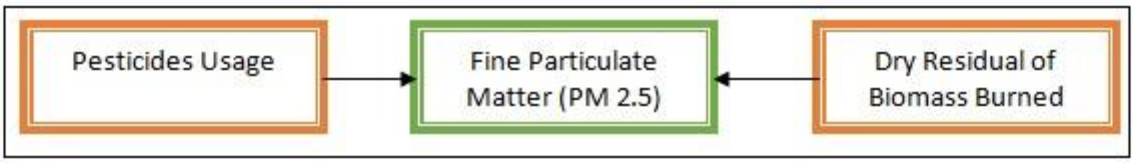

Figure 1: Research framework

Bases on the obove research framework, the following multiple regression model is formulated for panel analysis. The regression equation will measure the effects of Pesticide usage (PEST) and Biomass Burned (dry residual (BMB) on the Fine Particulate Matter (PM2.5).

$$PM2.5_{it} = \beta_0 + \beta_1 PEST_{it} + \beta_2 BMB_{it} + +\varepsilon_{it}$$

Where, i = 1, 2, 3, ……N indicates cross-sectional units and t = 1, 2, 3, ………T indicates time period, β's are coefficients and ε_{it} is the error term.

MATERIALS AND MEDHODS

This research concerns the 25 OECD countries to test our hypotheses, thus estimating panel data association. As panel data give us more informative data, variability, and reduced co-linearity among the explanatory variables. It also increases the degree of freedom and furthermore panel data allow us to identify and measure effects that are not detectable in pure cross-sections or time-series data. Furthermore, panel data also control individual heterogeneity (Baltagi, 2015).

Pooled OLS

Initially we assume the coefficient PM2.5 remains unchanged across all the investigated years and samples. Considering the assumption of POLS the estimates are not biased and consistent even if the heterogeneity exists in the data. Furthermore each used sample countries holds its own attributes based on location; social, political and economic factors. The refore in this situation the error term correlates with the model regressors (Panait et al., (2022).

Fixed Effect Driscoll-Karay

By considering the possibility of heterogeneity, we estimate the results by applying the fixed effect model. It incorporates the sampled country's specific policies and practices of the ecological factors and shows the effects in the intercept coefficient. "α_{1j}". The intercept of one country differs from the other country but is time-invariant. The fixed effect captures the countries' specific effects by takings the different economic, geological and social characteristics. Ramoutar, (2017) also affirms in his empirical analysis that, the advantage of fixed effects with Driscoll and Kraay standard errors is that the problems of heteroscedasticity, autocorrelation, and cross-sectional dependence are all corrected.

RESULTS AND DISCUSSION

Based on our research hypothesis, the endogenous variables is used as PM2.5 which refer to the size of the pollutant, in micrometers in the air whereas; the other two exogenous variables are total pesticide usage (per area of cropland-Kg /ha) 'PEST' and dry residual of agriculture biomass burned in tonnes. The source of data is mentioned in Table 1.

Table 1 Source of Data and variables

Variable	Definition	Symbol	Source
Fine Particulate Matter (PM 2.5)	PM 2.5 refers to the size of the pollutant, in micrometers.	PM2.5	IEA-International Energy Agency
Pesticide usage	Total pesticide used(per area of cropland-Kg /ha)	Pest	FAO- Food and Agriculture Organization
Biomass Burned (dry residual)	All crops biomass burned (residual - tonnes)	BMB	FAO

The relative statistic of the all used variable are indicated in table 2 where as correlation analysis are mentioned in table 3. The sample average of PM2.5 is 13.78 micrometers with highest 27.18 micrometers and lowest 5.85 micrometers. The standard deviation of 4.634 reveals a minimal dispersion from the sample mean. Similarly, the sample average of PEST is 3.665 Kg /ha with highest and (13.84 Kg /ha) and lowest (0.245 Kg /ha). For PEST, the standard deviation of 2.658 reveals a minimal dispersion from the sample mean. Furthermore, the sample average of BMB is 610076.1 tonnes with highest 3982668 tonnes and lowest 4406 tonnes. Similarly for biomass burn the standard deviation of 871302.1 reveals a minimal dispersion from the sample mean. Furthermore, below figure 1,2 and 3 indicate yearly mean values of pesticides usage, biomass burn and PM2.5.

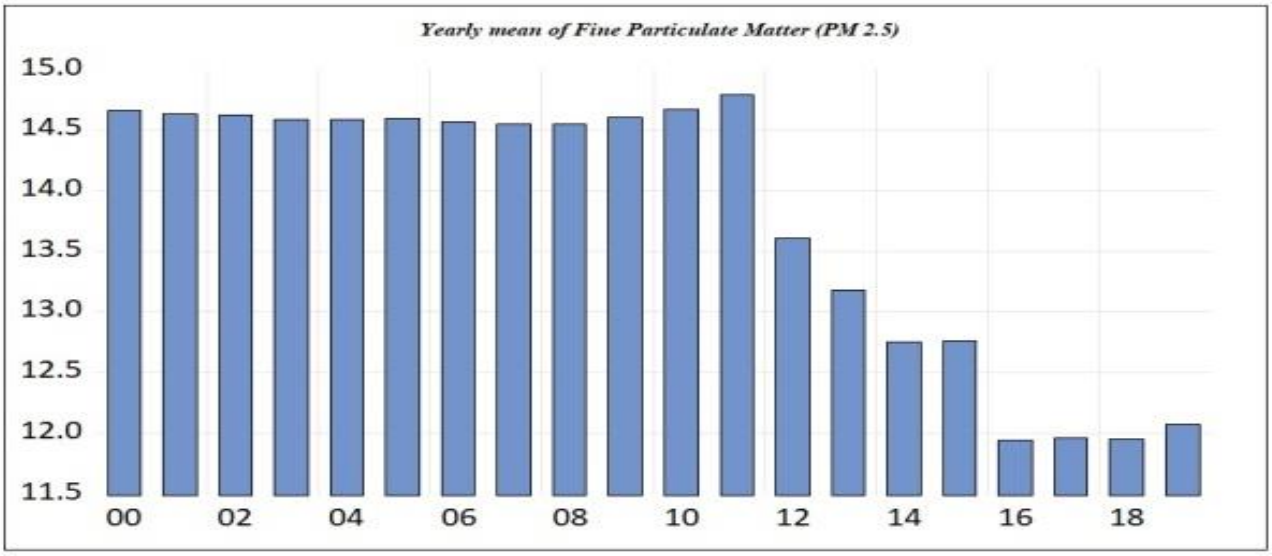

Figure 1- PM2.5 yearly mean

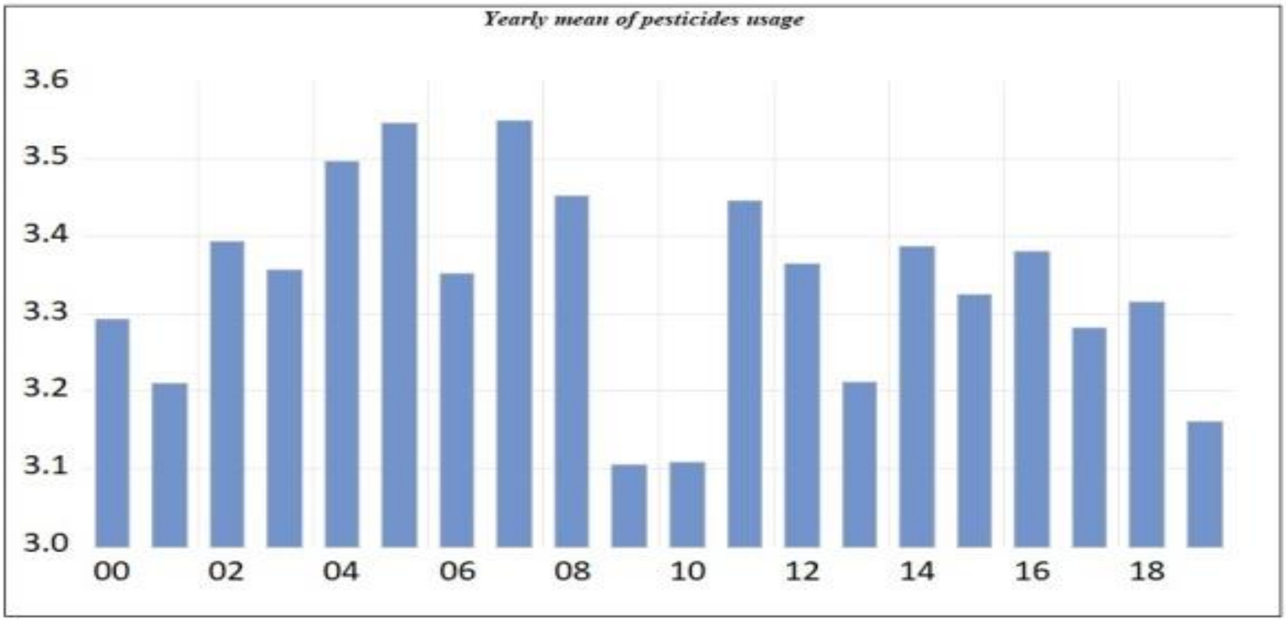

Figure 2- Pesticide usage yearly mean

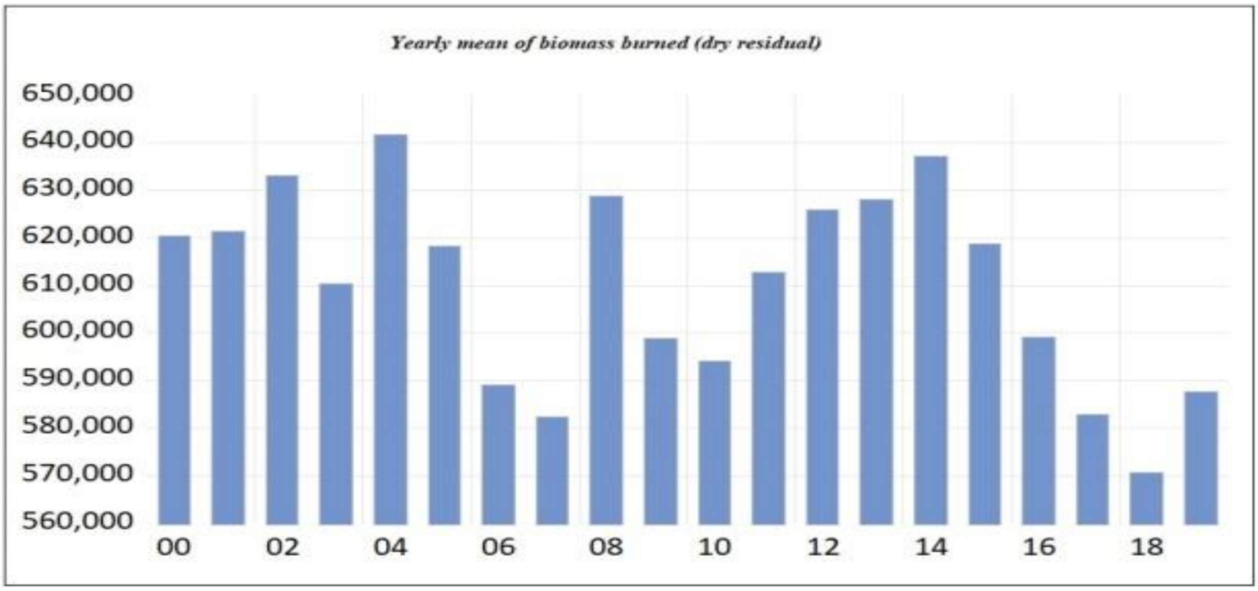

Figure 3 - Biomass burned yearly mean

Table 2 Summary statistics

Variable	Observations	Mean	Std Deviation	Min	Max
PM2.5	500	13.781	4.634	5.85	27.176
Pest	500	3.665	2.658	0.24	13.842
BMB	500	610076.1	871302.1	4406	3982668

Table 3, indicate that there is no multicollinearity exist among all the used variables as correlation coefficients are below 0.75

Table 3 Correlation Matrices

Variable	PM2.5	Pest	BMB
PM2.5	1.000		
Pest	0.051	1	
BMB	0.293	0.042	1

Table 4 Estimation

Variable	POLS	Driscoll-Kraay Fixed effect
Pesticide usage -(Pest)	0.051 (0.016)***	0.048 (0.026)**
Biomass Burned -dry residual-(BMB)	0.098 (0.008)***	0.012 (0.028)***
Constant	1.311 (0.109)***	2.785 (0.286)***
Observations	500	500
Number of groups	25	

Table 4, reports the impact of pesticide usage and dry residual of agriculture biomass burn on fine particulate concentration (PM2.5) used as proxy for environmental sustainability. The empirical estimation of analysis is done by using panel pooled OLS as mentioned in column 1 and then fixed effect Driscoll-Kraay estimation as mentioned in column 2. Column (1) shows that (Pest) and (BMB) positive increase pollutant particles in the environment. Result indicates that, a 1 unit increase in (Pest) and (BMB) increases PM2.5 by 0.051% and 0.098%. Similarly findings also indicate by Driscoll-Kraay Fixed effect estimation as mentioned in column (2); thus 1 unit increase in (Pest) and (BMB) increases PM2.5 by 0.048% and 0.012% respectively. The harmful effect of pesticide usage on environment sustainability proxied by PM2.5 also confirmed by previous studies such as (Coscollà et al., 2009; Fu et al., 2009; He et al., 2022). Likewise other studies which indicate similar harmful effect between agriculture residual biomass burning on environment were conducted by (Singh et al., 2021; Srivastava, 2022).

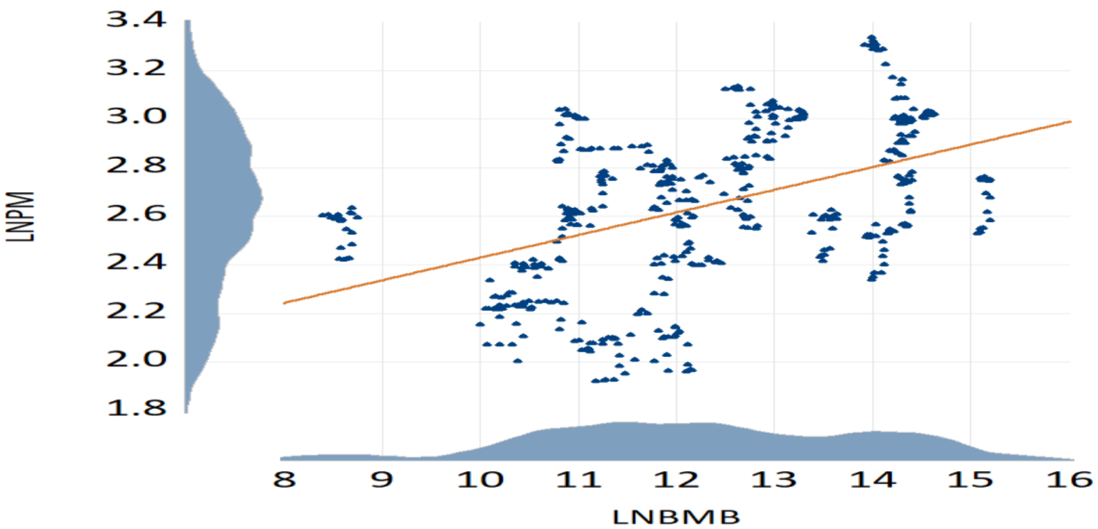

Figure 4 : Assoication between PM2.5 and BMN – LN refer to log transformation

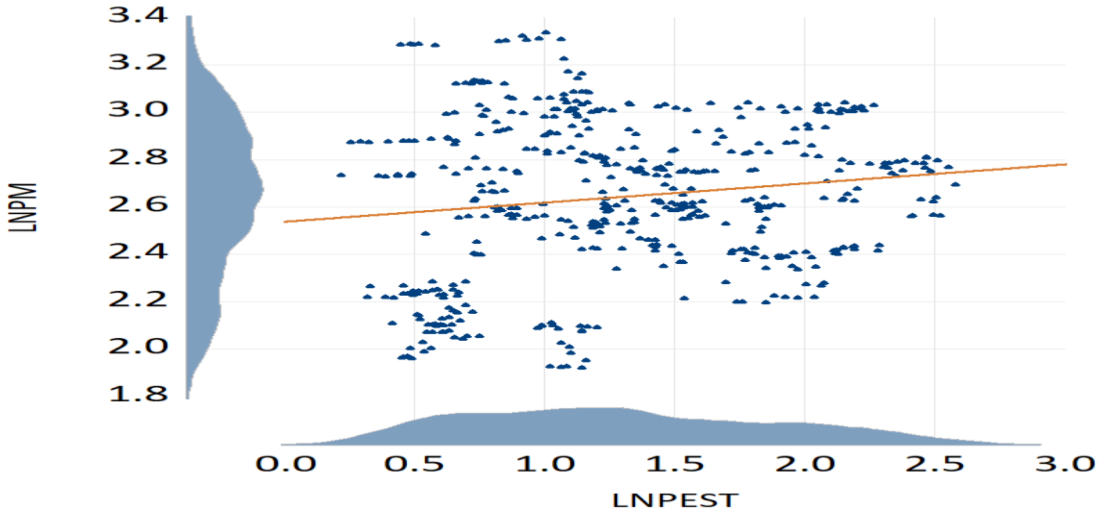

Figure 5 : Association between PM2.5 and PEST – LN refer to log transformation

CONCLUSION

To reduce greenhouse gas emissions by adopting sustainable production practices, this study aligns with the 2030 SDG agenda as the goal 2 and goal 13, which represent sustainable agricultural practice and climate change. The empirical research work contributes to the debate on pesticide usage-agriculture biomass burning-environmental sustainability from the sample of 25 OECD countries from 2000 to 2019. Findings reveal that residual agricultural biomass burning and massive use of pesticides cause air pollution in the sample countries. Based on finds this research work, from a policy perspective, the government of sample countries should increase the awareness of adaptation of eco-friendly agricultural practices. Government should adopt sustainable waste management practices concerning residual agricultural biomass. Furthermore, the government should increase the usage of eco-friendly pesticides which not cause a high concentration of air pollution.

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SUSTAINABLE MANAGEMENT OF LAND RESOURCES IN THE CONTEXT OF AGRICULTURAL POLICY IN THE REPUBLIC OF MOLDOVA

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Abstract: *Natural and anthropogenic conditions determine the intensity and direction of pedogenesis, as well as the nature and degree of degradation of the soil cover of the Republic of Moldova. Depending on the combination of natural and anthropogenic factors, the forms of land degradation are expand. The main natural factors of land degradation are: quaternary deposits, represented by loess clay, ancient and modern alluvial deposits of different granulometric compositions, from clays to sands; parental rocks; the presence of seven orographic units in a restricted area. The most common exogenous processes leading to land degradation are: erosion, landslide, proluvio-deluvial, avalanche, fusion and karst process. The evolution of the balance of organic matter in arable soils became negative. In a period of 150 years, the chernozems lost up to 50% of their initial humus content. The annual losses of organic matter through decomposition are on average 600-700 kg/ha, in the last 20 years – 900 kg/ha. The torrential nature of the precipitation in the conditions of a fragmented relief contributes to the intensive development of land erosion and the manifestation of different forms of soil degradation. The arid character of the climate, the frequent dry periods (droughts), the predisposition of the territory to the manifestation of desertification processes, require the adaptation of agriculture to these conditions.*

Keywords: *land degradation, land resources, sustainable management, agricultural policy.*

JEL classification: Q1, Q15

INTRODUCTION

Food security is one of the key global challenges of this century. Agriculture plays a strategic role in all countries of the world, as it is the main sector responsible for food security of the population, having, at the same time, a special contribution to the general process of sustainable economic development and environmental protection.

The sustainable management of land resources is a primordial social problem, because increasing agricultural production can only be achieved through the rational use of soil resources. The rational management of the land fund within the national economy and the sustainable exploitation of soil resources in the Republic of Moldova must be based on (Leah, 2012):

a) the production of the necessary volume of agricultural production to satisfy the needs of the population in the respective products and for export;

b) the organization of agriculture in such a way that the agricultural production process ensures the protection of soils, their conservation and increasing their fertility.

Soil degradation is a pedological process generated by the action of natural and anthropogenic factors with a negative impact on soil functions, which leads to a decrease in its fertility.

The total land area of the Republic of Moldova on 01.01.2022 is 3.384.938 thousand ha, including: agricultural land - 2.260.81 thousand ha; lands in the urban areas of the localities - 316.07 thousand ha; lands intended for industry, transport and other special purpose - 60.01 thousand ha;

lands intended for nature protection, health protection, recreational activities - 4.11; lands of the forestry fund - 450.62 thousand ha; lands of the water fund - 87.95; lands of the reserve fund - 205.35 thousand ha (Land Cadastre of 01.01.2022).

According to the Land Cadastre data, on January 1, 2022: the surface of irrigated land was 215.93 thousand ha, with a decrease of 2.01 thousand ha, compared to 2020; the area of drained land is 57.85 thousand ha, with a decrease of 350 ha, compared to 2020.

According to the type of ownership, the land surface is: public property of the state constitutes - 783.86 thousand ha (23.1%), public property of administrative-territorial units - 698.81 thousand ha (20.7%), land private property - 1902.2 thousand ha (56.2%), (Land Cadastre of 01.01.2022).

MATERIALS AND METHODS

The policy documents developed in which the management of soil resources and the main causes of soil degradation and their impact are characterized served as material. The method is based on the analysis of agricultural policies in which the aspects of land management are reflected. The soil is subject to a series of degradation processes. Some of these processes are closely related to agriculture: water erosion, agricultural soil preparation works; compaction; decrease in the amount of organic carbon in the soil and soil biodiversity; salinization and sodification, etc.

Soil degradation processes imply the need to protect, maintain and improve soil quality through the implementation of conservation technologies. The object of the analysis of the situation in the field of land improvements in order to ensure the sustainable management of soil resources can be formulated as follows: the study of all aspects of the degradation forms and the development of methods to reduce them.

RESULTS AND DISSCUSION

The strategic objectives, foreseen for the next 20 years, specifically aim at increasing the well-being of the entire people and each citizen, as well as the prosperity of the next generations. For the Republic of Moldova, sustainable development requires a complex approach to the problem of resource use (National Environmental Strategy for 2014 – 2023. GD no.301 of 24.04.2014):

1) lack of resources limits development;

2) the development of urban and rural settlements causes pollution of the environment - soil, air, surface and groundwater, etc.;

3) the intensive exploitation of some resources (soil, water, forests) reduces their regeneration capacity, leads to the poverty of the population.

The Republic of Moldova recognized the importance of applying the principles of sustainable development in all sectors of the national economy and in the social sphere (National Environmental Strategy for 2013 – 2023, GD 301 of 24.04.2014). The 18 principles of sustainable development are paramount for the strategic planning process at national and sectoral level (Cainarean Gh., et al., 2015), taking into account that:

- People have the right to a healthy and prosperous life in harmony with the environment.
- Today's development must not undermine the development and environmental needs of future generations.

- Nations have the sovereign right to exploit their resources, but without causing destruction outside their borders.
- Nations must propose international laws to provide compensation for damages caused outside their country's borders.
- People have the right to a healthy and prosperous life in harmony with the environment.
- Today's development must not undermine the development and environmental needs of future generations.
- Nations have the sovereign right to exploit their resources, but without causing destruction outside their borders.
- Nations must propose international laws to provide compensation for damages caused outside their country's borders.
- In order to achieve sustainable development, environmental protection must become an integral part of the development process.
- The reduction of poverty and the disappearance of economic differences between various parts of the world are essential for the achievement of sustainable development.
- Nations must cooperate to conserve and protect ecosystems.
- Nations should reduce and eliminate unsustainable patterns of production and consumption and implement appropriate demographic policies.
- Environmental problems are better solved with the participation of all citizens.
- Nations should facilitate and encourage citizen participation in solving environmental problems, therefore environmental information must be made accessible to the general public.
- Nations must pass laws to protect the environment, protect the victims of pollution and when appropriate prevent actions on the environment that would have irreversible negative impacts.
- Nations should cooperate to create an open economic environment that ensures sustainable development for all countries.
- The polluter must cover the costs of the damage caused.
- Nations must inform each other about natural disasters.
- Sustainable development requires a scientific approach to the problem.
- Nations must share knowledge and innovative techniques to achieve the goal of sustainable development.
- Peace, development and environmental protection are inseparable.

The transition from economic growth and development is difficult and achievable only in the long term. It involves serious costs and certainly affects productivity. However, it starts from the premise that these losses, strictly economic and in the short term, will be compensated in the long term by an increase in the quality of people's lives (Mitchell et al., 2004).

The Land Improvement Program for the purpose of ensuring the sustainable management of soil resources for the years 2021-2025 and the Action Plan regarding its implementation for the years 2021-2025 (GD 864 of 09.12.2020) provides for land improvement works, protection, conservation and enhancement of soil fertility, made for:

1) to protect the soil against the mechanical action of water and wind (category that includes the complex of works to prevent and combat / control the soil erosion);
2) to restore (complete) the moisture deficit (category that includes land irrigation);

3) to prevent or remove excess water from the soil, from its surface (category in which desiccation and drainage fall);

4) to restore the soils (category in which the works of construction and exploitation of hydrotechnical objects, the works of selective uncovering and covering of damaged or degraded lands, the works of improvement of alkaline and saline soils).

The objectives of the 2030 Sustainable Development Agenda establish Objective no. 15. Life on Earth, National Target 15.3: By 2030, combat desertification, restore degraded lands by implementing the Land Degradation Neutrality (LDN) mechanism, to achieve a land degradation neutral world and Objective no. 12. Responsible consumption and production, National Target 12.2: By 2030, achieving sustainable management and efficient use of natural resources.

In recent decades, the intensification of multiple forms of soil degradation, especially through erosion, has been recorded (Andrieş, et al., 2004; Constantinov, 1998; Constantinov et al., 2003). Thus, in conditions of rugged relief of the Republic of Moldova, the most degraded soils are: soils with surface and deep erosion (rivers), soils affected by active landslides and solonized and salinized soils. Soils affected by surface erosion occupy about 981.560 ha including: with moderate and strong degree of erosion – 423.390 ha (or 43%). Compared to non-eroded soils, the productivity of moderately eroded soils decreases up to 50%, and of strongly eroded ones - up to 70% (IPAPS, 2005a, 2005b).

Annual losses of fertile soil through erosion are approximately 26.000.000 tons. This amount of soil contains 700.000 tons of humus, 50,000 tons of nitrogen and 34.000 tons of phosphorus (Andrieș, 2011). The cost of washed soil is about 1.85 billion lei, and that of agricultural production losses about 0.873 mil. lei. Thus, the direct and indirect damage caused by erosion is 2.723 mil. lei. In the republic, about 80% of arable soils are located on slopes, therefore, the works to prevent and combat surface erosion are a priority for the sustainable development of agriculture (Andrieș, et al., 2004; IPAPS ”N.Dimo” (1996).

Thus, in 2008 the surface of the eroded land was about 877644 ha, and in 2019 about 1015693 ha, which shows an increase of about 16% (Land Cadastre of 01.01.2008 and 2019) (Table 1).

Table 1. The current situation regarding the area of eroded agricultural land

Year	Agricultural lands, ha	Eroded land, ha			
		Total	Weakly	Moderate	Strongly
2008	1939114	877644	504777	259332	114165
		45%	26%	13%	6%
2019	2019359	1015693	572353	300341	143204
		55%	28%	15%	7%

The main causes of soil degradation and their impact are (IPAPS ”N.Dimo”, 2001):

1) non-observance of crop rotation in crop rotations - changes the soil structure, soil nutrient imbalance, soil erosion and crop reduction;

2) reduction of fodder and leguminous crops - reduces the nutrients necessary for the development of agricultural crops;

3) reducing the use of organic and mineral fertilizers - they lead to the loss of organic matter in the soil, soil compaction, the reduction of the physical structure of the soil and the reduction of soil fertility;

4) improper tilling of the soil - decreases the productivity potential of the soil, increases the compaction and degradation of the soil surface;

5) change in hydrological conditions - lead to reduced water infiltration and soil loss on the surface;

6) deforestation of forests and protective strips of fields - causes severe droughts, wind and water erosion of the soil, desertification of the soil and loss of biodiversity;

7) improper management of pastures - degrades the structure and soil cover;

8) improper use of heavy machinery in agriculture - compacts the soil surface and degrades its structure;

9) biological degradation of the soil - leads to the reduction of soil fertility and the loss of productive potential.

To increase the volume of agricultural production, simultaneously with the long-term preservation of soil quality, it is recommended to implement conservative technologies, which includes a complex of organizational, pedo-ameliorative and agrotechnical measures. The implementation of conservation technologies in agriculture requires (Boincean, 1999):

- improving the national system of pedological and agrochemical research, creating the computerized soil quality information system (soil quality monitoring) for the management and correct use of the land fund at the level of parcel, agricultural enterprise, commune, district and republic;
- development of standards, technical regulations, land exploitation rules;
- improving land legislation, solving problems regarding the calculation of land tax, the price of land, rent payments, the tax on land operations, the way of accumulating and using the means collected in the form of land payments;
- specifying the form and limits of state supervision over land transactions, the order of contractual relations and responsibility for these relations;
- the consolidation of land into profitable agricultural holdings of optimal sizes, which would allow the implementation of crop rotations and modern technologies, the development of a system of sustainable use of soil resources;
- the creation of a viable economic mechanism that would ensure the improvement of the price, credit and taxation policy and that would allow the implementation of programs with a special purpose in the agro-industrial complex, especially in the field of protection, improvement and rational use of soils;
- the creation in different pedoclimatic zones of model households of specialized farmers, of high profitability and optimal sizes, determining the optimal size of peasant households of different specializations, taking into account the pedological and economic conditions of the concrete territories and the existence of the machines necessary;
- the distribution of agricultural crops within the land for the creation of a rational correlation between the field crops and the livestock sector, which would ensure the annual production of at least 10 mil. tons of manure, necessary to stabilize the humus balance in the soil and preserve its fertility. The recommended crop structure will allow the production of the necessary volume of grain to ensure the food security of the population, as well as the necessary volume of fodder for the livestock sector and the necessary volume of technical and vegetable crops for the needs of the processing industry. At the same time, this structure of crops will allow protective soil rotations to be applied in agriculture.

- restoring the irrigation/drainage systems and carrying out pedological research in order to assess the quality of the irrigated soils and establishing pedo-irrigational monitoring.

The principles that define the development of sustainable management are defined for the agricultural sector by the fact that (Strategia națională de dezvoltare agricolă și rurală 2014-2020, HG nr. 409 din 04.06.2014):

- renewable resources are only used according to their regeneration rate;
- exhaustible sources of raw materials are only used by humans as long as they can be replaced, both materially and functionally, with renewable resources, guaranteeing, at the same time, a higher productivity;
- the damage to the environment does not exceed the natural regeneration capacity of the main environmental factors - air, soil and water;
- a temporary equivalence must be maintained between the time of the intervention and the time of the processes in nature.

Sustainable agriculture, primarily viable from an economic point of view, meets the demand for healthy and high-quality food, being an agriculture that guarantees the protection and improvement of natural resources in the long term and transmits them intact to future generations. Such type of agriculture determines a sustainable management of the lands and diversifies rural economic activities, because the raw materials appear and are subjected to primary transformations at the level of agricultural exploitation, for which it is necessary, along with preserving the quality of the natural production environment, to develop infrastructure and to increase the economic potential of the villages (Măgdălină, 1994; ACSA, 2006; Ministerul Agriculturii şi Alimentaţiei al Republicii Moldova, 1997).

Therefore, effective sustainable agriculture, based on conservative technologies, can be conceived within a system of long-term protection and preservation of the quality and productive capacity of soils. These measures are provided for in the Land Improvement Program for the purpose of ensuring the sustainable management of soil resources for the years 2021-2025 and the Action Plan regarding its implementation for the years 2021-2025 (Directive no.2 of 25.01.2011, Ministry of Agriculture and Industry Food of the Republic of Moldova).

CONCLUSIONS

It was found that the existing system in the agriculture of our country leads both to the decrease in the volume of agricultural production and to the degradation of soil resources. The situation can be changed by the gradual implementation, simultaneously with land consolidation, of conservation technologies in agriculture, so that agriculture and research are concerned not only with increasing harvests, but also with optimizing the system as a whole, to maintain soil productivity in the long term. The activity in a household with sustainable agriculture is based, first of all, on the use of natural processes, on the biological and renewable resources of the household and only secondly - on the purchased resources.

A primordial necessity remains the creation of a rational correlation between the field crops and the zootechnical sector, which allows the return of perennial grasses to the fields and the production of the necessary organic fertilizers. The support of agriculture is a major priority, but currently more attention is being paid to its new branches - precision agriculture, biological agriculture, carbon sequestration, etc. - and, at the same time, the restoration of degraded lands (conservative agriculture), that is, all aspects related to land consolidation (The program for the valorization of land and the increase of soil fertility, GD no. 636 of May 26, 2003).

The ultimate challenge for soil science is the accumulation and provision of useful information related to the appropriate, optimal use of agricultural land, taking the necessary precautions in time to essentially preserve the vital functions of the soil.

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AGROECOLOGICAL LIVING LABORATORIES (ALL-ORGANIC) FROM ROMANIA "BELEZA STORE SRL ECOLOGICAL VEGETABLE FARM - VALCELELE/CĂLĂRAȘI"
(CASE STUDY)

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Abstract: *Since 2005 when, at the initiative of the Finnish Presidency, the European Network of Living Laboratories (ENoLL) was established, the term "living laboratory (LL)" has spread throughout the scientific and technical world because: it aims to stimulate innovation in all its complexity, it can be understood and used according to the particularities of each component of sustainable development - nature, society and economy and in different ways - as a means of stimulating innovation, a multiple approach way, a working methodology, a development strategy, a way to support the transition towards local agri-food sustainability, concept in (re)designing business models, etc. and applied relatively easily, with the help of information and communication technology (ITC), then promising and now fashionable and in full creative momentum in both urban and rural environments. The paper presents the first results of the research project "Living Agroecological Laboratories for the promotion of resilient organic production systems - ALL-Organic", code ERANET-COREORGANIC-ALL-Organic, CORE Organic Cofund financing scheme for the period November 15, 2021 - November 14, 2024, regarding the identification of the specific characteristics of the Agroecological Living Laboratory (ALL-Organic) "SC Beleza Store SRL", corresponding to the structural components of any Agroecological Living Laboratory (ALL): Mission, Activities, Resources, Participants and Context.*

Keywords: *living laboratory, agroecology/agroecosystem, field vegetables.*

JEL Classification: Q12

INTRODUCTION

Today, perhaps more than ever in history, humanity faces many environmental problems simultaneously – climate change, especially global warming and acid rain, land degradation, biodiversity loss, air, water and soil pollution, and contamination of agricultural products and food with substances toxic, etc., economic - the financial and energy crisis and social - inequalities, especially in terms of living standards, human migration, unemployment and, at the same time, the lack of qualified labor, the health crisis as a result of*the unexpected appearance and the galloping evolution of some diseases, more or less incurable (coronaviruses, cancer, AIDS, nutritional diseases, stress, drug and alcohol addiction, etc.) and political-military crises.*

The most important examples of success in solving some of these problems are the business models based on the "Living Labs" concept, an approach suggested for the first time in 1985 by

William (Bill) J. Mitchell of Massachusetts Institute of Technology (MIT) combining the vision of a digital future with a new style of creative invention, initially in the field of smart/future homes and cities and then generalized in the scientific and technical world since Mats Eriksson et al, published in 2005, the work "*State-of-the-art in using Living Labs approach to user-centric ICT innovation – a European approach*" (Eriksson et al., 2015) and The Presidency of Finland established, in 2006, the European Network of Living Laboratories (EnoLL) with the aim of promoting the concept of living labs to influence EU policies, to improve existing living labs and enable the implementation of this concept globally. This initiative stimulated innovation by moving research out of laboratories in the real life of cities and regions, where citizens and users were encouraged to cooperate with researchers, developers and designers to contribute to the whole innovation process [8. 9]. ENoLL also lists five elements that must be present in a living lab: (1) active user involved, (2) real-life setting, (3) multi-stakeholder participation, (4) multi-stakeholder approach methods and (5) co-creation (Mc Phee et al., 2021).

Another important achievement regarding the characterization of living labs in general and urban living labs in particular is the book "Urban Living Labs - A living lab way of working" written and published in July 2017 by Kriss Steen & Ellen van Bueren from the University of Technology from Deft(Steen and Van Beuren, 2017). Based on a literature review of living labs, urban living labs and a number of 90 local innovation projects in the Amsterdam region, the following defining characteristics of urban living labs (LLUs) were identified:

Table 1. Defining characteristics of real-life urban living labs

	Characteristics
PURPOSE	**Innovation** *New product development to find new solutions to existing or new problems*
	Developing knowledge for replication *Producing and sharing knowledge about products and the processes developed to make these products*
	Increasing urban sustainability *Sustainable development emphasizes the need for sustained local solutions*
ACTIVITY	**Development of innovation** *Living labs aim to develop an innovation or product and not only, for example, test or implement a pre-developed solution*
	Co-creation *Participating actors together shape the innovation process*
	Iterate between activities *Feedback gathered from product usage and evaluation is used for further product development*
PARTICIPANT	**Users, private actors, public actors and knowledge institutes** *Actors in these four groups actively contribute to the innovation and development process that takes place in a living laboratory*
	The power of decision All participants, including users, consumers, have decision-making power in the different stages of the innovation process
CONTEXT	**Real-life usage context** *The activities of the living lab are implemented in a real usage context*

Source: Steen & vn Buearen, 2017

From these scientific reference works mentioned above it is clear that the theoretical and applied achievements in the field "Living Labs (LLs)" refers to:

1) Definition: LL is a user-centered research methodology for detecting, prototyping, validating and refining complex solutions in multiple and evolving real-life contexts(Eriksson et al., 2015); or LLs are ecosystems user-centered open innovation based on a systematic user co-creation approach that integrates research and innovation processes into real-life communities and environments - ENoLL cited by (Mc Phee et al., 2021) and more comprehensive: LLs are open innovation ecosystems in real-life environments that use iterative feedback processes throughout an innovation's lifecycle approach to create sustainable impact. They focus on co-creation, rapid prototyping and testing and scaling up innovations and businesses, delivering (different types of) shared value to the stakeholders involved. In this context, living labs function as intermediaries/orchestrators between citizens, research organizations, companies and government agencies/levels (MIT) .

From a methodological perspective, living labs are networks composed of heterogeneous actors, resources and activities that integrate user-centered research and open innovation (Leminem et al., 2012) , and from an infrastructure perspective, they can be seen as facilities that enable experimentation and co-creation with users from real-life environments (Sundramoorthy et al. 2011).

Also, "Living Lab" concept can be understood in other ways - tool to stimulate innovation, multiple approach, work methodology, development strategy, way to support local transition to agro-food sustainability, concept in (re)designing business models, etc.

2) Characteristics: There are NO standard LLs (Eriksson et al., 2015), because there are no standard users either,

3) Focus on 3 key areas: User (client, source and provider of ideas, knowledge and practical experience and with innovation skills), Technology (including IT) available and Business (Models) (Osterwalder and Pigneur, 2017)*;*

4) Unreserved and widespread use of Information and Communication Technology (IT): as a tool for participatory (re)design of Living Labs and sustainable development of society in which users/citizens are involved (Eriksson et al., 2015);

5) Integration of Research and Innovation in real life, according to their characteristics summed up in the following quote from Per Eriksson „research transform money to knowledge and competence; innovation, on the other hand, transforms knowledge and competence into money and value*"*. Knowledge from research and real life and IT are the most important components in the innovation process, but they are optimally leveraged only if the participants in this process have the ability to cross-interact (Eriksson et al., 2015);

6) Value creation, perhaps unique and/or customized– because if *"You will create, you will have", and if "You will not create, you will not exist" [Octav Onicescu]*, and value is understood as something good, desirable and important for Nature, Society and Economy (especially in Technology and Market).

7) Establishment of science parks in the vicinity of Universities and Testing & Experimentation Platforms strongly stimulated the innovation process and was successful as a result of the creation of new businesses, probably of the Living Labs type, in high-tech fields (Eriksson et al., 2015);

The rather gloomy international context, described at the beginning of this chapter, is also noticed in countries that support their economy, in particular, on agricultural production, such as Romania, but less so in those with developed ecological agriculture, since this can contribute, at least in part, to solving the big contemporary problems (Toncea et al., 2011) , because it is the most strictly regulated and controlled agricultural system in terms of land cultivation technologies, animal welfare, the quality of agricultural and food products and the quality of the environment, and the only source of certified "living food" (Toncea et al., 2011) . The problem is that organic agriculture does not produce food and agricultural products according to the demand, taste and own budget of consumers/users/citizens, because: only part of the agricultural area (maximum 25% in the European Union) is cultivated in an organic system, the wishes of all consumers and retailers are not known, the processing of agricultural products is poorly developed and often takes place far from the place of agricultural production and trading centers, and because it is not supported to cope with the fluctuation of the market for agricultural products and certified organic food.

In the field of Agroecology, a first significant step was taken by the International Working Group made up of scientists from the G20 (19 countries + the European Union) in the field of agroecosystems, established at the proposal of the Canadian government in 2018 (Mc Phee et al., 2021). In 2019, the G20 Group concluded that both the Canadian and French case studies are representative of the definition of an agroecosystem Living Laboratory, or agroecosystemic, and identified, based on the Steen & van Bueren (2017) template, the defining characteristics of Agroecosystem Living Laboratories, or regarding Agroecosystems (Mc Phee et al., 2021):

ALLs - Agroecosystem Living Laboratories or Agroecosystems are transdisciplinary approaches involving farmers, scientists and other interested partners in the co-design, monitoring and evaluation of new and existing agricultural practices and technologies to improve their effectiveness and early adoption(Mc Phee et al., 2021).

For the expansion of the concept of Living Labs (LL) in agriculture, substantial support is expected from the project "The European Agroecology Living Lab and Research Infrastructure Network (ALL-Ready) - preparation phase" financed by the European Union through the Horizon 2020 Program for research and innovation, grant agreement no. 101000349, for the period November 2020 – October 2023 and coordinated by Dr. Heather McKhann from INRAE/France. The main objective of this project is to prepare a framework for a future European network of Living Labs – LL (Living Labs) and Research Infrastructure (Ris), which will be called "AgroEcoLLNet" and will enable the transition to agroecology throughout Europe(ALL Ready project) .

For the Agroecological Living Laboratories (ALLs) in Romania, the project is also important***Agroecological Living Laboratories for the promotion of resilient organic production systems - ALL-Organic"***,code ERANET-COREORGANIC - ALL-Organic, which takes place between 15 November 2021 and 14 November 2024 and in which the Romanian Association for Sustainable Agriculture (ARAD) is a partner (https://uefiscdi.gov.ro.). The general objective of the ALL-Organic project is to build a functional network of experiences, models and farms capable of promoting and supporting the development of diversified ecological agri-food systems, with the aim of obtaining productions of robust and resilient ecological crops, by involving actors in the agri-food system "from field to fork". The project will be based on a network of Agroecological Living Laboratories or Agroecology (ALL) in organic agriculture aimed at implementing and scaling up systemic agroecological innovations. Such socio-technical innovations are aimed at strengthening local sustainable, diversified, low-input agri-food productions through transdisciplinary and multi-actor activities [11]. An important guide for the characterization of Agroecological Living Labs is also the scientific work "The Defining Characteristics of Agroecosystem Living Labs", authors Chris McPhee, Margaret Bancerz, Muriel Mambrini-Doudet, François Chrétien, Christian Huyghe and Javier Gracia-Garza, published in 2021 (Mc Phee et al., 2021).

MATERIALS AND METHODS

The studies were carried out in the period 2020-2022 and were of two types - documentary or office research, based on written documentary sources, especially articles and other scientific and informative publications related to the keywords of this scientific report: living laboratory, agroecology /agroecosystem, characteristics, field vegetables and field research, in the farm of field vegetables cultivated in an ecological system of "Beleza Store SRL", work point located in Vâlcelele commune (NUTS 4), Călărași county in the South Region - Muntenia, in a very large plain with chernozem type soil and arid climate. Also, in this region, in the year 2021, about 98 ha were cultivated in an ecological system with field vegetables, including melons and strawberries, (table 2), which, compared to the regional average area of 153 ha (MADR data) and above all, with the agroecological potential (8559 – 12836 ha) and with the total number (3274525) and from the rural environment (1925335) of inhabitants, potential consumers of ecological vegetables in the region, it is an insignificant surface. What seems encouraging is the fact that, according to MADR data, of the 98 ha area cultivated with vegetables, 41% is under conversion and, with proper counseling, could be true ALLs.

Table 2. The area cultivated with field vegetables, including organically certified melons and strawberries in 2021, the agroecological potential and the total number of inhabitants in the rural area in the development region "Sud-Muntenia"

County	Area cultivated with field vegetables in ecological system (ha)		Agroecological Potential (Vegetables 2008)		Residents[xx] (2008)	Villagers[xx] in the countryside (2008)
	(Ha)	(%)	Minimum (ha)	Maximum (Ha)	No.	No.
Arges	1.34	1.37	929	1393	643762	337266
Calarasi	13.88	14,17	506	760	313626	193268
Dambovita	13.87	14,15	2514	3770	520849	366607
Giurgiu	20.42	20.84	1024	1536	282554	194952
Ialomiţa	12.52	12.78	1697	2545	288725	156446
Prahova	30.99	31.63	785	1177	817632	405428
Teleorman	4.96	5.06	1104	1655	407377	271367
Total	*97,98*	*100*	*8559*	*12836*	*3274525*	*1925334*

Source: www.madr.ro - ecological agriculturex and Statistical Yearbook of Romania 2009xx

The research carried out focused on the distinctive characteristics of "SC Beleza Store SRL" regarding the mission, activities, resources, participants and context, structural components identified in the majority of Viu Agroecological or Agroecosystemic Laboratories in the specialized literature. A good part of this information was collected on the occasion of the "Seminar and Study Visit" event organized on 18.07.2022 by ARAD at the organic vegetable farm "Beleza Store SRL" Vâlcelele, Jud. Călăraşi, which was attended by researchers (8), farmers (4), consultants (2), councilors (2), students (1), representatives of the local administration (1) and ARAD (1), traders (1) and consumers (1).

RESULTS AND DISCUSSION

According to art. 6 of the Constitutive Act Updated on 18.08.2021, the commercial company "Beleza Store SRL" has the field of activity GROUP 011 "Cultivation of non-permanent plants" and as its main activity CLASS 0113 "Cultivation of vegetables and melons, roots and tuberculiferae".

According to Fig. 1, the "Beleza Store SRL" business model has 5 (five) structural components - Mission, Activities, Resources, Participants and Context, each having 2-3 distinctive characteristics.

MISSION"Beleza Store SRL" has 2 (two) specific characteristics:

1. Product innovation–the cultivation of field vegetables in an ecological system, unique from a nutritional and therapeutic point of view as living food (*any agricultural or natural product, consumed instinctively by humans and/or animals and plants, raw or (semi) processed by biological, mechanical and physical methods that maintain its vital qualities)* (Toncea et al., 2011) ,with high added value and commensurate with consumer demand and purchasing power, as well as the marketing of organically certified fresh vegetables packaged and unpackaged (bulk) according to the Global GAP standard

2. Preservation of rural sustainabilitybased on functional biodiversity following long-term rotation (4 - 6 years, depending on market requirements) of crops (alfalfa, mix of ornamental plants and flowers, pumpkins, peppers, aubergines, strawberries, sweet potato, mix of oats and peas), of the diversified ecological technologies of their cultivation and friendly to the environment and of the employment of local labor force (Table 3).

Table 3. Dynamics of the number of employed workers, their domicile and structure at "Beleza Store SRL"

The year	Permanent			Seasonal			
	Barbie	Ladies	domicile	Barbie	Ladies	domicile	Employment Period
2020	2		Vâlcelele, Călărași County	5	2	Vâlcelele and Ciocănești, Călărași County	May to November
2021	2			1	6	the hills, Calarasi County	May to November
2022	2	1			9	Vâlcelele and Dragoș Vodă, Călărași County	May to November

ACTIVITIES carried out by "Beleza Store" SRL are:

1. Research – Development – Testing – Implementationat the farm level, all focused on the consumer and materialized in reports and scientific reports developed by the company administrator in the framework of the doctoral thesis "The economic, social and environmental impact of the integrated protection of vegetable plants grown in an ecological system", as well as in the dissemination , on the occasion of the field day, of knowledge regarding the technology of cultivating field vegetables in an ecological system and the modern techniques of marketing fresh vegetables, ecologically certified.

2.Co-creation,together with employees, customers and partners, of agroecological technologies and techniques for selling organic field vegetables corresponding to seasonal, or/and (multi)annual environmental disturbances (eg climate change and soil fertility decrease), economic (eg high input costs) and social (eg labor shortage) and the increasingly frequent demand for agricultural products and ecological food of the living food type.

THE RESOURCES of "Beleza Store SRL" are important in creating, delivering and capturing value, penetrating markets, maintaining customer relationships and generating revenue (Toncea and Iordache 2020) and in several ways: Agro-pedoclimatic – flat land, continental climate with cold winters and hot summers, chernozemous soil and water for deep irrigation (60 m), favorable for vegetable crops, economic – own ecological technologies for cultivating field vegetables and human – ressource of young, local and job-trained labour.

Table 4. Agroecological Living Laboratory "Beleza Store SRL"

components	Distinctive features
MISSION	**Product innovation** *organically unique certified field vegetables such as live food*
	Restoring and preserving rural sustainability *based on functional biodiversity and the employment of local labor*
ACTIVITY	**Research – Development – Testing – Implementation** *for solving environmental, technological and social problems*
	Co-creation *of agroecological technologies and techniques for selling organic field vegetables*
RESOURCES	**Agro-climatic** *Agricultural land, continental climate, black soil and deep water*
	Economic *Technologies for cultivating field vegetables in an ecological system*
	Social *Local workforce trained on the job*
PARTICIPANTS	**Customers** *CARREFOUR Romania, FRESHUL, Groceries and the "Young Mums" Social Group*
	Farmer *and its employees, permanent and seasonal*
	Partner *Academic Public Actors and Non-Profit Civil Actors (NGOs)*
CONTEXT *(from real life)*	**Legislative** *International and national agro-ecological normatives and regulations*
	The Associative Environment *Part of a network (associations)*

Participants to the activities of "SC Beleza Store SRL" are, in the order of their importance:

1. Customers, the heart of any business model (Osterwalder and Pigneur, 2017) , including ALLs, are in this case: CARREFOUR Romania, FRESHFUL, CORA, Groceries and direct consumers: Social group "Young mothers" (tab. 4). Among them, the most important and constant customer is CARREFOUR Romania, with the largest volume (67 - 81%) of goods purchased each year, followed by Groceries (9.71 - 18.82%), FRESHFUL (17 .85% in 2022) and the Social Group "YOUNG MOTHERS" (2.57 - 6.10%), with constant and growing interest in the vegetables produced by "SC Beleza Store SRL".

Table 5. **"Beleza Store SRL" customers and sales volume in the period 2020 - 2022**

CUSTOMERS	SALES VOLUME (%)		
	2020	***2021***	***2022***
CARREFOUR Romania	81.00	74.23	66.90
CORA	5.06	2.75	0.44
FRESHFUL	-	-	17.85
Grocery	11.35	18.82	9.71
Social group "YOUNG MOTHERS"	2.57	4.20	6.10

"SC Beleza Store SRL" is also permanently concerned with relations with customers, listening to their wishes and identifying their needs. Maintaining customers is done through seriousness and professionalism - diversified production and constant deliveries, minimum 3 deliveries/week in the long term "May-December", compliance with the delivery schedule, confirmation of product quality by performing analyzes (nitrates and pesticide residues). The farmer maintains a close relationship with customers by phone calls, promotions and prompt and positive response to requests. Even if it is not openly acknowledged, the influence of customers on "SC Beleza

SRL" is felt on the entire value chain (from fork to fork), but most visible through the adaptation of crop rotation to market requirements.

2. The farmer and farm employees, permanent (2) and seasonal (7 – 9), dedicated to the ecological management of the cultivation and marketing of field vegetables in accordance with international and national organic farming regulations and customer requirements (standards).

3. Key partners from the Academic environment, such as the Faculty of Horticulture of USAMV Bucharest and the Research Station - Development for Plant Culture on Sandy soils, from Dăbuleni and from the Association environment, such as the Romanian Association for Sustainable Agriculture (ARAD);

CONTEXT or favorable relevant circumstances that precede, accompany, succeed or mitigate a fact, an action or a phenomenon related to Beleza Store SRL, are of two types:

1. Legislative Context -International agro-ecological normative acts (regulations and other legislative acts) (Regulation 848/2018 and other 34 specific Regulations) and national (OG 34/2000 and nine other orders, ordinances and decisions);

2. The Associative Environment– Networks (Associations) of farms, such as the Romanian Association for Sustainable Agriculture.

CONCLUSIONS

1. In real life there are 4 types of Living Labs – living labs (LL), urban living labs (LLU), agroecosystem living labs (LLA) and agroecological living labs (ALL-Organic).
2. The Agroecological Living Laboratory (ALL) is a real-life system, open to new ideas, oriented towards and supported by users - customers, including those from the associative and information technology (IT) environment, co-creative and/or co-innovative of products, such as living food and services for common use and for the benefit of the environment, economy and society.
3. Any ALL has 5 components, of which 3 are methodological: Mission, Activities and Resources and two are infrastructural – Participants and Context, and each component has two or three distinctive characteristics.
4. The distinctive characteristics of ALL "Beleza Store SRL" are: product innovation, restoration and preservation of rural sustainability, research-development-testing-implementation, co-creation, favorable natural, economic and human resources, customers, staff, partners, legislation and the associative framework.
5. ALL can be any farm or ecological peasant household, in conversion or certified, as well as any sustainable conventional or traditional agricultural unit and their structural and functional components producing goods and services that satisfy the needs of food, clothing and of the consumer and were produced and are in harmony with the environment.
6. Every ALL is a business model/case , but not every agroecologic business models/cases is a LL.
7. ALL standard does not exist, because there are no standard users either.

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THE LIVING AGROECOLOGICAL LABORATORIES IN ROMANIA. CASE STUDY - ECOLOGICAL VINEYARD FROM SCDVV MURFATLAR

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Abstract: *Within the Era-NET Core Organic - ALL project (Agroecology Living Labs to promote robust and resilient Organic production systems) in the period 2021-2022 in Murfatlar, an innovative system of ecological cultivation of grapevines was experimented, aiming to by increasing the biodiversity of the viticultural ecosystem to improve environmental, economic and social factors. The degree of health of the plants was monitored, carrying out phytosanitary treatments only upon warning. In this way, the frequency of treatments was reduced by up to 40%. With the help of the DEXiPM multifactorial model that allows the evaluation of the sustainability of the culture system according to several objectives, they were comparatively evaluated. the innovative system of increasing biodiversity compared to the classic one, in the ecological vineyard from Murfatlar. All three pillars of sustainability: economic, social and environmental were improved when using the innovative system. We mention in particular, the increase in farmers' "job satisfaction" (from medium to high) despite the increased "operational difficulties" of the proposed techniques. The environmental impact of intercropping on wine plantations is a variable factor that strictly depends on the climate and the area where the wine crops are located. It should not be overlooked that intercropping can compete for resources with vines, both for water and nutrient uptake. From an economic point of view, the "real profitability" of the system is increased from low to medium, while the "viability" of the system is not changed by the introduced innovation.*

Keywords: *viticulture, sustainability, environmental, economic, social impact.*

JEL classification: Q01, Q16, Q57

INTRODUCTION

The concept of ALL - "Agroecological Living Labs" (living agroecological laboratories) is materialized through an initiative recently launched by the European Commission with the aim of accelerating the transition from conventional agricultural systems to sustainable ones, with the help of research in the field (https://ec.europa .eu/info/strategy/priorities-2019-2024/european-green-deal_en). In this way, the premises are created for the realization of candidate European partnerships in the field of food, bioeconomy, natural resources, agriculture and the environment within the Horizon Europe program (https://ec.europa.eu/eip/agriculture/en).

The application of the concept of agroecological system in farms can support the transfer towards resilient agricultural systems, more closely related to the environment and society, which can provide sufficient, safe, nutritious and accessible food, also rewarding the efforts of farmers https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/european-partnerships-horizon-europe/food-bioeconomy-natural-resources-agriculture-and-environment_en).

Through such partnerships, a network of living laboratories and research infrastructures can be created and supported that will accelerate the transition to organic farming in Europe by providing innovative technologies, techniques and products applicable on plots for long-term experimentation or demonstration, specific to the area, involving as many interested parties as possible, including farmers, the academic and administrative environment, input suppliers, etc. Their priority is to provide validated solutions that support farmers in understanding and implementing agroecological practices to obtain a positive economic, environmental and social impact (https://op.europa.eu/en/publication-detail/-/publication/edace3e3-e189-11e8-b690-01aa75ed71a1/language-en/format-PDF/source-200108204).

Agroecological partnerships can be a powerful tool for addressing climate, biodiversity, environmental, economic and social challenges facing the world. The potential of agroecology to reduce the use of pesticides, fertilizers and antimicrobials should be emphasized. Last but not least, agroecology is one of the types of agricultural practices that the future common agricultural policy in Europe could support financially through the so-called eco-schemes (https://enoll.org/).

One of the functions of living labs is to accelerate innovation and the adoption of sustainable practices by engaging farmers and other stakeholders in the joint development of solutions to problems they face in their locality or region, taking into account the specifics of agricultural systems and their environment.

Experiments must be coupled with research efforts to increase understanding of the long-term evolution of ecosystems and the effects of adopted agroecological practices (https://enoll.org/network/living-labs/).

In this context, in the coordination of ARAD - the Romanian Association for Sustainable Agriculture, through the ERA-Net ALL-Organic project with the title: Agroecological laboratories for the promotion of robust and resistant organic production systems, at the Research-Development Station for Viticulture and Vinification Murfatlar was established a demonstrative plot cultivated in an ecological system where new methods of increasing the biodiversity of vineyards were applied, with the aim of better controlling the evolution of diseases and pests and improving the impact of this method on the economic and social environment.

MATERIALS AND METHODS

In an experimental plot planted with the Fetească neagra variety cultivated in an organic system, in the period 2021-2022 two experimental variants were configured, one innovative, using mixtures of plants that formed a vegetal carpet (mix of Lolium perenne 50%, Onobrychis viciifolia 25%, Trifolium repens 25% - semi-permanent, mowed and mulched after flowering), (fig. 1) and another, as a control, with cultivated land - black field. Observations and determinations were made on the health status of the plants and upon these data cummulated with climatic ones was applied the phitosanitary treatments.

The TFI (treatments frequency indice) was calculated for both variantes (TFI reflects the number of applications at full recommended dose), (Gravensen, 2003).

The DEXiPM multifactorial model (Pelzer et al., 2012) was used to assess the environmental, economic and social impact*, which is a hierarchical and qualitative model with several attributes (or criteria) that allow the evaluation of the sustainability of the culture system according to several objectives , sometimes contradictory.

Figure 1: Innovative variant - intercropping

DEXiPM was implemented within the DEXi decision support system to design the culture system, directing it towards sustainability (Alaphilippe et al., 2013). At the same time, its use allows the evaluation of the level of sustainability of innovative systems (Caffi et al., 2017). In short, overall sustainability is broken down into smaller, less complex problems characterized by attributes (or criteria) that are hierarchically organized in decision tree.of data recording, measurements and statistical models, all described clear and synthetic.

* DEXiP model was used with the support of Dr. Tito Caffy from the Universita Cattolica Sacro Cuore, Piacenza, Italy

In DEXi, attributes are characterized by their name, a description, and a scale, i.e. possible qualitative values for the attribute (discrete values described in words rather than numbers, e.g. "low, medium, high"). Even though the scales are qualitative, some may be based on quantitative values (eg yield).

The DEXiPM decision tree can be used as a "dashboard": all aggregated criteria are independent indicators, compared to a reference scenario. The analysis of these criteria values provides explanations regarding the final result and performances of the evaluated systems.

RESULTS AND DISSCUSION

The implementation of sustainable viticultural systems balances the ratio between reducing the application of treatments (Table 1) and increasing environmental resources, which leads to increased yield and fruit quality. The application of an innovative system by planting intercrops in grapevine plantations grown in an ecological system, contributes to reducing the number of phytosanitary treatments, suppresses the development of weeds and creates favorable conditions for the development of arbuscular mycorrhizae. At the same time, intercropping can compete for resources with grapevines, both in terms of water and nutrient use (Rossi et al., 2013). To limit this effect, it is recommended that, after flowering, mowing and mulching or incorporation into the soil are carried out.

Table 1. Treatment frequency index (TFI) applied in ecological culture versus innovative ecological culture (SCDVV Murfatlar)

YEAR	2021		2022	
SYSTEM	Organic	Inovative organic	Organic	Inovative organic
TFI	9	5.5	7	4
No. of treatments	9	7	7	6

The economic-social impact - the use of intercropping in a vineyard depends on several factors. Winegrowers must balance the direct benefits of applying this method of organic cultivation (maintaining yields), the indirect benefits (reducing the costs of maintaining the vineyard) and external factors such as social and environmental protection.

From an economic point of view, intercropping comes with both direct and indirect costs. Direct ones include the method of sowing and crop maintenance, indirect ones involve the cost of seeds. The procurement of seeds generates significant acquisition costs, the price of which varies according to the species and can change in the long term through changes in supply and demand. Although the benefits of intercropping are beneficial in terms of soil organic matter, nitrogen fixation and erosion control, the cost of seed can be an impediment.

Intercropping requires special equipment that is not usually found on a vineyard. If the planting areas are reduced, the use of labor at the expense of the purchase of machinery can represent a cost-reducing factor. The use of fertilizers can generate additional costs. Although it is not necessary to apply them to all intercrops, the addition of fertilizers can increase the yield and production of these crops and implicitly, their ability to suppress weeds (Sainju et al., 2018).

In most cases, intercrops remain unharvested due to the benefits brought to the soil by the decomposition of their biomass. Inadequate management can lead to an uncontrolled growth of intercrops that can compete with the vines. Although the application of herbicides is a solution, the costs of this practice generate negative economic and social effects on the producer.

So, the economic and social impact depends equally on the winegrowers, through managerial decisions, the selected species or plantation maintenance methods, and on external factors such as soil type, climate, etc. (Pannell, 1999).

The environmental impact of intercropping on wine plantations is a variable factor that strictly depends on the climate and the area where the wine crops are located. Monitoring soil properties and the quality of the finished product can provide the necessary data in the selection of plant species capable of providing sustainable ecosystem services in a plantation (Gattullo et al., 2020).

By applying the innovative system of increasing biodiversity in organic vineyards, all three pillars of sustainability: economic, social and environmental have been improved (Figure 2). We mention in particular, the increase in farmers' "job satisfaction" (from medium to high) despite the increased "operational difficulties" of the proposed techniques (Figure 3). From an economic point of view, the "real profitability" of the system is increased from low to medium, while the "viability" of the system is not changed by the innovations introduced for vineyard management (Figure 4). In the environmental pillar of sustainability there is the greatest improvement of the innovative viticultural system: it increases by two points in both environmental quality and "aerial biodiversity" (above ground), confirming that the innovative approach has a positive impact on the environment (Figure 5).

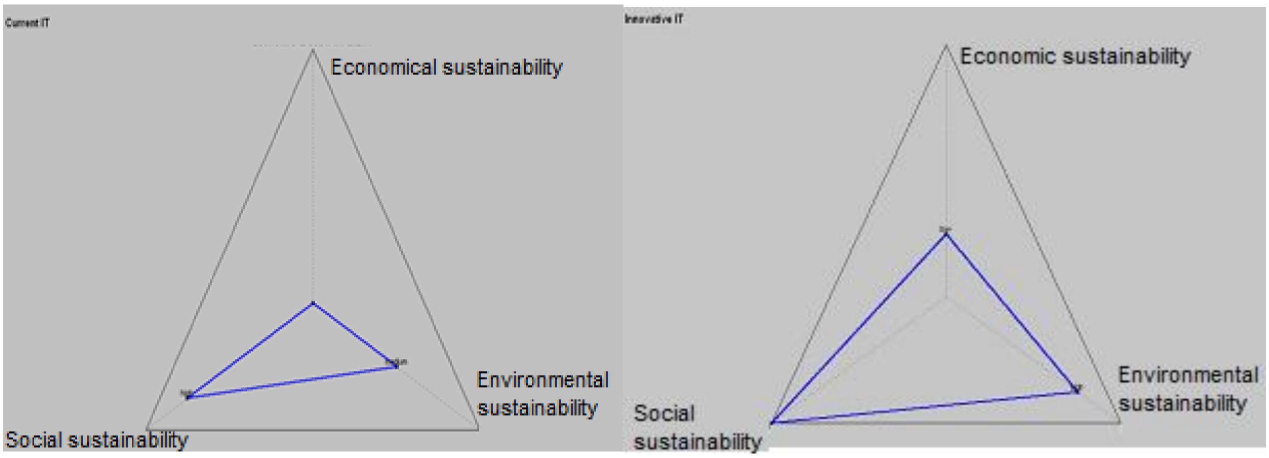

Figure 2: Indicators of economic, social and environmental sustainability provided by post-ante analysis in current (left) and innovative (right) Murfatlar ecological vineyards.

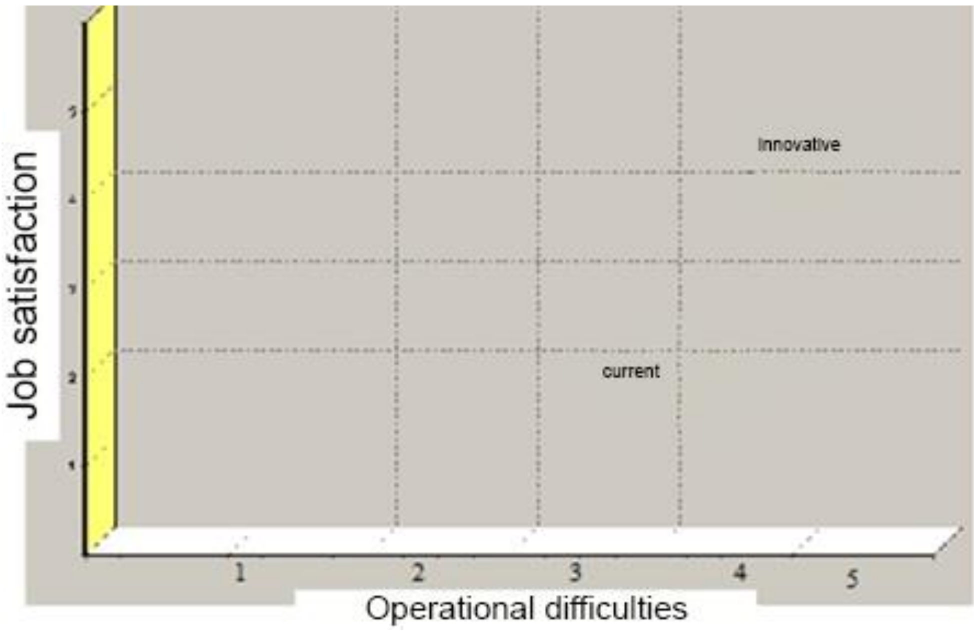

Figure 3: Social sustainability indicators for farmer "job satisfaction" and for "operational difficulties" of the innovative viticultural system, for Murfatlar ecological vineyards, provided by the ex-post evaluation

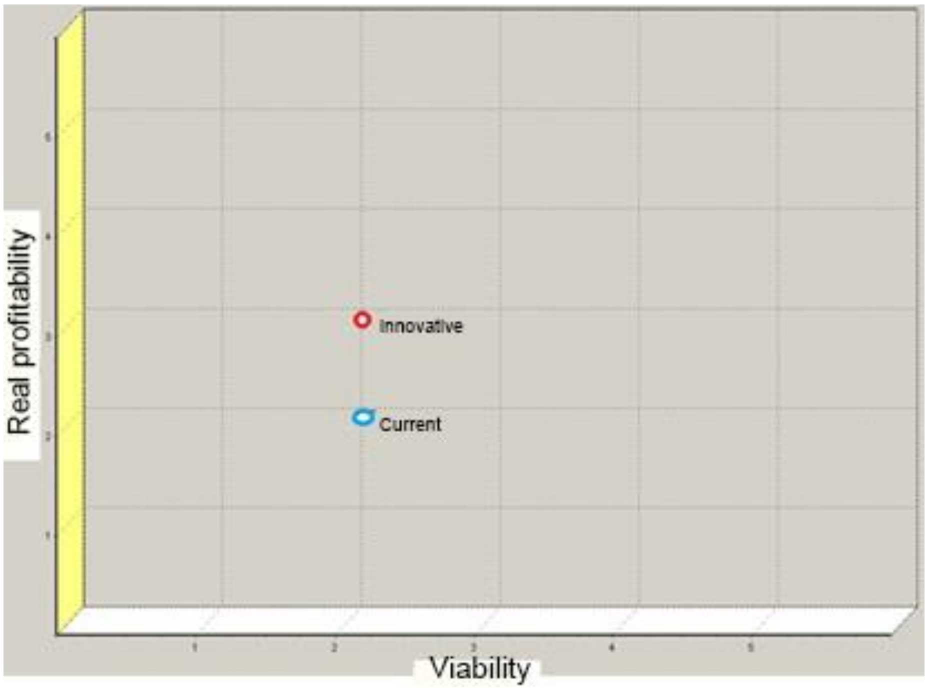

Figure 4: Indicators of economic sustainability of the "real profitability" and "viability" of the innovative viticultural system for Murfatlar ecological vineyards, provided by the ex-post evaluation.

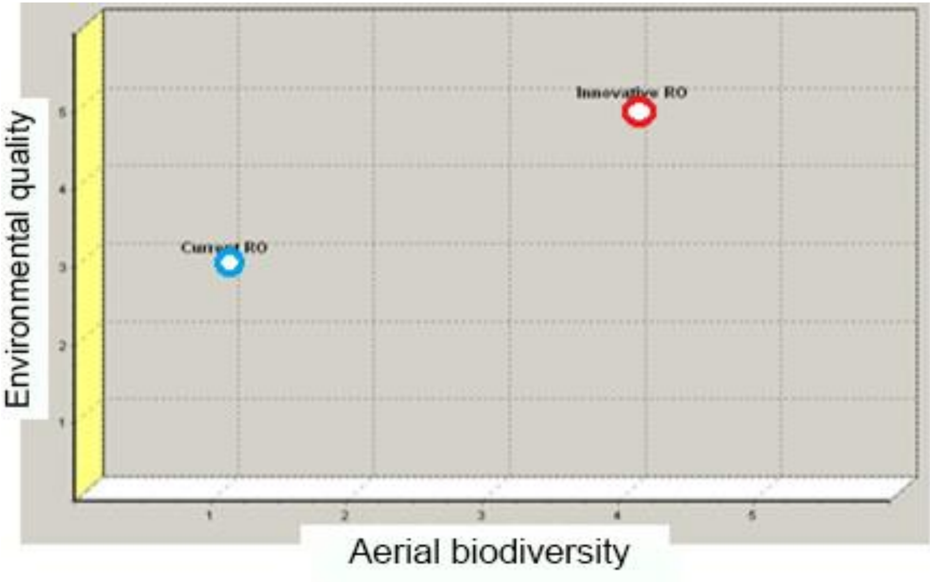

Figure 5: Sustainability indicators regarding "environmental quality" and "aerial biodiversity" (above ground) of the innovative viticultural system for Murfatlar ecological vineyards, provided by the ex-post evaluation

CONCLUSIONS

The study to determine the economic-social and environmental impact of the application of the innovative system of ecological cultivation of the vine that exploits the biodiversity of plants, reveals the need to know and respect the specificity of the viticultural ecosystem where this system is applied. Several key points were identified in the implementation of the innovative system adapted to the zonal scale. These key points can provide guidance for evaluating an existing method or designing a new method for regional environmental impact assessment of viticulture.

The key points that depend on the scale of implementation and apply both at the farm scale and at the wine region scale are:

• The inclusion of economic and social objectives in the management of the farm that can balance the environmental value of the new innovative system;

• The time period used to analyze the environmental impact must be a compromise between the precision of the analysis and the practicability of the innovative system;

• From a spatial point of view, the knowledge of the application area must be sufficiently precise to allow a weighting of the effects according to the vulnerability of the environment;

• The implementation of sustainable viticultural systems balances the discrepancy between reducing the application of treatments and increasing yields;

• Applying an innovative system by planting intercrops can increase the amount of organic matter in the soil, reduce nutrient loss, prevent water runoff, limit the erosion process, suppress weed development, improve soil permeability;

• At the same time, intercropping can compete for resources with vines, both in terms of water use and nutrient uptake, so different methods of intercropping are used to prevent this process.

• The environmental impact of intercropping on wine plantations is a variable factor that strictly depends on the climate and the area where the wine crops are located.

By applying the innovative system of increasing biodiversity in organic vineyards, all three pillars of sustainability: economic, social and environmental have been improved. We note in particular the increase in farmers' "job satisfaction" (from medium to high) despite the increased "operational difficulties" of the proposed techniques. From an economic point of view, the "real profitability" of the system is increased from low to medium, while the "viability" of the system is not changed by the innovations introduced for vineyard management.

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EFFECTS OF AVERAGE PRODUCTION AND PRICE RISK ON GROSS MARGIN FOR CEREAL PRODUCTS OBTAINED CONVENTIONALLY AND IN ORGANIC FARMING

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Abstract: *The study aims to present from a technical-economic point of view aspects related to the cost behaviour, according to the cost-volume-profit analysis model and the sensitivity analysis, of cereal products (maize and wheat) grown in conventional and organic farming systems. In Romania, according to EUROSTAT statistical data, in the period 2014-202, the production harvested with wheat was increasing, on average by 823 thousand t/year, compared to organic wheat, which decreased, on average by 3.3861 thousand t/year. Maize production harvested increased, on average, by 2771.3 thousand t/year, as production yield increased by 1.184 t/ha, while organic maize production decreased by 12.413 thousand t/year. Production costs vary according to planned production levels, with differences being determined by agro-technical conditions (irrigated/non-irrigated). Estimated profit for 2022 are €86/ha for non-irrigated wheat and €171/ha for irrigated wheat, and €91/ha (non-irrigated) and €161/ha (irrigated) for organic wheat. For maize, the estimated gross profit is 94 euro/ha for non-irrigated and 225 euro/ha for irrigated, and for organic maize the gross profit to be obtained is 125 euro/ha for non-irrigated and 181 euro/ha for irrigated. However, in the context of the 2021/2022 production year the effects of all factors (political conflict in Ukraine, grain market, price volatility, inflation, production costs and growing conditions - climate conditions, soil, pedological drought, a etc.) complete the economic risk profile for the studied cereals.*

Keywords: *cost-volume-profit analysis, sensitivity analysis, price volatility, wheat, maize*

JEL classification: O12, P50, Q18, Q57

INTRODUCTION

Maize is the world's most widely grown cereal after wheat, and global trade in wheat is greater than all other crops combined. In 2020, global wheat production was 760 million tonnes. China, India and Russia are the world's largest individual wheat producers, accounting for about 41% of the world's total wheat production, followed by the United States which is the world's fourth largest individual wheat producer, and the European Union, if considered as a single country, its wheat production would exceed that of any country except China. (Wheat Production by Country, 2022). Romania accounts for 10% of the European Union's cereal and oilseed production. In Romania, maize is the main crop grown both in terms of area and production, followed by wheat and barley (Romania - Country Commercial Guide, 2022).

Why wheat and maize? The main objective of food security is to produce cereals worldwide to meet the growing demand for food, feed and biofuels. Global agricultural markets face new uncertainties, which on the supply side include regulatory responses to new plant breeding techniques and responses to the increasing likelihood of extreme events. (Patrick Kelly, 2019).

In the EU the cereals sector faces both structural challenges related to the reform of the Common Agricultural Policy - post 2020, and financial and climate challenges.

Russia's invasion of Ukraine has significantly disrupted world agricultural markets, creating more uncertainty about the future availability of cereals and oilseeds, as well as the EU's dependence on feed and fertiliser imports from Ukraine, Russia and Belarus. The EU's concerns relate to the affordability of these products due to high market prices and inflationary trends. (European Commission, 2022).

MATERIAL AND METHOD

In the present study we present issues related to the variability of gross margin generated by the increase/decrease of recovery prices and production yield, while variable costs remain constant. In the analysis model, fixed costs were also considered to see if the change in gross margin is large enough to cover them in order to make a profit. The input indicators in the cost-volume-profit analysis and the sensitivity analysis are: variable costs and fixed costs (based on the 2021-2022 production year, in phase 3 of Sectoral Project A.D.E.R. 23.1.1) for wheat and maize products, produced under conventional and organic farming, break-even point or breakeven point, prices and estimated revenues. Cost-volume-profit analysis, also called break-even analysis, is a way of determining how changes in costs (fixed and variable) and production volume affect the profit achieved. The analysis is very useful for assessing the relationship between production volume, production costs and profit (Letitia Zahiu et al., 1999).

Formula for calculating the break-even point:

$$\mathbf{PR} = \frac{\boldsymbol{CF}}{\boldsymbol{MCV}(\%)}$$

where:

PR= break-even point is that level of production activity from which profit starts to be made

CF= fixed costs

MCV= variable cost margin = revenue - total variable costs

For a crop to be profitable, the variable cost margin must exceed total fixed costs.

The unit variable cost margin is calculated as the difference between the unit selling price and the unit variable cost. The contribution margin ratio is determined by dividing the contribution margin by the total revenue.

RESULTS AND DISCUSSIONS

From a statistical point of view, conventional wheat shows increases both in cultivated area (+7.8452 thousand ha/year) and harvested production (+823.1 thousand tonnes/year). The situation is reversed for organic wheat, with reductions in both area cultivated (-4.8311 thousand ha/year) and harvested production (-3.3861 thousand tonnes/year). It is worth noting that the production yield increased both for conventional wheat (+0.419 kg/ha/year) and for organic wheat (+0.4214 kg/ha/year), being even better for organic wheat.

Conventional maize shows reductions in area cultivated (-33.4411 thousand ha/year) and increases in harvested production (+2771.3 thousand tonnes/year), amid an increase in average production of 1.1849 kg/ha/year. For organic maize there are reductions both in cultivated areas (-4.3629 thousand ha/year) and in harvested production (-12.413 thousand tonnes/year). It is worth noting that the production yield increased on average by 0.9584 kg/ha/year.

Table 1. Summary techno-economic indicators for wheat, 2021-2022

Nr. crt.	Indicators	Non-irrigated wheat conventional		Non-irrigated organic wheat		Conventional irrigated wheat		Organically irrigated wheat	
1	Average yield (kg/ha)	4400		3700		6150		4600	
2	UM	lei	euro	lei	euro	lei	euro	lei	euro
3	Price (lei/t)	958	194	1228	248	958	194	1228	248
4	Revenue	4215	852	4543	918	5892	1191	5648	1142
5	- Variable costs	3470	701	3453	698	4359	881	3758	760
6	=Margin of variable costs (MCV)	745	151	1090	220	1533	310	1890	382
7	MCV (%)	17.7	17.7	24.0	24.0	26.0	26.0	33.5	33.5
8	- Fixed costs	324	65	636	129	689	139	1093	221
10	= Gross result	421	86	454	91	844	171	797	161
11	Break-even point (break-even)	1833	370	2651	536	2648	536	3266	661
12	PR tonnes/ha	1.91		2.16		2.76		2.66	

Source: own calculations, ADER Project 23.1.1 - Phase Report No 3/2021
1 euro=4,9475 lei

Making a profit depends on production costs and the volume of sales of a product. These components help determine the break-even point. The break-even point is an economic indicator necessary in the conduct of economic activities in order to know what measures need to be taken in production planning so that total costs are covered and the profitability of crops is increased. For conventional wheat the profitability threshold is reached at a production yield of 1.91 tonnes/ha for non-irrigated wheat and 2.76 tonnes/ha for irrigated wheat. For organic wheat the break-even point is 2.16 tonnes/ha for non-irrigated organic wheat and 2.66 tonnes/ha for irrigated organic wheat.

Table 2. Maize summary indicators, 2021-2022

Nr. crt.	Indicators	Conventional non-irrigated maize		Non-irrigated organic maize		Conventionally irrigated maize		Organic irrigated maize	
1	Average yield (kg/ha)	5500		5400		7700		6700	
2	UM	lei	euro	lei	euro	lei	euro	lei	euro
3	Price (lei/t)	850	172	1149	232	850	172	1149	232
5	Revenue	4677	945	6203	1254	6548	1324	7697	1556
6	- Variable costs	3514	710	4431	896	4443	898	5521	1116
7	=Margin of variable costs (MCV)	1163	235	1772	358	2105	426	2176	440
8	MCV (%)	24.9	24.9	28.6	28.5	32.1	32.2	28.3	28.3
9	- Fixed costs	696	141	1152	233	994	201	1281	259
10	= Gross result	467	94	620	125	1111	225	895	181
11	Break-even point (break-even)	2799	567	4033	816	3092	625	4531	916
12	PR tonnes/ha	3.29		3.51		3.64		3.94	

Source: own calculations, ADER Project 23.1.1 - Phase Report No 3/2021
1 euro=4,9475 lei

In conventional maize, revenue equals production costs at a yield of 3.29 tonnes/ha for non-irrigated maize and 3.64 tonnes/ha for irrigated maize. For organic maize the break-even point is 3.51 tonnes/ha for non-irrigated organic maize and 3.94 tonnes/ha for irrigated organic maize.

For non-irrigated conventional maize, Table 3 shows the gross margins at different production levels (from 3.08 tonnes/ha to 5.72 t/ha). Gross margins vary both with production levels and with market prices. In the case of non-irrigated conventional wheat, the gross margin is sensitive to price decreases of 10%, especially at 766 lei/t. When yields fall below 5.28 t/ha the sensitivity of the gross margin is very high, fixed costs are not covered and no profit is made. When the price rises to 1054 lei/tonne the gross margin is sensitive when the yield rises above 3.52 tonnes/ha.

Table 3. Sensitivity analysis - effect of average output and the gross margin for non-irrigated wheat

Non-irrigated conventional wheat, 2021-2022					
Average production (t/ha)	4,40				
Farm price (lei/t)	958				
A. Main product revenue (lei)	4215				
B. Total variable costs (lei)	3470				
Gross margin (A-B)	745				
Fixed costs	324				
Average production t/ha	Farm price lei/tonne				
	766	**862**	**958**	**1,054**	**1,150**
3.08	-1111	-815	-519	-224	72
3.52	-774	-436	-98	240	578
3.96	-437	-56	324	704	1084
4.40	-100	323	**745**	1168	1590
4.84	237	702	1167	1631	2096
5.28	574	1081	1588	2095	2602
5.72	912	1461	2010	2559	3108

Source: own calculations

Irrigated conventional wheat: Table 4 shows the gross margins at different production levels (from 4.31 tonnes/ha to 8.00 t/ha) as a function of the variation in the recovery price (from 766 lei/tonne to 1150 lei/tonne). A 10% decrease in the recovery price results in a decrease in the gross margin, especially when the price falls to 766 lei/tonne, when the yield falls below 6.77 tonnes/ha. At this price and yield level fixed costs (689 lei) are covered, resulting in a gross profit of 134 lei.

Table 4. Sensitivity analysis - effect of average output and the gross margin for irrigated wheat

Irrigated conventional wheat, 2021-2022					
Average production (t/ha)	**6,150**				
Farm price (lei/t)	958				
A. Main product revenue (lei)	5892				
B. Total variable costs (lei)	4359				
Gross margin (A-B)	**1,533**				
Fixed costs	689				
Average production t/ha	Farm price lei/tonne				
	766	**862**	**958**	**1,054**	**1,150**
4.31	-1061	-648	-235	178	592

4.92	-590	-118	354	827	1299
5.54	-119	412	944	1475	2006
6.15	352	942	**1533**	2123	2714
6.77	823	1472	2122	2771	3421
7.38	1294	2003	2711	3420	4128
8.00	1765	2533	3300	4068	4835

Source: own calculations

Non-irrigated organic wheat: Table 5 shows the gross margins at different production levels (from 2.59 t/ha to 4.81 t/ha). For non-irrigated organic wheat the safety intervals at the recovery prices differ from the safety interval for conventional wheat. We assume that the recovery prices for organic wheat are 28% higher than for conventional wheat (1.288 lei/kg compared to 0.958 lei/kg for organic wheat). In this context we say that the gross margin is sensitive to a 10% increase for a production level of 2.96 t/ha, in the context of covering fixed costs (689 lei/ha) and obtaining a gross result of 92 lei/ha (18.6 euro/ha).

Table 5. Sensitivity analysis - effect of average output and the gross margin for non-irrigated organic wheat

Non-irrigated organic wheat, 2021-2022					
Average production (t/ha)	3,70				
Farm price (lei/t)	1228				
A. Main product revenue (lei)	4543				
B. Total variable costs (lei)	3453				
Gross margin (A-B)	1091				
Fixed costs	454				
Average production t/ha	Farm price lei/tonne				
	982	**1,105**	**1,228**	**1,351**	**1,474**
2.59	-910	-591	-272	46	365
2.96	-546	-182	182	546	910
3.33	-183	227	636	1046	1455
3.70	180	636	**1091**	1546	2001
4.07	544	1044	1545	2046	2546
4.44	907	1453	1999	2545	3092
4.81	1270	1862	2454	3045	3637

Source: own calculations

Table 6. Sensitivity analysis - effect of average output and the gross margin of irrigated organic wheat

Irrigated organic wheat, 2021-2022					
Average production (t/ha)	**4,6**				
Farm price (lei/t)	1228				
A. Main product revenue (lei)	5648				
B. Total variable costs (lei)	3758				
Gross margin (A-B)	**1891**				
Fixed costs	**797**				
Average production t/ha	Farm price lei/tonne				
	982	**1,105**	**1,228**	**1,351**	**1,474**
3.22	-596	-200	196	592	988
3.68	-144	308	761	1214	1666

4.14	307	817	1326	1835	2344
4.60	759	1325	**1891**	2457	3022
5.06	1211	1833	2456	3078	3700
5.52	1663	2342	3021	3700	4378
5.98	2114	2850	3585	4321	5057

Source: own calculations

Irrigated organic wheat: Table 6 shows the gross margins at different production levels (from 3.68 t/ha to 5.52 t/ha). For irrigated organic wheat we analyse the situation where the gross margin is sensitive to a 10% price reduction (1105 lei/tonne) when yield falls below 4.14 t/ha.

Non-irrigated conventional maize: Table 7 shows the gross margins at different production levels (from 3.85 tonnes/ha to 7.15 t/ha), depending on the variation in the recovery price (from 680 lei/tonne to 1020 lei/tonne). A 10% decrease in the recovery price results in a decrease in the gross margin, especially when the price falls to 680 lei/tonne, when the yield falls below 6.60 tonnes/ha. Since fixed costs (696 lei) were also taken into account, a gross profit of 278 lei (56.1 euro/ha) is obtained from a yield of 6.60 tonnes/ha.

Table 7. Sensitivity analysis - effect of average output and on the gross margin of non-irrigated conventional maize

Non-irrigated conventional maize, 2021-2022					
Average production (t/ha)	5,50				
Farm price (lei/t)	850				
A. Main product revenue (lei)	4677				
B. Total variable costs (lei)	3514				
Gross margin (A-B)	1161				
Fixed costs	696				
Average production t/ha	Farm price lei/tonne				
	680	**765**	**850**	**935**	**1,020**
3.85	-896	-569	-242	86	413
4.40	-522	-148	226	600	974
4.95	-148	273	694	1114	1535
5.50	226	694	**1161**	1629	2096
6.05	600	1114	1629	2143	2657
6.60	974	1535	2096	2657	3218
7.15	1348	1956	2564	3171	3779

Source: own calculations

Table 8. Sensitivity analysis - effect of average output and price on gross margin for irrigated maize

Irrigated conventional maize, 2021-2022					
Average production (t/ha)	**7,7**				
Farm price (lei/t)	850				
A. Main product revenue (lei)	6548				
B. Total variable costs (lei)	4443				
Gross margin (A-B)	**2,102**				
Fixed costs	**994**				
Average production t/ha	Farm price lei/tonne				
	680	**765**	**850**	**935**	**1,020**
5.39	-778	-320	139	597	1055

6.16	-254	269	793	1317	1840
6.93	269	858	1448	2037	2626
7.70	793	1448	**2102**	2757	3411
8.47	1317	2037	2757	3476	4196
9.24	1840	2626	3411	4196	4982
10.01	2364	3215	4066	4916	5767

Source: own calculations

Conventional irrigated maize. Table 8 shows gross margins at different production levels (from 5.39 tonnes/ha to 10.01 t/ha) and recovery prices (from 680 lei/tonne to 1020 lei/tonne). Increasing the recovery price by 10% results in an increase in the gross margin, especially when increasing the price to 1020 lei/tonne, starting from a yield of 5.39 tonnes/ha. Since fixed costs (994 lei) were also taken into account, starting from a yield of 5.39 tonnes/ha and a price of 1020 lei/tonne, a gross profit of 61 lei (12.3 euro/ha) is obtained. We thus say that the gross margin is sensitive to price increases and for a lower production level.

Non-irrigated organic maize: Table 9 shows the gross margins at different production levels (from 3.78 t/ha to 7.02 t/ha). For non-irrigated organic maize the safety intervals at the value price differ from the safety interval for conventional maize. We assume that the recovery prices for organic maize are 35% higher than for conventional maize (1.149 lei/kg compared to 0.850 lei/kg for conventional maize). In this context we say that the gross margin is sensitive to a 10% increase for a production level of 4.86 t/ha at a recovery price of 1264 lei/tonne, when fixed costs are covered (1152 lei/ha), resulting in a gross profit of 520 lei/ha (113 euro/ha).

Table 9. Sensitivity analysis - effect of average output and on the gross margin of non-irrigated organic maize

Non-irrigated organic maize, 2021-2022					
Average production (t/ha)		5,40			
Farm price (lei/t)		1149			
A. Main product revenue (lei)		6205			
B. Total variable costs (lei)		4431			
Gross margin (A-B)		**1774**			
Fixed costs		1152			
Average production t/ha	Farm price lei/tonne				
	919	**1,103**	**1,149**	**1,264**	**1,390**
3.78	-957	-522	-88	347	782
4.32	-461	36	533	1029	1526
4.86	35	594	1153	1712	2271
5.40	532	1153	**1774**	2395	3016
5.94	1028	1711	2394	3077	3760
6.48	1524	2269	3015	3760	4505
7.02	2020	2828	3635	4442	5250

Source: own calculations

Table 10. Sensitivity analysis - effect of average output and on the gross margin of irrigated organic maize

Irrigated organic maize, 2021-2022					
Average production (t/ha)	**6,70**				
Farm price (lei/t)	1149				
A. Main product revenue (lei)	7698				
B. Total variable costs (lei)	5521				
Gross margin (A-B)	**2177**				
Fixed costs	**1281**				
Average production t/ha	Farm price lei/tonne				
	919	**1,103**	**1,149**	**1,264**	**1,390**
4.69	-1211	-672	-132	407	947
5.36	-595	21	638	1254	1870
6.03	21	714	1407	2101	2794
6.70	636	1407	**2177**	2948	3718
7.37	1252	2100	2947	3795	4642
8.04	1868	2792	3717	4642	5566
8.71	2483	3485	4487	5488	6490

Source: own calculations

Irrigated organic maize. Table 10 shows gross margins for different production levels (from 4.69 tonnes/ha to 8.71 t/ha) and recovery prices (from 919 lei/tonne to 1390 lei/tonne). We say that the gross margin is sensitive to a 10% price increase, starting from a production level of 6.70 t/ha and a valorisation price of 1103 lei/tonne, when fixed costs are covered (1281 lei/ha) and the gross result is 126 lei/ha (25 euro/ha).

CONCLUSIONS

Gross margin is an economic indicator that shows whether the revenue from the sale of a product is sufficient to cover operating costs. From the analysis of wheat and maize products produced in conventional and organic farming, it was found that the gross margin is sensitive to both price and yield changes in the same proportion, which means that product profitability depends on both production yield increase and price increase.

We mention that the study has its limitations, in the sense that sensitivity analysis has to be carried out periodically due to: market price fluctuations, inflation - which changes production costs, growing conditions - climate, soil, pedological drought conditions - which affect the yields obtained.

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THE INFLUENCE OF SOWING SEASON ON CORN YIELD UNDER THE CONDITIONS OF CURRENT CLIMATE CHANGES

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Abstract: *The purpose of this work is to evaluate the corn production obtained following the change of the sowing date. In the current context of current climate changes, adaptation of cultivation technology is essential to obtain satisfactory quantitative and qualitative results. The experimental factors analyzed in this study are sowing season with three gradations (Season I - 6ºC in soil; Season II - 8ºC in soil; Season III - 10ºC in soil); corn hybrids (Turda 248 – control; Turda 165; Turda 201; Turda Star; Turda 332; Turda 344; Turda 335) and the climatic conditions of the two experimental years (2020; 2021). In 2021, production was lower than in 2020, with 922 kg/ha, the climatic conditions during the vegetation period being the decisive factor in the realization of these productions. All analyzed hybrids recorded a higher average yield when sown at 8ºC (10504 kg/ha), compared to the other two sowing seasons. Among the analyzed hybrids, the Turda 335 hybrid achieved the highest production (10862 kg/ha), 48 kg/ha more than the Turda 248 control.*

Key words: *sowing season, corn, yield, climatic conditions*

Classification JEL: Q01, Q15, Q16

INTRODUCTION

Obtaining quantitatively and qualitatively stable harvests depends categorically on the climatic conditions, the technologies recommended for the cultivation area and the biological used material.

Our country is affected by rising temperatures and variations in rainfall, there being areas where flooding occurs or experiencing extreme droughts, but also areas where both phenomena meet (Șimon, 2021). Also, the climatic evolution shows variations with large amplitudes, being the factor that negatively influences the level and stability of production (Picu, 2003). Moisture is a limiting factor with consequences for plant growth and distribution when associated with high temperature (Zheng, 2000).

For Romania, the minimum amount of precipitation during the corn vegetation period is 250-300 mm, and optimal between 300-380 mm with the following monthly distribution: 60-80 mm in May, 100-120 mm in June, 100-120 mm in July and 40-60 mm in August (Salontai, 1982). In our country, corn is one of the most widespread crops, but productions remain low for numerous reasons, among which its expansion on slopes exposed to erosion, with soils poor in nutrients and water, can be noted (Cristea, 2009).

Agricultural crops are responsive to extreme climate events, especially those involving variations in temperature and precipitation. Usually, plants need a definite growth rate (DGR) to reach maturity, depending on the daily temperature and the sowing season (Choudhury et all., 2021). To adapt as quickly as possible to climate change, the population began to take action regarding to agricultural technologies, such as changing the sowing date, optimizing the vegetation period of crops, the use of biological material with tolerance to prolonged drought and high temperatures, etc. (Șimon, 2022).

MATERIAL AND METHOD

The purpose of this paper is to evaluate the corn production obtained following the change in the sowing date, and to achieve the objective, an experience was placed at Agricultural Research Development Station Turda (ARDS Turda) on a clayey epicalcareous cambic para rendzina chernozem type soil (after SRTS 2012). The soil profile has the following physical characteristics: clay-clay texture, the clay between 33,45 and 52,21 mm, fine pores, moderately compact, clear transition from one horizon to the other. As a chemical description, the soil has a slightly alkaline neutral pH, neutral to high humus content, well supplied in nitrogen and potassium, average phosphorus content.

The experimental factors are: Sowing Season with three graduations, Sowing Season I - 6ºC in soil; Sowing Season II - 8ºC in soil; Sowing Season III - 10ºC in soil; corn hybrids Turda 248 – Control; Turda 165; Turda 201; Turda Star; Turda 332; Turda 344; Turda 335, created at ARDS Turda and the climatic conditions of the two experimental years 2020 and 2021.

At sowing, a basic fertilization with 150 kg/ha NPK (20:20:0) was applied, and in the phenophase of 4-6 leaves an additional fertilization with 200 kg/ha CAN (27%). The sowing rate was 70,000 plants/ha. The predecessor plant was winter wheat.

The obtained results were processed statistically by the variance analysis method and establishing the smallest significant difference - LSD - (5%, 1% și 0,1%) (ANOVA, 2015).

Climatic conditions are a determining factor of agricultural production, and the analysis of the evolution of climatic factors is justified in the current context of increasingly visible climatic changes, both globally and in our country. The climatic data presented come from the Turda Weather Station, located on the coordinates: longitude 23°47'; latitude 46°35'; altitude 427 m.

An important aspect regarding the average monthly temperature recorded in recent years is that although the temperatures recorded in recent years indicate a warming of the weather, there are also exceptions that do not have a cyclicity, such as the decrease of temperatures in May (important period in the corn crop), with significant negative deviations of 0,9-1,3ºC from the multi-year average, in conditions where the climate is continuously warming. In the other months, the temperature values fluctuated from the average, temperatures in the summer months reaching positive deviations of up to 2,9ºC compared to the multiannular average (figure 1).

For a culture dependent on water from rainfall, the rainfall regime and its distribution are vital in plant development and achieving its productivity and quality. In the two years, a deficient water regime was observed in the months of April-May of 2020 and in the months of April and June of 2021, the most pronounced being that of June of 2021.

There is a direct relationship between the rainfall in June and corn yield, which can be observed through the lower productions obtained in 2021, when in June a rainfall deficit of 39.6 mm was recorded (figure 2).

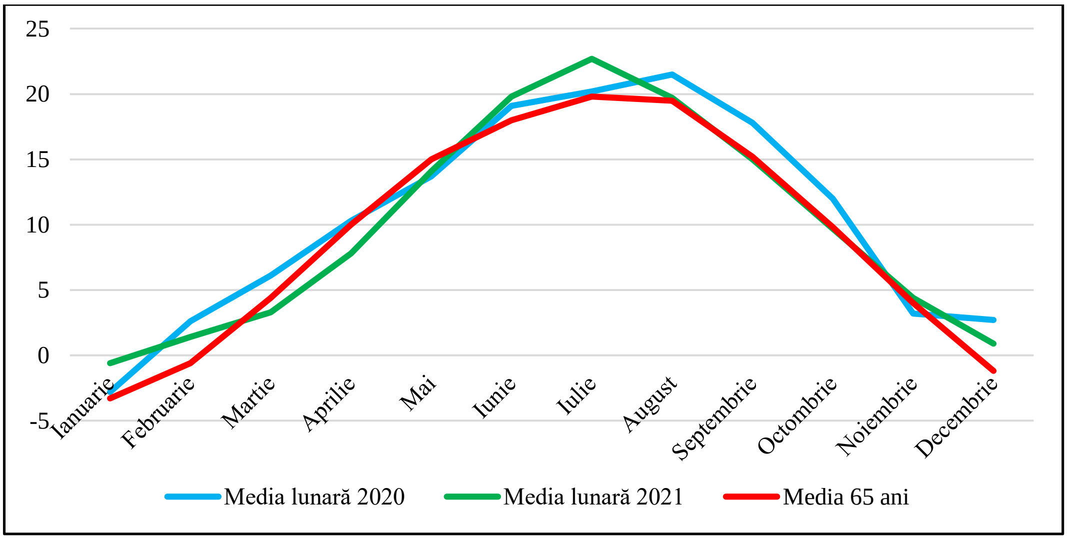

Figure 1. Average monthly temperatures recorded during 2020-2021

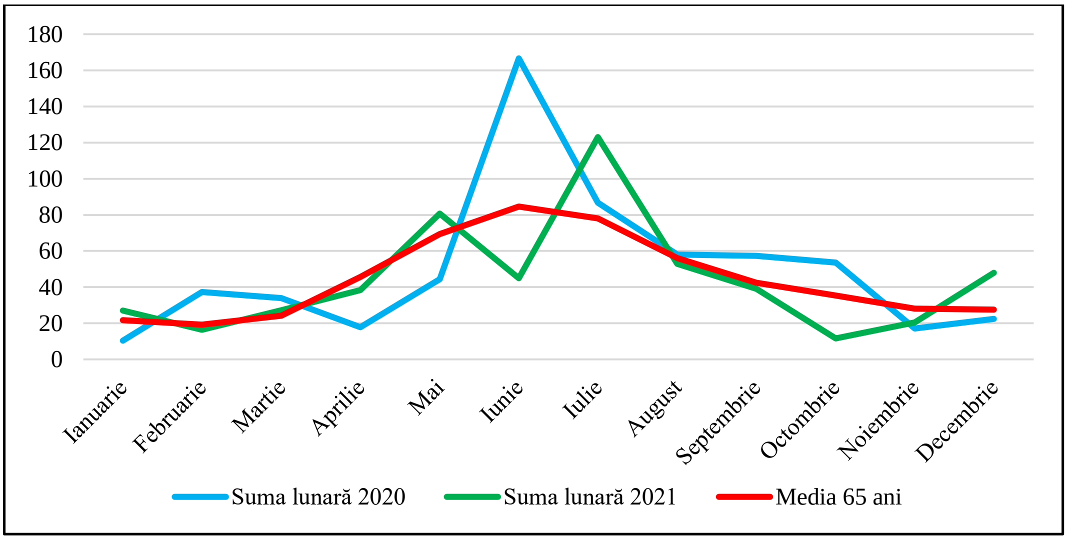

Figure 2. The amount of monthly precipitation recorded in the period 2020-2021

RESULTS AND DISCUSSIONS

The studied hybrids performed very well in terms of tolerance to suboptimal temperatures, all hybrids showing an advanced degree of tolerance to low temperatures, the number of plants per surface unit not being affected, but the temperatures of May, of the two years, which were lower than normal for this period, they affected the growth rate of plants in the first phases of vegetation, slowing the growth process of the plants emergence until that time.

The negative effect of the influence of climatic conditions, from the first part of the vegetation period, was observed in regard to the emergence of culture, thus, in the first season the corn emergence approximately 18-20 days after sowing in the year 2020 and 21-25 days for the year 2021, in the second season, the emergence was noted 20-23 days after sowing for the year 2020 and 12-14 days for the year 2021 and in the third season, emergence was determined 18-19 days after sowing for the year 2020 and 11-13 days for the year 2021 (table 1).

Table 1. Number of days from sowing to emergence

Hybrid	Sowing Season I		Sowing Season II		Sowing Season III	
	2020	**2021**	**2020**	**2021**	**2020**	**2021**
Turda 248	20	22	21	12	19	11
Turda 165	18	25	21	13	19	12
Turda 201	20	24	20	13	19	12
Turda Star	19	24	22	13	18	12
Turda 332	19	23	23	14	19	13
Turda 344	19	22	22	14	19	12
Turda 335	20	21	21	14	19	12
Amplitude	18-20	21-25	20-23	12-14	18-19	11-13

Table 2. The sum of useful thermal degrees from sowing to the emergence of plants (Σt≥10ºC)

Hybrid	The sum of useful thermal degrees (ºC)					
	Sowing Season I		**Sowing Season II**		**Sowing Season III**	
	2020	2021	2020	2021	2020	2021
Turda 248	26.5	27.3	36.8	25.3	51.6	47.3
Turda 165	25.8	32.4	37.4	27.1	53.6	48.6
Turda 201	26.8	30.9	36.3	26.1	51.6	50.0
Turda Star	25.8	30.9	36.8	28.2	49.9	48.6
Turda 332	25.8	28.4	37.9	30.1	53.4	50.2
Turda 344	26.1	27.3	37.4	28.9	53.4	48.6
Turda 335	26.5	25.9	36.8	29.7	53.4	48.6
Amplitudine	25.8-26.8	25.9-32.4	36.3-37.9	25.3-30.1	49.9-53.6	47.3-50.2

During the growing season, average temperatures below 10ºC are considered inactive temperatures, which does not help the optimal development of the metabolic processes of corn, therefore only average daily temperatures exceeding 10ºC are used for this study.

Even if the number of days from sowing to emergence was greater, the fact that in the spring of the two years the average temperatures were lower than normal led to a different sum of the useful thermal degrees for the three sowing season of the two years, thus in 2020 the sum of the degrees had an amplitude of 25.8-26.8ºC for sowing season I, of 36.3-37.9ºC for sowing season II and of 49.9-53.6ºC for sowing season III. In the year 2021 the amplitude of the sum of degrees was higher for sowing season I (25.9-32.4ºC) and lower for Sowing Season II (25.3-30.1ºC) and III (47.3-50.2ºC) compared to 2020 (table 2).

Climatic conditions during the vegetation period of the crop are the most important factor in achieving production, the accumulation of an amount of precipitation of 413.2 mm between May and September makes 2020 a favorable year for obtaining an average production of 10343 kg/ha, with a distinctly significant difference of 922 kg/ha compared to 2021, in which the amount of precipitation during the vegetation period was 340.9 mm (table 3).

Due to a higher rainfall regime during the growing season, the average production value for cultivated hybrids is higher in 2020, as he also states Wang et all., in 2014, precipitation is the dominant climatic factor in achieving maize production.

The water available to plants in the surface layer is in reality much lower than the calculated value, because for the most part it is subject to the process of evaporation from the soil surface and decreases with increasing temperature, having a direct effect on the production achieved.

Table 3. Influence of climatic conditions on corn yield

Experimental Year	Yield		Diference (kg/ha)	Signifiance
	kg/ha	%		
2020 (Control)	10343	100	0	Control
2021	9421	91	-922	00
LSD (p 5%) 317	LSD (p 1%) 732		LSD (p 0,1%) 1329	

Of the 3 sowing seasons, in the sowing season in which corn was sown at 8ºC, temperature recorded in the soil, the highest production was achieved (10504 kg/ha), with a very significant difference of 272 kg/ha from optimal sowing season for the Transylvanian Plateau, considered control (10ºC in the soil), and the smallest increase in production was achieved at the time of sowing season when sowing was executed at 6ºC in the soil, with a very significant difference of 1321 kg/ha compared to the Control, where a production of 10231 kg/ha was obtained (table 4).

Changing the sowing date can also have an effect on the life cycle of specific pests and the manifestation of the attack produced by them, in research conducted by Obopile et all., (2008) in a study of corn sown at different seasons, corn sown later was found to have a higher degree of pest attack.

In our country, sowing in different periods was taken into account to avoid periods of water and heat stress that usually coincide with critical periods for crops, but sowing too early can lead to crop losses because as stated Mhizha et all., in 2012, critical growth stages may coincide with periods of extended mid-season drought, but also with the low spring temperatures.

Araya et all., 2017 hypothesize that the shortening of the maize vegetation period (reducing days to maturity with 9-18%) due to high temperatures, it could cause production to decrease by an average of 18-33%.

Table 4. Influence of sowing season on corn yield

Sowing Season	Yield		Diference (kg/ha)	Signifiance
	kg/ha	%		
Sowing Season III (10ºC in soil) (Control)	10232	100	0	Control.
Sowing Season I (6ºC in soil)	8911	87	-1321	000
Sowing Season II (8ºC in soil)	10504	103	272	***
LSD (p 5%) 90	LSD (p 1%) 131		LSD (p 0,1%) 197	

The grain yield achieved in 2020-2021, among the hybrids studied, the hybrid Turda 335 stood out, which achieved an average yield of 10862 kg/ha (in two experimental years and three different sowing season), the difference of 48 kg/ha compared to Control (hybrid Turda 248) being without statistically signifiance. An average production of 10653 kg/ha was recorded for the hybrid Turda 344, with a difference of -160 kg/ha compared to the Control, with statistically significant difference. The other hybrids analyzed did not match the yield value recorded by the Control, very significant differences in their production being included between 627 kg/ha (Turda 332) and 2274 kg/ha (Turda 201) (table 5).

Table 5. Yield achieved by corn hybrids grown in different seasons

Hybrid	Yield		Diference (kg/ha)	Signifiance
	kg/ha	%		
Turda 248 (Control)	10814	100	0	Control.
Turda 165	8822	82	-1992	000
Turda 201	8539	79	-2274	000
Turda Star	9299	86	-1515	000
Turda 332	10187	94	-627	000
Turda 344	10653	99	-160	0
Turda 335	10862	100	48	-
LSD (p 5%) 138	LSD (p 1%) 184		LSD (p 0,1%) 238	

The average productions obtained in the two years of research show us that the hybrids Turda 248, Turda Star and Turda 344 achieved the highest productions when the sowing was carried out in the second sowing season (at 8ºC in soil), the differences from the third sowing season (at 10ºC in soil), considered Control, were highly significant.

The behavior of all the hybrids sown in the first sowing season (at 6ºC in the soil) was not very good, yield differences from the Control being statistically assured as highly significantly negative, only the Turda 335 hybrid registering a significant negative difference compared to the third sowing season. The Turda 201 hybrid registered very significant yield declines in the two sowing season (I and II) compared to sowing season III, yield differences being between 443 and 887 kg/ha.

The most important yield reductions were observed in corn hybrids Turda 165 (-1207 kg/ha), Turda Star (-1287 kg/ha), Turda 332 (-1378 kg/ha), Turda 335 (-2948 kg/ha) when where cultivated in the first sowing season (table 6).

Table 6. Influence of sowing season and hybrid interaction on corn yield

Hybrid	Yield		Diference (kg/ha)	Signifiance
	kg/ha	%		
Sowing Season III* x Turda 248 (Control)	10669	100	0	Control
Sowing Season I** x Turda 248	10126	95	-543	000
Sowing Season II*** x Turda 248	11647	109	978	***
Sowing Season III x Turda 165 (Control)	9172	100	0	Control
Sowing Season I x Turda 165	7966	87	-1207	000
Sowing Season II x Turda 165	9327	102	155	-
Sowing Season III x Turda 201 (Control)	8983	100	0	Control
Sowing Season I x Turda 201	8096	90	-887	000
Sowing Season II x Turda 201	8539	95	-443	000
Sowing Season III x Turda Star (Control)	9545	100	0	Control
Sowing Season I x Turda Star	8259	87	-1287	000
Sowing Season II x Turda Star	10092	106	547	***
Sowing Season III x Turda 332 (Control)	10622	100	0	Control
Sowing Season I x Turda 332	9244	87	-1378	000
Sowing Season II x Turda 332	10694	101	72	-
Sowing Season III x Turda 344 (Control)	10697	100	0	Control
Sowing Season I x Turda 344	9697	91	-1000	000
Sowing Season II x Turda 344	11566	108	870	***

Hybrid	Yield		Diference (kg/ha)	Signifiance
	kg/ha	%		
Sowing Season III x Turda 335 (Control)	11935	100	0	Control
Sowing Season I x Turda 335	8987	75	-2948	000
Sowing Season II x Turda 335	11664	98	-271	0
LSD (p 5%) 239 LSD (p 1%) 322 LSD (p 0,1%) 426				

* Sowing Season III (10ºC in soil) **Sowing Season I (6ºC in soil) *** Sowing Season II (8ºC in soil)

Yield losses by changing the sowing period can reach up to 25%, when sowing is in the first season and up to 9% in the case of sowing in the third season, depending on the biological material used. Soler et all., (2007) reported a 55% yield loss in four corn hybrids due to seeding delay, in pluviometric conditions, without irrigation. Liaqat et all., (2018) also recorded a reduction in grain yield in corn hybrids, produced by delayed sowing.

CONCLUSIONS

Climatic conditions as well as biological material have a significant influence on production, by achieving higher pluviometric conditions, the yield of corn in 2020 registered a distinctly significant increase in production of 922 kg/ha, compared to 2021. The biological material performed well in all experimental variants, but the Turda 335 hybrid made the best use of the environmental conditions encountered in the variant where the corn was sown at 10ºC.

Changing the sowing season has an influence on the development of the corn crop, especially by the fact that in recent years spring temperatures have been lower than the multiannual average, and the corn crop failed to develop properly in the first part of the growing season.

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CLIMATE SMART AGRICULTURE - CONCEPT AND PERSPECTIVES

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Abstract: *The negative effects of climate change are felt in the form of rising temperatures, weather variability, shifting boundaries of agro-ecosystems, the spread of invasive species and pests, and more frequent extreme weather events. Climate change reduces crop yields, the nutritional quality of most cereals, and lowers productivity in the livestock sector. In this regard, substantial investment in adaptation will be required to maintain current yields and to achieve increases in food production and quality to meet food needs under the expected exponential growth of the world's population.*

Key words: *climate change, agriculture, resilience, adaptation, CAP*

JEL classification: Q20, Q57

INTRODUCTION

Climate smart agriculture- Concept and History

As an emerging field of climate change economics, agricultural carbon emission reduction has attracted much attention. The United Nations Food and Agriculture Organization and other institutions and academia have proposed the concept of "Climate-Smart Agriculture (CSA for short)", which is a new agricultural development (Chandra et al. 2018). The model emphasizes the use of climate-adaptive (smart) agricultural technologies to address the triple challenges of food security, climate change, and greenhouse gas emissions, to achieve higher crop yields, stronger climate change adaptability, and lower agricultural carbon emissions, covering economic and environmental goals. multiple comprehensive goals (Lipper et al.2018). It is the integration, innovation and transcendence of development concepts such as "ecological agriculture", "low-carbon agriculture", "circular agriculture" and "green agriculture" (Bhattacharyya et al 2020).

Climate Smart Agriculture is a term used to refer to the application of technological and data-driven solutions to improve agricultural production and reduce the environmental impact of farming. It includes the use of sensors, drones, artificial intelligence, and other technologies to monitor conditions, optimize irrigation and crop management, and improve the use of water, energy, and other natural resources (Rosenstock et al., 2016). Smart climate agriculture can also involve the use of precision agriculture, which focuses on using data to improve efficiency and reduce environmental impact (Mizik, 2021). The goal of smart climate agriculture is to increase agricultural productivity while decreasing its environmental impact.

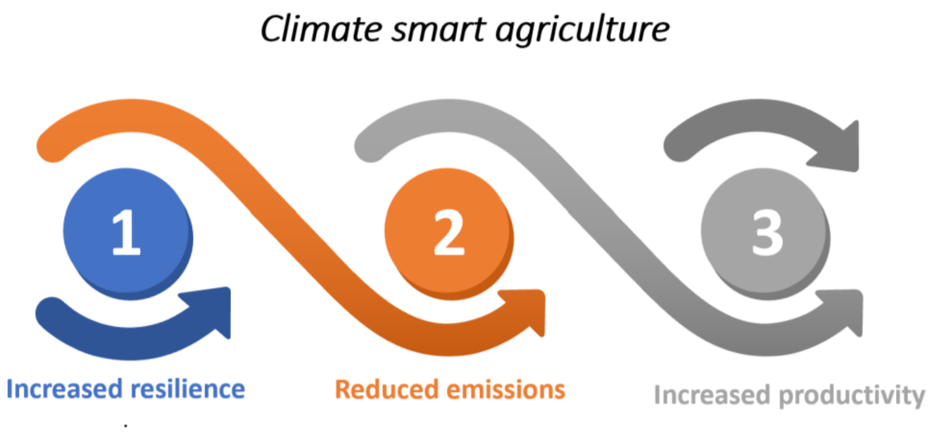

Figure 1. Climate smart agriculture objectives

The concept of climate smart agriculture (CSA) emerged in 2010 in response to concerns about the imminent threat posed by the effects of climate change. The Food and Agriculture Organization (FAO) at that time defined climate-smart agriculture as that agricultural system that aims to increase productivity in a sustainable way, adapt to the dynamics of climate phenomena and reduce greenhouse gas emissions, aiming , at the same time, ensuring food security" (FAO, 2010).

In this sense, CSA represents an integrated approach to resource management – agricultural land, livestock, forest and fisheries – that addresses the interconnected challenges of accelerating climate change and risks associated with food security (Figure 1).

As a new agricultural development model, "climate-smart agriculture" puts more emphasis on emission reduction, adaptability and high efficiency (Figure 2).

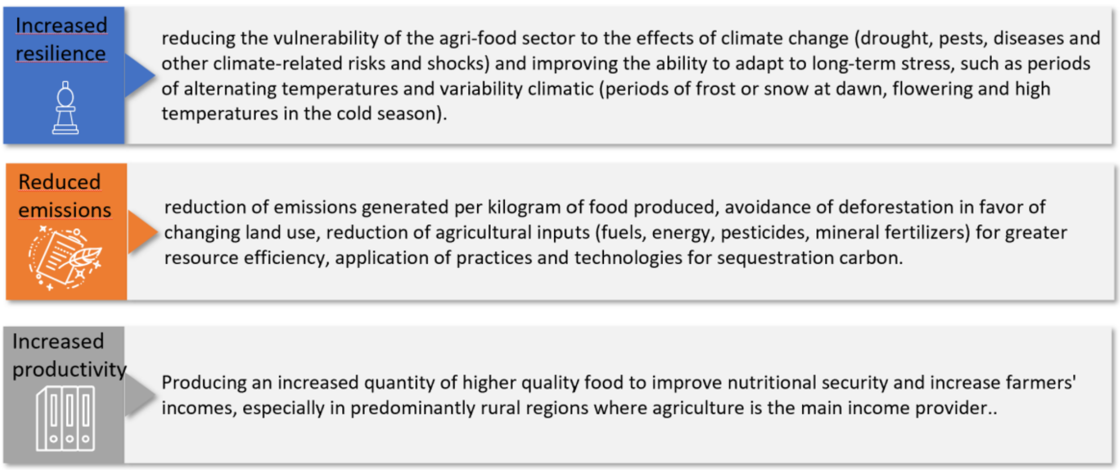

Figure 2. Climate smart agriculture explained

Having in mind the evolution of CSA concept, we have run a bibliometric analysis on Scopus Platform related to scientific publications that included this concept in. The search string was defined as "climate smart agriculture" included in authors' keyword, title or abstract.

The search has returned 2188 documents. Several document types (erratum, notes, letter, note, editorial) were excluded, as considered irrelevant, resulting a final count of 2147 documents.

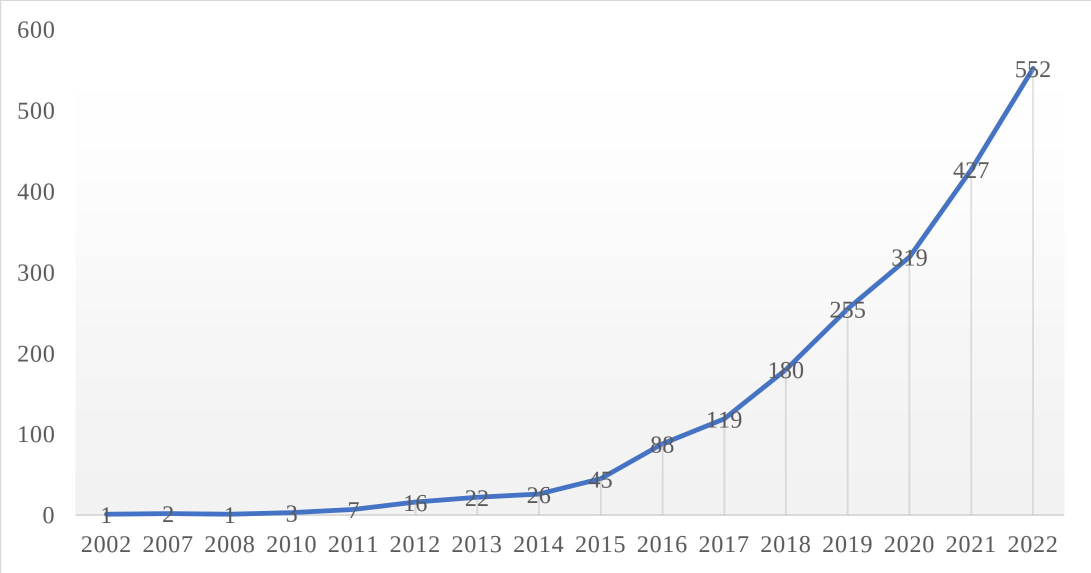

Figure 3. Number of documents related to CSA, by year

According to author's affiliation country, India United States and United Kingdom lead the scientific production of papers related to CSA (Figure 4)

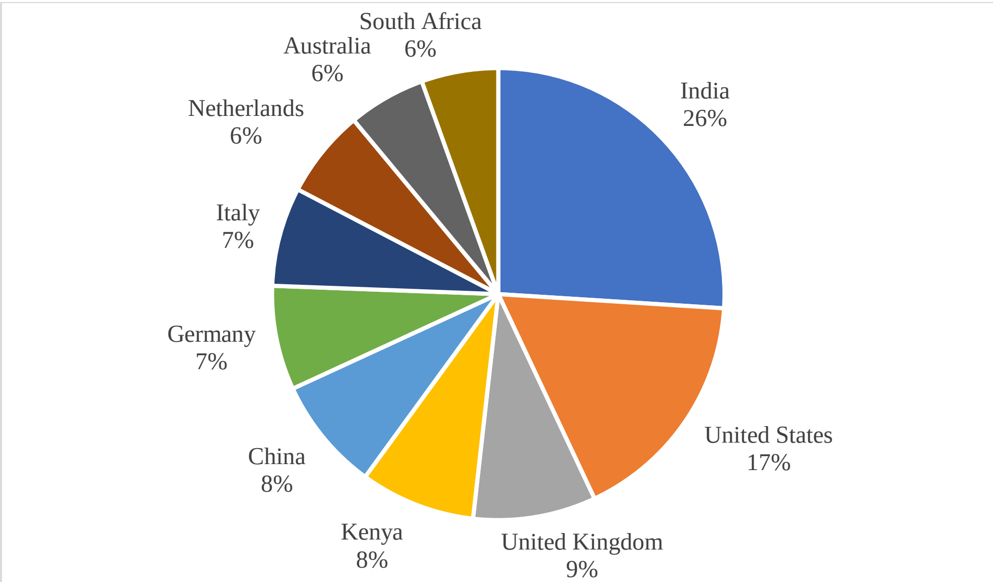

Figure 4. Top ten countries that published CSA related papers.

For content analysis, only the documents written in English were extracted to a xls. File, and co-occurrence analysis was run in VOSviewer.

A total of 5224 keywords were retrieved and minimum threshold of occurrences was set to 10, in order to generate a co-occurrence map, resulting in a total number of 76 keywords, grouped by clusters (Figure 5).

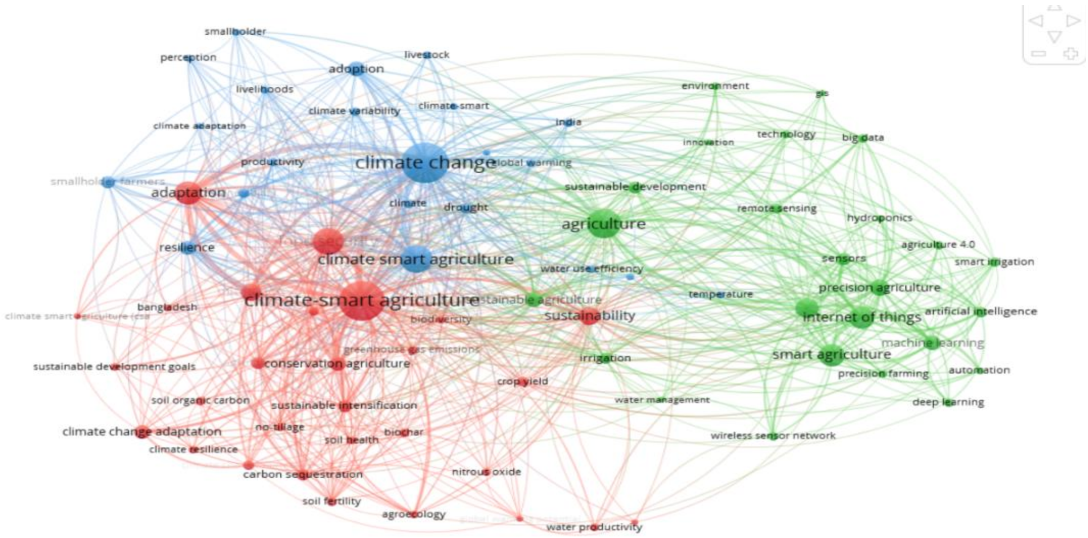

Figure 5. Co-occurrence map of keywords

Cluster 1 (red color)

Climate smart agriculture is the core keyword of this cluster (Figure 6). Other related keywords included sustainable agriculture cropping systems that embed CSA practices or technologies that are related to these systems, such as adaptation, agroecology, agroforestry, biochar, carbon sequestration, climate change adaptation, climate change mitigation, climate resilience, ecosystem services, conservation agriculture, food security, no tillage, soil organic carbon.

Cluster 2 (green color)

Digitalization of agriculture was tackled by published papers (Figure 6)., comprising keywords such as agriculture 4.0, artificial intelligence, automation, big, data, deep learning, GIS, innovation, IoT, machine learning, precision farming, precision agriculture, remote sensing, sensors, smart farming, smart agriculture, smart irrigation, technology, sustainable development, water management, wireless sensors network

Cluster 3 (blue color)

Climate change is the central theme for this cluster (Figure 6), and keywords were as follows: abiotic stress, adoption, climate adaptation, climate variability, climate-smart, drought, global warming, productivity, resilience, soil moisture, temperature, water use efficiency, vulnerability.

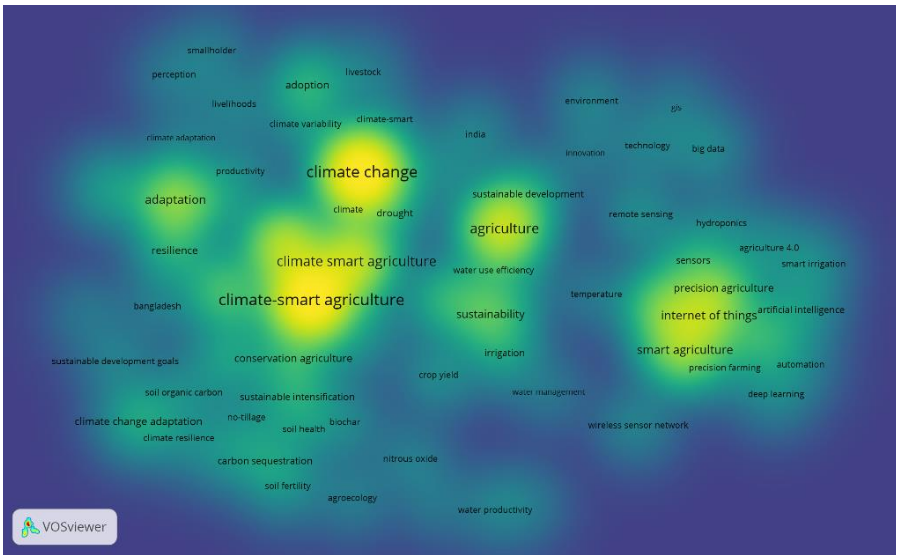

Figure 6. Core concepts of the three clusters

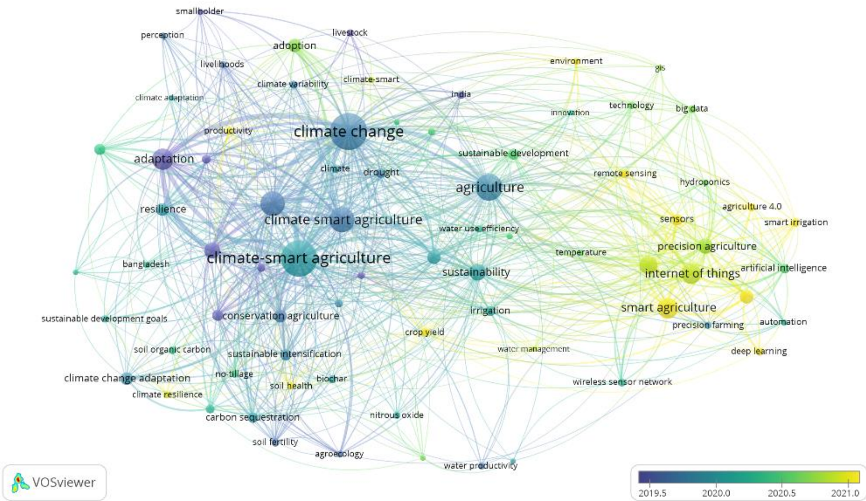

Figure 7. Co-occurrence map of keywords, by year

The interest has evolved over the years, from concepts such as conservation agriculture, agroecology, adaptation (2019) to climate change, drought, climate change adaptation (2020) and sustainability, sustainable development goals, carbon sequestration, soil orgaic carbon, technology (2021) reaching further to 2022 to precision agriculture, internet of things, smart agriculture, agriculture 4.0, sensors, deep learning, smart irrigation (Figure 7).

Challenges of climate change

A large amount of scientific data proves that climate change and agricultural production are an interactive whole. On the one hand, climate change changes some basic elements of the agricultural production system and increases the frequency and intensity of extreme weather events, thus bringing varying degrees of impact on agriculture. Climate change can explain fluctuations in global grain production (Mc Carthy et al., 2018; Azadi et al., 2021).

Agriculture is one of the most vulnerable industries to the effects of climate change, as it is highly dependent on weather and climate conditions. Climate change is causing shifts in temperature, precipitation, and extreme weather events, which can have a significant impact on agricultural production (FAO 2011). Warmer temperatures can lead to increased water stress and drought, as well as increased pest and disease pressure. More extreme weather events, such as floods and storms, can also damage crops, disrupt production, and limit access to markets. In order to adapt to climate change, farmers and agricultural systems need to become more resilient, which includes adopting sustainable farming practices and diversifying their operations. This can include implementing water-saving irrigation technologies, adopting conservation tillage practices, and planting more resilient crop varieties. Farmers can also implement climate-smart agriculture practices, such as agroforestry and soil carbon sequestration, to help store carbon dioxide and mitigate the effects of climate change (Has et al, 2021).

The Food and Agriculture Organization of the United Nations estimates that at least one-fifth of total greenhouse gas emissions come from the agricultural sector, mainly from fertilized soil, ruminant fermentation, straw burning, rice production, organic and chemical fertilizer releases emissions of methane and nitrous oxide, forestry and land use change, such as rice fields, are one of the most important sources of methane emissions in the world, and ultimately cause continuous changes in the global climate (FAO 2013). Therefore, agriculture has become one of the important fields for countries to cope with, mitigate and adapt to climate change.

CSA and Common Agricultural Policy 2023-2027

The new Common Agricultural Policy (CAP) contains a series of reforms to support the transition to sustainable agricultural systems in the European Union in the context of meeting the objectives set out in the European Green Deal. The environmental ambitions of the new CAP are increased, and climate action is recommended to be stepped up compared to the previous programming period. Furthermore, member states are required to align their strategies if the EU updates climate and environmental legislation.

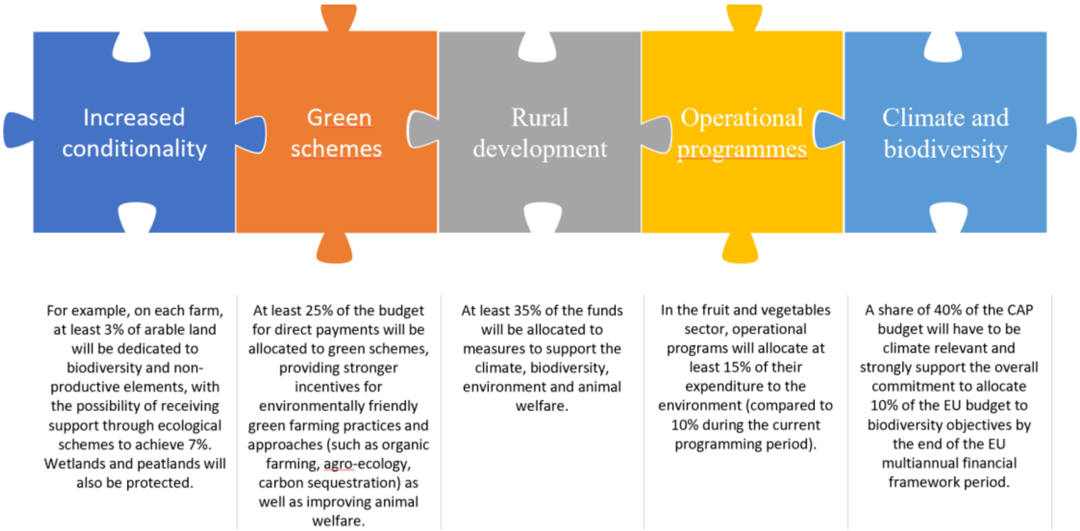

Figure 8. CSA and CAP 202-2027

The CAP also proposes a major contribution to the objectives of the Green Deal, and the CAP recommendations set out how this contribution is expected (Figure 8).

Organic agriculture, Agro-ecology, Regenerative agriculture

CSA has become a benchmark of a "triple win", based on a synergistic development mechanism of three pillars, namely: adapting and mitigating the effects of climate change and ensuring food security. On the other hand, CSA has given rise to heated debates both in the scientific community and in civil society, although it addresses the urgent need for an effective strategy to manage the natural resources necessary for agri-food systems.

When it comes to a comparison between climate-smart agriculture and organic agriculture, the former is defined by the desired outcomes - agricultural systems that are resilient, productive and have low emissions, while organic agriculture is defined by the production method (without the use of synthetic pesticides or fertilizers). However, many of the practices used in organic farming are climate smart. Ecological farming practices lead to the improvement of the uptake of nutrients from the soil and the restoration of organic matter in the soil, which can support resistance to climate change and contribute to the sequestration of carbon in soils.

Agroecology has been variously defined, from the simple "application of ecological principles" in agriculture (Saj et al., 2017) to the integrative study of the ecology of the entire food system", encompassing ecological, economic and social dimensions (FAO, 2016).

Regarding regenerative agriculture (carbon farming), it has been shown that agriculture has enormous potential to sequester organic carbon in soil, plants and trees, reducing CO_2 emissions that contribute to global warming (Zilberman 2014). Healthy soils help mitigate the effects of climate change and lead to better yields, maintaining biodiversity and improving ecosystem services (*Gosnell et al, 2019)*. In the long run, agricultural practices such as agro-ecology, conservation agriculture, using rotations of crops and greening technologies including cover crops and permanent pastures are able to support capture carbon in the soil (Newton et al., 2020).

CONCLUSIONS

Agriculture, perhaps the most climate-dependent human activity, was initially seen as a victim of climate change. Increasing temperature trends, greater frequency of extreme weather events and greater seasonal variability have been described as posing new threats to global agriculture. Agriculture was then considered to be one of the culprits responsible for climate change, due to direct emissions of greenhouse gases from ruminants, the manufacture and application of fertilizers, as well as energy use on farm or indirect emissions related to land-use change. Agriculture is now also beginning to be seen as a solution to climate change due to the role it can play in mitigating greenhouse gas emissions. Climate-smart agriculture can help design land-use systems that make adaptation-mitigation connectivity a reality at all levels, and thereby help farmers become key players in climate change solutions

Sustainable, climate-smart agricultural practices are essential for mitigating the effects of climate change on agricultural production. Governments and international organizations should continue to provide support to farmers and rural communities in order to help them adapt to the changing climate. This could include providing access to financing, investing in research and development of new technologies. CSA is also a key component of the European Union's CAP. The CAP encourages farmers to adopt CSA practices, such as the use of climate-smart crop varieties and soil-management practices, as well as to improve the resilience of agricultural production to climate change. Furthermore, CAP provides financial support to farmers to help them adopt CSA practices and invest in technologies and infrastructures that are adapted to climate change.

ACKNOWLEDGEMENTS

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DIAGNOSTIC ANALYSIS REGARDING THE QUALITY OF LIFE IN THE RURAL ENVIRONMENT IN ROMANIA

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Abstract: *In Romania, at the level of residential environments there are gaps in terms of quality of life, these are reflected through socio-economic indicators. The degree of poverty is high in rural areas, determined by both economic and demographic, social and cultural factors. It is known that incomes are much lower in rural areas than in urban areas, which is evidenced by the increasing trends in the poverty rate in rural areas, both compared to urban areas and compared to the European average. All this leads to the accentuation of the discrepancies between the two residence environments, as well as the accentuation of the phenomenon of social exclusion. The paper aims to carry out a descriptive statistical analysis of the socio-demographic and economic aspects of the quality of life in the Romanian countryside. To carry out the study, the demographic, social and economic statistical indicators from the TEMPO Online database of the National Institute of Statistics (INS) were processed and interpreted.*

Keywords: *Romania, development, rural, urban,, quality of life.*

JEL classification: R11

INTRODUCTION

Quality of life is an evaluative concept aimed at the living conditions of the population (standard of living, access to education and culture, medical care, living conditions, social protection, the environment, etc.), the population's satisfaction with the level livelihood, as well as the public policies that propose its improvement. (Iftimoaei, 2021)

The concept of quality of life is also present in rural development policies, which are based on the following principles: "preserving the identity and cultural values of the rural community" and "orienting rural policy towards improving the quality of life". (Palicica & Palicica, 2005)

Compared to other countries in the European Union, in Romania almost half of the total population lives in rural areas. The rural area is characterized by a large number of small households, aging population, low productivity, lack of diversification of economic activity, the main activity being agriculture, a low level of training of the population, and a low standard of living. In this context, population migration to cities or other countries, with the aim of looking for a job, becoming a real problem for the Romanian countryside. (Popescu, 2013; Dumitru et al., 2021)

In Romania, most rural areas are going through a demographic crisis much more pronounced than at the urban level, this crisis is manifested by an accelerated process of aging of the rural population and a massive depopulation of some extensive areas in this area. The lack or precariousness of basic services such as: medical assistance, education or the lack of opportunities to have a decent job have contributed to maintaining some negative trends at the level of the demographic structure. (Marinescu, 2021)

From an economic and occupational point of view, agricultural production is predominantly practiced in the rural environment: field crops and meadows, vegetable growing, fruit growing, viticulture, forestry, animal husbandry, trade, industry derived from agriculture, as well as crafts have an important weight in the activities general from the Romanian countryside. (Palicica & Palicica, 2005)

MATERIALS AND METHODS

The paper studies the issue of socio-economic discrepancies at the level of the 2 residence environments. For this purpose, statistical data were processed and analyzed regarding: the resident population, the school population, the number of educational units, the structure of income and expenses per household, as well as the labor force indicators. All these data were collected from the TEMPO Online database of the National Institute of Statistics (INS).

The research methods used in carrying out the research consisted in the systematic and comparative analysis and the complex approach to the theme by studying the previous research carried out by different authors in the field.

RESULTS AND DISSCUSION

For the national economy, demography represents an important component in its structure and dynamics, depending in a high percentage on the rate of economic growth. At the level of 2021, of the total resident population in Romania, a percentage of 53.81% was represented by the urban population, and 46.19% by the rural population. In the period 2015-2021, the resident population in Romania registered a decrease of 3.52%, from 19822 thousand people in 2015 to 19124 thousand people in 2021. The decrease was also recorded at the level of residence environments, the population from the environment urban registering a decrease of 3.57%, and the rural one of 3.47%. At the level of 2021, of the total resident population in Romania of 19124 thousand people, a percentage of 53.81% was represented by the urban population (10291 thousand people), and 46.19% by the rural population (8833 thousand people) . Currently, the Romanian countryside faces demographic problems, as well as the proportional decline of the labor force and education. The aging of the population, as well as the migration of the population to urban areas or to other EU or non-EU countries has led to the reduction of the rural population. (Figure no. 1)

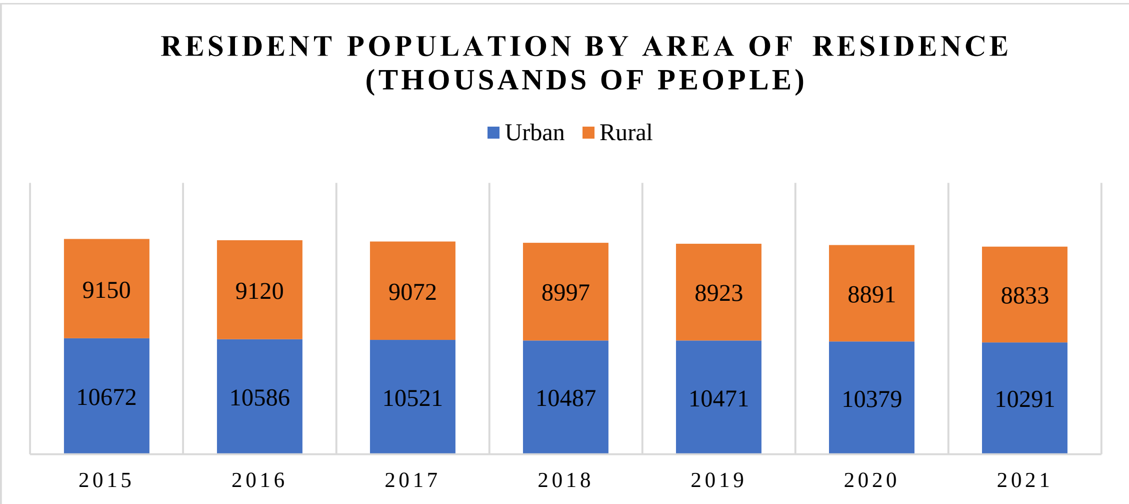

Figure no. 1 – Evolution of the resident population by area of residence in the period 2015-2021 (thousands of people)

Source: National Institute of Statistics, tempo online, accessed on 22.09.2022

The school population in Romania registered a decrease of 4.03% in the analyzed period. In terms of residence, it was noted that the school population in rural areas registered a significant decrease of 12.08%, while that in urban areas showed a decrease of only 0.63%. (Table no. 1)

Table no. 1 – The evolution of the school population by residence in the period 2015-2021

Specification	Residential environments	Years							Average	2021/2015%	2021/2020 %
		2015	2016	2017	2018	2019	2020	2021			
School population (thousands of people)	Urban	2561	2546	2556	2553	2559	2550	2545	2553	-0,63%	-0,18%
	Rural	1081	1051	1023	994	967	945	951	1002	-12,08%	0,60%
	Total	3643	3597	3579	3547	3526	3495	3496	3555	-4,03%	0,03%

Source: National Institute of Statistics, tempo online, accessed on 22.09.2022

In the year 2021, of the total school population in Romania (3496 thousand people), the one in the urban environment was represented in proportion of approx. 73% (2545 thousand people), while the school population from rural areas recorded a percentage of 27.20% (951 thousand people). (Table no. 1)

Table no. 2 – Evolution of the number of educational units by residence environment in the period 2015-2021

Specification	Residential environments	Years							Average	2021/2015 %	2021/2020 %
		2015	2016	2017	2018	2019	2020	2021			
Educational units (number)	Urban	3903	3870	3907	3894	3884	3850	3893	3886	-0,26%	1,12%
	Rural	3205	3140	3140	3126	3117	3120	3122	3139	-2,59%	0,06%
	Total	7108	7010	7047	7020	7001	6970	7015	7024	-1,31%	0,65%

Source: National Institute of Statistics, tempo online, accessed on 22.09.2022

Regarding the number of educational units, a decrease of 1.31% was observed at the national level. The sharpest decrease was in rural areas of 2.59% from 3205 in 2015 to 3122 educational units in 2021. (Table no. 2)

Total average monthly income per household increased significantly between 2015 and 2021. In the urban environment, there was a 118% increase in incomes, from 2997 lei in 2015 to 6521 lei in 2021. In the rural environment, incomes increased by 102%, from 2279 lei in 2015 to 4607 lei in the year 2021. However, there is a rather large gap between the incomes recorded at the level of residence environments, the incomes recorded in rural areas being significantly lower compared to those in the urban environment, where the quality of life is higher. At the level of 2021, the difference between rural and urban incomes was 1914 lei. (Figure no. 2)

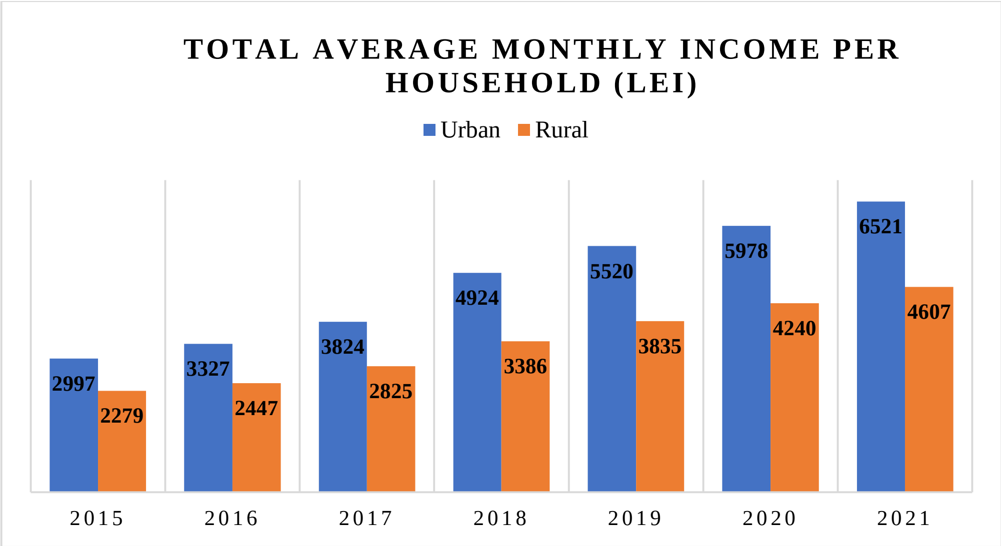

Figure no. 2 – Evolution of total average monthly income per household by average residence in the period 2015-2021 (lei)

Source: National Institute of Statistics, tempo online, accessed on 22.09.2022

Together with the incomes, the total average monthly expenses of a household were also increased. Thus, at the level of 2021, the expenses recorded by an urban household reached the value of 5579 lei, 116% higher than those recorded in 2015, respectively 2581 lei. In rural areas, the average expenses per household increased by approx. 94% in the analyzed period, from 2049 lei in 2015 to 3973 lei in 2021. (Figure no. 3)

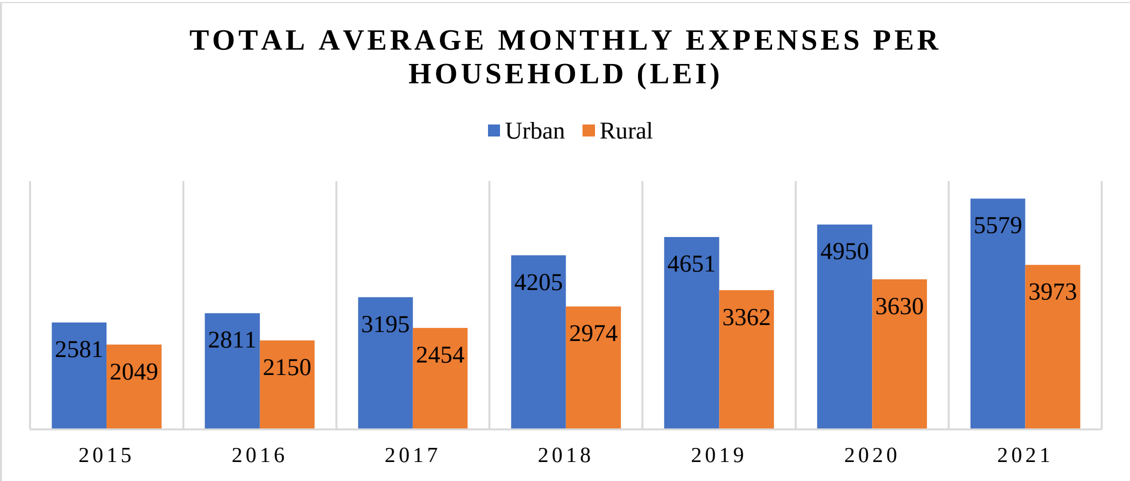

Figure no. 3 – The evolution of total average monthly expenses per household by average residence in the period 2015-2021 (lei)

Source: National Institute of Statistics, tempo online, accessed on 22.09.2022

The increase in expenses is the direct effect of inflation. In 2021, the inflation rate was 96.15 percentage points lower than the previous year. Regarding the annual consumer price index, which measures the overall evolution of the prices of goods purchased as well as the rates of services used by the population in the current year compared to the year chosen as the reference period, a slight downward trend was observed. In 2021, there was a decrease of 2.36 percentage points compared to the previous year. (Figure no. 4)

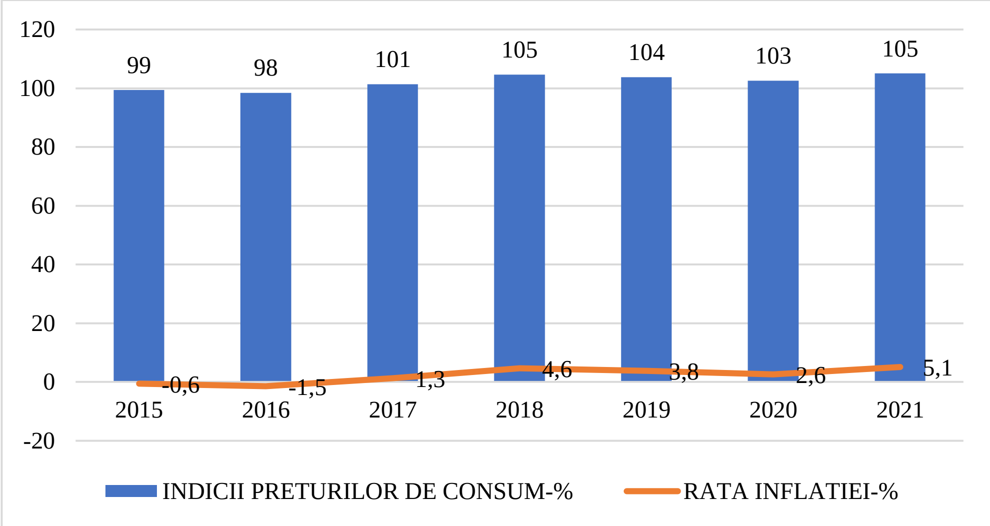

Figure no. 4 – The evolution of the annual index of consumer prices in Romania in the period 2015-2021

Source: National Institute of Statistics, tempo online, accessed on 22.09.2022

The systemic changes produced in rural areas after 1989 regarding ownership, sectors of activity and labor force, led to a significant mobility of the labor force, both to cities and to other countries, especially the Community ones. It is known that the decline of rural communities is intensified by the migration of the young population, the active population being attracted to economically developed cities.

Table no. 3 – The evolution of the workforce by place of residence in the period 2015-2021

Specification	Residential environments	Years							Average	2021/2015 %	2021/2020 %
		2015	2016	2017	2018	2019	2020	2021			
The working population (thousands of people)	Urban	5013	4962	4994	4955	4952	4920	4746	4935	-5,32%	-3,52%
	Rural	4146	4016	4126	4113	4082	4053	3468	4001	-16,35%	-14,43%
	Total	**9159**	**8979**	**9120**	**9068**	**9034**	**8973**	**8215**	**8935**	**-10,31%**	**-8,45%**
Occupied population (thousands of people)	Urban	4662	4684	4769	4769	4784	4703	4584	4708	-1,68%	-2,52%
	Rural	3873	3765	3902	3920	3897	3819	3171	3764	-18,11%	-16,95%
	Total	**8535**	**8449**	**8671**	**8689**	**8680**	**8521**	**7755**	**8471**	**9,14%**	**-8,98%**
Inactive people (thousands of people)	Urban	5680	5658	5562	5550	5494	5484	5493	5560	-3,28%	0,18%
	Rural	5020	5141	4977	4914	4878	4858	5367	5022	6,91%	10,48%
	Total	**10700**	**10799**	**10539**	**10464**	**10372**	**10342**	**10861**	**10582**	**1,50%**	**5,02%**
Unemployed BIM (thousands of people)	Urban	350	278	225	186	168	217	162	227	-53,68%	-25,25%
	Rural	273	252	224	194	185	235	297	237	8,56%	26,54%
	Total	**624**	**530**	**449**	**380**	**353**	**452**	**459**	**464**	**-26,40%**	**1,64%**

Source: National Institute of Statistics, tempo online, accessed on 22.09.2022

In the period 2015-2021, the active population, which constitutes the available labor force, at the national level was on average 8935 thousand people, during this period a decrease was observed in the population providing the available labor force for the production of goods and services , in the rural area registering the largest decrease of 16.35%, from 4146 thousand people in 2015 to 3468 thousand people in 2021, having a share of 42.22% in the total population.

A downward trend was also noted in terms of the employed population, at the national level it recorded a decrease of 9.14% in the period 2015-2021. Analyzing by residence environment, a greater decrease was noted in the rural environment, where the population employed in administrative-social services and activities is smaller, this being 18.11% in the analyzed period, compared to the urban one, which recorded a decrease of approx. 1.68%. In urban areas, most employed people are found in manufacturing and trade, while in rural areas the largest share of the employed population is in agriculture, followed by industry.

The inactive population, represented by students, pensioners and other categories of people who cannot provide labor, showed a decreasing trend in the urban environment, while in the rural environment the trend was an increasing one, at the level of the analyzed period registering there is a 6.91% increase in inactive people. As for the unemployed population, which refers to people looking for a job, at the national level there was a reduction of 26.40% in the period 2015-2021. Depending on the area of residence, the statistical data from this period show a significant reduction of the unemployed population of approx. 53.58% in the urban environment, while in the rural environment there is an increase of 8.56% of the unemployed population. (Table no. 3)

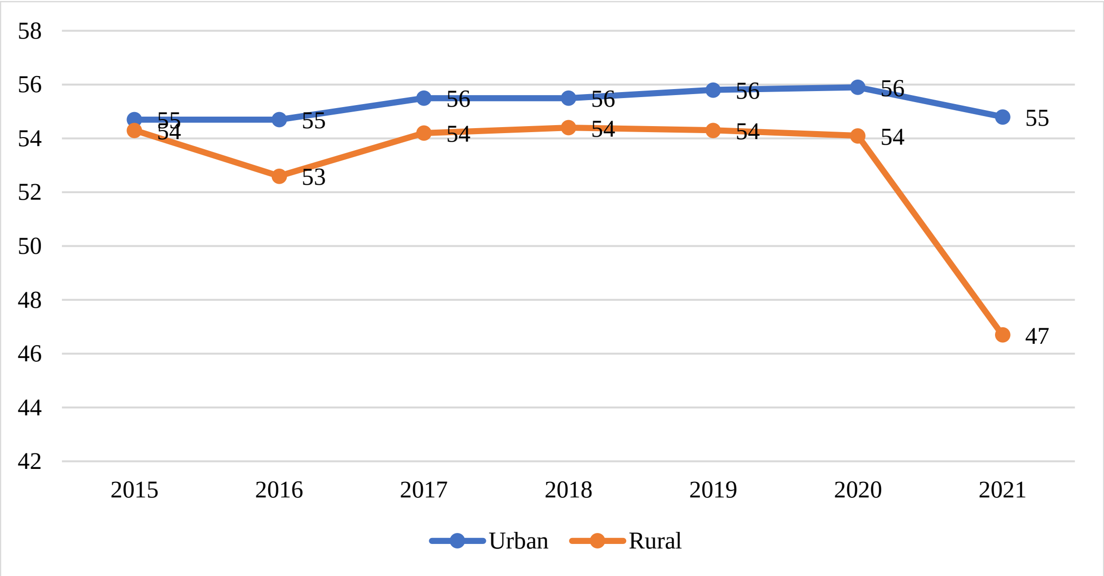

Figure no. 5 – The evolution of the activity rate by residence and activity during the period 2015-2021

Source: National Institute of Statistics, tempo online, accessed on 22.09.2022

The analysis of the activity rate underlines significant aspects of the population's participation in economic activity, being an indicator for its quantification. Following the analysis of the rate of activity registered in the rural area in the period 2015-2021, a decrease of approx. 14 percentage points, from 54% in 2015 to 47% in 2021. Regarding the percentage of the activity rate registered in the urban environment, an oscillation between 55% and 56% was observed in the analyzed period. Also, the activity rate in urban areas is higher than in rural areas. (Figure no. 5)

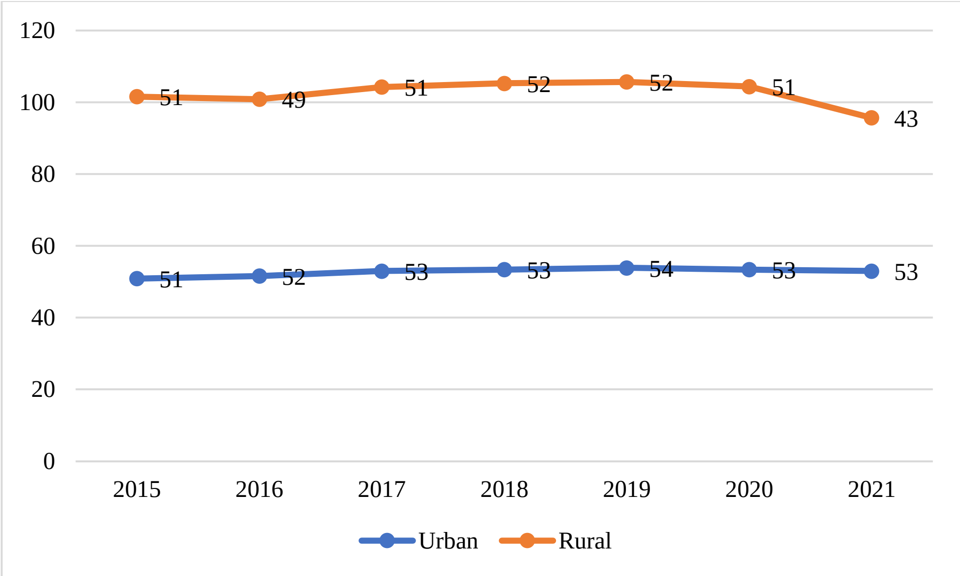

Figure no. 6 – The evolution of the employment rate by medium of residence and activity in the period 2015-2021

Source: National Institute of Statistics, tempo online, accessed on 22.09.2022

The employment rate registered a slight upward trend in urban areas, of 4.13 percentage points, while in rural areas, it decreased from 51% in 2015 to 53% in 2021, when a decrease was evident by 15.78 percentage points. (Figure no. 6)

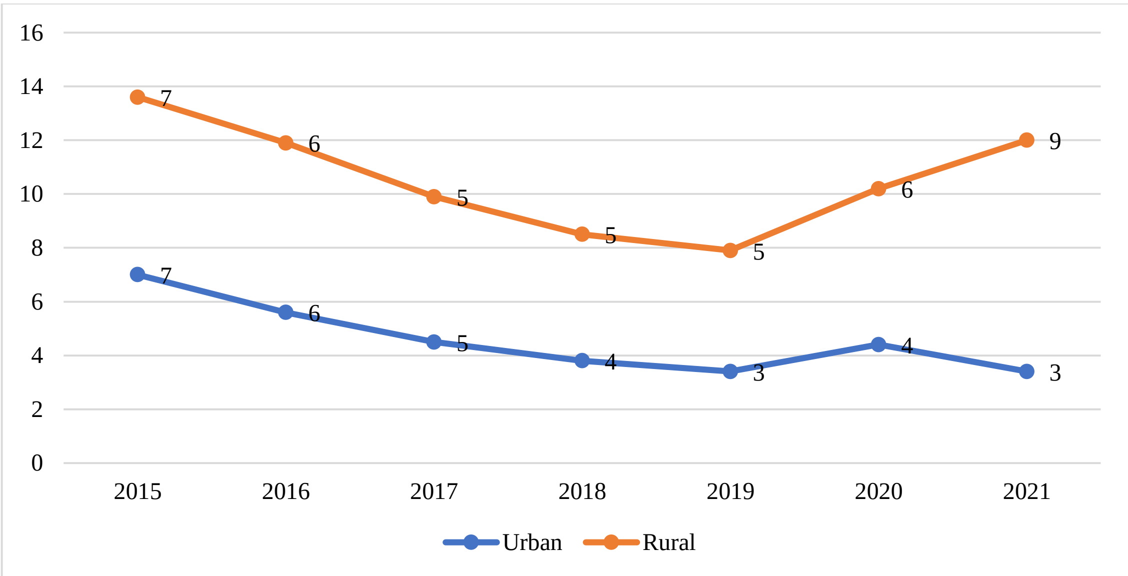

Figure no. 7 – The evolution of the BIM unemployment rate by medium of residence and activity in the period 2015-2021

Source: National Institute of Statistics, tempo online, accessed on 22.09.2022

Overall, the unemployment rate decreased, a fact also recorded in the urban environment, while an increase was recorded in the rural environment. In rural areas, the unemployment rate increased significantly by 30.30 percentage points between 2015 and 2021, from 7% in 2015 to 9% in 2021, while in urban areas the unemployment rate decreased from 7% in 2015 to 3% in 2021, with approx. 51.43 percentage points. (Figure 7)

CONCLUSIONS

The research conclusions reflect the need for the socio-economic development of the Romanian rural space, so as to reduce the discrepancies regarding the quality of life between the urban and the rural environment. The increasing trends of the rural poverty rate, both compared to the urban and compared to the European average, highlight the low level of income of the rural population, at the level of 2021, the difference between the income of the rural population and that of the urban population being 1914 lei.

In the absence of an adequate labor market policy, in Romania unemployment continues to be a major socio-economic risk, especially in rural areas. The vulnerability of the labor force in relation to unemployment is unequal and dependent on a series of characteristics: demographic, educational, professional, regional, behavioral. At the level of the 2015-2021 period, the unemployment rate increased significantly by approx. 30 percentage points, while in the urban environment it decreased by 51.43 percentage points. The labor market benefits and disadvantages some categories of the active population. In this context, the development of the labor market, the increase of investments, of the specialized and trained workforce, is necessary for the development of the Romanian rural space, this can change the image of the village and its community. Also, in the development of rural development strategies, it is very important to pay special attention to the human factor in all aspects of its manifestation.

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STUDY ON THE IMPACT OF CLIMATE CHANGES ON ALIVE'S ORGANISMS

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Abstract: *The paper aims to briefly present the main problems regarding the impact of climate change on living organisms (humans, animals, plants), the measures taken so far to solve these problems and the actions that must be taken into account by the European Union and the states members. They propose increasing the resilience of health and social systems and emphasize the need to ensure adequate surveillance and control of climate change impacts on health, such as epidemiological surveillance, control of communicable diseases and the effects of extreme events. In general, climate change does not cause many new or unknown health risks, but it will intensify certain interactions between the environment and human health, with more drastic effects than at present. Most public health measures and systems already exist, but they need to be adapted to the new situation and new needs.*

Key words: *climate change, living organisms, health*

JEL classification: Q30, Q39, Q54

INTRODUCTION

As early as 1958 the World Health Organization defined health as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (WHO, 1958; Studiu AEM/CCC/OMS). Later the definition was supplemented with the phrase "the ability to lead a socially and economically productive life".This has been contested by some critics, who appreciate that "health cannot be defined as a state, but must be seen as a continuous process of adaptation to the changing demands of life". Health is viewed as the functional and/or metabolic efficiency of a living organism (human, animal, plant), at any moment, both at the cellular and global level, absolutely all varying between optimal and zero (World bank report, 2010). The Lalonde Report suggested in 1974 that there are four determinants of health: "biology", "environment", "lifestyle" and "medical care" (Lalonde, 1974). Health is maintained through scientific research and practice and can be improved through collective and individual effort.

In this paper, we will analyze the impact of climate change on living organisms, respectively on their health and adaptation to new conditions of temperature, precipitation, humidity, etc. Climate change has been defined by the Intergovernmental Panel on Climate Change as: "a statistically significant change in either the mean state of the climate or its variability that persists over a longer period of time (Smit B., Skinner M. W. 2002; Smith P., Olesen J., 2010).

"According to the United Nations Framework Convention on Climate Change, they are "attributed directly or indirectly to human activity that alters the composition of the atmosphere at a global level and that adds to the natural variability of the climate observed during comparable periods" (O. Edenhofer,2014; Richards M. B., Eva Wollenberg & Detlef van Vuuren 2018).

MATERIAL AND METHOD

According to the specialists Arseni O., Baltag D. and Boilă L.R., cited by Victor DONOS in his work "Documentation as a method of conducting doctoral research" published in July 2020, "documentation is a necessary stage of scientific research, with the aim of knowing the experience scientific in the field under investigation, in related fields and in other fields of knowledge of reality. Documentation is a multilateral process that outlines the means needed to disseminate documents and familiarizes with the subject of future research. In its essence, documentation is a process with a complex content that includes bibliographic documentation, direct documentation and specialist consultation"(Donos V., 2020).

As it appears from these definitions, the role of documentation is to create a starting point in the respective research, to determine what has been studied/discovered up to the time of the research, to identify the problems that remain unresolved or unclear and to try to solve them from the point from the point of view of the one doing the investigation. The basic tool of documentation is bibliographic research, which represents the activity of determining the sources and studying the data contained in books, treatises, monographs, scientific articles or published in specialized magazines on the respective topic, national and international databases. The first research method used in this paper is the "bibliographic research", which aims to study the existing works, articles and materials in the research scope of the paper focusing on the chosen topic.

The second method is the analysis based on statistical data provided by the National Institute of Statistics regarding the average amount of precipitation, multiannual average temperatures, floods and damage caused by them, afforestation, anti-hail systems, GHG reduction, deaths caused by the exacerbation of cardiovascular and pulmonary diseases , but also following the floods in Romania during 2016-2020. Based on them, the statistical indicators were calculated: the arithmetic mean, the standard deviation, the coefficient of variation, the annual growth rate and the linear trend equation. The formulas used to calculate these indicators are the known ones (Anghelache Constantin, Manole Alexandru, 2012 and Necula, R., Stoian, M. and Drăghici, M., 2016).

RESULTS AND DISCUSSIONS

Issues regarding the health of living organisms related to climate change are one of the main concerns of the European Commission. According to impact assessments carried out in a number of European countries, contained in the European Commission's White Paper, as early as 2009, climate change was predicted to influence the epidemiology of many diseases and health conditions (https://www.eea.europa.eu/themes). The effects of climate change on health are felt unevenly from one country to another or within the same country, as a result of the physical-geographical characteristics of each region. The state and evolution of nature depend on the capacity to adapt, the measures taken and the actions taken , as well as the accessibility of different categories of the population to these preventive and health care services. Some measures may be effective under current climate conditions, but in the case of accentuated or accelerated climate change, they may need to be strengthened or modified. (https://bodyandface.ru/ro/senses/zdorove-cheloveka---kriterii-zdorovya-ponyatiezdorovya.vidy. html).

Climate change affects people's health directly by increasing the number of cardiovascular patients and accentuating symptoms with periods of heat or cold, by changing human behaviors (forced migration), by increasing the transmissibility of diseases due to the decrease in the immunity of organisms. In EU countries, mortality is estimated to increase by 1–4% for every one degree increase in average annual temperature. This means that heat-related mortality could increase by 30,000 deaths per year by 2030 and by 50,000 – 110,000 deaths per year by 2080 (PESETA Report). According to the same report, infectious diseases due to the multiplication of different pathogens against the background of rising temperatures will be more and more common. (http://peseta.jrc.ec.europa.eu/docs/Agriculture.html).

Thus, Europe could see a significant increase in morbidity due to vector-borne diseases, with a potential evolution of 20,000 additional cases per year by 2030 and 25,000 – 40,000 additional cases per year by 2080. Milder winters in certain regions have caused changes in mosquito and tick distribution areas, with the limit of their distribution area moving north and to higher altitudes. The spread of these insects increases people's exposure to Lyme disease (tick-borne) and encephalitis (mosquito-borne). Hot weather causes heat exhaustion and increases the risk of heart attacks. The risk increases if the weather is both hot and humid, which makes people sweat more and dehydrate. Whether it's snow, frost, or heavy rain, capricious, cold, or wet weather can affect people with heart disease to a greater extent than healthy people. For them, cold temperatures can trigger episodes of cardiac ischemia (deprivation of oxygen to the heart muscle), thus causing episodes of angina pectoris or even heart attacks. A rapid decrease in the temperature of the environment can lead to a sudden worsening of symptoms, to an increased risk of hospitalization and even death, say cardiologists, as the body is forced to make certain physiological "adjustments" to keep the body's normal temperature. They can be a real challenge for people with cardiovascular diseases, because the heart rate and blood pressure increase, the heart pumps blood harder and the blood's tendency to clot increases.

Romania's climate has changed a lot compared to 40-50 years ago, heat waves last longer, it snows less and less often, and extreme phenomena are multiplying. 40 years ago there were summer months when temperatures did not exceed +35 degrees, and at Christmas there was often frost and heavy snow. Now there are more and more frost-free days and more and more summer nights with temperatures above +20 degrees. Most cold records stand from 60-70 years ago, while many heat records were broken in the last 10-15 years.

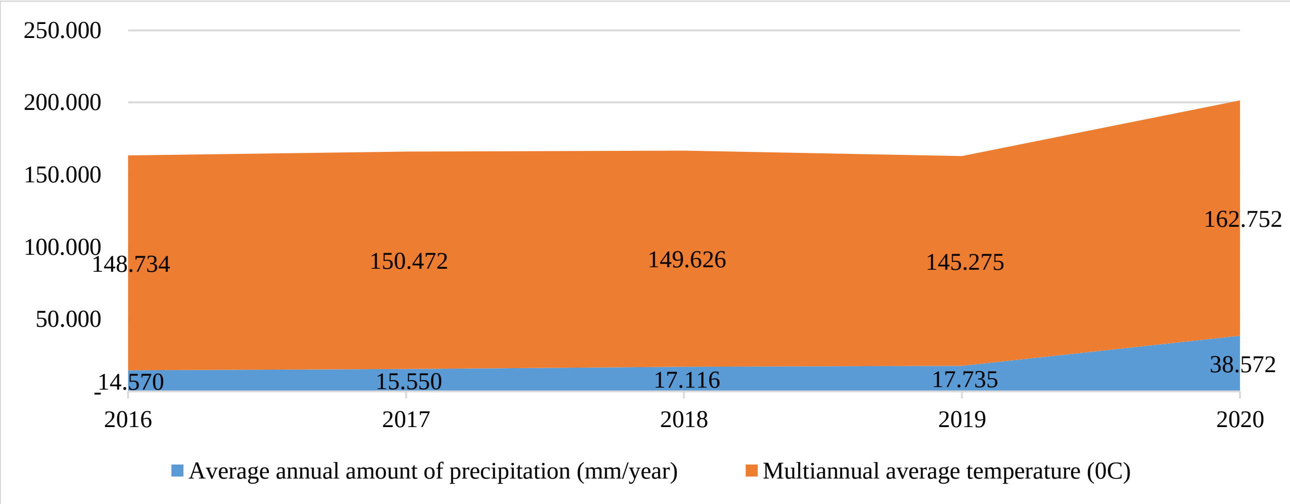
Table no. 1 – Variation of environmental conditions in Romania, in the period 2016-2020

	Min	**Max**	**Average**	**Deviation**	**Coefficient of variation**	**Annual rate**
Average annual amount of precipitation (mm/year)	601	700	658.52	39.71545	0.06031	1.071555
Multiannual average temperature (0C)	9.94	11.18	10.598	0.521459	0.049204	-0.66778
Forest area (ha)	6,405,814	6,450,707	6,430,298	19,598	0.003048	0.174746
Forested areas (ha)	8,027	10,736	8,871	1,122.963	0.126591	-6.86736

Source: INS data processing (http://statistici.insse.ro)

The 30-year history of weather data for Romania shows us that the average annual precipitation calculated for the entire territory is 637 mm annually, with significantly higher values in the mountainous areas (1,000-1,400 mm/year) and progressively lower towards the east, in Bărăgan being below 500 mm/year, and in Dobrogea and the Danube Delta dropping below 400 mm/year. Average annual temperatures decrease slightly, from the south (10°-11°C) to the north (8.5°-9°C), due to the country's latitude and relief distribution. Also, the temperature decreases with the increase in altitude, respectively by 6°C for every 1,000m. Average annual maximum temperatures range between 22°C and 24°C in summer and -3°C and -5°C in winter.

During the analyzed period, precipitation varied between 601 mm/year in 2019 and 700 mm/year in 2021, the driest month being January 202 with 8.9 mm/month, and the rainiest June 2018 with 155.5 mm/month , the calculated deviation being 39.71 mm/year. The multiannual temperature average was 10.59°C, falling within the limits recorded by meteorologists. The area occupied by the forest varied between 6,405 thousand ha and 6,449 thousand hectares, the increase of 44 thousand ha being extremely small (0.7%). Regarding the situation of afforestation with seedlings from nurseries, the increase was 3,588 ha (44.70%) (Table no. 1).

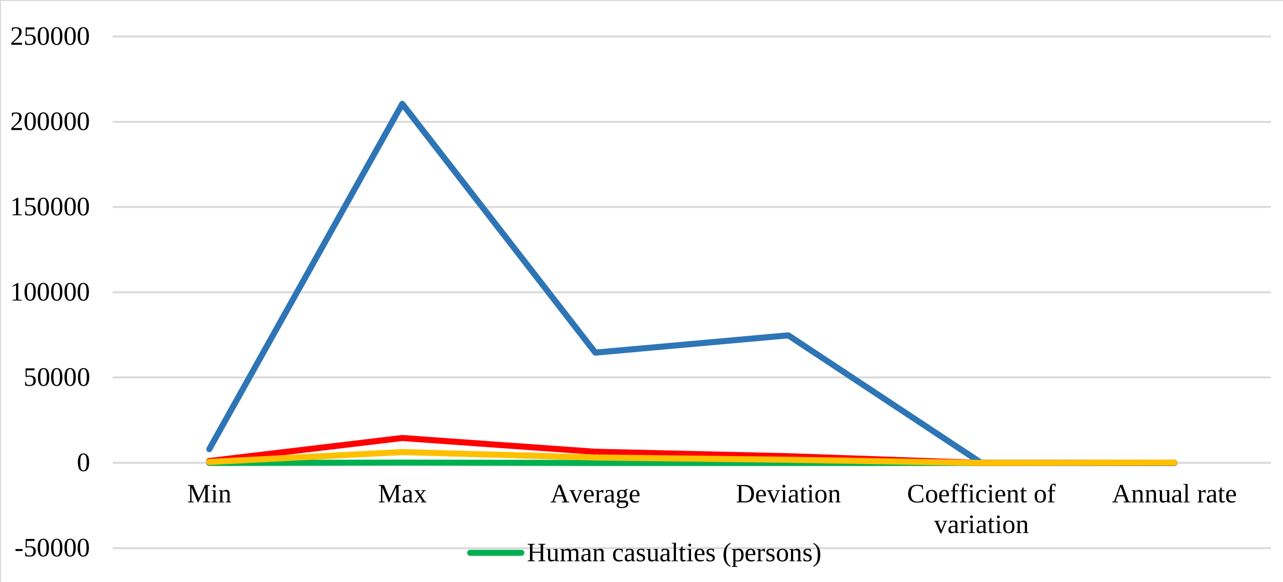


Graph no.1- The main causes of deaths caused by large temperature variations

Source: INS data processing (http://statistici.insse.ro)

In Romania, the number of injured and dead due to natural disasters was insignificant - 4 people/year on average during the analyzed period, compared to the number of people who died due to increased cardiovascular and respiratory diseases. Deaths caused by exacerbations of cardiovascular diseases increased at an annual rate of 27.55%, compared to those caused by exacerbations of respiratory diseases, which increased at a rate of 2.28% per year. (Graph no. 1).

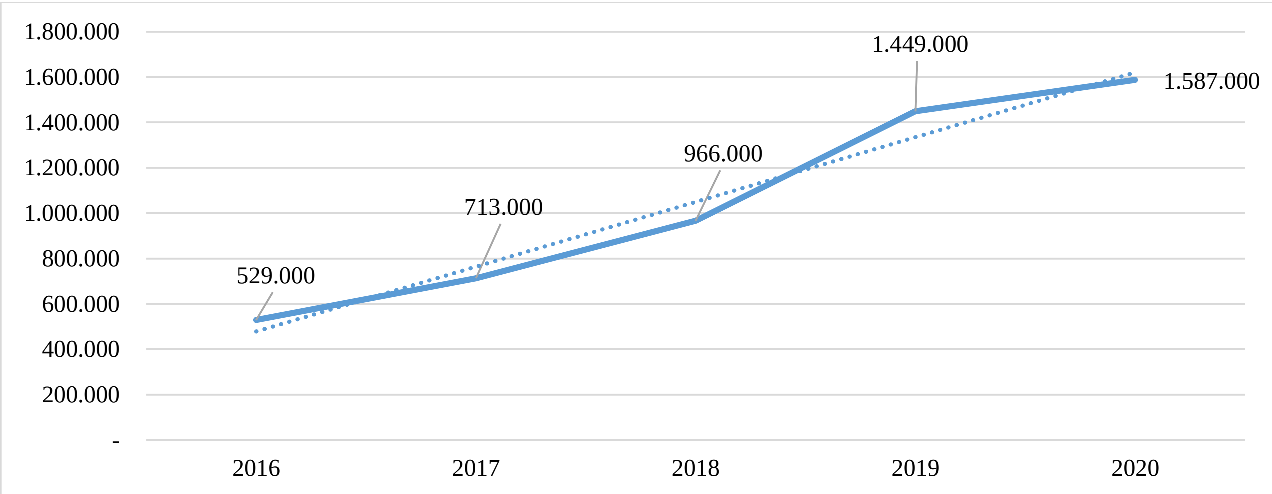
Heavy rainfall has been shown to cause a number of outbreaks of water-borne diseases as a result of the growth of pathogens or water contamination. Drastic reduction in precipitation in dry years and high temperatures seriously affect drinking water catchment systems and lead to insufficient water for daily hygiene essential to health. Climate change causes a number of water-related problems, not only through floods that cause property damage and loss of human life. (Chart no.2).



Graph no.2 - Annual damages caused by floods

Source: INS data processing

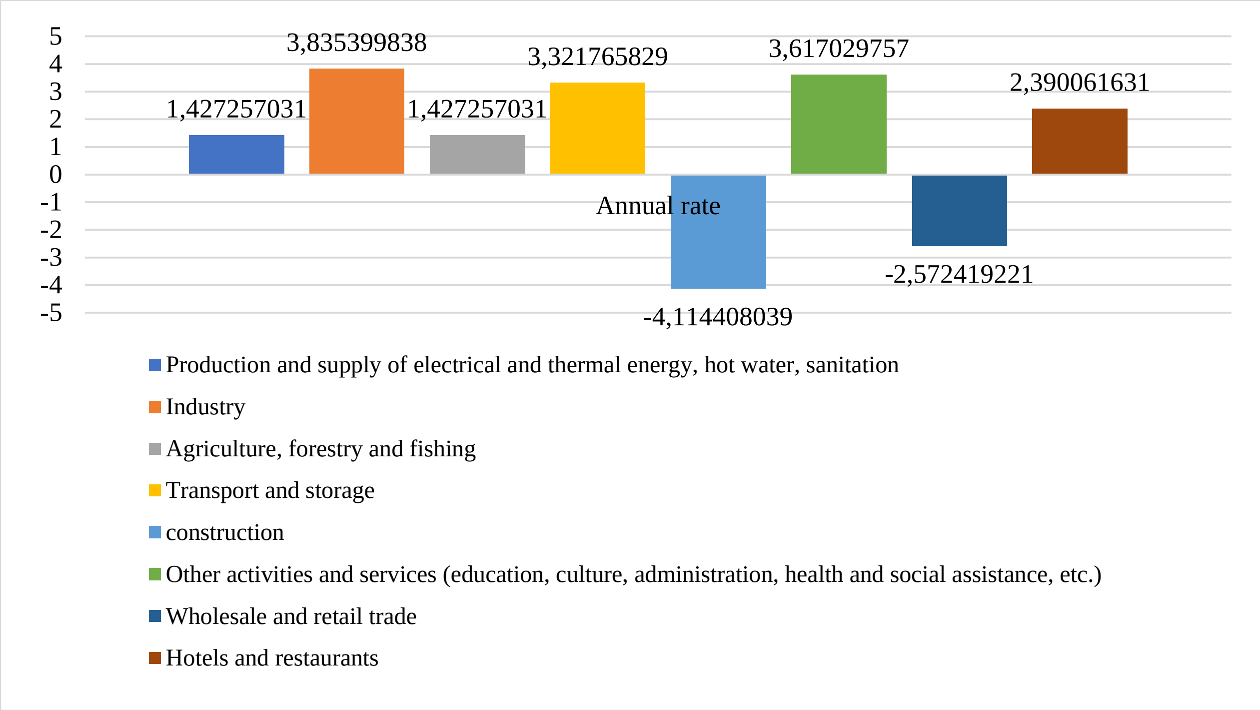
The area protected with anti-hail systems (ha) tripled during the analyzed period 2016-2020 (Graph no. 3).



Graph no. 3 - The surface protected with anti-hail systems (ha)

Source: INS data processing

In recent years, the EU member states have approved and implemented a series of measures to reduce air pollution and GHG, in Europe, the health risks caused by suspended particles and ozone, being significant. In Romania, an analysis of data on greenhouse gas emissions, by economic activity, shows that the main polluter is industry with an annual growth rate of 3.835% per year, followed by other activities and services with 3.61%/year and by transport and storage activities (3.321%/year). As we can see, agriculture had an annual growth rate of 1.427% in terms of GHG pollution. (Chart no.4).

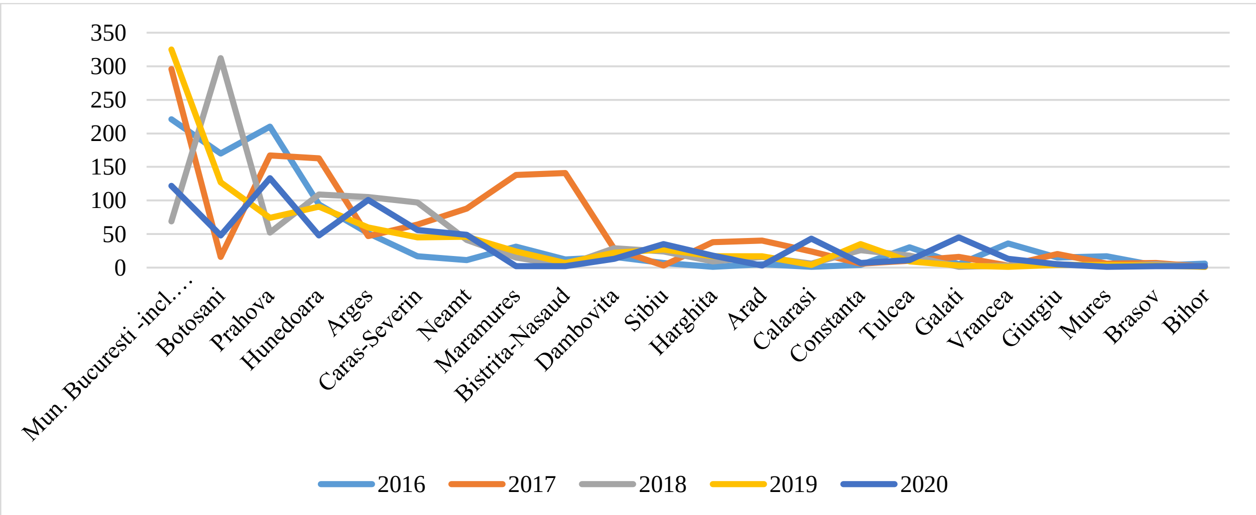


Graph no. 4 – The annual growth rate of greenhouse gas emissions, by economic activities

Source: INS data processing

It is estimated that ozone causes 21,000 premature deaths and more than 100,000,000 days with respiratory symptoms every year in Europe. A WHO study shows that climate variability and climate change have contributed to increased ozone concentrations in central and south-western Europe, and that climate-driven increases in ozone levels could pose an obstacle to current efforts to reduce this one.

At the national level, the budget for emergency situations was on average 3,792.52 million lei, representing 0.71% of the average multi-annual budget expenditure of 444,954.7 million lei, the number of ISU interventions caused by the occurrence of dangerous meteorological phenomena and/ or associated being continuously decreasing at national level, from 1,615 in 2017 to 930 in 2020.



Graph no.4 - The number of ISU interventions, caused by the occurrence of dangerous and/or associated meteorological phenomena by county

Source: INS data processing

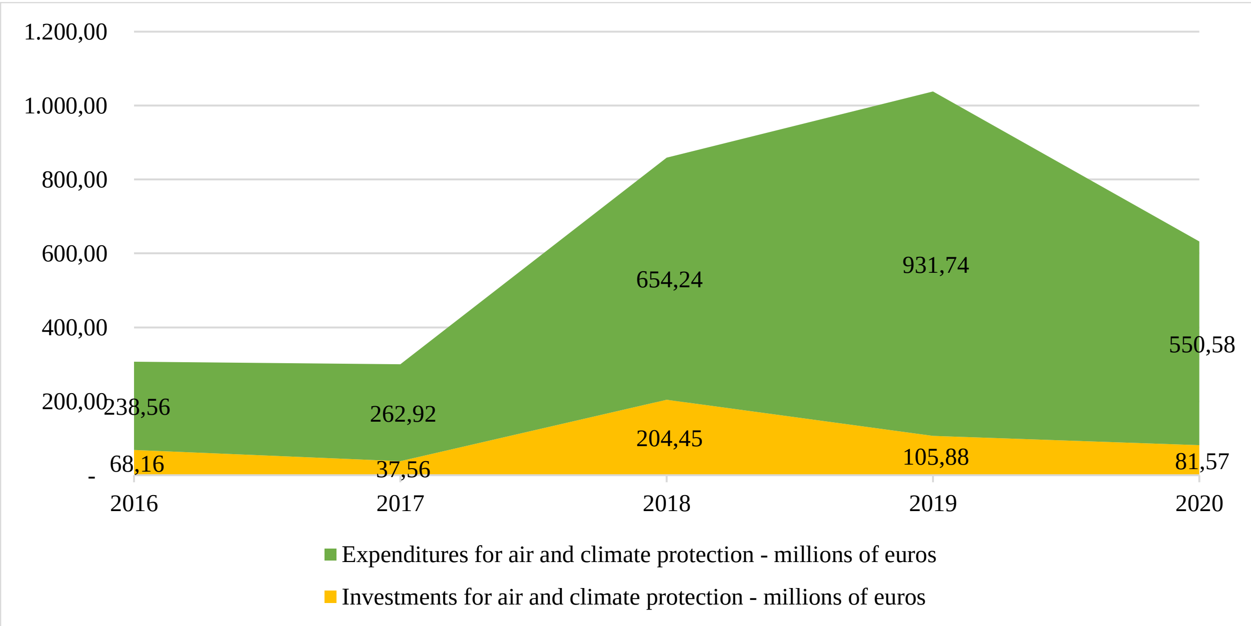
It is appreciated that health systems are vulnerable in relation to extreme climatic events, the demand for medical services increasing in direct proportion to the frequency of their production. This relationship is related to the degree of preparedness and response of the health system to emergency situations.

Table no. 2 – The situation of investments and expenses regarding air and climate protection

	2016	2017	2018	2019	2020
GDP - millions of euros	170,400	187,800	204,450	211,760	203,920
Share of Investments for air and climate protection in GDP	0.04%	0.02%	0.10%	0.05%	0.04%
Share of Expenditures for air and climate protection as a percentage of GDP	0.14%	0.14%	0.32%	0.44%	0.27%

Source: INS data processing

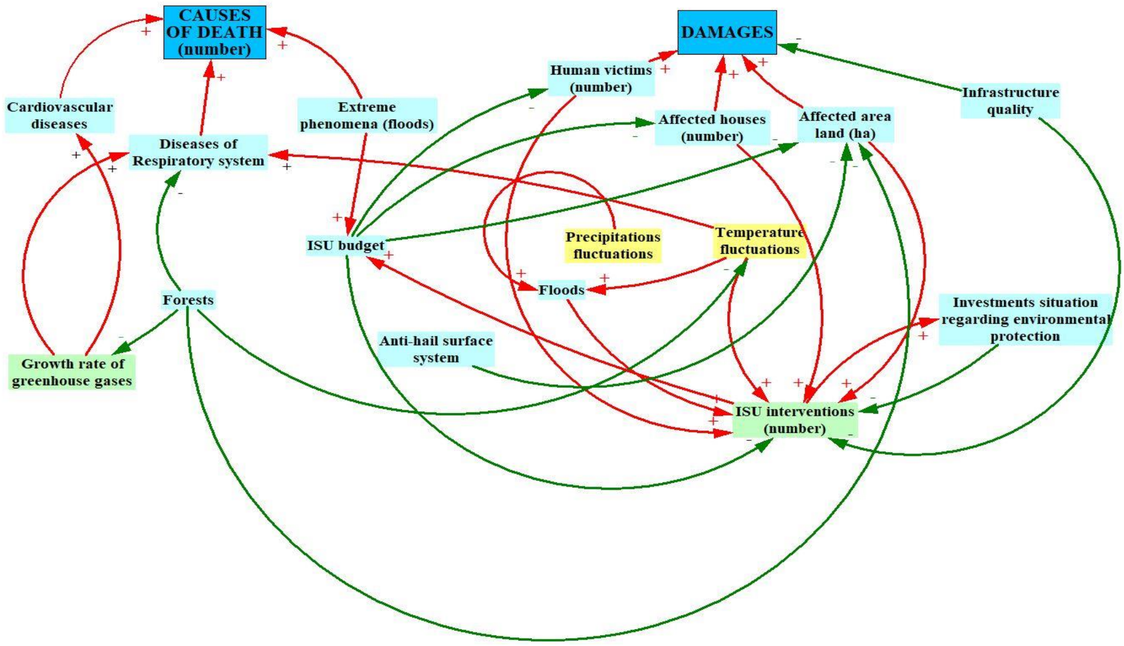
As can be seen from Table no. 2 and Graph no. 5 for air and climate protection, although the amounts increased until 2019, they do not even represent a percentage of Romania's GDP. Putting together all the analyzed elements, I created the cause-effect diagram, using the Vensim program, in which the main interactions at the level of the mentioned and analyzed variables are presented. Thus, the impact that climate change has on living organisms was analyzed by means of quantitative variables, such as: the number of deaths caused by cardiovascular diseases, diseases of the respiratory system or extreme phenomena, the size of the damage caused by climate change (the number of victims human losses, the number of affected homes, the quality of the road infrastructure, the size of the affected land surfaces).



Graph no. 5 – Amounts spent/invested for air and climate protection

Source: INS data processing

On the other hand, the effect variables were analyzed from a statistical point of view, within the present work and were represented by: the growth rate of GHG, afforestation, budget/number of ISU interventions, floods, anti-hail systems area, the level of investments regarding environmental protection, precipitation and temperature fluctuation. It is thus observed that the effect variables can be included in the typology of the measures taken by the state regarding climate change, of the instruments used in order to apply these measures, but they are also included in the typology of specific factors of the external environment, unpredictable, environmental or climatic (temperature , precipitation) (Chart no. 6).



Graph no. 6 - Cause-effect diagram regarding the impact of climate change on aliving's organisms

Source: own processing

Thus, in the paper it is observed that some variables were characterized by an increasing trend (blue color), and the level of other variables decreased (green color). The variables whose level cannot be precisely quantified are those characterized by an oscillating trend (yellow color). The "+" sign shows a directly proportional influence between the analyzed variables (red arrow color). For example, when the rate of growth of greenhouse gases is increasing, the level of deaths from cardiovascular or respiratory diseases increases. The "-" sign shows an inversely proportional influence between the analyzed variables (color of green arrows). For example, in a situation where the quality of the road infrastructure decreases, the number of ISU interventions increases. Interesting is the situation where, initially, the increase in the level of one value leads to an increase in the other analyzed value: for example, in the situation where the number of ISU interventions increases, this leads to an increase in investments regarding environmental protection. This last increase produces, in turn, a decrease in the number of ISU interventions, implicitly when the ISU budget decreases. Other examples of causal loop diagrams found at the level of figure xx: number of ISU interventions – ISU budget – human casualties – number of ISU interventions; number of ISU interventions - ISU budget - affected houses - number of ISU interventions; ISU budget - number of interventions - ISU budget; the situation of investments regarding environmental protection – number of interventions - the situation of investments regarding environmental protection. In the case of these types of links, it is necessary for the strategic directions at the level of a state to mitigate the impact of climate change to act bilaterally, taking into account the evolution of the variables of interest, in a dynamic system of their interaction.

CONCLUSIONS

In conclusion, many regions around the world face challenges such as increasing frequency of extreme air temperatures, storms, floods caused by heavy rainfall or drought. Due to climate change, such extreme events will occur more often in the future. This trend will increase the risk of economic damage and life-threatening weather hazards. Climate Prediction provides a simple summary of complex climate change simulations for any location on Earth based on the various emissions scenarios in the IPCC report (2007). This must be realized, and the measures taken by governments must be implemented without any delay.

In general, climate change does not cause many new or unknown health risks, but it will intensify certain interactions between the environment and human health, with more drastic effects than at present. Most public health measures and systems already exist, but they need to be adapted to the new situation and new needs.

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DETERMINING FACTORS IN ROMANIAN CONSUMER BEHAVIOR ON THE NUTS MARKET (NUTS, CASHEWS, ALMONDS, PISTACHIOS)

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Abstract: *Within the internal research plan of the Research Institute for Agrarian Economy and Rural Development, the project entitled "Marketing studies for sustainable agri-food products and analysis of consumption behavior, in the objectives context of the European strategy From farm to Fork (From farm to consumer)". Starting from the objectives of the strategy mentioned in the title of the project, in the first phase, we identified 4 groups of agri-food products for which marketing studies will be carried out, respectively: nuts, fruits, vegetables and whole grains. The present work presents the main results obtained following the analysis methodology used, to outline the profile of consumers of nuts in Romania, as well as a form of validation or not of research hypotheses, using the SPSS program, in order to calculate reference parameters for studying the synergies between the independent and dependent variables under research, such as the chi-square test or the contingency coefficient.*

Keywords: *consumer behavior, quantitative research, chi-square test, contingency coefficient, nut market*

JEL classification: M31, C12

INTRODUCTION

The choose motivation for this market segment, of nuts, in this paper, derives from the importance of this category of agri-food products, recommended both within the From farm to fork (2020) strategy as being sustainable, but also by medical specialists, in order to maintain a balanced, healthy lifestyle. Moreover, the changes in food consumption trends, in our country and beyond, the increase in the number of those who travel abroad, the diversification of food recipes promoted on online communication channels, the increase in the number of those who are interested in a vegetarian, vegan lifestyle and others, all these represent causes and reasons underlying the diversification of the offer of economic agents operating on the nut market. In order to determine the consumption behavior in the Romanian market of interest, a quantitative research was carried out, applying a questionnaire among consumers in Romania, with the aim of identifying the preferences and requirements of consumers in terms of the qualities and properties of nuts and products derived from them.

MATERIALS AND METHODS

Regarding the quantitative research carried out in order to achieve the results presented in this work, the applied questionnaire have ***21 questions***, in which ***140 respondents*** participated, *65% women* and *35% men*, with ages between 18 and over 60. Consumers residing in Bucharest, Timisoara, Craiova, Neamţ, Teleorman, Cluj, Otopeni, Călăraşi, Ploiesti, Vaslui, Arad, Suceava, Brăila, Sibiu, Braşov, Constanţa, Pitesti, etc. participated in the research. Regarding the composition of the questionnaire, there are filter questions, questions with one or more answer options, open questions, questions with different measurement scales as answer options, aiming to facilitate the process of coding the questions and answers by the which analyzes the collected results. Due to the context regarding the spread of the COVID-19 virus, but also to make the research more efficient, the collection of answers from the interviewed consumers was carried out online, using the Google Forms platform. The research was carried out between 01.05.2022 and 30.06.2022.

In order to study the correlations between the variables of research, the SPSS program was used, for chi square test (hi ^{2}) calculation, when its value was below the threshold of 0.05 we calculated contingency coefficient also, because only for values smaller than 0.05 of the chi square test, it can be stated that there are links between the studied variables. To calculate the values of the mentioned parameters, the following method will be used, in the SPSS calculation program ***(Analyze – Descriptive statistics – Crosstabs – Statistics – Chi-square, Contingency coefficient)*** (Datculescu, 2006). Also, in order to choose the best questions in order to achieve the objectives of the quantitative research, publications were disseminated (domestic or international scientific works, the results of other research of interest, studies, reports, etc.).

RESULTS AND DISSCUSION

Over time, many specialists tried to define the consumer behaviour and to observe it, irrespective of what category of products they consume . For example, Ph. Kotler (1999) defines in his paper the main factors that influences the consumer behaviour:

- **Cultural factors**: culture or subculture, social class;
- **Social factors**: reference groups, family, rolles and status;
- **Personal factors**: age, occupation, life style, economic circumstances,
- personality;
- **Psychological factors**: motivation, perception, learning, convictions, attitudes.

R. Boier (2002) defines the major factors that influences the consumer behaviour, such as:

- **Individuals factors of consumer behaviour**: needs, motivations, personality, self-image, attitudes and preferences;
- **Social factors**: family, reference groups, opinion leaders, role and social status, social classes;
- **Cultural factors.**

A different type of approach is delimitated by I. Catoiu (1997), that consider the consumer behaviour is influenced by two types of variables: direct observable and deducted through the interferential research as a result. This lead to the following classification:

- **Direct influences**: demo-economics factors, marketing mix specific factors, situational factors;
- **Induced influences**: psychological factors (endogenous nature), social factors (exogenous nature).

Thus, it is observed that some categories of factors are identified by the majority of authors, in terms of the influence they exert on consumer behavior. For this paper, the focus will be on the socio-demographic factors of the respondents, such as: *gender, age, marital status, education level*. Demographic factors characterize the structure of the population and the processes that affect it. At the macroeconomic level, the main variables are: population size and geographic distribution, birth rate and mortality rate, age, occupation, level of education, number of members in a household, type of residence (urban or rural). The category of economic factors is of major importance at the macroeconomic level, because it defines, at a given moment, the purchasing power of society. These factors directly affect the size and evolution of consumption. At the microeconomic level, the level of consumer income is the main factor, thus representing, depending on size and fluctuation, the material premise, and also the main restriction imposed on the consumer. However, not all goods and services have the same cost sensitivity.

Starting from this determining factors identification in the purchase process of a product in question, at the level of research, for the present work, 2 hypotheses were formulated, in order to validate them, or not, as follows:

- ***Hypothesis 1:*** The gender and age of the respondents influence the consumption of nuts products following the advice received from a medical specialists;
- ***Hypothesis 2***: Gender, age and marital status of the respondents influence the association of the nuts consumption with the consumption of alcoholic beverages;

From socio-demographic characteristics point of view outlined for the sample of the conducted quantitative research, the following are mentioned:

- **Sample size**: 140 respondents;
- **Sample structure**:
  - ***gender***: 92 women, 48 men;
  - ***age***: 18 – 25 years – 12 respondents; 26 – 34 years – 20 respondents; 35 – 42 years - 48 respondents; 43 – 52 years – 36 respondents; 53 – 60 years - 16 respondents; over 60 years – 8 respondents;
  - ***marital status***: 80 married; 40 singles;
  - ***education level***: postgraduate studies - 56 respondents, higher education (bachelor's degree) - 80 respondents;

The respondents socio-demographic characteristics are of interest for the present work, the hypotheses of the stated research being based on different possible correlations that may exist between the independent variables of the present research (socio-demographic characteristics of the respondents: age, sex, education level, marital status) and the independent variables subject to research, represented by the centralized answers following the application of the questionnaire in this case. So, according to the first hypothesis of the research, *the gender and age of the respondents influence the consumption of nut products, following the advice received from medical specialists*. Thus, to the question ***Do you consume nuts at the urging of the specialist doctor?*** the answers showed that 114 respondents do not consume nuts for this reason (figure 1).

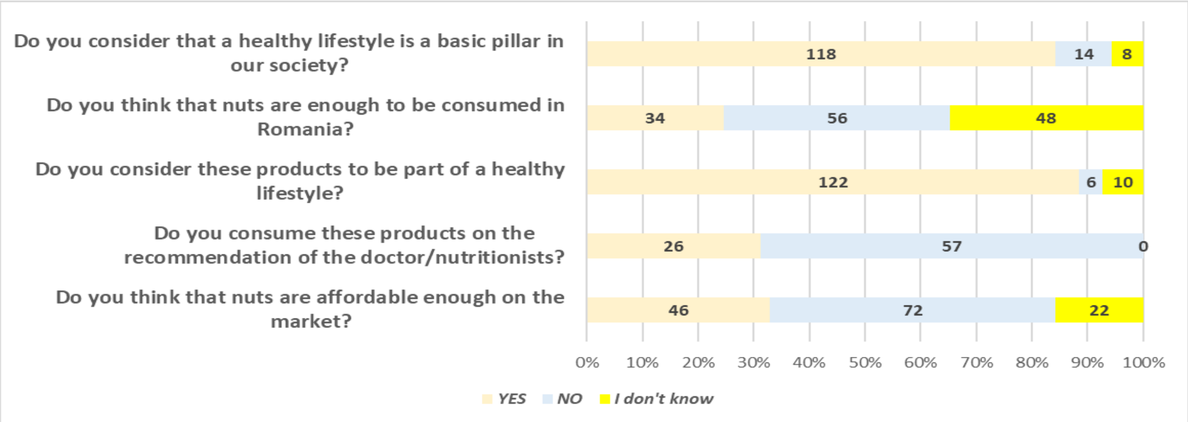

Figure 1. Questionnaire responses regarding consumer's perception regarding the nuts consumption

Source: processing answers of quantitative research regarding the consumers behavior on the nuts market

Regarding hypothesis 1 of the present work, according to which "gender and age of the respondents influence the consumption of nut products following the advice received from medical specialists", the following results were obtained in the SPSS program, following the application the methodology described in the section related to it:

Symmetric Measures			
		Value	Approx. Sig.
Nominal by Nominal	*Contingency Coefficient*	**.287**	**.002 (hi^2 test)**
N of Valid Cases		138	

Figure 2. Validation of hypothesis 1. The gender of the respondents influences the consumption of nuts, following the advice received from the medical specialist

Source: result of SPSS interogation for hypothesis 1

Thus the value of the hi^2 test is 0.002 (<0.05), which proves the existence of the correlation between the independent variable (gender of the respondents) and the dependent variable (the answers to the question Do you consume these types of products at the urging of the specialist doctor?), in the sense that women take into account in - a greater measure than men of the exhortation received from the specialist doctor regarding the consumption of nuts. The value of the contingency coefficient is, according to the SPSS program, 0.287, which shows that there is a weak link between the two mentioned variables.

Regarding the second part of hypothesis 1, the value of the hi^2 test is 0.000 (<0.05), which proves the existence of the correlation between the independent variable (the age of the respondents) and the dependent variable (the answers to the question Do you consume these types of products at the urging of the specialist doctor?), in the sense that the mature audience in the sample (35-42 years, respectively 43-52 years) answered the reference question in the affirmative, unlike the younger ones (18-25 years). The value of the contingency coefficient is, according to the SPSS program, 0.443, which shows the fact that between the two mentioned variables there is a link of medium intensity (fig. 3).

Symmetric Measures			
		Value	Approx. Sig.
Nominal by Nominal	*Contingency Coefficient*	*.443*	**.000 (hi^2 test)**
N of Valid Cases		138	

Figure 3. Validation of hypothesis 1. The age of the respondents influences the consumption of nuts, following the advice received from the medical specialist

Source: result of SPSS interogation for hypothesis 1

Regarding the second hypothesis stated, according to which the association of the consumption of nuts with that of alcoholic beverages is influenced by gender, age and marital status, it is observed that the majority of respondents agree with the statement from which the hypothesis stated starts, obtaining an average score of 2.91, based on the Significance Differential measurement scale (figure 4). The other results show that respondents consume more nuts during fasting periods, when preparing homemade sweets, but not when dieting.

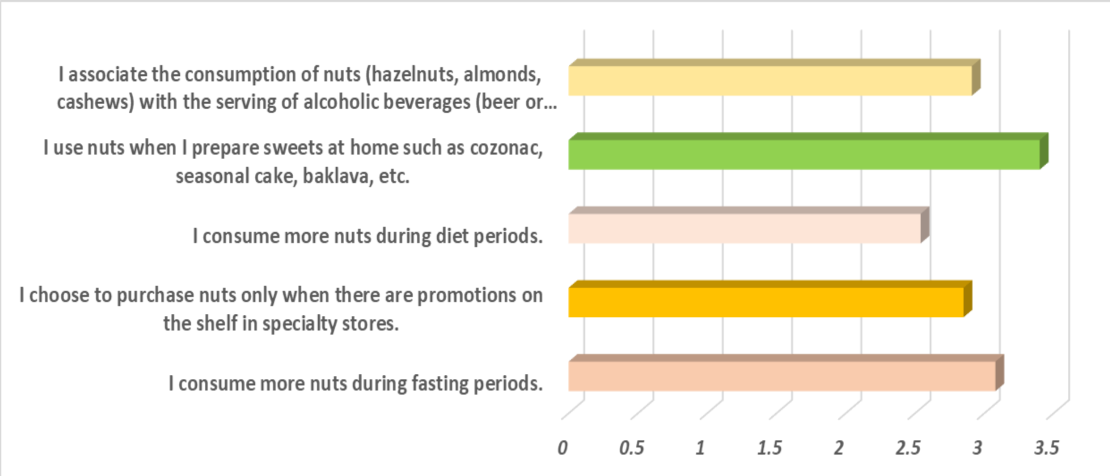

Figure 4. The average score obtained in terms of the respondents' Agreement/Disagreement with regard to the statements contained in the questionnaire

Source: processing answers of quantitative research regarding the consumers behavior on the nuts market

Regarding the degree of influence that the respondents' gender, age and marital status exert on the association studied under hypothesis 2, figures 5, 6 and 7 show the values of the hi2 test and the contingency coefficient, obtained with the help of the program SPSS.

The test value the resulting hi2 test value is 0.000 (<0.05), which confirms the existence of the synergy between the gender of the respondents and the statement of interest for this hypothesis, in the sense that men associate the consumption of nuts more often with that of alcoholic beverages more often than the female part of the sample. The value of the contingency coefficient is 0.357, which demonstrates an average intensity of the link analyzed. (figure 5).

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	*Contingency Coefficient*	*.357*	**.000 (h^{i2} test)**
N of Valid Cases		140	

Figure 5. Validation of hypothesis 2. The gender of the respondents influences the association of the consumption of nuts with the serving of alcoholic beverages

Source: result of SPSS interogation for hypothesis 2

Regarding the influence of the age of the respondents on the association of the consumption of nuts with the serving of alcoholic beverages, the value of the hi2 test, of 0.001, reflects the existence of the link between the studied variables, in the sense that the respondents aged between 35 and 42 years, respectively 43-52 years old, agree to a greater extent with the given statement, compared to the younger audience submitted to the questionnaire (18-25 years old respectively 26-34 years old). The value of the resulting contingency coefficient is 0.494, which reflects an average intensity of the connection between the two studied variables (figure 6).

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	*Contingency Coefficient*	*.494*	**.001 (hi^2 test)**
N of Valid Cases		140	

Figure 6. Validation of hypothesis 2. The age of the respondents influences the association of the consumption of nuts with the serving of alcoholic beverages

Source: result of SPSS interogation for hypothesis 2

Marital status also influences the association between the consumption of nuts and alcoholic beverages, the value of the chi-square test being 0.000, in the sense that the unmarried part of the sample associates the consumption of these 2 types of products less often than the married ones, they the latter agreeing to a greater extent with the given statement. The value of the contingency coefficient, 0.470, shows an average intensity of the link between the studied variables (figure 7).

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	*Contingency Coefficient*	*.470*	**.000 (hi^2 test)**
N of Valid Cases		140	

Figure 7. Validation of hypothesis 2. The marital status of the respondents influences the association of the consumption of nuts with the serving of alcoholic beverages

Source: result of SPSS interogation for hypothesis 2

Thus, as the results of the conducted research show, but also the results of other reference studies, publications, socio-demographic characteristics are important in creating the profile of consumers and the decision to purchase agri-food products. The two hypotheses of the present research were validated, and the premises from which they started as well.

Among other results of the conducted quantitative research, important in achieving the stated objectives, we mention:

- The respondents have a particularly favorable perception of the consumption of nuts, consuming them often and the main reason for their consumption being represented by the actual pleasure of serving them;
- The preferred supply location is that of supermarket/hypermarket stores;
- Respondents are aware of the benefits that the consumption of nuts can have on health: decreasing the risk of cardiovascular diseases or diabetes;
- High importance is not given to the provenance of the nuts, in the purchase process;
- Respondents prefer walnuts, almonds and pistachios;
- The preferred brands identified by consumers were Nutline, Alesto (Lidl's own brand), Alpro vegetal milk and Milbona milk (Lidl's own brand), the quality-price ratio, freshness and taste being the criteria by which consumers choose a product on this market;
- Nuts are mostly consumed fresh, preferably in salted, fried form and less often in raw form. Substitutes for traditional and non-dairy products such as butter, milk or oil are hardly consumed by the studied sample;

CONCLUSIONS

In the present paper, the main results obtained following the quantitative research were presented, results that aimed to achieve the main objective of the research, that of outlining the profile of the Romanian consumer, on the tree fruit market. Also, the questions in the questionnaire met the secondary objectives, which include: determining the perception of the Romanian consumer on the consumption of nuts and products obtained from them; the frequency of consumption, reasons for consumption, the form in which it is consumed, the period in which it is consumed; determining the influencing factors in the consumer's purchase decision: which characteristics and attributes of nuts and nut products are of major importance in the purchase decision, subjecting to analysis indicators such as: product type, price, packaging, quality, method of preparation, origin and others; determining consumer preferences regarding the types of nuts consumed frequently or occasionally; determining the reasons why consumers choose to consume nuts and derived products; determining the frequency in which Romanian consumers choose to purchase nuts, depending on the occasion or period (diet, fasting, consumption of alcoholic beverages); determining the notoriety of the producers from whom Romanian consumers choose to purchase nut products; establishing the type of nuts consumed mainly in our country and the reasons why this happens; determining favorite culinary preparations from nuts

Thus, the consumers participating in the present research have a predominantly favorable perception regarding the consumption of nuts, consuming mainly walnuts, pistachios, almonds and hazelnuts. However, they are not familiar with products obtained from the processing of nuts, such as milk, vegetable butter or oil. They prefer to eat them fresh and the main reason they do it is because they like their taste. Although consumers know that serving these types of products can help lower the risk of developing medical conditions such as cardiovascular disease or diabetes, they do not consume them at the urging of medical specialists. Nuts are consumed throughout the year, but in greater quantity during fasting or when preparing homemade sweets such as cozonacs or baklava. Thus, the influence of traditions and customs on the consumption of agri-food products can be observed, even in the present case. The main criteria underlying the purchase process are: the quality/price ratio, the taste and the freshness of the nuts. The price is also a major factor in the purchase process, even if this is not explicitly mentioned by the respondents, however the preferences regarding the choice of the manufacturer in this market demonstrate the importance of the prices (predominantly choosing the own brands of some hypermarkets) .

The two hypotheses of the present paper, based on specialized publications in the field of marketing, implicitly of consumer behavior, were also confirmed by the results obtained in the research. Both hypotheses demonstrate the fact that the independent variables represented by the socio-demographic characteristics of the respondent (in the present case, the age, gender and marital status of the respondents) influence, with a medium or high intensity, the consumption of certain food products following the advice of specialist doctors, the association certain foods and others.

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RESEARCHES REGARDING THE CONSUMPTION OF GRAPES AND WINE IN ROMANIA

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Abstract: *Viticulture in Romania is a traditional activity, harmoniously developed as a result of the extremely favourable natural conditions that grapevine encounters throughout the country. Viticulture has always taken an important spot in the agricultural economy on a national level as well as worldwide, being appreciated from several points of view like: social (nutrition sources: grapes, wine, traditional products that come from them) and economic (viticulture products capitalization, internal commerce, international commerce). Education, viticulture tourism and socio-economic development in the last years have left their mark upon the consumption of grapes and grapes products by Romanian consumers. The consumption and choosing of products has become a more and more documented activity for Romanians. The purpose of this study is to follow the evolution of grapes and wine consumption in Romania with the help of statistic indicators. By analyzing future perspectives regarding consumption on a national level it is expected that by 2025 the average annual grapes consumption will surpass 23 kg/inhabitant, if it maintains the same tendency from the analyzed period. In order to develop this sector, a series of financial aids and support measures have been extended in order for the farmers to benefit from.*

Key words: *grapes, wine, wine products, consumption*

JEL ranking: Q 10, Q 11, Q18

INTRODUCTION

Viticulture represents an agricultural activity that is usually more profitable on the surface than annual crops. The red and white grapes varieties are being cultivated for raw consumption and for wine, juice and raisins production.

The productivity and the quality of the grapes rests on soil fertility and the nutritional status of the plants. Grapes are placed among the main fruits that are consumed globally, with a production of approximately 75 mil. tons every year, from which 50% are used to produce wine. (Bărbulescu O., 2017)

Romania places among the main viticulture countries in the world. It's ranked 11th globally and 5th in the EU when it comes to surface. (Mereanu D., 2010).

In the Romanian agriculture the grapevine and wine sector represents an important percent through its contribution to the country's economy. (Bucur GM,2014).

The factors that contribute to the viticulture development are the favourable conditions that the grapevine finds on the country's territory as well as the climate and the soil. (Soare I., 2010).

The viticulture plantations are grouped territorially by viticulture regions, viticulture areas, viticulture centres, vineyards and viticulture fields according to the Vineyard and Wine Law nr. 2004/2002.

Romania's viticulture regions are: Muntenia Hills, Banat Hills, Oltenia Hills, Moldova Hills, Transilvania Plateau, Crișana and Maramureș Hills, Dobrogea Ledge.

Being a sector of interest, there have been made many studies in this domain. The researchers and farmers are motivated to reproduce new varieties that are being used in viticulture so that they can stand disasters that viticulture is faced with: epidemics, global warming but also the changes in the consumer's demands. Bărbulescu O., 2017, has highlighted the fact that promoting the national viticulture sector on the outer market is essential for its development, especially by using inland grapevine varieties (Turek Rahoveanu A., 2010). It can be taken advantage of this fact through the tourism potential of specific areas, Romania having a series of wineries with diversified ranges of wines. (Macici, 1996)

MATERIAL AND METHOD

The current study makes an analysis of the average grapes and wine consumption per inhabitant. Within, one can also find a series of forecasts for this sector at a national level by presenting its evolutions and tendencies.

The data that is being used in the study are being processed with the help of different statistic indicators: arithmetic mean, standard deviation, variation coefficient and annual rate, those being determined with the help from the following formulas:

- arithmetic mean: $\overline{X} = \frac{\sum_{i=1}^{n} x_i}{n}$, where x_i- observed values; n- observed values number

- standard deviation: $S = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{N-1}}$, where x_i- observed values; N- observed values number, $\bar{x}$ – observed values average

-variation coefficient: $CV = \frac{S}{\overline{X}}$, where S – standard deviation, $\overline{X}$– arithmetic mean

- average annual rate: *R= [radical of the order n-1 from (x_n / x_0)] - 1 * 100, where x_n, x_0 – current year-past year value.*

Using the *FORECAST* function, made possible to present predictions of human consumption of grapes, wine and wine products at a national level.

The FORECAST predictions a value based on existing values along a linear tendency. FORECAST calculates predictions of future value using linear regression and can be used to predict numeric values like sales, inventory, expenses, measurements etc.

In statistics, linear regression is an approach in order to shape the relation between a dependent variable (y value) and an independent variable (x value).

FORECAST uses this approach to calculate the value y for a certain value x based on existing x and y values. In other words, for a given x value, FORECAST returns an estimated value based on the linear regression relation between x values and y values.

RESULTS AND DISCUTIONS

Globally, grapes and grapes products are very appreciated by consumers. Production growth and grapes sale implicitly globally has been supported by the increased demand generated by changes in consumer behaviour as well as the improvement in viticulture technologies, but also regarding the transport and storage of grapes. (Soare E., 2019).

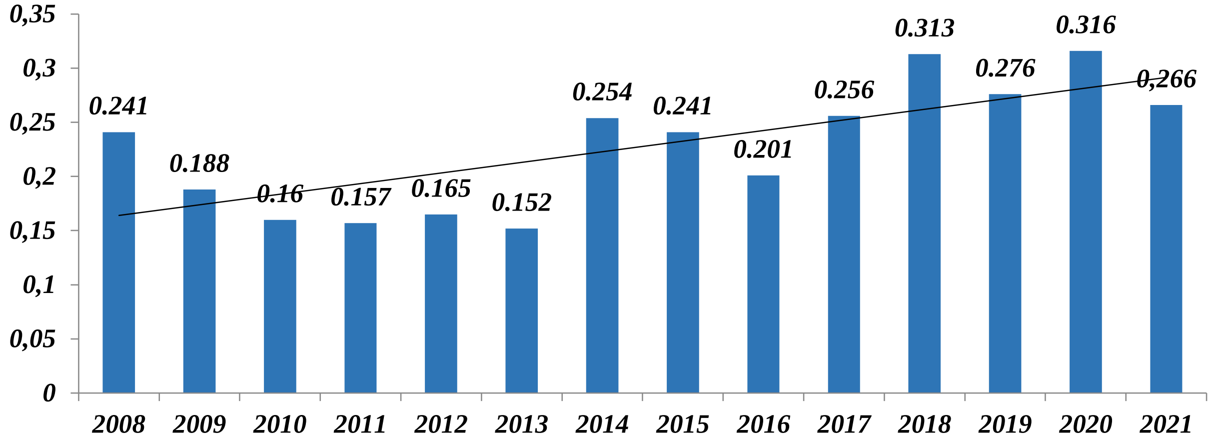

Figure nr.1. The quantity of grapes purchased by a household – monthly average per individual between 2008-2021 (kg)

In the analyzed period of time, it has been registered an increase of the average quantity of grapes purchased by a household by 10%, from 0.241 kg in 2007 to 0.266 kg in 2020. (Figure nr. 1.)

Table nr. 1. Annual average consumption per inhabitant for the main grape products and drinks between 2008-2020

Main alimentary products and drinks	2008	2010	2012	2014	2016	2018	2020	Media	Standard deviation	Variation coefficient (%)	Annual growth rate (%)
Grapes - kg	7.6	5.4	6.3	6.2	6.9	8.5	7.9	6.88	0.91	13.28	2.82
Wine and wine products - litres	25.8	22.2	21.1	22.6	18	23.8	21.1	22.17	2.09	9.43	-1.02

Source: processed data from INSSE

After analyzing the statistic indicators calculated for the quantity of grapes purchased by a household, it was noted a high value of the variation coefficient (13.28%) which indicates a large variation of the series of data and a positive annual growth rate (2.82%), which suggests an increase of the purchased quantity during the analyzed period. (Table nr.1)

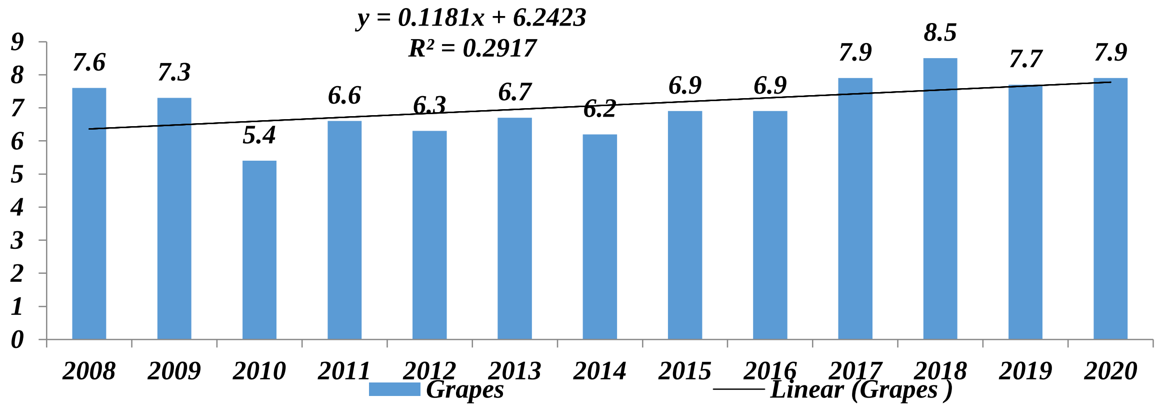

Figure nr.2. Evolution of the average annual grapes consumption per inhabitant between 2008-2020

During the analyzed period, the average annual grapes consumption registered an average of 6.88 kg, oscillating between 5.4 kg in 2010 and 8.5 kg in 2018, the evolution tendency being an ascending one. From calculating linear regresion it results that, the value of average consumption of grapes has increased with an average of approx. 0.118 kg per year.

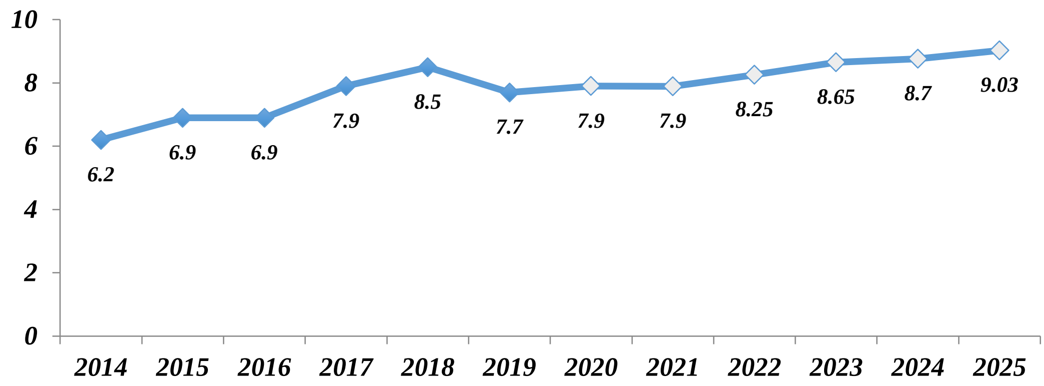

Figure nr. 3. Tendency for annual average consumption of grapes per inhabitant (kg/inhabitant)

According to estimations made using the forecast function, it's expected that by 2025 the annual average grapes consumption to surpass 9 kg/inhabitant, if the analyzed tendency stays the same. Between 2008-2020, annual average grapes consumption per inhabitant showed a positive evolution tendency highlighting an increase by 0.4% in 2020 (7.9 kg/inhabitant) compared to 2008 (7.6 kg/inhabitant).

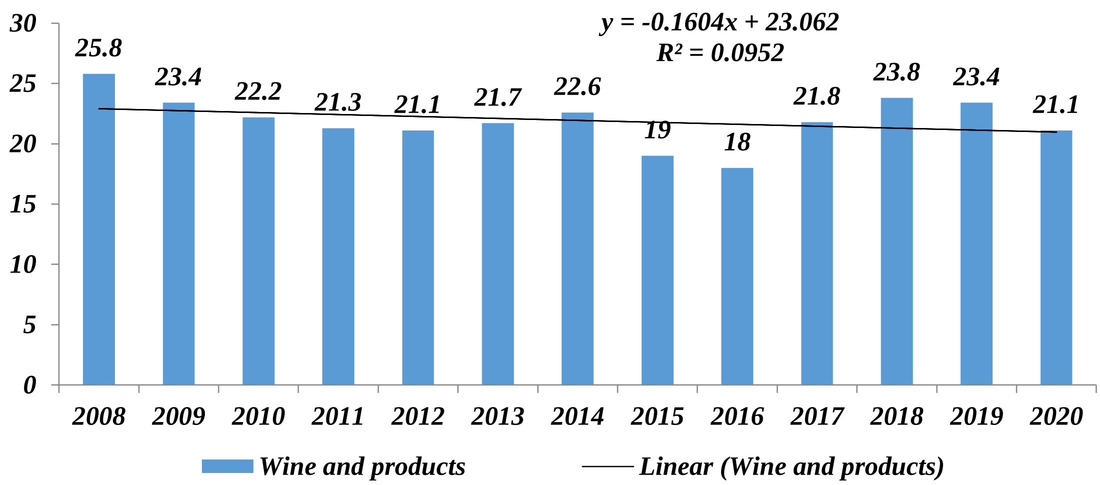

Figure nr. 4. Evolution of annual average consumption of wine and wine products per inhabitant between 2008-2020

Regarding the average consumption of wine and wine products, one can see a negative evolution tendency, during the analyzed period it has been registered a decrease of 4.7 litres in 2020 compared to 2008. (Table 1)

The tendency for wine and wine products average consumption is relatively constant, according to estimations it will reach in 2025 the value of 23.50 litre/inhabitant.

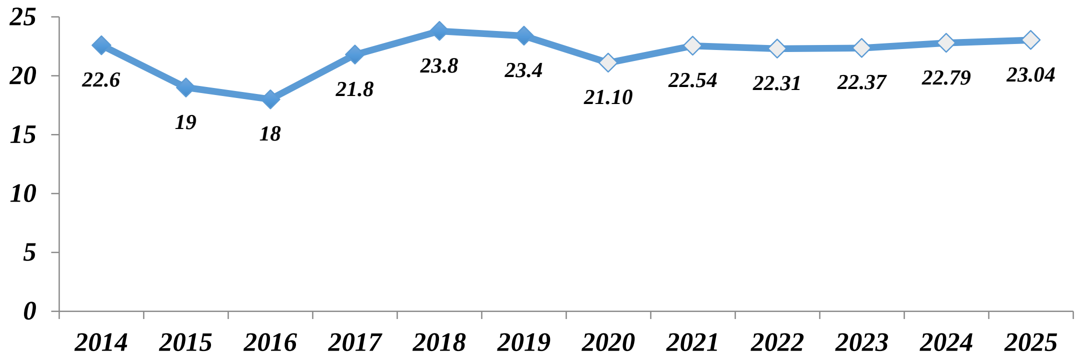

Figure nr. 5. Tendency of annual average consumption of wine and wine products per inhabitant (litres/inhabitant)

According to a study conducted by Revino.ro and CrameRomânia.ro in the first part of 2020 it was noticed that Romanians insist upon producing wineries and grapes varieties as well as on the colour of the wine (red, white or rose) and on the moment of consuming when deciding to consume wine.As per the same study it was noted the Romanian consumers preference for varieties: Black Maiden, Cabernet Sauvignon, Merlot and Sauvignon Blanc. The Black Maiden is topping the preferences, because it's one of the most known and appreciated inland varieties, having great potential internationally. (www.oiv.2019).

CONCLUSIONS

The increase of the annual average consumption of grapes per inhabitant was due to many factors like: the increase of population income and awareness of the fact that, grape consumption has a direct contribution on the health of the body due to its nourishing properties.

In Romania, a country in which the consumption of quality wine increases yearly, the number of new wineries that open yearly is growing with 3-5 units. And consumers are shaping better and better their preferences and tend to have well informed choices.

The forecasts made based on statistic data have shown a long term increase tendency of consumption of grapes, wine and wine products so that we can say that the viticulture sector is one for the future. In order for Romania to keep its place among the big grapes/wine producers, consistent investments are required in the viticulture sector.

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OPTIMIZATION OF SOME TECHNOLOGICAL FACTORS TO SOYBEAN CROP

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Abstract: *The research conducted at the Agricultural Research and Development Station Turda (ARDS), situated in the Transilvanian Plateau, they pursued the possibility of obtaining yield increases and quality for the Caro TD soybean variety, cultivated in four tillage systems (CS - conventional plow, MTC – minimum till chisel, MTD – minimum till disk, NT – no till direct sowing), by creating a larger space for plant nutrition and development. Sowing was done at 65 (germinative grains) gg/m^2, the distance between the rows being 18-36-54 cm. From the results obtained, in two experimental years, it was concluded that, in the climate and soil conditions of Turda, the tillage system corresponds to a certain sowing distance at which soybean lends itself, achieving higher yields: classic at 18 cm (3189 kg/ha), minimum till chisel at 36 cm (2779 kg/ha), minimum till disc at 54 cm (2875 kg/ha) and for no till direct sowing 36 cm (2349 kg/ha). It noted, the high percentage of protein content in the grains in the variant MTD (32,0% at 54 cm and 31,9% la 18 cm). The lowest values were recorded in the variant NT, at the same distances between the rows. The fact that in the variant NT the lowest values of grain protein content were determined, 30% at18 cm, respectively 29,6% at 54 cm distance between rows, and the highest percentage was found at the same distances between rows in the variant MTD, at 54 cm 32,0%, respectively at 18 cm 31,9%. In terms of fat content, the minimum range was 20% in SC at 18 cm and maximum in MTC at 36 cm distance between rows.*

Key words: *non-conventional system, distance between rows, yield, soybean.*

Classification JEL: Q 01, Q 15, Q 16

INTRODUCTION

The development and modernization of industry, starting in the year 1800 (The Industrial Revolution), conducted to economic growth and the standard of living of mankind. Fossil fuels have been used on a large scale, and by burning them, the level of greenhouse gas emissions also increased. Also for the purpose of expanding cities, of agricultural areas or for tourist purposes, the degree of land use also changed, through massive deforestation. As a result, there was a sharp increase for the average temperature at the land surface. At European level, according to the European Environment Agency, in the year 2019, the polluter with the highest share of participation in the intensification of the greenhouse effect was the energy sector (77,01%), followed by the agricultural sector (10,55%), industrial processes (9,1%) and the waste management sector (3,32%). Romania contributes a percentage of 0,3% to global greenhouse gas emissions and under 3% from the total emissions of EU member countries (www.europarl.europa.e; www.mmediu.ro).

In Europe, many regions are at risk of desertification, due to the increase of temperature, and Romania is no exception to these calamities. An eloquent example is the fact that, due to uncontrolled deforestation of forests with a protective role, specialists say that the southern area is gradually turning into a desert, the largest area affected by aridification is found in Dolj (over 100,000 hectares), thus, this area is also called „Sahara of Oltenia" (www.digi24.ro). And in the Turda area, in the last 65 years, a slight increase in average annual temperatures has been observed, as well as a higher fluctuation in the distribution of precipitation (Șimon, 2022).

Soybean cultivation technology present differences depending on the climatic characteristics, of soil, the relief of the area, the machine system and the impact of applied technologies on the environment (Schutte și Nleya, 2019; Miransari, 2016; Anda, 2019; Taha, 1990; Chețan, 2020).

The paper presents the behavior of soybeans when is cultivated in different types of tillage and varied thicknesses, in the pedo-climatic conditions from ARDS Turda.

MATERIAL AND METHOD

Reducing the effects of atmospheric drought and pedological are part of the reasons that determine the orientation towards new variants of soil works and also the specific orography of the Transylvanian Plateau including also the experimentation area.

The experiment was established on a Clay Iluvial Vertic Chernosem type soil with loamy-clay texture, a neutral pH, good supply of nitrogen, phosphorus and potassium and a medium humus content (SRTS, 2012).

The experience is organized according to the method of subdivided plots (Săulescu and Săulescu, 1967) and is included in a three-year rotation, winter wheat – maize – soybeans.

The early soybean variety Caro TD was used as biological material, a variety with good resistance to falling and shaking, good tolerance to disease attack, and the insertion height of the first basal pods at approx 17 cm facilitates mechanized harvesting with minimal losses (Mureșanu, 2017).

The experimental factors were represented by:

- the tillage system (A): a_1 conventional plough (CS), a_2 minimum till chisel (MTC), a_3 minimum till disk (MTD), a_4 no till direct sowing (NT);
- sowing distance (B): b_1 18 cm, b_2 36 cm, b_3 54 cm;
- the climatic conditions of the two experimental years (C); c_1 2020, c_2 2021.

Soybeans generally have a slow growth rate in the first stages of vegetation, so that, by pre-emergent herbicides on the ground, a wide spectrum of weeds are combated and the crop is kept clean in the first phenophases of vegetation, without weed pressure. To achieve this goal, we chose a proven herbicide, namely the Sencor 600 herbicide dose of 0,35 l/ha (metribuzin 66 g/l) and another molecule, the herbicide Spectrum (dimetenamid-P) 1,4 l/ha). Post-emergence weed control is an absolutely necessary link to the success of the soybean crop, however, for combating dicot weeds, the range of herbicides is quite limited. Thus, to combat dicot weeds, Corum product where used 1,9 l/ha (480 g/l bentazon, 22,4 g/l imazamox), and after 4 days, to combat monocotyledonous weeds, Agil 100 EC was applied 1,0 l/ha (100 gr/li propaquizafop).

Soybean sowing was realized at 65 germinative grains/m^2, simultaneously applying mineral fertilization with 100 kg/ha NPK 20:20:0 ($N_{20}P_{20}$ a.s/ha).

Rising temperatures, prolonged drought (Hossain, 2006; Bailey, 2011; Lombardi, 2015), uneven distribution of precipitation and tillage systems with mulch, they represented favorable conditions for the manifestation of the pest *Tetranychus urticae* Koch (the common red spider) in the first decade of July, in both experimental years. Chemical treatment was required, this being done with the Ortus 5 SC (50 g/l fenpiroximat) product in dose of 0,5 l/ha.

The harvesting of the soybean experiment was carried out respecting the methodological rules of the experimental technique. The harvestable surface of the experimental plot was 28 m^2.

The experimental data were processed by analysis of variance (PoliFact, 2015) and the establishment of limit differences.

Climatic conditions from April to September 2020 and 2021 are presented in figure 1 and 2 (source: Turda Meteorological Station).

RESULTS AND DISCUSSIONS

The thermal regime of the area has a particularly important role in choosing the assortment of varieties to be cultivated. From the data presented, result, in most months, temperatures registered positive deviations in relation to the multi-year monthly average (Figure 1). A limiting factor of soy culture is water. To obtain satisfactory harvests, a pluviometric distribution is necessary in relation to the critical phenophases for water and at least one volume of 500 mm from sowing to physiological maturity, as mentioned in the specialized literature (https://www.donausoja.org/wpcontent/uploads/2022/03/BMP_Soia_ro_06.02.2020_Moldova_conventional-1.pdf). If we analyze the rainfall regime of the two years (Figure 2) sit can be observed that there are negative deviations from the soy requirements, but still the reserve of moisture in the soil that has accumulated until the time of sowing must also be taken into account.

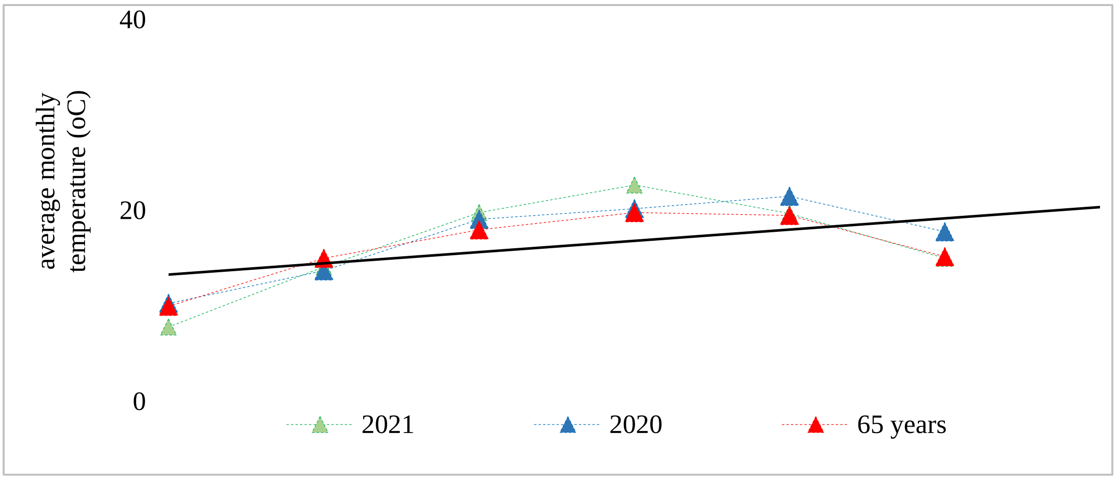

Figure 1. The thermal regime from the period IV-IX 2020, 2021 in Turda

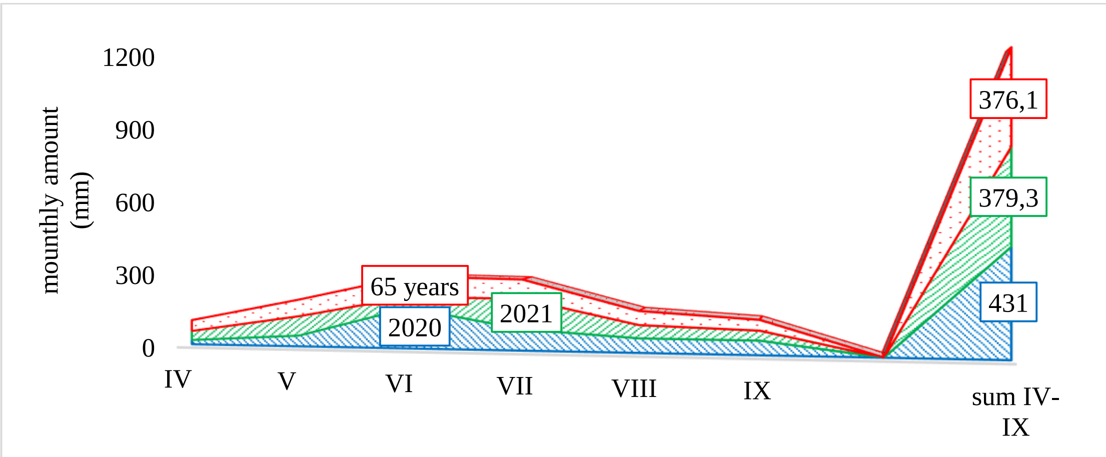

Figure 2. Rainfall regime from IV-IX 2020, 2021 in Turda

The soybean yield obtained show the importance of choosing the optimal tillage option. Soil work, fertilization, plant protection from pest attacks (Mureșanu, 2020; Tărău, 2020), in interaction with other important factors (variety, climatic conditions) they have a direct influence on the yield and quality of crop yield (Morea, 2017; Chețan, 2020; Chețan, 2015). Soybean plants use nitrogen from the soil solution (35-50%) and nitrogen obtained from symbiosis with bacteria *Bradyrhizobium japonicum* from soybean root nodules. Including soybeans in a crop rotation also leads to an economy of chemical fertilizers (Okereke , 1996; Arima, 2000; Ruiz, 2005; Hartman, 2011; Basal, 2020; Șimon, 2018).

The data in table 1, reflect the fact that, soybeans have tillage requirements. Of the four variants studied, the conventional tillage system (plough) it is the most suitable for soybean culture in the pedo-climatic conditions of Transylvania. In the other non-conventional systems compared to the conventional one, soybean yield were diminished, the differences being very significantly negative. Apparently, under the conditions of a soil with more than 40% clay, soybeans are less suitable for direct sowing in uncultivated land (no till), in this variant, the lowest yield is recorded.

Table 1. The influence of the tillage variant in achieving soybean production, Turda 2020-2021

Factor A, tillage system	Yield kg/ha	%	Diferenvce ± kg/ha
a_1 conventional - plough	3079	100	control
a_2 minimum till - chisel	2730	89	-348^{000}
a_3 minimum till - disk	2653	86	-426^{000}
a_4 no till - direct sowing	2259	73	-820^{000}
LSD (p 5%) = 65, LSD (1%) = 120, LSD (0,1%) = 266.			

^{000} = very significantly negative for the probability 0,1%

Soybean spacing is a technological element debated by many researchers, but most opinions converge towards the idea that soy reacts most favorably, if it is sown at a greater distance between the rows, distance that is not over 70 – 80 cm. From field observations followed by further analyses Ardelean, (1973) state that sowing in closer rows favors vegetative development, while sowing in more distant rows is favorable to generative development (grain crops). And our observations were in the same direction, thus, at the sowing distance of 54 cm, the plants formed a compact bush and they branched much more pronounced compared to the 18 cm distance. This fact was realized through a yield of 2744 kg/ha, superior to the other two sowing options. Compared to the control variant, an increase of approximately 100 kg was obtained, the difference being statistically ensured as significantly positive (Table 2). However, it need to mention that, there are certain situations in which due to the large reserve of weeds, if sowing in rare rows is practiced and no special attention is paid to weed control, soybean yield could be significantly affected. Based on the results obtained, the distance between rows at sowing can vary from 18 cm up to 70 cm and it is chosen taking into account primarily the cultivated variety (compact or sprawling bush shape), the degree of weeding of the soil, equipping with machines and equipment for weed control (chemically, leeks), the cultivation system (classical or ecological) etc.

The specialized literature also mentions other research on the influence of the distance between rows of plants, however, it is not possible to accurately determine the effect on plant variability as well as the response of varieties to different sowing densities (Mellendorf, 2011). Taylor (1980) states that the greater distance between the rows contributes to a better development of the plants, these forming more pods.

Table 2. The influence of row spacing in achieving soybean yield, Turda 2020-2021

Factor B, distance between rows	Yield kg/ha	%	Diference ± kg/ha
b_1 18 cm	2647	100	control
b_2 36 cm	2549	96	-98 ^{ns}
b_3 54 cm	2744	104	97*
LSD (p 5%) = 86, LSD (1%) = 125, LSD (0,1%) = 188.			

^{ns} = insignificant, * = significantly positive for probability 5%

As it results from the data presented in table 3, the difference between the average yield of the two years is only 96 kg/ha, therefore it can be stated that in the two years the climatic conditions were not very differentiated regarding the degree of favorability for the soybean crop. In the two years, there were large fluctuations of the two climatic factors throughout the soybean vegetation period, as is: low temperatures in the first part of spring, the alternation between periods of prolonged drought and torrential rains, sometimes accompanied by strong winds or light hail, dbig differences between day and night temperatures etc. The difference compared to the control variant (the average of the two years) is insignificant, only 48 kg/ha. Even though there were no important quantitative differences between the soybean yield of the two years affecting the profitability of the crop are also years in which soybean yield can be significantly reduced and therefore also the profit obtained. It was found that, lately, the frequency of recorded years in which climatic conditions are less favorable to soybean cultivation is increasing. There are other authors who confirm that, crop productivity is mainly conditioned by the climatic conditions during the vegetation period, among which Yamoah, (1998). He claims that soybean production is negatively correlated with rising temperatures in late summer.

Table 3. The influence of climatic conditions on soybean yield, Turda 2020-2021

Factor C, crop year	Yield kg/ha	%	Diference ± kg/ha
c_0 average years	2680	100	control
c_1 2020	2632	98	-48^{ns}
c_2 2021	2728	102	48^{ns}
LSD (p 5%) = 71, LSD (1%) = 100, LSD (0,1%) =142.			

^{ns} = insignificant

The value of protein content in soybeans was around 31% (Table 4). The highest percentage was found in the MTD variant at 54 cm (32,0%), respectively at 18 cm (31,9%), and the lowest in the NT variant at 54 cm. Protein content did not fluctuate much in soybeans grown in deeper tillage variants (CS, MTC), this being contained between 31,0-31,7%. It seems that both soybeans cultivated in SC, where the soil is very loose, as well as for the version without soil mobilization, the grain fat content was the most reduced at the row spacing of 18 cm (20,0%).

Table 4. Results regarding the influence of tillage system x row spacing on the main quality parameters of soybean, Turda 2020-2021

Tillage system	Spacing between rows (cm)	Protein (%)	Fat content (%)
CS (conventional-plough)	18	31.3	20.0
	36	31.3	20.4
	54	31.2	21.1
MTC (minimum till-chisel)	18	31.7	20.5
	36	31.3	21.3
	54	31.0	21.1
MTD (minimum till-disk)	18	31.9	20.1
	36	31.5	20.7
	54	32.0	20.9
NT (no till-direct seeding)	18	30.2	21.2
	36	31.0	20.9
	54	29.6	21.0

CONCLUSIONS

According to the results obtained, we can say that, in the Transylvanian Plateau and on soils with a high clay content, soybean lends itself best to the classic tillage system. Also, the chisel work system cannot be omitted, system in which the yield obtained are quite close to those of the classical system, but in return the amounts of fuel saved are significant, knowing that plowing is the work with the highest fuel consumption. From the sowing distances between rows experimented it is very clear that, soybeans react best at a distance of 54 de cm and recommend to farmers, using this distance when precision planters are not available for creeping plants.

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MANAGEMENT OF PUBLIC INSTITUTIONS

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Abstract: *The study addresses the issue of the management of public institutions in Romania by reviewing the main approaches presented in the specialized literature. The research identifies and describes the characteristics and functions of the management of public institutions as well as the main management systems used in the public management process.*

Keywords: *management, public institutions, public sector, Romania*

JEL classification: H11, H61.

INTRODUCTION

According to the Romanian explanatory dictionary, the public institution is defined as "a form of organization of social relations, according to the legal norms established by fields of activity", this definition centers around collective property which, in its essence, is in a relationship less intense with the personality of the individual, which composes/makes up the society (Siserman & Siserman, 2016).

Public institutions represent "the ensemble of organized structures, which are created in society for the management of public affairs." In the bureaucratic sense, public institutions represent the only way of social-economic organization of the state that can face new challenges such as: the large number of the population, the diversity and complexity of the human needs that need to be met (Marinescu, 2003).

Currently, the trend in the evolution of public administration is to reduce and, as far as possible, to eliminate bureaucracy, a concept that has long been the basis of the organization of public administration and services, making it difficult to carry out activities within it. The way to achieve the liberalization of the public administration consists, first of all, in changing the practiced management style (Dediu et al., 2017).

The emergence of management in the public sector represents a response to the crisis of legitimacy of the public administration, in its traditional mode of operation (Profiroiu et al., 2008).

The management system of public institutions providing services differs from general management techniques by its scope and complexity. Its general objective is to support the public interest. Considering these considerations, we can affirm that the management of public institutions represents the component of the public administration that studies the way in which the methods of achieving the public administration program are applied through the following activities: organization, allocation of resources depending on the own budget, evaluation and control of the activity public administration (Bărăian et al., 2014).

Public management studies the management processes and relationships between different departments of the administrative system, forms principles and regulations regarding the proper functioning of public administration, perfects the organization and proper functioning of public institutions, as the main bodies that provide public services to citizens, influences economic values, political and socio-cultural both at local and central level and aims to satisfy the general and specific interest of the community (Bărăian et al., 2014).

MATERIALS AND METHODS

The research method used in the realization of the work is the complex approach to the theme by studying previous researches developed by various authors in the field, using online resources such as: Google Academic and Enformation.

RESULTS AND DISCUSSIONS

The main normative acts that regulate the organization and operation of public institutions in Romania are the following:

- The Constitution of Romania published in Official Gazette no. 233 of November 21, 1991;
- Law no. 53/2003 – Labor Code (republished and updated);
- Law no. 215 of April 23, 2001 regarding local public administration;
- Law no. 188 of December 8, 1999 regarding the Statute of civil servants;
- Law no. 7/2004 regarding the Code of Conduct of Public Officials;
- Law 500/2002 on public finances, updated;
- Law no. 544 of October 12, 2001 regarding free access to information of public interest, amended and supplemented;
- Law no. 52 of January 21, 2003 on decision-making transparency in public administration;
- Law no. 98/2016 regarding public procurement as well as Decision no. 395 of June 2, 2016 for the approval of the Methodological Norms for the application of the provisions relating to the awarding of the public procurement contract/framework agreement, updated with subsequent amendments;
- Framework Law no. 153 of June 28, 2017 regarding the salary of staff paid from public funds;
- Order 600 of April 20, 2018 regarding the approval of the Code of Internal Managerial Control of Public Entities and the Code of April 20, 2018 of Internal Managerial Control of Public Entities.

The complexity of the concept of scientific management has led to the use of a much greater variety of management systems, methods and techniques. The main systems and general methods specific to the management of public institutions are presented in figure 1:

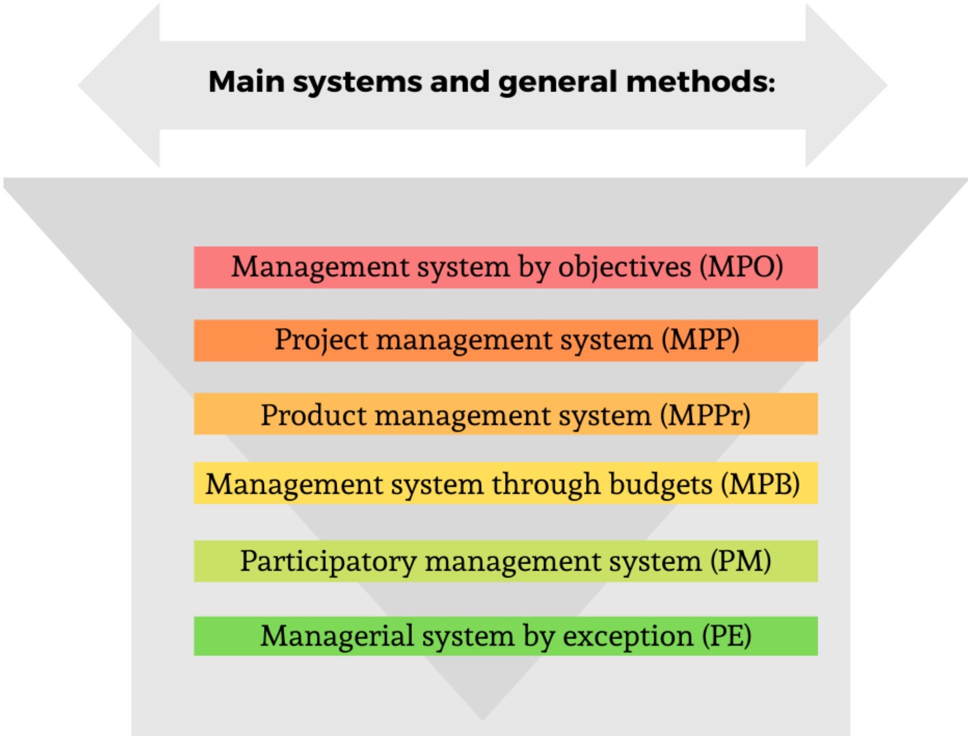


Figure 1 – The general systems and methods of the management of public institutions
Source: GRECU, 2021

The management system by objectives (MPO), this management system vertically harmonizes the management system, based on the transposition of the efforts and results of each component. This is done with the help of instructions, which materialize in action programs made for each subdivision of the public institution. The synchronization of the action is done with the help of the GANT chart or the term calendars, which are drawn up starting from the final deadlines for the fulfillment of the fundamental and specific objectives.

The framework/logistic support of this type of management is provided with the help of the methods assigned to each individual objective, through which the management functions are carried out. The most used methods used on management functions are: forecasting, organization function, coordination and training, control.

Benefits	Disadvantages/Limitations
Realistic substantiation of objectives.	The possibility of not obtaining the consensus of the operations in fulfilling the institution's objectives.
Increasing staff motivation, responsibility in terms of meeting objectives.	-
Developing and maintaining a climate that enhances creativity.	-
Realistic correlation of results with salary level.	-

The project management system (MPP) was created to be a specific variant of management adaptation to the current scale and pace of the manifestation of technical-scientific progress, to solve those problems of an innovative character, in the short term, and for specific organizations that it requires the contribution/involvement of several specialists, from different organizational subdivisions, integrated for a limited period of time, in an autonomous organizational network.

The main organizational methods adopted are grouped into three versions/forms:

- Project-based management with individual responsibility, which assigns responsibility for the development of the project exclusively to a single person, who is responsible for ensuring the coordination necessary to achieve the objectives.
- Project-based management with staff, through which the management of the actions foreseen in the implementation of the project is ensured by the project manager in collaboration with a team that deals exclusively with this problem.
- Mixed project-based management, this represents a mix of the two previously mentioned variants, in which the project as a whole is coordinated by a project manager who collaborates with the managers of the subdivisions within the public institution, who have specific responsibility for the established attributions.

Benefits	Disadvantages/Limitations
Favoring the exchange of experience between the subdivisions of the organization.	Difficulties in harmonizing the organizational network of the public institution with the organizational network related to the project.
It represents the most optimal training framework for managers, who later gain experience in implementing national and international projects.	Difficulty in finding and choosing good project managers and convincing them to take the risks involved.

Product management system (MPPr) This system involves increasing the company's ability to design, assimilate, manufacture and market new products. It is implemented by private equity firms, which must implement activities to maintain products on the market or services provided.

The managerial system by budget (MPB) This system consists in ensuring the management functions of the institution, through budgets. In order for the system to be applied, the fulfillment of several premises must be ensured, such as: the fundamental objectives of the institution must be predominantly of a financial nature; the organizational structures of the institution must allow a delimitation of detailed functional attributions, responsibilities and competences for each subdivision of the public institution; the institution's information system should be centered on the registration, transmission and operational analysis of deviations from the forecasted level of expenses; the design of mechanisms to adapt general and analytical accounting to the requirements imposed by the determination of costs that reflect as faithfully as possible the contribution of each employee to the achievement of objectives.

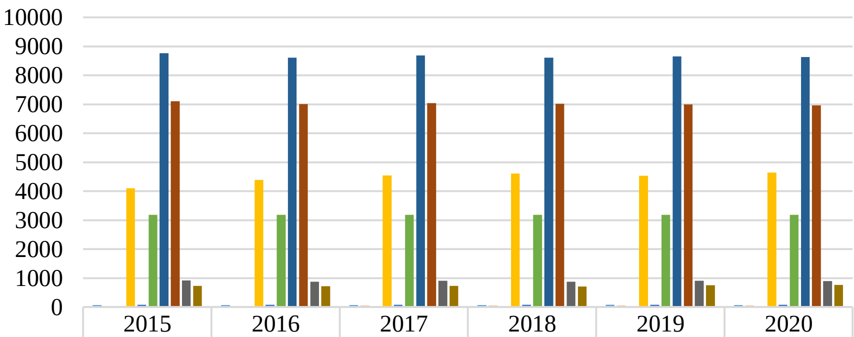
Benefits	Disadvantages/Limitations
The advantages of using budget management derive from the possibility of correctly and clearly highlighting the contribution of each structural component, of amplifying the motivational role of budgets.	Difficulties in adopting the information system, in launching and tracking the execution of budgets.

Managerial System by Exception (MPE) This system was created as a reaction to the tendency of indirect expenses to increase in a much higher proportion than that of direct expenses.

Management by exception is a simplified management system based on the upward provision of information that reflects deviations from established tolerance limits and on the concentration of the best managers in decision-making and operational areas key to the company's competitiveness.Management by exception is advisable to apply in commercial or mass production or small series companies, with well-established technological processes, where the level production activity does not register major variations in the short term.

Participatory managerial system (MP) This management system consists in the exercise of management processes, through the involvement of a large number of managers and executors, and of all institutionalized participatory subdivisions.

Benefits	Disadvantages/Limitations
Increasing the general level of employee information.	Excessive time spent consulting subordinates, participating in organized meetings.
Increasing the degree of substantiation of decisions as a result of the participation of a large number of employees in decision-making processes.	Increasing expenses regarding the preparation of meetings, the creation and multiplication of materials.
-	Poor effectiveness of emerging novel problems.



	2015	2016	2017	2018	2019	2020
Central administration	67	70	73	74	77	69
Ministries and central bodies	42	43	46	48	53	45
Institutions belonging to the government	25	27	27	26	24	24
Local administration	4101	4388	4549	4615	4538	4647
Prefectures, county councils	84	84	84	84	84	84
Mayors, local councils	3187	3187	3187	3187	3187	3187
Social security	8767	8608	8693	8610	8662	8637
Educational units	7108	7010	7047	7020	7001	6970
Health and social assistance units	926	875	912	876	906	902
Cultural and recreational units	733	723	734	714	755	765

Figure 2 - Evolution of public administration institutions, by type of institution in the period 2015-2020 (number)

Source: National Institute of Statistics (INS), tempo online, accessed on 05.09.2022

According to the data provided by the National Institute of Statistics, in 2020, 25,330 public administration institutions were registered.

Analyzing the number of public administration institutions, by type of institution, it was noted that most public institutions are active in the field of social security (8,637 institutions in 2020, down by approx. 1% compared to those registered in 2015), these being followed by educational units (6,970 institutions reported in 2020) and local government institutions (4,647 institutions in 2020). In the period 2015-2020, a decrease in the number of educational units of 2% was noted, and in terms of local administration, an increase in the number of institutions of approx. 13%.

At the opposite pole, with the lowest number of institutions are the institutions that belong to the government, their number reaching 24 institutions in 2020. (Figure 2)

CONCLUSIONS

The management of public institutions, a term also found in the form of public management, is characterized by the following features: it is based on principles and legislation, it studies management processes and relationships, it is determined and determines: economic, political and socio-cultural values, it increases the level of performance in the organization and operation of public institutions, with the general objective of satisfying the public interest.

Considering the new trends and orientations towards digitalization, the management of public institutions in Romania must be permanently enriched conceptually and optimized from an operational point of view.

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HOUSING CONDITIONS IN THE ROMANIAN RURAL HOUSEHOLD IN THE 21ST CENTURY

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Abstract: *Living conditions in the rural area are precarious in Romania, our country being at the bottom of the European ranking, and the situation is getting worse as the degree of isolation increases (mainly in the hilly and mountain areas) combined with the precariousness of livelihood resources in these areas (extremely low possibilities of income-gaining employment, as well as with poor coverage of social services (education, healthcare and social assistance services, etc.). The housing conditions in the Romanian rural household reveal a series of disparities, the most obvious being the rural / urban divide, as well as the disparities existing between different rural areas. The main hypothesis of the paper is the following: there is a strong link between the housing conditions and the development level in the rural area, as well as the rurality level. From the methodological point of view, the first stage of the study was the selection of housing indicators, followed by the identification of the correlation between these indicators and the degree of rurality at county level, in the period 2007-2020. The results reveal a strongly significant correlation between the living conditions and the degree of rurality, the important cities functioning as a growth and development pole for the rural areas in their proximity, with beneficial effects on the housing conditions (modernization of dwellings and easy access to utilities).*

Key words: *rural-urban divide, rural dwelling, living conditions, housing strategies*

JEL Classification: R00, R210, I310

INTRODUCTION

The main idea of the paper is the following: the quality of living conditions is closely linked to the socio-economic condition of the family/household, to the degree of rural development of the area, the degree of rurality. Among the deprivations of the Romanian countryside, the most relevant are the following, as reported in the literature (Mărgineanu, 2006):

- the degree of isolation (determined by the difficult access to certain rural areas, deteriorated roads, lack of means of transport) leads to the depopulation of certain communities, mainly located in the hilly and mountain areas;
- lack/scarcity of necessary livelihood resources in certain rural areas characterized by low possibilities of income-gaining activities;
- limited access to public utilities;
- poor supply of social services in certain rural areas.

Unfortunately, there are some areas where these factors are cumulated, resulting in severe deprivations in terms of living conditions, of housing conditions respectively.

MATERIAL AND METHOD

The housing conditions will be evaluated in close connection to the Rural Development Index (Chițea, 2021), and the indicators selected in the calculation are the following:

- *the living area per inhabitant in the rural area* – is an indicator that captures the quantitative aspect of the living conditions;

- *the renewal of dwelling stock* is a relevant indicator for the modernization of dwellings, also revealing the attractiveness of the area for the active population;
- *the quantity of drinking water supplied to the population, the quantity of natural gas supplied to the population* are useful indicators that measure the degree of comfort, as well as the degree of security for the rural residents' health (ensuring minimal hygiene conditions), for carrying out economic activities (thus the existence of these supply networks increase the opportunity to attract investors in the area), as well as from environmental protection perspective.

The statistical method used in measuring the correlation between the housing conditions and the development level of the rural area is based on Pearson correlation[1] that can be positive (in the case of direct correlations), negative (in the case of inverse correlation) or neutral (no influence) between the analysed variables.

RESULTS AND DISCUSSIONS

There was a downward trend of the rural development index in the period 2007-2020, which may seem strange at first sight. But the composition of this index (demographic, social, economic and ecological dimension) should be taken into consideration, as well as its influence on the index (demographic dimension 34.46%, social dimension 29.05%, economic dimension 20.27% and ecological dimension 16.22%), which reveals the particular importance of the demographic and social dimensions, both being in sharp decline (Chitea, L., Dona, I., Chitea, M., 2018).

The rural development index, in the investigated period, reveals the widening of gaps between different rural areas. The classification of counties by the rural development level, in the year 2020, shows the following structure: counties with a good development level (4.88%): Ilfov, Brașov; counties with an acceptable development level (2.44%): Timiș; counties with a medium development level (26.83%): Iași, Călărași, Satu-Mare, Dâmbovița, Harghita, Mureș, Alba, Maramureș, Sibiu, Bihor, Suceava; counties with a low development level (41.46%): Tulcea, Sălaj, Neamț, Gorj, Dolj, Botoșani, Vrancea, Bacău, Covasna, Constanța, Galați, Cluj, Argeș, Arad, Brăila, Bistrița Năsăud, Hunedoara; counties with a very low development level (24.39%): Olt, Vâlcea, Buzău, Teleorman, Caraș-Severin, Giurgiu, Mehedinți, Vaslui, Ialomița, Prahova. The concentration of more than 60% of the rural areas from Romania in the lower part of the ranking can be noticed.

The links identified through the Pearson correlation between the Rural Development Index and the analysed indicators referring to the housing conditions are direct and highly significant with the indicator Share of new dwellings (+0,638**), as well as with the indicator Quantity of natural gas per inhabitant (+0,643**); a low direct link with the indicator Quantity of drinking water per inhabitant (+0.234) and with the indicator Living area per person (+0.206).

The analysis of aspects regarding housing in the Romanian rural area reveals an increase in the dwelling stock and the living conditions in all the regions and counties of the country, yet the rate of growth is different depending on a number of cumulative factors. Just as the rural development index has as main influence factor the proximity of the development poles, the living conditions keep the same evolution pattern. The more isolated a locality is (generally it is the case of localities located in the hilly and mountain areas), the more precarious the living conditions are, being confronted with a number of synergistic shortcomings, such as: difficult accessibility, lack of livelihood resources,

[1]The Pearson correlation coefficient measures the intensity of the relationship between a resultative variable and a factorial variable, and the values that it may take range from -1 to +1, where the values between (0; 0.2) – no link; (0.2;0.5) – a weak link; (0.5; 0.75) – a medium intensity link; (0.75; 0.95) – a strong link; (0.95; 1) – deterministic link.

low employment possibilities in an income gaining activity, limited access to education, healthcare and social services, major drawbacks related to the access to public utilities, etc.

Table 1. Housing indicators by rural development level, in the year 2020

	Rural development level				
	Very low	**Low**	**Medium**	**Acceptable**	**Good**
RDI 2020	1.02	1.35	1.59	2.04	2.32
Living area per inhabitant (m²/inhabitant)	20.76	20.59	19.11	24.88	24.74
Share of new dwellings (%)	0.22	0.45	0.55	3.58	1.74
Quantity of natural gas per inhabitant (m³/inhabitant)	54.42	78.73	124.17	213.52	454.99
Quantity of drinking water per inhabitant (m³/inhabitant)	22.58	26.43	21.66	37.67	39.82

Source: NIS tempo-online, accessed in September 2022

Table 2. Housing indicators by the degree of rurality, in the year 2020

	Rurality		
	Predominantly urban	**Intermediate**	**Predominantly rural**
RDI	2.34	1.52	1.29
Living area per inhabitant (m²/inhabitant)	28.55	20.71	20.12
Share of new dwellings (%)	2.68	0.88	0.29
Quantity of natural gas per inhabitant (m³/inhabitant)	624.92	148.50	60.78
Quantity of drinking water per inhabitant (m³/inhabitant)	24.69	28.27	23.28

Source: NIS tempo-online, accessed in September 2022

The living area in the countryside significantly increased in the period 2007-2020, from 145,064,495 m² in 2007 to 197,254,950 m² in 2020 (by 35.98%), mainly in the predominantly urban and intermediate rural areas. București-Ilfov region had the highest increase of the living area, even though the region has the lowest share.

Table 3. Evolution of the living area in the countryside in Romania, in the period 2007-2020

Macro-region/region	**Year 2007**	**Year 2020**	**Evolution 2016 versus 2007**	**Share in total 2020**	**Share of macro-regions 2020**	**Share of region in the macro-region 2020**
TOTAL	***145,064,495***	***197,254,950***	***35.98***	***100.00***		
MACRO-REGION 1	**35,847,401**	**48,031,466**	**33.99**	**24.35**	**24.35**	
NORD-VEST Region	19,864,412	27,300,894	37.44	13.84		56.84
CENTRU Region	15,982,989	20,730,572	29.70	10.51		43.16
MACRO-REGION 2	**47,118,926**	**64,430,171**	**36.74**	**32.66**	**32.66**	
NORD-EST Region	27,606,627	38,694,842	40.17	19.62		60.06

Macro-region/region	Year 2007	Year 2020	Evolution 2016 versus 2007	Share in total 2020	Share of macro-regions 2020	Share of region in the macro-region 2020
SUD-EST Region	19,512,299	25,735,329	31.89	13.05		39.94
MACRO-REGION 3	**31,065,037**	**43,927,986**	**41.41**	**22.27**	**22.27**	
SUD-MUNTENIA Region	27,723,156	36,922,763	33.18	18.72		84.05
BUCURESTI – ILFOV Region	3,341,881	7,005,223	109.62	3.55		15.95
MACRO-REGION 4	**31,033,131**	**40,865,327**	**31.68**	**20.72**	**20.72**	
SUD-VEST OLTENIA Region	18,579,148	23,223,077	25.00	11.77		56.83
VEST Region	12,453,983	17,642,250	41.66	8.94		43.17

Source: NIS tempo-online, accessed in September 2022

The living area per person had quite a spectacular evolution in the investigated period, from 15.19 m²/inhabitant in the year 2007 to 20.54 m²/inhabitant in 2020, which can be explained by two contradictory phenomena, namely the decline of the population and of the number of members in the household, on the one hand, and the expansion of the new dwelling stock through the investments of families who worked abroad and through the coming back to the rural areas of city dwellers. There is a gap between different rural areas, also revealed by the hierarchy of counties by average living area, the top counties being Ilfov 28.55 m²/inhabitant, Cluj 25.70 m²/inhabitant, Timiș 24.88 m²/inhabitant; at the bottom of the ranking we can find the counties lacking perspectives or with low perspectives: Iași 16.18 m²/inhabitant, Botoșani 17.09 m²/inhabitant, Vaslui 17.32 m²/inhabitant, Călărași 17.70 m²/inhabitant.

Table 4. Living area per inhabitant in the period 2007-2020

m²/inhabitant

Macro-region/region	2007	2010	2013	2016	2018	2020
TOTAL	***14.90***	***15.55***	***19.03***	***19.60***	***19.97***	***20.40***
MACRO-REGION 1	**15.44**	**16.00**	**19.30**	**19.72**	**19.96**	**20.27**
NORD-VEST Region	15.39	16.14	19.71	20.23	20.54	20.92
CENTRU Region	15.50	15.84	18.79	19.09	19.26	19.48
MACRO-REGION 2	**13.76**	**14.36**	**17.67**	**18.14**	**18.49**	**18.84**
NORD-EST Region	12.93	13.52	16.83	17.24	17.58	17.86
SUD-EST Region	15.13	15.75	19.09	19.66	20.05	20.54
MACRO-REGION 3	**14.79**	**15.70**	**19.48**	**20.25**	**20.74**	**21.36**
SUD-MUNTENIA Region	14.36	15.01	18.54	19.26	19.77	20.38
BUCURESTI – ILFOV Region	19.79	22.93	28.46	28.76	28.45	28.55
MACRO-REGION 4	**16.40**	**16.99**	**20.68**	**21.42**	**21.87**	**22.40**
SUD-VEST OLTENIA Region	15.78	16.41	20.04	20.71	21.12	21.61
VEST Region	17.41	17.93	21.68	22.48	22.97	23.52

Source: NIS tempo-online, accessed in September 2022

The analysis of living conditions specific to rural households reveals the following characteristics: the individual house is the fundamental option of farmers: in the year 2007, the share of those benefitting from an individual house was 94.9%, up to 97.9% in 2020; the quality of living conditions increased: the share of rural households with dwelling problems was lower, in the period

2007-2020, from 49.3% to 17.8% (Mărginean I., 2010). In the list of problems existing in the rural household, the hierarchy is the following: share of households with problems “damaged window frames, walls or floors” – increased from 61.2% in 2007 to 63.3% in 2020; the share of those with “dampness in walls, floors, foundation” – increased from 42.3% in 2007 to 47% in 2020; the share of those with “leaks through the roof or walls” – increased from 30.5% in 2007 to 31.5% in 2020; the share of those with “insufficient light” – increased from 15.5% in 2007 to 27.6% in 2020.

The number of rooms in the rural household had significant evolutions for all types (1-2 rooms; 3-5 rooms; 6 rooms and more); in the same period, 2007-2020, there was an increase from 59.5% to 70.3% for the rural households with dwellings with 3 – 5 rooms; from 2.9% to 3.5%, for the rural households with 6 or more rooms and a decrease from 37.6% to 26.2% for the dwellings with 1-2 rooms (INS, 2007 și 2020). The share of rural dwellings by the endowment with utilities significantly increased in the period 2007-2018, with a diminution of the rural-urban divide, yet the difference remains significant.

Table 5. Endowment with utilities of dwellings, by residence areas, years 2007 and 2020 (%)

Specification	2007	2020
Urban		
With bathroom/shower inside the dwelling	87.5	96.3
With sanitary group (toilet) inside the dwelling	87.4	95.8
Rural		
With bathroom/shower inside the dwelling	20.4	56.7
With sanitary group (toilet) inside the dwelling	16.5	55.2

Source: NIS tempo-online, accessed in September 2022

The share of new dwellings is an indicator that captures modernization through the renewal of the housing space. In the case of this indicator, the category of counties with acceptable modernization-development level stands out, with the highest share of new dwellings, which continued to increase, from 1.35% in 2007 to 3.58% in 2020; all the other categories have low values, with a decreasing trend, ranging from 0.22% for the counties with very low development level to 1.74% for the counties with good development level.

Table 6. Share of new dwellings in total dwellings in the rural area, in the period 2007-2020

Macro-region/region	2007	2010	2013	2016	2018	2020
TOTAL	***0.62***	***0.68***	***0.58***	***0.60***	***0.60***	***0.62***
MACRO-REGION 1	**0.49**	**0.60**	**0.51**	**0.63**	**0.68**	**0.64**
NORD-VEST Region	0.52	0.72	0.61	0.76	0.86	0.75
CENTRU	0.45	0.45	0.37	0.47	0.45	0.49
MACRO-REGION 2	**0.78**	**0.79**	**0.62**	**0.62**	**0.56**	**0.52**
NORD-EST Region	0.77	0.84	0.70	0.70	0.62	0.57
SUD-EST Region	0.79	0.71	0.51	0.49	0.47	0.45

Macro-region/region	2007	2010	2013	2016	2018	2020
MACRO-REGION 3	**0.74**	**0.85**	**0.71**	**0.64**	**0.66**	**0.68**
SUD-MUNTENIA Region	0.52	0.65	0.49	0.43	0.44	0.42
BUCURESTI – ILFOV Region	3.29	2.96	2.72	2.42	2.45	2.68
MACRO-REGION 4	**0.41**	**0.41**	**0.43**	**0.49**	**0.53**	**0.67**
SUD-VEST OLTENIA Region	0.33	0.32	0.28	0.19	0.20	0.19
VEST Region	0.55	0.57	0.72	1.03	1.10	1.50

Source: NIS tempo-online, accessed in September 2022

The share of new dwellings remained relatively the same in the period 2007-2020, the national average being 0.62%; values greater than one were found in the rural areas from București-Ilfov (2.68%) and Vest regions (1.50%), namely in the counties Timiș (3.58%), Ilfov (2.68%), Cluj (1.89%), Sibiu (1.41%) and Constanța (1.01%). The share of new dwellings increased only in 12 counties, namely in Timiș, Cluj, Sibiu, Giurgiu, Brasov, Bihor, Arad, Iași.

It is worth noting that there are rural localities in the proximity of cities that attract the retired population from cities who prefer to return to the countryside, as well as young persons for whom the rural area is a refuge for the weekend. This phenomenon may contribute to the increase in the number of new dwellings.

The indicators *quantity of natural gas supplied to the population* and *quantity of drinking water supplied to the population* are relevant for measuring the degree of rural area modernization through the increase in the degree of comfort as well as the degree of health security of rural people (ensuring minimum hygiene conditions), for the development of economic activities (the existence of these networks increase the chances for the area to attract investors), as well as from the perspective of environmental protection.

In the Romanian rural area, the drinking water supply and sewerage networks are less extended on rural households. Even though there are drinking water supply and sewerage networks at the level of the locality, the households cannot use them, as there are no equipped kitchens and bathrooms on the households, and the rural people do not have the possibility to make investments to have access to these utilities. In the rural households, only 8% of the population uses the sewerage network.

Table 6. Quantity of drinking water supplied per inhabitant in the rural areas, 2007-2020

m³/inhabitant

Macro-region/region	2007	2010	2013	2016	2018	2020
TOTAL	***15.71***	***16.51***	***18.01***	***19.50***	***20.86***	***23.14***
MACRO-REGION 1	**21.37**	**21.99**	**22.04**	**23.45**	**25.08**	**27.06**
NORD-VEST Region	16.98	20.84	20.73	21.62	22.96	25.30
CENTRU Region	26.86	23.42	23.66	25.70	27.67	29.22
MACRO-REGION 2	**13.04**	**12.77**	**13.64**	**14.54**	**15.67**	**17.44**
NORD-EST Region	6.36	6.26	7.01	8.30	9.68	10.18
SUD-EST Region	24.11	23.59	24.73	25.16	25.93	30.01
MACRO-REGION 3	**12.84**	**15.02**	**16.87**	**18.34**	**20.10**	**24.41**
SUD-MUNTENIA Region	12.67	14.89	16.53	18.74	20.41	24.37

Macro-region/region	2007	2010	2013	2016	2018	2020
BUCURESTI – ILFOV Region	14.86	16.45	20.15	14.94	17.61	24.69
MACRO-REGION 4	**16.79**	**18.20**	**22.27**	**25.01**	**25.96**	**27.29**
SUD-VEST OLTENIA Region	13.11	13.86	15.09	17.39	18.31	19.78
VEST Region	22.84	25.11	33.40	36.50	37.24	38.04

Source: NIS tempo-online, accessed in September 2022

At national level, the average amount of drinking water supplied to the population is 23.14 m³/inhabitant in the year 2020. The territorial differences are obvious across macro-regions, regions and counties, and the smaller the territorial unit, the greater the differences:

- at macro-regional level, from 17.44 m³/inhabitant in Macro-region 2 to 27.29 m³/inhabitant in Macro-region 4;
- at regional level, from 10.18 m³/inhabitant in Nord-Est region to 38.04 m³/inhabitant in Vest region;
- at county level, from 4.23 m³/inhabitant in Giurgiu county to 57.35 m³/inhabitant in Brașov county.

In the case of rural localities connected to the natural gas network, the natural gas supplied to the population increased in the investigated areas, and the largest quantities and the highest growth rates are mostly found in counties with a high development level, such as Ilfov county, with 693.05 m³/inhabitant, Cluj with 354.41 m3/inhabitant, Brașov with 320.76 m³/inhabitant and Prahova with 302.21 m³/inhabitant.

Table 7. The quantity of natural gas supplied per inhabitant in the rural areas, 2007-2020

m³/inhabitant

Macro-region/region	2007	2010	2013	2016	2018	2020
TOTAL	***66.16***	***66.99***	***68.30***	***79.39***	***96.14***	***112.66***
MACRO-REGION 1	**107.90**	**105.12**	**101.65**	**113.23**	**126.81**	**148.75**
NORD-VEST Region	56.96	68.55	75.08	84.91	95.60	112.06
CENTRU Region	171.64	150.49	134.45	148.04	165.14	193.74
MACRO-REGION 2	**32.53**	**23.80**	**24.05**	**31.77**	**42.45**	**53.55**
NORD-EST Region	41.40	28.22	22.92	28.24	41.22	55.31
SUD-EST Region	17.85	16.44	25.93	37.78	44.57	50.50
MACRO-REGION 3	**86.78**	**114.90**	**127.39**	**147.80**	**185.07**	**201.23**
SUD-MUNTENIA Region	64.02	80.31	87.15	99.26	128.79	143.83
BUCURESTI – ILFOV Region	347.04	481.18	511.52	566.65	632.63	624.92
MACRO-REGION 4	**52.92**	**45.18**	**41.48**	**47.77**	**56.45**	**76.74**
SUD-VEST OLTENIA Region	8.75	20.70	15.37	19.85	23.39	32.88
VEST Region	125.64	84.19	81.91	89.88	105.23	139.57

Source: NIS tempo-online, accessed in September 2022

The national average quantity of natural gas supplied to the population is 125.83 m³/inhabitant, with significant differences across counties, regions and macro-regions:

- **at macro-regional level**, from 60.47 m³/inhabitant in Macro-region 2 to 226.21 m³/inhabitant in Macro-region 3;
- **at regional level**, from 38.69 m³/inhabitant in Sud-Vest region to 693.05 m³/inhabitant in București-Ilfov region;
- **at county level**, from 0 m³/inhabitant in Mehedinți county to 693.05 m³/inhabitant in Ilfov county.

CONCLUSIONS

From the analysis of the link between the indicators of housing and rurality, the rural development level respectively, an increase of discrepancies between the developed and underdeveloped areas, with diametrically opposite trends, can be noticed, as follows: the developed rural areas continue to have access to resources, which also translates into the housing size, the increase of living conditions (new dwellings, more generous spaces, access to utilities, housing equipment, etc.); at the same time, the underdeveloped rural areas are confronted with a high depopulation level, a high degradation of living conditions (many deserted dwellings, under a high degradation process, while the populated dwellings most often do not have adequate living conditions out of the lack of financial resources, small-sized unsanitary dwellings, lack of access to utilities, etc.

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DETERMINATIONS OF THE AREA NEEDED FOR THE FAMILY FARM TO REACH A VIABLE ECONOMIC SIZE

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Abstract: *The high number of subsistence and semi-subsistence farms is due to their small economic size, mainly due to the low efficiency of the crops grown in relation to the small area they cultivate. Using the Simplex method, the areas that family farms would need to farm in order to ensure a normal living for all family members were determined. The aim of this study is to identify the economic size of family farms and to create scenarios that indicate to farmers the categories of crops they can cultivate in order to reach the determined economic size, thus ensuring a normal/optimal standard of living for family farm members.*

Keywords: *family farm, rural development, Romania, sustainable*.

JEL classification: Q10, Q12, Q14, Q19.

INTRODUCTION

Family farms should support economic activity in rural communities. On this basis, rural areas can develop harmoniously, reducing the disparity between urban and rural areas, rejuvenating the rural population and preventing rural exodus to urban areas or other countries (Ana, 2017; Andrei et al., 2017).

Through Law No. 37/2015 on the classification of farms and agricultural holdings, which establishes a unified framework for the implementation of programmes financed from the state budget and EU funds. Commercial farms that market more than 50% of agricultural production and have an economic size between 8,000 and 49,000 SO, family farms can also be included in this range (Rădulescu, 2003).

At the European level, family farms are given particular importance and are defined differently in different countries, depending on the particularities of each country. At European level, the term 'family farm' or 'family farmer' can be defined in a number of ways, referring to the share of farm work, the form of ownership and control and the legal status (who is at risk) (Bădescu et al., 2009; Păun, 2014; Drăgoi, 2012).

In Austria, for example, family farms take several forms, depending on the natural, social and cultural conditions, as well as the economic situation and the respective purposes of the farm. The FAO has also developed the following definition for this type of farm, based on: the way it is run by the family, based primarily on the domestic work of women and men. Households and farms are economic, environmental, reproductive, social, and cultural functions that are interconnected, developed, and integrated." (Dumitru et al., 2021; Brînzan, 2007).

In Spain, "family farming" is a way of organising agricultural, forestry, livestock, and aquaculture production, managed and run by families, based primarily on domestic work by both women and men. In order to create viable family farms, it is necessary to have an appropriate legislative framework that defines these farms according to certain criteria and is developed on the basis of the main farm profile (Bonny, 1994; Micu et al., 2022; Iancu et al., 2022).

A possible definition of the family farm could be translated as: "the family farm is a means of organising agriculture as a whole, owned by one or more persons, the activities on the farm are carried out by family members and the marketing of production provides the main source of income at family level. At the same time most of the food consumption comes from the farm itself" (Mateoc-Sîrb et al., 2010; Cimpoieș, 2012).

The aim of this study is to identify the economic size of family farms and to create scenarios that indicate to farmers the categories of crops they can grow to reach the determined economic size, thus ensuring a normal/optimal standard of living for family farm members.

MATERIALS AND METHODS

In order to meet the above definition, the family farm should reach a minimum income per family member, which corresponds to the standard of living in our country. For this purpose, an annual income at farm level has been established according to the formula shown in the figure below, taking into account the following aspects (Figure 1.):

- Number of household members,
- The minimum/average wage in the economy,
- Farm profile,
- Consumption by the household.

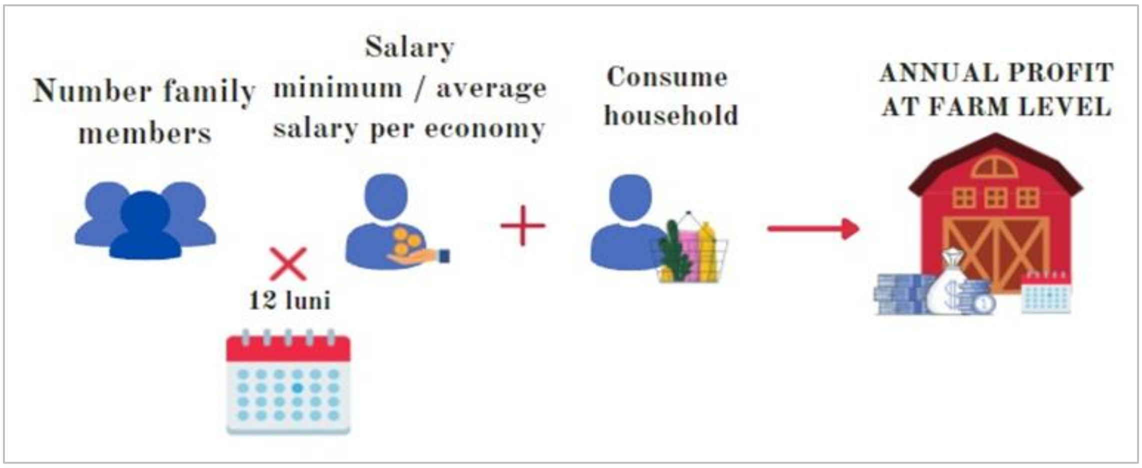

Figure 1. How the minimum income for a family farm is determined (Dumitru, 2020)

Source: own processing;

To determine the economic size of a family farm, the following assumptions were taken into account:

- I1 - Determination of a minimum income per family farm according to the number of members;
- I2 - Determination of a maximum income for the family farm according to the number of members;
- I3 - Classification of family farms by economic size.

To determine the viable economic size of a family farm, the following elements were taken into account:

- Composition of the family farm (number of members),
- Minimum net wage in the economy for the year 2022,
- Average net wage in the economy in 2022,

- Average monthly expenditure on food and beverages consumed in rural areas for the year 2019.
- Average exchange rate for the year 2021 NBR (1 euro = 4.9204 lei)

The family farm consists of a minimum of 2 people, but can be made up of up to 8 people, which is 3 times the existing average. According to INS data, in 2020, the number of rural households was 3.509 million and the rural population was 8.87 million, giving an average of 2.5 inhabitants/household.

The average monthly expenditure on food and beverages consumed in rural areas, according to the NSI, is about 211 lei/month/person.

The share of farm income (result/profit) in total production was determined at the Romanian level, according to statistical data found on Eurostat, at 37.5% (including subsidies).

For the determination of the economic size, the most recent available data were taken as parameters to reflect as accurate a situation as possible for the farms.

The simplex method is an iterative procedure for solving linear programming problems in tabular form. The simplex method generates new basic feasible solutions that increase the value of the objective function (or at least leave it unchanged) by generating new tabular forms for the system of equations. When no further improvement can be made, the optimal solution has been reached.

The simplex method consists of 3 steps:

1. Find the largest positive value for cj - zj. This will designate the pivot column. If there is no such value, then the optimal solution has already been found.

2. For each positive value in the pivot column, find the ratio: (right member)/(corresponding element in the pivot column). The minimum ratio establishes the pivot line. At the intersection of the pivot column and the pivot line is the pivot element.

3. Generate the new tabular form as follows:

(a) Split the pivot line at the pivot element;

(b) For all other lines, multiply the new line generated in (a) by the corresponding element in the pivot column and extract from the current line.

(c) Complete the cells of the table and proceed to step 1.

On the basis of the determination presented above, 7 scenarios with two variants (Normal variant and Optimistic variant) have been produced, based on the following methodology of scenario development using the Simplex method:

1. The average value of SO was calculated for the main categories of plant products: cereal crops,, oilseed crops, protein crops and vegetable and flower crops according to the list of standard production calculation coefficients for the crop and livestock sector.

2. The restrictions imposed by this method were as follows:

Table 1. Restrictions on the use of the simplex method

<table>
<tr><th>Restriction variant</th><th>Cereal plants</th><th>Oil plants</th><th>Protein plants</th><th>Vegetable/flowering plants (field)</th><th>Justification</th></tr>
<tr><td>Average S.O.</td><td>476</td><td>606</td><td>533</td><td>12,967</td><td>-</td></tr>
<tr><td>V1</td><td>0.25</td><td>0.25</td><td>0.25</td><td>0.25</td><td>The variant recommended by most profile authors, using this type of isolation</td></tr>
<tr><td>V2</td><td>0.2</td><td>0.2</td><td>0.2</td><td>0.4</td><td rowspan="2">As family farms use a reduced size of agricultural land, in order to record a higher OS value, they need to grow crops with a higher OS, where vegetable/floral crops fall into this category</td></tr>
<tr><td>V3</td><td>0</td><td>0</td><td>0</td><td>1</td></tr>
</table>

Source: own processing;

Each scenario was based on the economic size determined in Table 1. according to the number of existing members on the family farm.

RESULTS AND DISSCUSION

For the year 2022, the minimum and average wage in the economy has changed, which has altered the economic size of the family farm, as shown in the table below.

Table 2. Determining the Economic Size of the Family Farm in 2022

Nr. crt.	Family members	Minimum/average economy wage	Average monthly expenditure on food and drink consumed	Months	Suggested profit achieved at farm level (lei) (1*(2+3) *4	Recommended profit in euro (rate 4.9204 euro) (col. 5 * exchange rate)	Production expenditure (euro) (according to Eurostat *)	SO VALUE (firm income) (euro)	Simulation - Physical size of the farm (wheat crop)
0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1	2	1,524	211	12	41,640	8,463	15,716	24,179	39
2	2	3,879	211	12	98,160	19,950	37,049	56,999	93
3	3	1,524	211	12	62,460	12,694	23,575	36,269	59
4	3	3,879	211	12	147,240	29,924	55,574	85,498	139
5	4	1,524	211	12	83,280	16,925	31,433	48,358	79
6	4	3,879	211	12	196,320	39,899	74,099	113,998	186
7	5	1,524	211	12	104,100	21,157	39,291	60,448	98
8	5	3,879	211	12	245,400	49,874	92,623	142,497	232
9	6	1,524	211	12	124,920	25,388	47,149	72,538	118
10	6	3,879	211	12	294,480	59,849	111,148	170,997	278
11	7	1,524	211	12	145,740	29,620	55,008	84,627	138
12	7	3,879	211	12	343,560	69,824	129,672	199,496	325
13	8	1,524	211	12	166,560	33,851	62,866	96,717	157
14	8	3,879	211	12	392,640	79,798	148,197	227,995	371
15	9	1,524	211	12	187,380	38,082	70,724	108,806	177
16	9	3,879	211	12	441,720	89,773	166,722	256,495	418
17	10	1,524	211	12	208,200	42,314	78,582	120,896	197
18	10	3,879	211	12	490,800	99,748	185,246	284,994	464

Source: own processing;

*based on the minimum/average wage in the economy, the lower and upper limits were determined according to family members

Due to the increase in the minimum/average income in the economy, as well as the increase in the exchange rate, the value of the S.O. has increased significantly, so that in the case of a family farm, consisting of 2 persons, in the normal scenario, the economic size would be 24,179 S.O., In the "optimistic" scenario, the economic size of the same type of holding would be 56,999 S.O., compared to the previous year of analysis when it was 48,015 S.O. (equivalent to 93 hectares of wheat) (Table 2.).

Table 3. Scenario A1 (Objective function) - 2 members - 24,146 N/A

Subsistence and semi-subsistence farm	Cereal plants	Oil plants	Protein plants	Vegetable and flowering plants	Total
V1 Restrictions	0.25	0.25	0.25	0.25	1
Area (ha)	1.66	1.66	1.66	1.66	6.62
Estimated economic size (S.O.)	24,146				
V2 Restrictions	0.2	0.2	0.2	0.4	1
Area (ha)	0.88	0.88	0.88	1.75	4.39
Estimated economic size (S.O.)	24,162				
V3 Restrictions	0	0	0	1	1
Area (ha)	0.00	0.00	0.00	1.86	1.86
Estimated economic size (S.O.)	24,179				

Source: own processing;

In order to reach a minimum (normal) economic size of 24.146 S.O., the 2-person farm needs to cultivate 6.62 hectares taking into account the restrictions of option 1, 4.39 hectares taking into account the restrictions of option 2 and 1.86 hectares taking into account the restrictions of option 3 (where only vegetables and flowers are cultivated) (Table 3.).

Table 4. Scenario A2 (objective function) - 2 members - 56,999 N/A

Subsistence and semi-subsistence farm	Cereal plants	Oil plants	Protein plants	Vegetable and flowering plants	Total
V1 Restrictions	0.25	0.25	0.25	0.25	1
Area (ha)	3.90	3.90	3.90	3.90	15.61
Estimated economic size (S.O.)	56,845				
V2 Restrictions	0.2	0.2	0.2	0.4	1
Area (ha)	2.07	2.07	2.07	4.14	10.34
Estimated economic size (S.O.)	56,958				
V3 Restrictions	0	0	0	1	1
Area (ha)	0.00	0.00	0.00	4.40	4.40
Estimated economic size (S.O.)	56,999				

Source: own processing;

In order to reach an optimal economic size of 56,999 S.O., the 2-person farm needs to cultivate 15.61 hectares taking into account the restrictions of option 1, 10.34 hectares taking into account the restrictions of option 2 and 4.40 hectares taking into account the restrictions of option 3 (where only vegetables and flowers are cultivated) (Table 4.).

Table 5. Scenario B1 (Objective function) - 3 members - 36,269 N/A

Subsistence and semi-subsistence farm	Cereal plants	Oil plants	Protein plants	Vegetable and flowering plants	Total
V1 Restrictions	0.25	0.25	0.25	0.25	1
Area (ha)	2.48	2.48	2.48	2.48	9.94
Estimated economic size (S.O.)	36,243				
V2 Restrictions	0.2	0.2	0.2	0.4	1
Area (ha)	1.32	1.32	1.32	2.63	6.58
Estimated economic size (S.O.)	36,243				
V3 Restrictions	0	0	0	1	1
Area (ha)	0.00	0.00	0.00	2.80	2.80
Estimated economic size (S.O.)	36,269				

Source: own processing;

To reach a minimum (normal) economic size of 36,269 SO, the 3-person farm needs to cultivate 9.94 hectares taking into account the restrictions of variant 1, 6.58 hectares taking into account the restrictions of variant 2 and 2.80 hectares taking into account the restrictions of variant 3 (where only vegetables and flowers are cultivated) (Table 5).

Table 6. Scenario B2 (Objective function) - 3 members - 85,498 N/A

Subsistence and semi-subsistence farm	Cereal plants	Oil plants	Protein plants	Vegetable and flowering plants	Total
V1 Restrictions	0.25	0.25	0.25	0.25	1
Area (ha)	5.86	5.86	5.86	5.86	23.42
Estimated economic size (S.O.)	85,319				
V2 Restrictions	0.2	0.2	0.2	0.4	1
Area (ha)	3.10	3.10	3.10	6.20	15.51
Estimated economic size (S.O.)	85,435				
V3 Restrictions	0	0	0	1	1
Area (ha)	0.00	0.00	0.00	6.59	6.59
Estimated economic size (S.O.)	85,496				

Source: own processing;

To reach an optimal economic size of 85,498 SO, the 3-person farm needs to cultivate 23.42 hectares taking into account the restrictions of option 1, 15.51 hectares taking into account the restrictions of option 2 and 6.59 hectares taking into account the restrictions of option 3 (where only vegetables and flowers are cultivated) (Table 6.).

Table 7. Scenario C1 (objective function) - 4 members - 48,358 N/A

Subsistence and semi-subsistence farm	Cereal plants	Oil plants	Protein plants	Vegetable and flowering plants	Total
V1 Restrictions	0.25	0.25	0.25	0.25	1
Area (ha)	3.31	3.31	3.31	3.31	13.25
Estimated economic size (S.O.)	48,292				
V2 Restrictions	0.2	0.2	0.2	0.4	1
Area (ha)	1.75	1.75	1.75	3.51	8.77
Estimated economic size (S.O.)	36,243				
V3 Restrictions	0	0	0	1	1
Area (ha)	0.00	0.00	0.00	3.73	3.73
Estimated economic size (S.O.)	48,358				

Source: own processing;

In order to reach a minimum (normal) economic size of 48,358 S.O., the 4-person farm needs to cultivate 13.25 hectares under the restrictions of option 1, 8.77 hectares under the restrictions of option 2 and 3.73 hectares under the restrictions of option 3 (where only vegetables and flowers are cultivated) (Table 7.).

Table 8. Scenario C2 (Objective Function) - 4 members - 113,998 N/A

Subsistence and semi-subsistence farm	Cereal plants	Oil plants	Protein plants	Vegetable and flowering plants	Total
V1 Restrictions	0.25	0.25	0.25	0.25	1
Area (ha)	7.81	7.81	7.81	7.81	31.23
Estimated economic size (S.O.)	113,843				
V2 Restrictions	0.2	0.2	0.2	0.4	1
Area (ha)	4.14	4.14	4.14	8.27	20.68
Estimated economic size (S.O.)	113,916				
V3 Restrictions	0	0	0	1	1
Area (ha)	0.00	0.00	0.00	8.79	8.79
Estimated economic size (S.O.)	113,998				

Source: own processing;

In order to reach an optimal economic size of 113,998 S.O., the 4-person farm needs to cultivate 31.23 hectares taking into account the restrictions of option 1, 20.68 hectares taking into account the restrictions of option 2 and 8.79 hectares taking into account the restrictions of option 3 (where only vegetables and flowers are cultivated) (Table 8.).

Table 9. Scenario D1 (Objective function) - 5 members - 60,448 N/A

Subsistence and semi-subsistence farm	Cereal plants	Oil plants	Protein plants	Vegetable and flowering plants	Total
V1 Restrictions	0.25	0.25	0.25	0.25	1
Area (ha)	4.14	4.14	4.14	4.14	16.56
Estimated economic size (S.O.)	60,366				
V2 Restrictions	0.2	0.2	0.2	0.4	1
Area (ha)	2.19	2.19	2.19	4.39	10.96
Estimated economic size (S.O.)	60,405				

Subsistence and semi-subsistence farm	Cereal plants	Oil plants	Protein plants	Vegetable and flowering plants	Total
V3 Restrictions	0	0	0	1	1
Area (ha)	0.00	0.00	0.00	4.66	4.66
Estimated economic size (S.O.)	60,448				

Source: own processing;

To reach a minimum (normal) economic size of 60,488 SO, the 5-person farm needs to cultivate 16.56 hectares under the restrictions of option 1, 10.96 hectares under the restrictions of option 2 and 4.66 hectares under the restrictions of option 3 (where only vegetables and flowers are cultivated) (Table 9.).

Table 10. Scenario D2 (Objective function) - 5 members - 142,497 N/A

Subsistence and semi-subsistence farm	Cereal plants	Oil plants	Protein plants	Vegetable and flowering plants	Total
V1 Restrictions	0.25	0.25	0.25	0.25	1
Area (ha)	9.76	9.76	9.76	9.76	39.04
Estimated economic size (S.O.)	142,304				
V2 Restrictions	0.2	0.2	0.2	0.4	1
Area (ha)	5.17	5.17	5.17	10.34	25.84
Estimated economic size (S.O.)	142,395				
V3 Restrictions	0	0	0	1	1
Area (ha)	0.00	0.00	0.00	10.99	10.99
Estimated economic size (S.O.)	60,448				

Source: own processing;

In order to reach an optimal economic size of 142,497 S.O., the 5-person farm needs to cultivate 39.04 hectares taking into account the restrictions of option 1, 25.84 hectares taking into account the restrictions of option 2 and 10.99 hectares taking into account the restrictions of option 3 (where only vegetables and flowers are cultivated) (Table 10.).

Table 11. Scenario E1 (Objective function) - 6 members - 72,538 N/A

Subsistence and semi-subsistence farm	Cereal plants	Oil plants	Protein plants	Vegetable and flowering plants	Total
V1 Restrictions	0.25	0.25	0.25	0.25	1
Area (ha)	4.97	4.97	4.97	4.97	19.87
Estimated economic size (S.O.)	72,440				
V2 Restrictions	0.2	0.2	0.2	0.4	1
Area (ha)	2.63	2.63	2.63	5.26	13.16
Estimated economic size (S.O.)	72,486				
V3 Restrictions	0	0	0	1	1
Area (ha)	0.00	0.00	0.00	5.59	5.59
Estimated economic size (S.O.)	72,538				

Source: own processing;

In order to reach a minimum (normal) economic size of 72,538 S.O., the 6-person farm needs to cultivate 19.87 hectares taking into account the restrictions of variant 1, 13.16 hectares taking into account the restrictions of variant 2 and 5.59 hectares taking into account the restrictions of variant 3 (where only vegetables and flowers are cultivated) (Table 11.).

Table 12. Scenario E2 (Objective Function) - 6 members - 170,997 N/A

Subsistence and semi-subsistence farm	Cereal plants	Oil plants	Protein plants	Vegetable and flowering plants	Total
V1 Restrictions	0.25	0.25	0.25	0.25	1
Area (ha)	11.71	11.71	11.71	11.71	46.84
Estimated economic size (S.O.)	170,765				
V2 Restrictions	0.2	0.2	0.2	0.4	1
Area (ha)	6.20	6.20	6.20	12.41	31.01
Estimated economic size (S.O.)	170,874				
V3 Restrictions	0	0	0	1	1
Area (ha)	0.00	0.00	0.00	13.19	13.19
Estimated economic size (S.O.)	170,997				

Source: own processing;

In order to reach an optimal economic size of 170,997 S.O., the 6-person farm needs to cultivate 46.84 hectares taking into account the restrictions of option 1, 31.01 hectares taking into account the restrictions of option 2 and 13.19 hectares taking into account the restrictions of option 3 (where only vegetables and flowers are cultivated) (Table 12.).

Table 13. Scenario F1 (Objective function) - 7 members - 84,627 N/A

Subsistence and semi-subsistence farm	Cereal plants	Oil plants	Protein plants	Vegetable and flowering plants	Total
V1 Restrictions	0.25	0.25	0.25	0.25	1
Area (ha)	5.80	5.80	5.80	5.80	23.18
Estimated economic size (S.O.)	84,512				
V2 Restrictions	0.2	0.2	0.2	0.4	1
Area (ha)	3.07	3.07	3.07	6.14	15.35
Estimated economic size (S.O.)	84,566				
V3 Restrictions	0	0	0	1	1
Area (ha)	0.00	0.00	0.00	6.53	6.53
Estimated economic size (S.O.)	84,627				

Source: own processing;

To reach a minimum (normal) economic size of 84,627 SO, the 7-person farm needs to cultivate 23.18 hectares under the restrictions of option 1, 15.35 hectares under the restrictions of option 2 and 6.53 hectares under the restrictions of option 3 (where only vegetables and flowers are cultivated) (Table 13.).

Table 14. Scenario F2 (Objective function) - 7 members - 199,496 N/A

Subsistence and semi-subsistence farm	Cereal plants	Oil plants	Protein plants	Vegetable and flowering plants	Total
V1 Restrictions	0.25	0.25	0.25	0.25	1
Area (ha)	13.66	13.66	13.66	13.66	54.65
Estimated economic size (S.O.)	170,765				
V2 Restrictions	0.2	0.2	0.2	0.4	1
Area (ha)	7.24	7.24	7.24	14.47	36.18
Estimated economic size (S.O.)	170,874				
V3 Restrictions	0	0	0	1	1
Area (ha)	0.00	0.00	0.00	15.39	15.39
Estimated economic size (S.O.)	170,997				

Source: own processing;

In order to reach an optimal economic size of 199,496 S.O., the 7-person farm needs to cultivate 54.65 hectares taking into account the restrictions of option 1, 36.18 hectares taking into account the restrictions of option 2 and 15.39 hectares taking into account the restrictions of option 3 (where only vegetables and flowers are cultivated) (Table 14.).

Table 15. Scenario G1 (Objective function) - 8 members - 96,717 N/A

Subsistence and semi-subsistence farm	Cereal plants	Oil plants	Protein plants	Vegetable and flowering plants	Total
V1 Restrictions	0.25	0.25	0.25	0.25	1
Area (ha)	6.62	6.62	6.62	6.62	26.49
Estimated economic size (S.O.)	96,586				
V2 Restrictions	0.2	0.2	0.2	0.4	1
Area (ha)	3.51	3.51	3.51	7.02	17.54
Estimated economic size (S.O.)	96,647				
V3 Restrictions	0	0	0	1	1
Area (ha)	0.00	0.00	0.00	7.46	7.46
Estimated economic size (S.O.)	96,717				

Source: own processing;

To reach a minimum (normal) economic size of 96,717 SSO, the 8-person farm needs to cultivate 26.49 hectares taking into account the restrictions of variant 1, 17.54 hectares taking into account the restrictions of variant 2 and 7.46 hectares taking into account the restrictions of variant 3 (where only vegetables and flowers are grown) (Table 15.).

Table 16. Scenario G2 (Objective Function) - 8 members - 227,995 N/A

Subsistence and semi-subsistence farm	Cereal plants	Oil plants	Protein plants	Vegetable and flowering plants	Total
V1 Restrictions	0.25	0.25	0.25	0.25	1
Area (ha)	15.61	15.61	15.61	15.61	62.46
Estimated economic size (S.O.)	227,686				
V2 Restrictions	0.2	0.2	0.2	0.4	1
Area (ha)	8.27	8.27	8.27	16.54	41.35
Estimated economic size (S.O.)	227,831				

Subsistence and semi-subsistence farm	Cereal plants	Oil plants	Protein plants	Vegetable and flowering plants	Total
V3 Restrictions	0	0	0	1	1
Area (ha)	0.00	0.00	0.00	17.58	17.58
Estimated economic size (S.O.)	227,995				

Source: own processing;

In order to reach an optimal economic size of 227,995 S.O., the 8-person farm needs to cultivate 62.46 hectares under the restrictions of option 1, 41.35 hectares under the restrictions of option 2 and 17.58 hectares under the restrictions of option 3 (where only vegetables and flowers are cultivated) (Table 1.16.).

CONCLUSIONS

The high number of subsistence and semi-subsistence farms is due to their small economic size, mainly due to the low efficiency of the crops grown in relation to the small area they cultivate.

This is also the case for family farms whose agricultural area is small and should therefore be oriented toward crops with a higher economic value, such as the cultivation of vegetables or flowers.

It can be seen that, in all scenarios, the larger the area under vegetables or flowers, the faster the economic size is reached.

In addition, the optimistic variant, which requires a larger economic size in order to provide family members with an average standard of living, requires 2.3 times more land than the minimum variant, which is quite difficult for them to achieve.

However, growing vegetables and flowers can be a viable alternative for small-scale farmers (including family farmers) to provide a normal standard of living, but involves a somewhat higher initial labour and expenditure than other crops. The subsidies available to them can also help reduce production costs, thus increasing profitability at the farm level.

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FAMILY FARM: A MULTIDIMENSIONAL REALITY

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Abstract: *Family farming plays an important role in food security and sustainable rural development, in both developed and developing countries. If in recent history, Western Europe was based on a strong sector of family farming, for Romania and other former communist countries, it reappeared in the debate after the changes that occurred in the 1990s. (the collapse of the communist regimes). Due to the complexity and heterogeneity of farms all over the world, there is currently no consensus on the definition of family farming: how the family farm is defined varies by country and context. The objective of this paper is to identify family farms in Romania based on accessible parameters, easy to measure. The approached topic required the use of an appropriate methodology, which included both methods of documentary and statistical analysis. The emerged conclusion was that proposing a definition and selecting specific parameters has a significant importance in characterizing and evaluating the importance of family farms, an important step in proposing and implementing dedicated policies.*

Keywords: *farm, definitions of family farm, defining parameters, Romania*

JEL classification: Q12

INTRODUCTION

As the main institution of agricultural land operation, family farming is dominant in many countries of the world. Family farming has a significant role in food security, sustainable development, job creation, local development and social cohesion of rural areas (FAO, 2014; Belieres et al., 2013)). If in the last decades, Western Europe was based on a strong sector of family agriculture, Romania, along with other ex-communist countries, experienced a "revival" of family agriculture after the implementation of the land reforms of the 1990s (Lerman et al., 2004).

The role and place of family farming in socio-economic development is internationally recognized: the United Nations (UN) declared 2014 the *"International Year of Family Farming"*, recommending to promote new development policies, both at the national and regional level, policies that help small farmers and family farmers to eliminate hunger, reduce rural poverty and continue to play an important role in global food security by achieving sustainable agricultural production; in 2017, a resolution that proclaimed the period 2019-2028 the *"UN Decade for Family Farming"* was adopted and aims to support family farms through a global action plan based on seven pillars (FAO and IFAD, 2019).

MATERIAL AND METHODS

The main objective of this paper is to analyze and characterize family farms based on accessible, easily measurable statistical parameters. The proposed objective required the use of an appropriate methodology, which included documentary and statistical analysis methods. To describe the specific model of the family farming system, mainly secondary data from formal sources were analyzed: statistical information provided by the National Institute of Statistics (NIS) – Farming Structural Survey (FSS).

RESULTS AND DISSCUSIONS

A clear and unequivocal definition of the family farm is not found either in academic works or in agricultural policy documents (Bosc et al., 2015). Nagayets (2005), claims that in the process of defining family farms, the only consensus would be that there is no unitary definition. Van der Ploeg proposes a multi-criteria definition of the family farm: (1) the family has effective control over the main employed resources in the farm; (2) family labor has an essential role in the activity of these farms. This stated criteria are widely accepted and relatively easy to identify in statistical databases and policy documents. Considering the socio-economic specific context, this author also proposes the introduction of additional criteria: (3) the production unit/farm must be a means, used by the involved actors to preserve and/or improve their standard of living; (4) family members must assign control of the production process; (5) family farms must contribute positively to local and regional economies; (6) these farms must conserve and enrich local ecosystems (van der Ploeg, 2016: 27-28).

The definition of family farm varies according to countries and socio-economic context. Garner and O Campos analyzed 36 definitions and utilization of term "family farm" by academia, governments, and civil society organizations. Thus, the authors identified fourteen different criteria/dimensions used to designate family farms: *labor* - family farms are based on the work of family members; *management* - the family is responsible for managing agricultural production; *size* – with reference to the physical and/or economic size of a farm; *source of livelihood* - refers to the subsistence or market orientation of farms; *residence* - the farm is the family's place of residence; *family ties and generational aspects* - the farm is considered a succession unit or a source of inheritance within the family; *community and social networks* – the connection between family farms and the community has social implications; *subsistence orientation* - the main objective of food production oriented towards family consumption; *heritage* - the family farm is seen as a family asset; *land ownership* – the family owns the cultivated land; *investments* - the family is the only/main investor in the farm; *efficiency* - difficulties in adopting new agricultural technologies are the responsibility of the family; *sustainability* - the family farm is seen as a source of ecological agriculture (Garner and O Campos, 2014: p.2-3).

In Romania, a country where the majority of the rural population is dependent on agriculture, capturing the diversity and characterization of agricultural farms is an important step, the basis for the preparation of appropriate programs. In Romania, the term ”family farming” has often been used as a synonym for small-scale, subsistence and semi-subsistence agriculture with low resources and income, low use of inputs and outdated technologies (Boroka, 2015; Feher et al., 2017; Barjole et al., 2013). Starting from Garner and O Campos’ approach, five parameters were taken into account to define family farms in Romania: legal status, physical size, farm management, work force and production destination.

Legal status of the farm is an easily accessible parameter (data are available in censuses and agricultural surveys) that can be corroborated with a number of other parameters to characterize farms. In Romania, out of the total of 3.42 million farms, 99.24% were classified as farms without legal personality (3.396 million) and 0.76% (0.03 million) as farms with legal status.

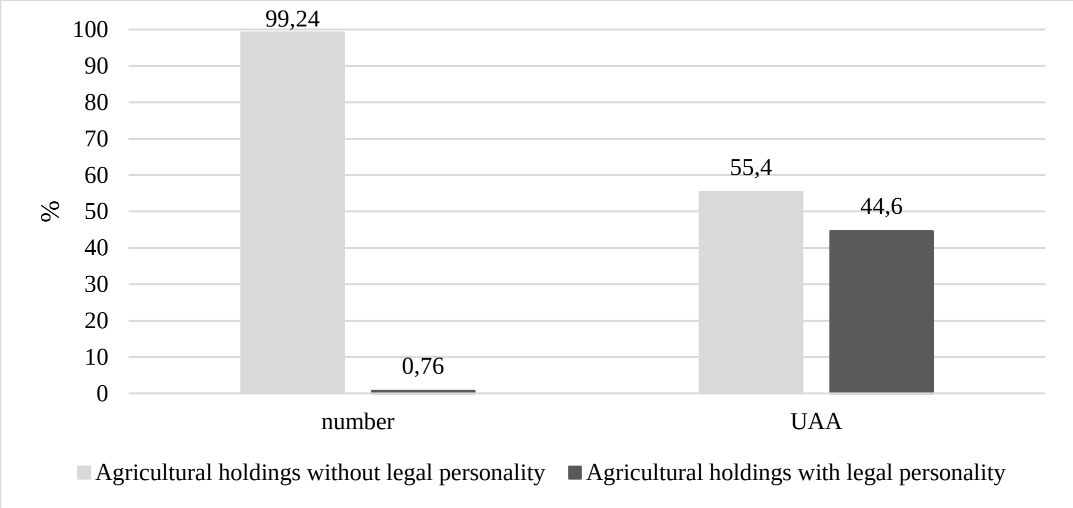

Figure 1. Distribution of agricultural holdings by legal status

(Source: own calculations based on NIS, FSS 2016)

Farms without legal personality managed 6.93 million hectares of the total utilized agricultural area (UAA)(55.40%) and farms with legal personality worked 5.58 million hectares (44.60% of the total UAA). Numerous researchers consider farms without legal personality as family farms (Gavrilescu & Florian, 2007; Rusu, 2002; Popescu, 2001). However, the classification according to legal status generates some confusion because a family farm can also acquire legal personality.

Physical size is another parameter frequently used to characterize and/or classify farms, regardless of the analyzed country or area. Physical farm size is relatively easy to measure and is also commonly collected through censuses and surveys of the agricultural sector. The availability of this parameter explains its extensive use in farms classification and official typologies in countries based on a poorly developed national statistical system (FAO, 2013). Sauer et al. (2012) consider that land size can also be implicitly used as an approximation of the economic size of farms: land endowment is associated with the ability to generate surplus, accumulate and invest. In a dynamic perspective, the "physical farm size" parameter is suitable to capture agricultural transformations initiate in a certain territory, such as the concentration, fragmentation or redistribution of land.

The analysis of the physical size was done on four size classes, as can be seen in table 1. The examination of the number of farms distribution confirms idea built around Romania's agriculture - considered as an agriculture dominated by numerous small and very small farms: 91.59% are in the category of farms smaller than 5 hectares and 7.87% in the category of 5-50 hectares. As can be noted the share of large farms, in total number is almost "invisible".

Table 1. Distribution of agricultural holdings by size class

Specification	Very small farms (under 1ha)	Small farms (1-5 ha)	Medium farms (5-50 ha)	Large farms (over 50 ha)	Total
Number pf farms – no.	1770569	1290358	262935	18323	3342185
Number of farms -%	52.98	36.81	7.87	0.55	100.00
UAA - ha	639180	2949227	2522226	6391903	12502536
UAA - %	5.11	23.59	20.17	51.12	100.00

Source: calculation based on NIS, FSS 2016

The distribution of farms according to the UAA shows a high proportion of areas worked by large farms (over 50ha) – 51.12% of the total UAA, while very small, small and medium farms work smaller areas of the total UAA – 48.88%% . This distribution of farms, with the preponderance of small and very small farms, is, among other, the result of the land reform implemented at the beginning of the 1990s. Although the main objective of the land reform aimed the development of an agricultural sector dominated by competitive family farms, in reality a strongly polarized agricultural structure was reached (Davidova & Thomson, 2014; Gavrilescu & Florian, 2007).

The main restriction of the "physical size" parameter is that it is contextual and thus difficult to compare. Another aspect that hinders comparisons is that, in many cases, a hectare of owned land is not equivalent to a hectare of leased/rented land, not to mention that a hectare of land can have very different values depending on its agro-pedo-ecological characteristics and sort of cultivated crops.

The farm management parameter reflects how decisions are made within farms. In SSA, there are no variables that directly reflect this parameter. To cover this dimension, the land tenure was used – in property, on lease, in share, common. Therefore, even if this variable does not directly respond to farm management, it can capture, to a certain extent, a number of specific features. Agricultural land is the most valuable asset among the total assets owned by most farmers. How much land they work and how it is acquired are two of the most important decisions for a farmer. If the farmer does not have enough agricultural land the efficiency of the other available resources can be limited and also the expansion of the business. If the farmer has too much agricultural land, the ability to manage it effectively is reduced and there may be cash flow problems that limit the ability to make productive investments.

From the data presented in Figure 2, it can be noted there is a direct relationship between the area cultivated on lease and the size of the farms, from which we can assume that small and medium-sized family farms mainly work the land in property.

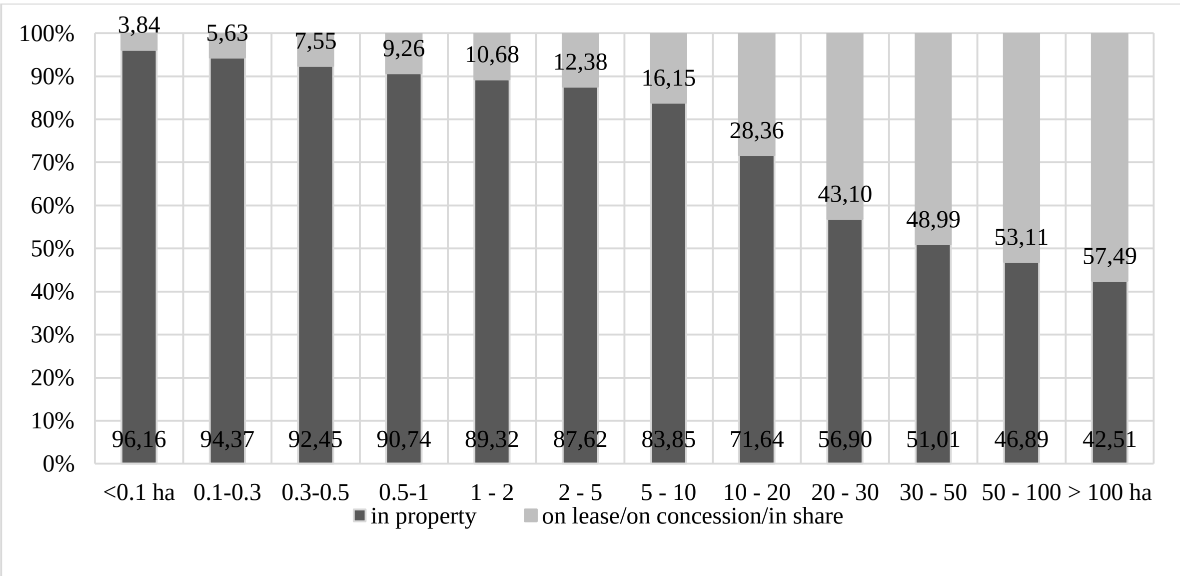

Figure 2. Agricultural holdings and the UAA by type of land tenure and by size class

(Source: own calculations based on NIS, FSS 2010)

In 2016, almost half (49.61%) of the total UAA was operated by the owners. Most of the small and medium-sized farmers, even if they own small areas of land in their ownership, work part of it themselves (crops for their own consumption and even for sale), and lease on the remaining area to larger farmers.

Table 2. Agricultural holdings and the UAA by type of land tenure

Land tenure	UAA (ha)	Percentage -%
In property	6202752	49.61
On lease	3581999	28.65
In share and other types of tenure	0717785	21,74
Total	12502536	100.00

Source: own calculations based on NIS, FSS 2010

Labor force parameter is often used in the classification of farms. This is generally used in combination with other variables (such as the management types and integration of farms into markets). The type of labor force can be documented by binary indicators to differentiate farms that depend on family labor, from farms that depend exclusively on non-family / hired labor. Accurately quantify agricultural labor requires a great deal of details related to the schedule work, as the amount of agricultural labor fluctuates throughout the agricultural year. In addition, it requires information on the demographic characteristics of the workers involved in the agricultural sector (age, sex, education).

In this paper we will consider family labor and hired labor as the main variables in the process of categorizing farm types. The idea behind this classification is that the predominant use of family labor is generally carried out in family farms. From Table 3 it can be seen that farms using more than 50% family workers represent 99.2% of total farms and operate 54.9% of total UAA. It is noteworthy that 96% of farms have only family workers.

How labor is used can provide important information about the agricultural market, structural or managerial characteristics of farms, etc. For example, high intensities of family labor are found in small farms, because the use of labor is the main means of increasing agricultural production per hectare.

Table 3. Distribution of farms by family workers

	Annual Working Units (AWU)	**Number of agricultural holdings**	**Utilized agricultural area (UAA)**
Total	1487000	3422030	12502530
Family farms with only family workers (no.)	1427690	3395240	6848250
%	96	99.2	54.8
Family farms with more than 50% family workers (no.)	890	390	13140
%	0.1	0	0.1
Total family farms	1428580	3395630	6861390
%	96.1	99.2	54.9
Family farms with less than 50% family workers (no.)	890	300	64860
%	0.1	0	0.5
Farms without family workers	57530	26100	5576280
%	3.9	0.8	44.6
Total of non-family farms	58420	26400	5641140
%	4.0	0.8	45.1

Source: calculation based on Eurostat, FSS, 2016

The market orientation parameter - commercialization and self-consumption - captures the farms market insertion: it helps, first of all, to differentiate commercial farms from subsistence ones. This information helps to estimate the monetization degree and contribution of these farms to the market economy. FSS allows the classification of farms in two main categories: - subsistence or market-oriented.

Of the total farms, 89.37% use the production of 31.53% of the total UAA for their own consumption and only 10.63% sell more than 50% of their production on the market: these operate 68.47% of the total UAA. It can be noted that depending on the production destination, the smaller the farms, the greater their orientation towards self-consumption; the larger the farms, the greater the orientation towards commercialization of production. It can be concluded that most of the farms that can be considered family oriented are engaged in subsistence and semi-subsistence agricultural activities and aim primarily at their self-consumption.

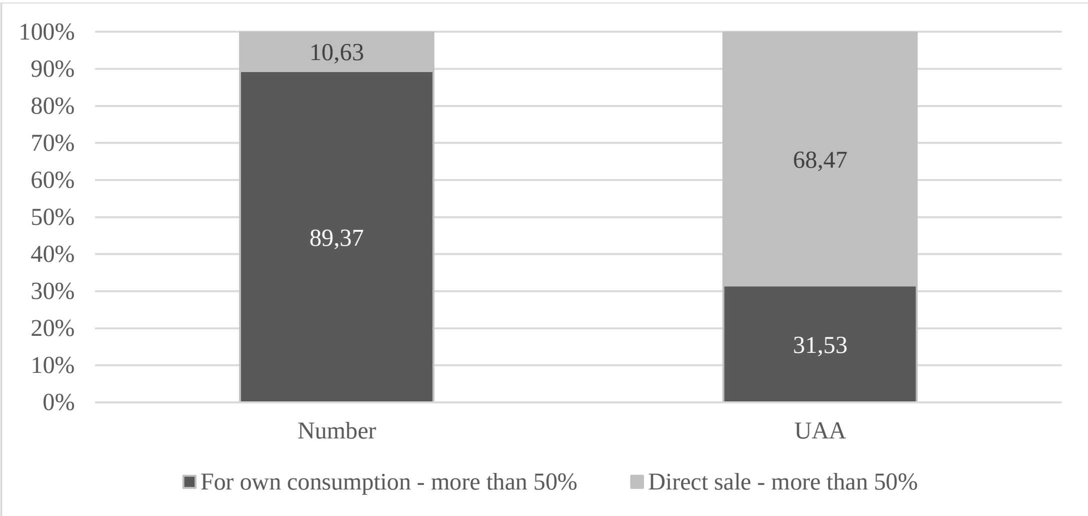

Figure 3. Agricultural holdings distribution by agricultural production destination

(Source: own calculations based on NIS, FSS 2016)

CONCLUSIONS

Due to the complexity and heterogeneity of farms, there is currently no consensus on the definition of family farming: how to define a family farm varies by country and socio-economic context. Each definition should capture the diversity of family farms, be stable and not dependent on the political and institutional context, and allow the evaluation and identification of family farms, comparison and aggregation of information that characterizes them.

As a means of organizing agricultural production, family farming is based on a close connection between the family and the farm, a connection that has evolved over time, combining economic, environmental and socio-cultural functions. In Romania, as in other EU countries, family farming is considered dominant, but not exclusive, as an institution for operating agricultural land. Classification of family farms, regardless of the parameter used, confirms the idea built around Romanian agriculture - considered as an agriculture dominated by family farms (numerous small and very small farms): a rough estimation shows that the share of family farms in the total number of farms is greater than 95% and that they work almost half of the total area.

This approach is part of the international trend that shows both the socio-economic context and the family farm are going through a transition process in which the previously established reality is changing - due to both internal and external factors - and requires a rethinking of this concept (van der Ploeg, 2016). The choice/proposal and use of a family farm definition is of significant importance in assessing the importance of family farms, their specificities, the challenges they face, the prospects and the need for dedicated policy support.

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REALIZATION OF THE LAND BANKING IN THE REPUBLIC OF MOLDOVA AS A STRATEGIC OBJECTIVE IN THE SUSTAINABLE RURAL DEVELOPMENT

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Abstract: *Agricultural land consolidation represents a complex of organizational, technical, economic, ecological and other legal measures requested by the rural community for the purpose of the most rational, efficient use and exploitation of land, as a whole and as a result, raising the living standard in rural communities. The creation of the Commercial Land Bank in the Republic of Moldova requires the consolidation of land and becomes a necessity even in conditions of private ownership over agricultural land, in conditions of wider structural reforms. The reasons for agricultural land consolidation, at present, are much deeper than its privatization. The research presents the basic structure and criteria in the organization of banking activity in the agricultural sector including the financial insurance of land transactions according to the nonparametric rating of data envelopement analysis.*

Key words: *land consolidation, land fragmentation, land bank, data envelopment analysis, european size unit*

Clasification JEL: Q14, R14, R30

INTRODUCTION

The basic objective of the sustainable rural development in the Republic of Moldova is the harmonious combination of its components: social, ecological and economic. Over the last decade, Moldova has achieved important achievements in the field of land reform. These include a dramatic increase in the share of privately owned agricultural land, which has grown from zero to 94 percent of total agricultural land and more than one million people became landowners. These positive trends have contributed to a significant improvement in agriculture, which has been observed since 2010, when it was recorded a halt in the decline of agricultural production followed by an increase both in production volumes and in productivity. Over the years 1995-2005, the land reform process took place in the Republic of Moldova, but it was a process of privatization and not one of restitution of private property, as it was done in some Eastern European countries. The basic principle of agricultural land privatization consisted in the fact that the members of collective farms (cooperative associations of farmers) should become landowners of a share of land free of charge. More than 98 percent of agricultural land subject to privatization today is privately owned. About 1.3 million landowners own on average 1.56 ha each one [5].

Land reform has contributed to the emergence of new enterprises of various sizes and legal forms of organization. But the basic purpose of the land reform was the creation of farm households and this purpose was fully achieved. Unfortunately, the same reforms have led to a serious negative impact on agriculture - excessive land fragmentation, which was based on the principle of equity. Namely this principle was the one that caused the excessive fragmentation of land. The existence of a relatively large number of people (about 25 percent of Moldova's population) and a relatively small area of land to be privatized contributed to the fact that about 1.7 million hectares were divided into over 3 million parcels with the average size less than 0.5 ha. On average, a landowner received 3 agricultural parcels with various land use destinations: arable land, perennial plantations and orchards. Moreover, another common practice consisting in dividing a land parcel into 6 or more plots.

The aim of this research is to develop an alternative mechanism for agricultural land consolidation by creating a Commercial Land Bank (CLB) in the Republic of Moldova that would concentrate all functions related to land relations and would participate as an active player in the land market in order to create a state land fund, which would facilitate the supply for agricultural land in rural areas with the purpose to intensify the land consolidation processes. Another major function of the CLB would be to grant preferential loans to farmers for the procurement of agricultural land in order to reduce land fragmentation and improve the structure of agricultural farms.

MATERIAL AND METHOD

The methodological approach in consolidating agricultural lands imposes the need for determining the optimal size of the agricultural farm and the legal form of organization ensuring the best economic performance of the agricultural farm. A fundamental indicator of rural performance is the nonparametric rating of the data envelopment analysis (DEA), which broadly reflects the economic efficiency of farmers and can serve as a conceptual approach in the creation of the CLB in the Republic of Moldova. Agricultural land consolidation represents a complex process in which the economic mechanism for restructuring the land market is of major importance. The modification of the regulatory framework of the land market regulation aims at increasing the efficiency of agricultural farms, i.e. their transformation into economic agents with a high degree of commercialization and the disposal of subsistence family farming in which everything produced by the farmer is used for own consumption. [2].

The main directions of agricultural land consolidation are focused on the procurement/sale and lease of land. The land procurement/sale mechanism must ensure a flow of agricultural resources (areas, means of processing, technologies, etc.) from less efficient operators on the land market to agrotechnically optimized solutions. After eliminating in 2017 the development restrictions of the land market, over 300 thousand ha of agricultural lands changed their owners during the investigated period. The distribution of land transactions depending on the legal form of organization of the land market operators is presented in Table 1.

Table 1. The size of the agricultural farms and their legal forms of organization depending on the percentage share of land ownership in the land transactions.

		Respondents, %	The size of the agricultural farm, ha	The share of land ownership, %
The people who procured land	Landowners of parcels next to the house	1,5	1,8	100,0
	Farmers	10,1	3,2	97,6
	Collective enterprises	40,0	923,0	39,4
The people who dindn't procure land	Landowners of parcels next to the house	98,5	2,1	100,0
	Farmers	89,9	2,6	98,9
	Collective enterprises	60,0	837,7	34,1

		Respondents, %	The size of the agricultural farm, ha	The share of land ownership, %
All options	Landowners of parcels next to the house	100	2,1	100,0
	Farmers	100	2,9	98,7
	Collective enterprises	100	868,5	36,1

An important goal in agricultural land consolidation and consequently overcoming excessive land fragmentation is to define the mechanism for the optimization of land parcels, efficient land use and conservation of natural resources, which would contribute to sustainable rural development. The nonparametric aggregate indicator of the DEA rating gives the possibility to assess, depending on the resources of the economic agent, the value of the optimal size according to type of activity and regional location. The landowners of parcels next to the house record an average size of 0.37 ha for the agricultrual farm, the farmers identified with property titles record on average 2.61 ha and the collective enterprises are characterized by an area of 851 ha of agricultural land. The econometric instrumentation based on the definition of the Lagrange multiplier on the land market represents the basic landmark in the banking activity in rural areas. [1].

RESULTS AND DISCUSSIONS

The conceptual definition of CLB involves the financial approach of the land market strictly delimitating the notions of arable land parcel and surface of agricultural land. Traditionally, the land bank is defined in terms of agricultural land transactions as „a public authorized acquisition of land subject to be kept for future use and implementation of land policies”. The definition of CLB already indicates the fact that the land bank does not only refer to the agricultural environment, but is a broader concept, which includes elements of ecology, rural and even urban development. At the same time, the term land bank it used as a „strategic management of land with subsequent use for strategic public purposes such as infrastructure development and expansion of urban localities”. The main criterion for land consolidation consists in the stability of the compact sector in space and time, according to which the land sector will keep its shape and dimensions for as long as possible. The stability of the land sector in space and time will allow the owner to invest in perennial plantations, irrigation systems, other expenses that, in order to be recovered, require long intervals of time. [7].

The size of the surface is a specific criterion for determining the level of land consolidation. Depending on the specialized land-use, the cultivated plants, the characteristics of the area and the potential of the owner, the appropriate surface can vary greatly. The decision on the adequate area of the land sector for various cases will not come „from the top administration”. The owners will decide for themselves which is the most appropriate area of land sector and the program will provide consultations and help the owner achieve the established goal. Another finding consists in the fact that the agricultural farms, which, in most cases, own land with an area of 1.0 -1.5 ha, located on several sectors, at great distances from each other, produce insufficient but competitive commercial production. Land use planning involves the establishemnt of irrigation systems, drainage systems, anti-erosion measures, access roads and crop rotation systems. An important role in land use planning is played by the scientific substantiation of the established systems. Based on the criteria for agricultural land consolidation, it will be possible to achieve the following activities:

- establishing the efficiency of the land consolidation methods;
- determining the level of land consolidation;
- evaluating the land consolidation process as a whole;
- making conclusions and presenting proposals regarding the continuation of the land consolidation process.

The definition of CLB stems from its historical use and also the way in which the land bank is defined differs depending on the organization, which is involved in the field of land planning Figure 1. Moreover, even the state does not use the term land bank consistently, because the two state institutions involved in the agricultural land bank use these definitions differently. Thus, the first presents the land bank as the structured procurement and temporary management of land in rural areas by an impartial state agency in order to redistribute and/or lease this land with the aim of improving the structure, and/or reallocating land for other purposes of general public interest. The procurement of agricultural land for the purpose of making land transactions requires the creation of an intermediate buffer, which can later serve as a basic tool in agricultural land consolidation. This buffer can be used not only for agricultural purposes, but also in rural development by improving the elements of infrastructure and other public interests. The term „land banking" refers to the use of this buffer, and the buffer itself simply represents the land fund. Taking into account the definitions already mentioned and their weaknesses, a conceptual approach to CLB is required in which the most valuable economic indicators - productivity, efficiency and competitiveness in the land market - are assessed on the basis of the DEA rating.

The advantage of this approach in agricultural land consolidation consists in determining the economic balance that ensures a sustainable rural development. First of all, it is not imperative that the public authorized to make land procurement has a certain fixed use for future purposes. At some time, the state can procure land to compensate a farmer for a road that was built on farmer's land. Second, it is not always necessary that the state procure the land intended for public purposes [6].

As a result of analyzing the primary data related to the economic performance of the agricultural farms in the Republic of Moldova, the concept of CLB is proposed in the research, which corresponds to the characteristics of the rural area in the country and does not face the traditional approach in land valuation. Thus, CLB represents „the principle of structural or strategic procurement, storage and sale of land for future use". A traditional approach of farmers working on agricultural lands involves defining an organizational structure (private or state) that coordinates land transactions with Local Public Agency (LPA) and additionally performs ecological expertise (or local sanitation criteria). Land fund management represents a special concern in order not to admit the distortion of the agricultural land procurement/sale market according to the macroeconomic concept of Gérard Debreu [4]. Local public administrations and agricultural decision-makers - Agency for Interventions and Payments in Agriculture (AIPA), Agency for the Development and Modernization of Agriculture and others are admitted to land banking in such a way that monopolization of the land market is not allowed. AIPA operates in a decentralized manner, with regional offices throughout the country and the CLB has the task to make the procurement and manage state property, both movable and immovable. In terms of land management, this service has the following tasks:

- development of the state policy in the land field;
- management of the state-owned land;
- facilitating the use of state lands;

• sale of state-owned land.

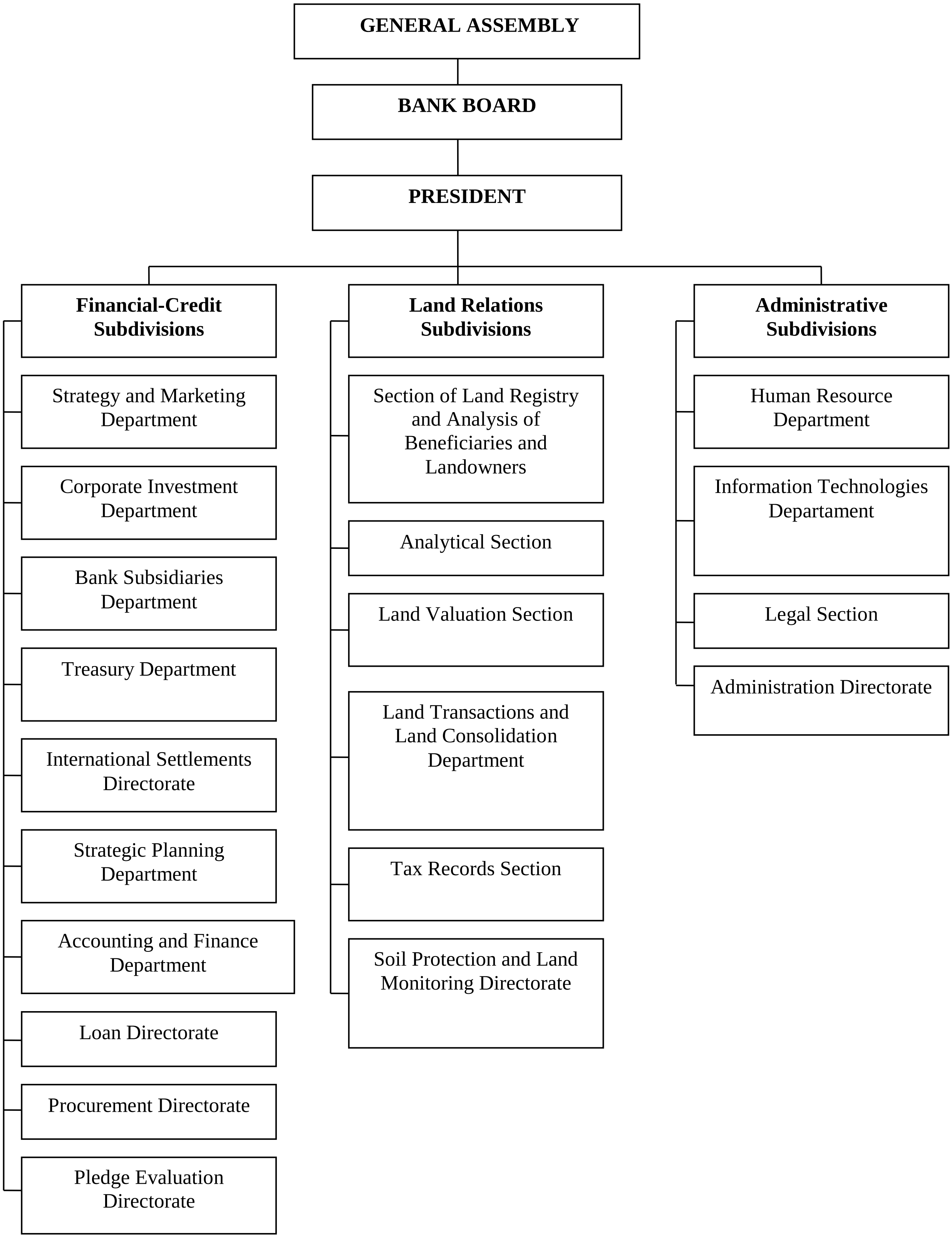

Figure 1. Organizational structure of the Commercial Land Bank meant to reduce the level of agricultural land fragmentation and optimize the size of agricultural farms.

The financial vision „strategic land management" assumes that property owners sell the land in order to subsidize high managerial performance in large corporate and medium private agricultural farms. The advantage of economies of scale for the agricultural farms having a major agricultural land area is oriented towards certain types of agricultural land that have important strategic land use and goals for the country (seed sector, biodiversity, etc.). In this context, unfortuntely, the farmers who choose the option of subsistence agriculture in which the agricultural production is fully consumed by the agricultural farm does not support unfair market competition in the Republic of Moldova [8]. Therefore, the tasks of the CLB as a land agency are focused on:

• the land procurement in rural areas in order to improve land use and management;

• the management of change of the land fund;

• facilitating the temporary use of land;

• making the sale and distribution of land for multiple purposes.

This agency implements its policy in the agricultural sector through concrete projects in the development of green areas for recreation, nature, aquatic resources or agriculture. To this end, the CLB procures land, redesigns its land-use planning and then transfers it to land management organizations and individual farmers. Thus, the Commercial Land Bank is looking for common concepts and solutions that correspond to the (administrative) ambitions and characteristics of a certain rural area and also brings together the financing flows and has a unique plan of subsidy options. The land agency collaborates with local and governmental decision-makers who have a common goal in carrying out land use planning projects and maintains land market regulatory offices throughout the country. Therefore, the CLB Board, for public purposes, cooperates with the real estate departments within the Ministry of Agriculture and Food Industry (MAIA) to implement more effectively the agrarian policies in the field of land relations [3]. At the same time, the policy of the MAIA departments can be improved in terms of correlation with the land transaction market by better positioning the state and anticipating sudden changes in the real estate market.

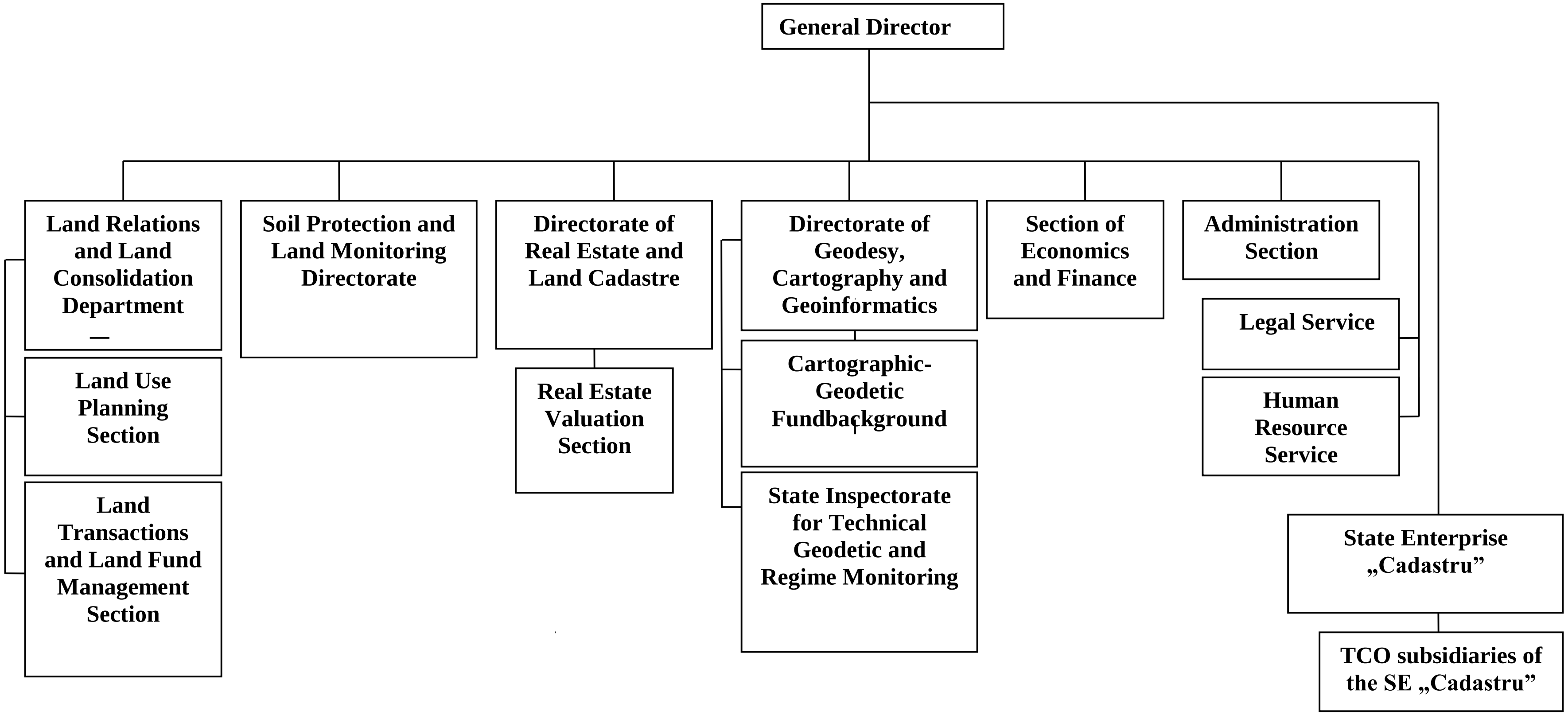

Figure 2. Organizational Structure of the Commercial Land Bank created based on the State Agency.

The five real estate departments that work together within MAIA are:

• project implementation unit in the field of environment;

• state hydrometeorological service;

• agency „Apele Moldovei”;

• agency for geology and mineral resources;

• consolidated unit for the implementation and monitoring of projects in the field of agriculture financed by the World Bank.

Municipalities play an active role in land issues. They have their own development corporations, which deal with the procurement, storage and sale of land, taking into account the future development of the locality. In this sense, a municipal development corporation can be considered a municipal land bank. The responsibilities for these land banks belong to the municipality (town hall). Private organizations also have their place in land relations. Among the roles of private organizations in land banking we could mention the financing of projects, which would make it possible to make land procurement. As mentioned above, there are various public organizations actively financing the land. In some cases, the money provided by the state is not enough to achieve the goals. In this case, private organizations can help to achieve public goals, but obviously these organizations also have their own goals.

At international level, in the agricultural sector, the land bank has been in place for a long time, especially the finance and exchange land bank. The first reason this became possible was state support. The government is assisting in land consolidation projects to ensure that the structure in agriculture can be improved. Thus, state regulations reprsent an important factor in the success of land banks in the Republic of Moldova. The tasks of MAIA, necessary to make possible the use of the land bank are coordination and financing.

The second important reason highlighting the necessity to create a CLB is the overcrowded territory. There is currently a high pressure on the land market, including the agricultural land market, which requires a new and different way of maintaining land market projects and actions. The land bank represents a way to bring together different participants to collaborate and find solutions to common problems.

Appropriate legislation is needed for the successful operation of land banks. The law on spatial planning controls the way in which land use in rural areas is carried out and in which all authorities participate. First, the specialized ministry establishes the basic rules of planning, which serve as the starting point for spatial allocation. The districts then outline regional plans for these decisions. As a result, regional plans are already more precise. They determine the places of extension of the localities, as well as the spaces that are free for agriculture, nature and rest. The latter serve as a benchmark for local plans, which are the most detailed. The town halls determine the destination of each area within the locality. Such areas include those intended for housing, industry, recreation, etc. The town hall should review its zoning plan every ten years. Decisions related to land planning are taken at the level of local public authorities. According to the Law on Spatial Planning, the district’s land use plan determines the possibilities of the land user. A primary task of area planning is to provide legal security for citizens. As a result, citizens gain certainty about the actions that can influence the market value of their land. Also, due to this, zonal planning provides a predictable framework for investment.

The practical tasks are mostly related to provide all the necessary premises for the creation of the land bank in the Republic of Moldova, as well as to determine its functions, functional subdivisions and finally, to elaborate its organizational structure Figure 2. Namely, the implementation of these tasks requires substantial financial resources and a methodological framework focusing on the authority of rural decision-makers in order to create the CLB. In this context, it is worth mentioning that the basic tasks in implementing land reform are the following:

I. first of all, the possibilities of creating a Commercial Land Bank, although based on the state capital, were examined, which in addition to creating the land fund and conducting transactions on the land market, would be empowered with a wide and diverse range of functions, among the most important being those related to the preferential crediting of agricultural producers, especially for the procurement of agricultural land, but also the availability of mortgage loan, by pledging the land they have, and in case of non-payment of the loan, their land would be included in the composition of the land fund for subsequent transactions;

II. an obvious advantage of the CLB ensured by AIPA consists in the possibility to use the territorial cadastral organizations as subsidiaries of the land agency for the promotion of its policy and directions of activity in the territory.

It is proposed to reorganize the Agency for Land Relations and Cadastre as follows in the diagram presented in Figure 2. Given that the created Land Bank is a public organization, in order to successfully carry out its activity, it is necessary to allocate some amount from the State Budget, which would allow the Bank to begin the process of land procurement, which is necessary for creating the land fund, subsequently used in the implementation of the state policy in the field of agricultural land consolidation. It is obvious that the CLB be conceptually based on the mechanism for assessing economic performance in agricultural land consolidation and creating levers that stop the distortion of the land market according to the Lagrange model.

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CONCLUSIONS

Though there has been much debate on the subject, it is clear that the agricultural land consolidation process takes place in compliance with the following basic principles:

a. free consent - adherence to the land consolidation process will be made with the consent of the landowner;

b. economic and social necessity - land consolidation will be carried out only in case of an economic need of the agricultural landowners, which will allow them to increase the efficiency of land use, to accumulate additional incomes and to improve the situation of the rural population;

c. respecting the interests of all landowners in the locality - this principle will not only promote land consolidation, but will also correspond to the interests of the community (village) as a whole;

d. economic interest - landowners will adhere to the process of agricultural land consolidation arising from personal economic interest;

e. democratization - this principle will mobilize the participation of the general public in the rebirth of rural communities;

f. multilateralism - land consolidation will include a complex of measures related to land improvements, land use planning, constructions (repairs), etc .;

g. transparency - the actions taken in the consolidation process will be brought to the attention of all owners;

h. staging - the activities related to the agricultural land consolidation will be carried out in stages. The initial stage may be the pilot project, based on which the legal framework will be developed. The second stage will be focused on the massive consolidation, which in turn will be carried out based of initial consolidation projects. Each project will also be carried out in stages;

i. environmental protection - any action related to the agricultural land consolidation will be carried out in compliance with the principle of environmental protection. The actions with ecological impact will be based on scientifically substantiated projects and will be controlled by the state.

The creation of a CLB, conceptually can be carried out in the Republic of Moldova only under the guidance of the nonparametric DEA mechanism for agricultural land consolidation as follows:

- land consolidation is a complicated process, which requires large financial resources, labor force and strict control over the results;
- the rapid consolidation of highly fragmented agricultural lands is possible respecting two basic requirements: ensuring a strong growth of the national economy and implementing a liberal agrarian policy;
- both land and labor productivity is decreasing along with the increase of the land fragmentation degree, expressed under the number of land parcels belonging to an agricultural farm;
- consolidation positively affects farmers' incomes by increasing the degree of trade, i.e. the share of production sold in the overall production of agricultural entities;
- sustainable development involves three important aspects: economic, ecological and social. Therefore, sustainable agriculture must be environmentally friendly, economically viable and socially responsible.

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TRADITIONAL AGRICULTURAL PRACTICES IN SUCEAVA COUNTY, ROMANIA

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Abstract: *The present paper focuses on the agricultural practices of the dairy farms from Dornelor Basin, Suceava county, regarding grassland management, livestock feed, livestock disease management, aiming to evaluate the relationship between traditional and ecological practices, based on the expected increase in the near future of the ecological farming in the area. The scientific approach turns to a comparative analysis, based on a structured communication method – Delphi, involving 10 experts/local actors and to a large-scale farm survey applied to 52 dairy farms from the Dornelor Basin area. The results highlight a correlation between experts' opinion regarding the most important practices for defining an ecological farm and the traditional agricultural practices of the dairy farms from the study area, as these can be considered, to a high extend, to be ecological practices.*

Keywords: *farm's characteristics, traditional agricultural practices, ecological practices.*

JEL classification: Q01, Q57

INTRODUCTION

Traditional agricultural practices represent an important component of the traditional farming/agricultural landscapes that are becoming more and more important at European level, as part of the efforts towards conservation of biodiversity. In general, these landscapes are present at the level of different regions where farming practices have changed little over the time, holding a high conservation value. (Fischer et al., 2012). At the same time, these landscapes hold an important cultural and historical value, based on the preservation of small-scale structure and typical agrarian landforms (Špulerová et al., 2017). During the last decades, these landscapes have been under constant pressure, due to both intensification of agriculture and abandonment of unprofitable land (Halada et al., 2011); in addition, some mixed farming structures, combining different historically, culturally and regionally characteristics have become rare, and in some European regions have disappeared (Slámová and Belčáková., 2019). The traditional land-use systems/ landscapes remaining are mainly found at higher altitudes/ remote areas, where physical constraints have limited the modernization of agriculture (Lieskovsky et al. 2014, Tryjanowski et al., in Špulerová et al., 2017).

The traditional agricultural practices, as part of these complex systems, are regarded, by some scholars, as having an ecological nature, based on a mix of social and economic characteristics such as mixed livestock, cropland and forestry systems, a high level of labor and a lower level of other inputs (like nutrients, mechanization and pest control chemicals), accumulation and transmission of local knowledge (Berkes et al., 2000). More so, they are considered to be associated with a rich knowledge of all aspects of sustainable food production, as farmers maintain local varieties for pest control, use local knowledge and agricultural traditions that form a strong connection with the environment. Taking a closer look at some of the traditional practices integral to organic farming (like manuring and covering crops, composting, low tillage, biological pest control) clearly highlights a linkage to traditional farming systems (Sofia et al., 2006). This is also the starting point of our present work, namely to evaluate the connection between the traditional agricultural practices of the dairy farms from Dornelor Basin and the most important ones for defining an ecological farm, based on experts' opinions.

MATERIALS AND METHODS

The paper turns to a comparative analysis, based on two methodological approaches, combining qualitative and quantitative analyses, aiming to highlight the link between experts' opinion regarding the farming practices that an ecological farm would use as opposed to a conventional one and agricultural practices deployed by dairy farms from the Dornelor Basin. The first one was a Delphi exercise, involving 10 experts from the area (researchers, civil servants, extension officers, farmers, food chain and NGO representatives) that was implemented in three stages: the first, was getting acquainted with the method and supplying information regarding the characteristics of ecological and conventional farms from the area; in this first stage, Delphi questionnaires for round I were sent to the 10 experts; in the second stage, a report containing the anonymized responses of expert was drafted and sent along with the questions from Delphi round II; a second report was drafted and sent along with the Delphi round III (Florian et al., 2021). After the final round was completed, a report was drafted and presented to the experts who participated at this Delphi exercise.

The second approach was based on a large-scale farmer survey, applied to dairy farms from Dornelor Basin area, based on a questionnaire with multiple sections: general characteristics of the farm and farmer, current and future production practices, drivers of practices' adoption as well as contracting / future policies. In total, 52 farms were investigated in the following communes from the Romanian case study area: Fundu Moldovei, Poiana Stampei, Coșna, Dorna Arini, Panaci, Pojorâta and Șaru Dornei. A centralized database was created, containing all the information collected through the questionnaires. The data was processed with the help of SPSS software.

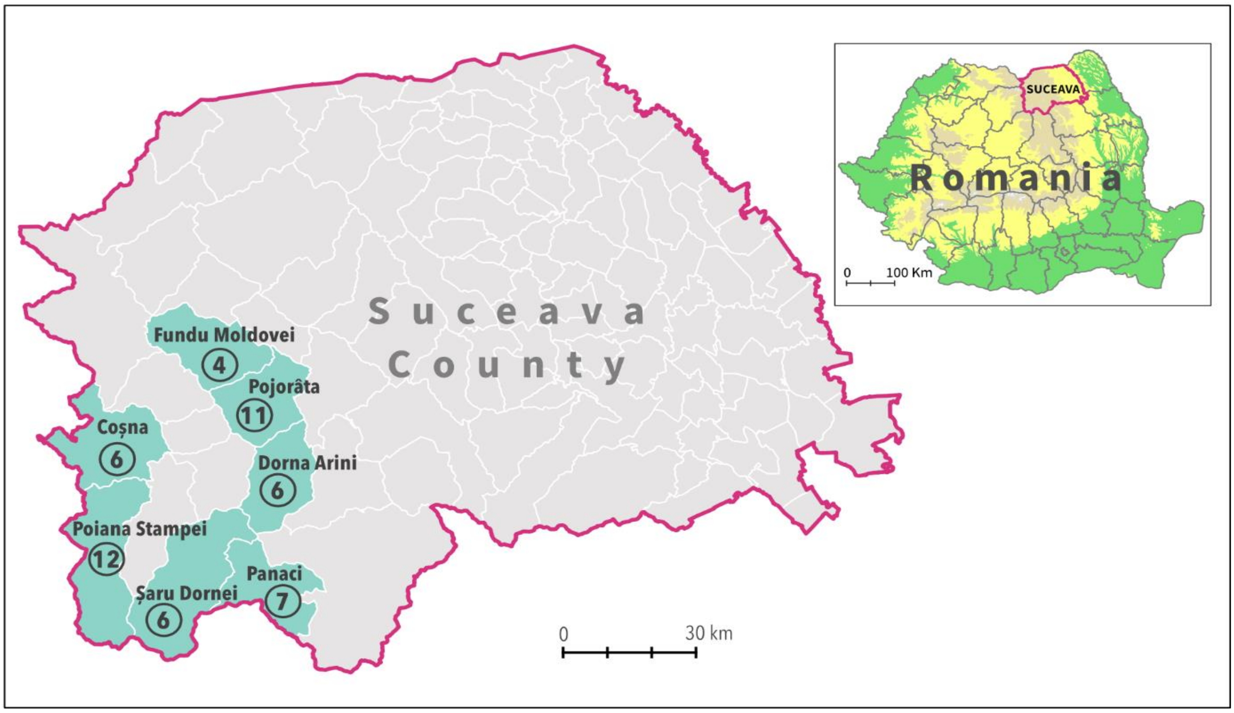

Figure 1. Romanian case study area (number of questionnaires/commune)

Source: authors' processing based on farmer survey database

The second section of the questionnaire applied to the dairy farms specifically targeted the current and future production practices, as regards pest and plant disease management, weed management, fertilization and soil management, grassland management, livestock feed and disease management and livestock location. Together with the Delphi exercise, this section represents the main data source for this present comparative analysis. Both methodological approaches (Delphi and the large-scale farmer survey) were elaborated within the H2020 LIFT project – "Low input farming and territories" and were applied in different case study areas at European level.

RESULTS AND DISSCUSION

The main objective of the present study was to identify the agricultural practices that dairy farms from Dornelor Basin are relying on in their specific activities and to evaluate the possible link with agricultural practices that an ecological farm would use. In this context, firstly, we turn to the Delphi exercise, where 10 experts from the Romanian case study area (Dornelor Basin, Suceava county) were invited to evaluate different aspects referring to ecological farms' characteristics, compared to those of conventional farms. During the first stage, the experts participating at this exercise were asked to rank 12 agricultural practices that are most important for defining an ecological farm. Experts' answers led to a strong consensus on the utilization of traditional agricultural practices, of local inputs (mainly organic inputs such as manure), with no chemicals and limited use of mechanical works.

Table 1. Agricultural practices that are most important for defining an ecological farm (From the most to the least important)

Practices – hierarchy	**Mean rank** (where 12 is the most important)	**% of respondents who have chosen this practice as the most important**
Use of organic manure or compost	11.29	80%
Integration of crop and livestock at farm level	10.00	10%
Strip grazing	8.43	
Alternative remedies for livestock disease management	7.43	
Extensive use of cover crops	6.64	
Number of crops	6.00	10%
Low tillage use	5.64	
Integrated Weed Management	5.57	
Precision technologies	5.29	
Integrated Pest Management	5.00	
Manual weeding	4.71	
Machine weeding	2.00	

Source: authors' processing based on the Delphi exercise

Experts' opinions on the farming practices that an ecological farm would use, compared to a conventional farm, support the hierarchy of the most important practices for defining the ecological farm, resulting from the processing of results from Delphi Round I.

Thus, there is a general consensus in ranking on the first place the use of organic fertilizers (manure and compost – 80% of respondents consider that this practice is the most important) in the ecological farming activities in Dornelor Basin; this is followed, depending on the average rank (on a scale from 1 to 12, where 12 is the most important practice) by the integration of crops and livestock at farm level and by strip grazing:

- *” The farming practices that would be suitable on the ecological farm, as opposed to conventional farm, are those that are the closest possible to traditional, manual practices, giving up chemical inputs and using ecological inputs”- participant in Delphi Round I*
- *” Low tillage use, use of organic fertilizers (manure or organic compost), manual weeding” - participant in Delphi Round I*
- *” In ecological farming, livestock raising is indispensable. Cattle are important in terms of production, for grazing and obtaining fertilizers”- participant in Delphi Round I.*
- *” In Dornelor Basin, traditional farming practices are used on livestock farms, where livestock raising, mainly dairy cows, is an occupation inherited from ancestral elders. The ecologically certified farms, few in number, comply with the ecological farming principles. In their activity no chemical fertilizers are used, and animal treatments are performed with drugs accepted in ecological agriculture. ”- participant in Delphi Round I*

Also, a strong agreement is reached by participants with regard to using natural products to replace the use of chemical inputs in agriculture; all participants considered that this process is feasible on the farms in the study area, i.e., Dornelor Basin. This consensus is also extended to the level of types of practices identified by participants, most participants considering that the use of local organic resources for fertilization (manure and compost produced on the farm) is the most convenient ecological practice for farmers in the area:

- ” *Composting the crop residues and manure is useful in obtaining a quality fertilizer, which, depending on crop, can satisfy the nutritional needs of plants to a great extent*” – participant in Delphi Round I;
- *” Increasing and maintaining soil fertility through adequate and very rigorous agro-technics, which involves the use of non-mechanical means to maintain the pastures and the application of organic fertilizers (fermented manure, dry manure, manure compost, liquid animal dejections, composted or fermented household waste, peat - domestic waste* – participant in Delphi Round I;
- *” Livestock and poultry manure, composted, solid manure, poultry manure inclusively* – participant in Delphi Round I.
- *” In Dornelor Basin chemical inputs have not been used for many years, as there are no agricultural crops and only manure is applied on natural pastures”* – participant in Delphi Round I.

Experts’ opinions from the Dornelor Basin area, regarding the most important agricultural practices for defining an ecological farm, are supported by various researches that highlight the importance of different agricultural practices, like using manure and compost, cover crops, rotation as a requirement for a sustainable agriculture system (Francis and Porter, 2011), but also the positive influence of using organic fertilizers on soil fertility at a biological, chemical and physical level (Gomiero et al., 2011).

With this in mind, we now turn to the second methodological approach, the large-scale farmer survey applied in Dornelor Basin, Suceava County, in order to identify the main agricultural practices of the investigated dairy farms. In total, 52 questionnaires were filled out in 7 communes from the case study area.

Table 2. Some general characteristics of the farmers and the farms

Farmers' characteristics	
Average age of farmers – respondents	49.9 years
Average number of years of agricultural experience – respondents	27 years
Education level – respondents (% in total number)	
No schooling	3.9%
Middle or secondary school	21.6%
High school – agricultural	9.8%
High school - non agricultural	23.5%
University – agricultural	9.8%
University – non agricultural	31.4%
Farms' characteristics	
Average Utilized Agricultural Area - ha	12.94
Average permanent grassland area – ha	12.86
Average permanent grassland area with pure pastures (only grazed) - ha	8.79
Average number of dairy cows	6.5
Average number of calves for fattening	3.9

Source: authors' processing based on the farmer survey database

Respondents' characteristics highlight an important agricultural experience of farmers from the case study area, as well as a significant share of higher education and high school levels, around 20% having a background in agricultural area. As regards the agricultural landscape, due to the geographical particularities of the case study area (hilly and mountain region), this is clearly dominated by the presence of permanent grassland area, with various functions: as areas with pure meadows (only cut), pure pastures (only grazed), strip grazing pasture and mixed use.

Figure 2. Agricultural landscape, Dornelor Basin, Suceava county

Source: Mihai Alexandru Chițea, 2019

Moving on to the agricultural activities, the second section of the large-scale farmer survey concentrated on the present and future production practices, in our case of dairy farms. Beside the types of practices, the data also refer to the moment when these practices began being used by farmers, the origin of the inputs and the future envisaged as regards the change of the practices in the next 5 years.

Table 3. Agricultural practices of dairy farms from Dornelor Basin

Grassland management	
Application of inorganic fertilizers	0% of farms
Application of animal manure	100% of farms
Application of compost	7.7% of farms
Mowing	90.4% of farms
Reseeding	19.2% of farms
Pest and plant disease management	
Chemical products allowed by organic regulations	1.9% of farms
Biological control (beneficial predators/ pheromones/ traps	3.8% of farms
Livestock feed	
Grazing on pasture	100% of farms
Strip grazing with dedicated pasture area	23.1% of farms
Conserved forage: silage	9.6% of farms
Conserved forage: hay	100% of farms
Grains	63.5% of farms
Beets	7.7% of farms
Livestock disease management	
Use of antibiotics only for treatment	71.2% of farms
Physical measures (separation, aeration)	34.6% of farms
Trait selection	26.9% of farms
Livestock location	
Local rotation around the farm	84.6% of farms
Seasonal movement (stay in summer rangelands, spend grazing on mountainous rangelands)	44.2% of farms

Source: authors' processing based on the farmer survey database

As regards grassland management, all farms from our sample declared that they are applying animal manure for organic fertilization, for the majority of them being something that they have been doing for more than 10 years, relying, mostly, as inputs, on their own farm, but also on other local resources (from neighboring farms and external sources). While 73% of farms declared that they will keep using this practice, 23% are inclined to increase its use in the next 5 years. Some other farms supplement the animal manure with compost, a practice newer to the area, but also based on internal inputs, with a strong plan to increase in the near future (25.5% of farms are interested in starting using this practice). At the same time, none of the farms is using inorganic fertilizers for grassland management.

Other traditional agricultural practices for grassland management are also used by the dairy farms from Dornelor Basin, like mowing and reseeding. Based on the topography of the area (slope areas), most of the work is carried out using manual labor, especially of family members. While this contributes to the preservation of old traditional practices, relying only very limited on mechanized works, at the same time it leads to an increase work load for family members, many farms having major difficulties in attracting local/regional external work force.

Table 4. Ecological versus traditional practices – Dornelor Basin case study area

Experts' opinion regarding the most important practices for defining an ecological farm (hierarchy)	Traditional agricultural practices of dairy farms from the case study area
Use of organic manure or compost	Yes, all farms when it comes to manure; some of them also use compost, with a trend to increase in the future (own production).
Integration of crop and livestock at farm level	Yes, the majority of farms (when it comes to producing their own livestock feed - hay).
Strip grazing	Yes, most of the farms, some of them with dedicated areas.
Alternative remedies for livestock disease management	Yes, like physical measures and trait selection.
Other practices of the dairy farms from the case study area in line with ecological practices	Manual mowing, biological pest control, reseeding (own production), seasonal movement of livestock, relying mostly on locally produced inputs, no use of chemicals, very low level of mechanized works.

Source: authors' processing based on Delphi exercise and farmer survey database

Traditional agricultural practices that match the ones that an ecological farm would use also extend to other aspects like:

- pest and plant disease management – using biological control measures and only, when necessary, products allowed by organic regulations;
- livestock feed - relying mostly on grazing on pastures (with an average of 5,6 month spent outside by the dairy cows), strip grazing and local resources (84% of the farms relying only on their own production of hay, while some others turn also to neighboring farms);
- livestock disease management – using antibiotics prescribed by the veterinary doctor only in the case of a necessary treatment, physical measures – like separation of animals and aeration and trait selection;
- livestock location – using local rotation around the farm and seasonal movement (summer rangelands, grazing on mountainous rangelands) as part of the agricultural tradition of the case study area.

CONCLUSIONS

The comparative analysis based on the experts' opinion from the Delphi exercise and the results of the large-scale farmer survey (dairy farms) from the Dornelor Basin, Suceava County, clearly highlights a strong overlapping between the agricultural practices that an ecological farm would use and the ones that have already been a tradition in the Romanian case study area, namely the use of locally produced inputs (organic fertilizers, livestock feed, local breeds etc.), manual labor (mostly of family's members), very low level of mechanized works and, maybe even important, of local traditional agricultural knowledge that has been passed from a generation to another that has been linked, organically, with the environment landscape where it has been evolving over time. This type of traditional way of practicing agriculture is now under an intense pressure induced by the population aging in rural areas, lack of external labor force that can be hired and, least but not last, by the competition of large agrifood companies.

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ACCESSING EUROPEAN FUNDS THROUGH SUB-MEASURES 16.4 AND 16.4A UNDER NRDP 2014-2020

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Abstract: *The financing of the Romanian agriculture and rural space through the SAPARD program created the technical and financial premises necessary for the process of accession to the European structures. Thus, the funds developed through the SAPARD Agency have directly contributed to the economic and social development of the rural environment, by supporting private producers, supporting agricultural associations, and financing investments made by local councils in rural areas. Subsequently, after Romania's accession to the European Union, the Paying Agency for Rural Development and Fisheries is the institution that fulfills the payment function for investment projects, financed from the European Fund for Agriculture and Rural Development. The investments made have directly contributed to economic growth and convergence of rural incomes by increasing productivity, stabilizing markets and ensuring a fair standard of living for the agricultural population. In the current budget year of the NRDP 2014-2020, according to existing analyzes, it is observed that farmers' interest in accessing grants differs from one region to another, from one sub-measure of funding to another and even from one farmer to another in the same community. Given the importance of cooperation between the actors involved in agri-food supply chains, in this paper, we conducted an analysis that seeks their interest in accessing sub-measures 16.4 and 16.4A of the NRDP 2020. In order to achieve this approach, I consulted relevant articles and specialized studies on the subject of accessing European funds for the agricultural sector and I carried out an analysis of the data provided by the Agency for the Financing of Rural Investments.*

Key words: *rural financing, NRDP 2014-2020, sub-measures 16.4 and 16.4A, cooperation, agri-food supply chains.*

JEL classification: O18, P25**,** R51.

INTRODUCTION

Despite the many debates, the importance of cooperation remains too little understood in terms of technical aspects, but especially in terms of opportunities. This scientific article aims to assess the interest of actors involved in agri-food supply chains (small farmers, non-governmental organizations, local councils, schools, health, leisure and public catering units) in establishing partnerships to contract funding, targeting the activities supported by sub-measures 16.4 and 16.4a - *Support for horizontal and vertical cooperation between actors in the supply chain in the agricultural and fruit sectors* in the financial years 2014-2020.

The use of European funds is both an opportunity and an obligation. The opportunity obviously consists of obtaining an important and essential source of financing necessary for the development, optimization and/or diversification of the activity carried out. At the same time, the signing of the financing contracts entails the obligation to respect for the entire duration of the project implementation the terms assumed at the time of signing the financing contract.

The innovative and atypical nature of these sub-measures has raised multiple issues for both applicants and experts of the Agency for Financing Rural Investments.

MATERIAL AND METHOD

Reviewing the specialized literature dedicated to the topic of accessing European funds, it is easy to see that most articles and studies contain mainly qualitative data.

Regarding the stages of the scientific approach, they have as starting point the analysis of the literature, regarding the horizontal and vertical cooperation between the actors in the supply chain in the agricultural and fruit sectors. Subsequently, the information from the databases provided by the Ministry of Agriculture and Rural Development on the main page of the Agency for the Financing of Rural Investments and on the Open Data page of AFIR were used.

Within the material, an analysis was performed through which I aimed to identify the factors that influenced the contracting on sub-measures 16.4 and 16.4a of the NRDP 2014-2020 and which led to an uneven distribution of projects.

RESULTS AND DISCUSSIONS

At the level of Romania, within the four submission sessions of the 2014-2020 program, a total number of 137 projects with a total value of 12,653,963.65 euro were contracted through Sub-Measure 16.4 and Sub-Measure 16.4a, of which 100 projects through sub-measure 16.4, with a total value of 9,162,190.08 euro and 37 projects through sub-measure 16.4a, with a value of 3,491,773.57 euro, unevenly distributed throughout the country (Figure 1). Of note is the high degree of contracting in the North-West region, with a total of 70 projects and a value of 6,522,133.66 euro. The North-West and Center regions, which form macro-region 1, have a total of 87 projects with a value of 8,062,757.26 euro, representing over 63.5% of the number of projects financed at national level. At the opposite pole are the regions Bucharest-Ilfov, with 2 projects and a value of 200,000 euro, North-East with 4 projects and a value of 374,830.45 euro and South-West with 5 projects and a value of 482,840.00 euro, together they represent only 8% of the total projects financed at national level.

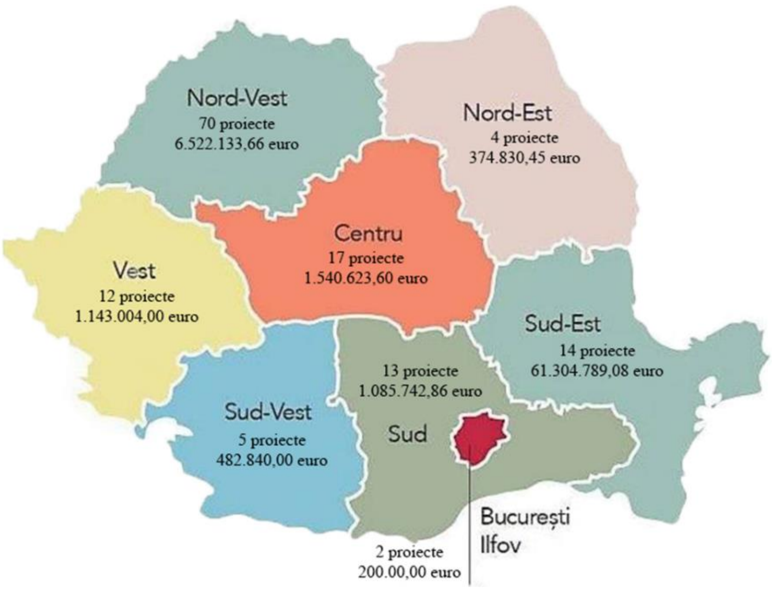

Figura 1. The situation of projects contracted through
Sub-measures 16.4 and 16.4a of the NRDP 2014-2020

Comprising Bucovina and most of Moldova, the North-East Region consists of the counties: Bacău, Botoșani, Iași, Neamț, Suceava and Vaslui. OJFIR experts subordinated to CRFIR 1 Nord-

Est IAȘI evaluated a total number of 30 projects, of which 26 projects concerned sub-measure 16.4 and 4 projects sub-measure 16.4a. Regarding the distribution by counties of the submitted projects, that reached the evaluation stage, it had a relatively uniform distribution: Iași and Suceava with 7 projects each, Bacău 5 projects, Vaslui and Neamț 4 projects and Botoșani 3 projects. In Iași and Suceava, higher values of the number of projects reached in the evaluation stage were registered, a situation that can be explained by the fact that in the two counties the research centers of the Romanian Academy as well as profile universities operate.

Following the analysis of the selection reports, we identified the main eligibility criteria that were not met, which led to the rejection, in proportion of 87%, of the funding projects. These were attempts to circumvent the maximum threshold set by the measure sheet, the submission of identical projects both in terms of project budget and in terms of marketing plans, the creation of artificial conditions and the inability to provide clarification on the additional information requested.

Only a number of 4 projects with a total value of 374,830.45 euro have reached the contracting phase, three of them being implemented in Iași County and one in Suceava. In the North-East Region, the rural communities from four counties did not contract any project through the 2 sub-measures. The low number of contracted projects places the North-East Region in last place in terms of the number of contracted projects compared to the number of farmers registered in the APIA database.

Comprising Dobrogea, as well as parts of Moldova and Muntenia, the South-East Region consists of the following counties: Brăila, Buzău, Constanța, Galați, Tulcea and Vrancea. In the South-East region, a total of 40 projects were evaluated, of which 32 projects concerned sub-measure 16.4 and 8 projects under sub-measure 16.4a. Regarding the distribution by counties of the submitted projects reached the evaluation stage, this was uneven, Tulcea county had 13 projects, Constanța 9 projects, while Buzău and Vrancea had 5 projects each, and Brăila and Galați 4 projects each.

Following the analysis of the selection reports, we identified the main eligibility criteria that were not met, which led to the rejection, in proportion of 65%, of the projects from funding. The reasons for granting ineligibility were the following:

- submission of projects with many identical aspects in order to create artificial conditions.
- non-correlation of the information from the marketing plan with those from the attached documents.
- multiple inconsistencies between the information in the grant application and the Cooperation Agreement.
- lack of supporting documents.
- discrepancy between the beneficiaries of these investments and the data about the building in which the investments will be located.
- lack of concrete information on the actions carried out within the project, on the investments to be made, on the promotional activities to be carried out and the rights and obligations of the members after the completion of the project.
- marketing plans made in an incomplete manner, without clear and personalized information about the activities to be carried out in terms of the following aspects: description of specific objectives, lack of information on how to achieve the objectives, the role of each member, etc.
- the total amount of co-financing was not correlated with that of the financial plan related to the indicated budget, as well as the lack of information on the amount of partners' participation to ensure the co-financing of projects.
- omissions regarding the defining information of the activity in the marketing plans.

- lack of information on how the concept of short supply chain will be set up and developed, starting from the areas cultivated by the members of the cooperation agreement, their processing and marketing of the proposed products.

- the value of the support was not justified in correlation with the complexity of the project, the quantity of products marketed, and the added value generated by it after implementation.

- failure to respond to requests for additional information requested.

Only 14 projects with a total value of 1,304,789.08 euro reached the contracting phase, as follows: Tulcea 7 projects, Constanța 4 projects, Vrancea two projects and Buzău one project. In the South-East Region, the rural communities from Brăila and Galați counties did not contract any project through the 2 sub-measures.

Being entirely in Muntenia, the Southern Region is made up of the following counties: Argeș, Dâmbovița, Giurgiu, Prahova and Teleorman. As in the South-East Region, a total of 40 projects were evaluated in the South Region, as follows: 27 projects targeted sub-measure 16.4, and 13 projects targeted sub-measure 16.4a. The similarities with the South-East Region continued in terms of the distribution by county of the submitted projects, which have reached the evaluation stage. As can be seen, the distribution was uneven, Dâmbovita County having 27 projects, more than double the total values of all other counties of the development region: Prahova 5 projects, Arges 4 projects, Giurgiu 3 projects and Teleorman 1 project.

It can be seen that of the total number of projects that reached the evaluation stage, the percentage of those that were contracted was 32.5%. Thus, the rural communities from Prahova and Teleorman counties failed to contract even one project, while the difference between the number of contracted projects in Dâmbovita county -10 projects and the other counties Arges -2 projects and Giurgiu - one project, creates major discrepancies on development opportunities.

Following the analysis of the selection reports, we identified the main eligibility criteria that were not met, which led to the rejection, in proportion of 67.5%, of the projects from funding. These were mainly due to the non-transmission of the answers to the requested additional information, the non-compliance with the principles of short agri-food chains and the lack of information on the justification of the expenses related to the investments provided in the Marketing Plan.

Only 13 projects with a total value of 1,085,742.86 euro reached the contracting phase, distributed as follows: Dâmbovita County 10 projects, Giurgiu County 2 projects and Arges county one project. In the Southern Region, the rural communities from two counties, although they had projects under evaluation, did not contract any project through the 2 sub-measures.

Comprising the entire Oltenie and a small part of Muntenia, the South-West Region is made up of the following counties: Dolj, Gorj, Mehedinti, Olt and Valcea. In the South-East region, a total number of 20 projects were evaluated, of which 15 projects targeted sub-measure 16.4 and 5 projects sub-measure 16.4a. Regarding the distribution by counties of the submitted projects reached the evaluation stage, it was uneven, Dolj and Olt counties had 8 projects and 6 projects, Gorj county 3 projects, Valcea county 2 projects and Mehedinti county had one project.

It can be seen that of the total number of projects that reached the evaluation stage, the percentage of those that were contracted was 25%. Thus, the rural communities from Mehedinti and Olt counties did not manage to contract even one project, while at the level of the entire region, 5 projects with a total value of 482,840.00 euro were contracted.

Following the analysis of the selection reports, we identified the main eligibility criteria that were not met, which led to the rejection, in proportion of 75%, of the funding projects. These were mainly represented by non-compliance with the presence at the confirmed date and time in order to perform field verifications, creating artificial conditions by submitting several projects during the same session, attempts to circumvent the contractual clauses by submitting the application for funding documents that do not reflect reality, the use of the deregistered companies identified by elements that no longer express reality and the presentation of information in order to mislead the assessor.

Comprising the entire Banat as well as parts of Crisana and Transylvania, the West Region has the following counties: Arad, Caras-Severin, Hunedoara and Timis. A total of 26 projects were evaluated in this region, of which 22 projects concerned sub-measure 16.4 and 4 projects under sub-measure 16.4a. Regarding the distribution by counties of the submitted projects reached in the evaluation stage in the Western region, it was relatively uneven, in Hunedoara and Timis counties they had 12 and 11 projects respectively, while Caras-Severin and Arad counties had 2, respectively 1 project.

It can be seen that of the total number of projects that reached the evaluation stage, the percentage of those that were contracted was 46%. Thus, the rural communities in Arad and Caras Severin counties failed to contract even one project, while the difference between the number of projects contracted in Hunedoara county 9 projects and Timiș county 3 projects creates major discrepancies regarding the development opportunities of local communities.

Following the analysis of the selection reports, we identified the main eligibility criteria that were not met. The reasons for granting ineligibility were related to the lack of correlation between the complexity of the project, the quantity of products sold, and the added value generated by it after implementation, non-compliance with deadlines for providing additional information and non-correlation of objectives in the Marketing Plan with the Cooperation Agreement. Only 12 projects with a total value of 1,143,004.00 euro have reached the contracting phase.

Comprising Maramures and important parts of Crisana and Transylvania, the North-West Region has the following counties: Bihor, Bistrita-Nasaud, Cluj, Maramureş, Satu-Mare and Salaj. According to the analyzed statistical data, we noticed that the distribution of projects is uneven in the region. This situation is due to the fact that out of the 120 projects evaluated in the North-West region, 50 of them are related to Cluj County. Of the total number of projects evaluated, 93 projects targeted sub-measure 16.4, while 27 projects targeted sub-measure 16.4a. As we mentioned regarding the distribution by counties of the submitted projects, that reached the evaluation stage, Cluj County leads detached with 50 projects, following the counties of Bistrita Nasaud, Bihor, Satul Mare with 18, 17 and 16 projects, respectively, while Maramures registered only 10 projects.

At national level, the North-West Region has the best territorial distribution, being the only one in which there was not even a county in which at least one project was contracted through the 2 support sub-measures. Moreover, the North-West Region has the most projects within the 2 sub-measures, both in terms of the number of projects evaluated and contracted (70 projects, of which 50 projects on Sub-measure 16.4, respectively 20 projects on Sub-measure 16.4a), with a value total contracted of 6,522,133.66 euro.

Following the analysis of the selection reports, we identified the main eligibility criteria that were not met, which led to the rejection, in proportion of 42%, of the funding projects. The reasons for granting ineligibility were the following:

- it has not been demonstrated the creation of at least one short chain in a food chain configuration capable of marketing farmers' products from the Cooperation Agreement.

- the members of the Cooperation Agreement also hold membership in other agreements related to several projects submitted for support in order to promote the same product categories, considering that the necessary artificial conditions have been created to benefit from multiple support and thus obtain an advantage that runs counter to the objectives of measure 16.4.

- the establishment of Cooperation Agreements between members of the same family.
- farmers do not have equipment specific to the activity, in the sense of preparing the products for marketing and do not prove compliance with the sanitary-veterinary norms.
- lack of a clear and personalized presentation of the project proposed for funding.
- non-fulfillment of the conditions of the guide by the partnership leader.
- partnerships structured identically / almost identically in several projects submitted on sub-measure 16.4, where the project leaders are the Local Councils of the territorial units, a few farmers.
- errors in budgetary calculations regarding the proportion of VAT eligibility.
- lack of farmers in the Partnership Agreement.
- lack of information on the substantiation of expenditure.
- the structure of the partnership does not involve school, health, leisure, public catering, farmers.
- submission of incomplete feasibility studies that do not present information on the technological flow, the investment opportunity, sketches showing the location of the equipment, forecasts on the evolution of the activity.
- lack of information in the Marketing Plan on how the implementation of the project brings added value for farmers and the local community, compared to the situation in which the project would not be implemented.
- multiple inconsistencies in the submitted documents.

Being in Transylvania, the Center Region consists of the following counties: Alba, Brasov, Covasna, Harghita, Mures and Sibiu. A total of 40 projects were evaluated in this region, of which 32 projects concerned sub-measure 16.4 and 8 projects under sub-measure 16.4a. Regarding the distribution by counties of the submitted projects that have reached the evaluation stage in the Center region, this was uneven. The counties of Brasov and Harghita had 16 and 13 projects, respectively Alba and Mures, 9 projects each, while Covasna had 8 projects and Sibiu only 4 projects.

It should be noted that the region is in second place in terms of both the number of projects evaluated and contracted through the two sub-measures, with a total of 17 projects contracted with a total value of 1,540,623.60 euro, of which 13 projects on Sub-Measure 16.4, respectively 4 projects on Sub-Measure 16.4a. In this regard, we cannot fail to notice that out of the total number of projects reached in the evaluation stage, only a percentage of 28.8% were contracted in relation to the North-West Region region, where the contracting percentage was 58.3%.

Following the analysis of the selection reports, we identified the main eligibility criteria that were not met, which led to the rejection, in a proportion of 71%, of the funding projects. The main reasons for granting ineligibility were the following:

- the lack of correlation of the data mentioned in the Marketing Plan with the attached documents.
- providing erroneous data in the application for funding.
- the non-existence of the NACE authorized codes specific to the activity in the agricultural field for the partner-farmers in the Cooperation Agreement.
- the lack of price offers within the Financing Application and the documents attached to it.
- lack of a clear and personalized presentation on the project proposed for funding.
- submission of projects in which a mixture of information and documents taken over from other projects submitted under the same measure was made.

- providing insufficient and omitted information in the answers provided to requests for additional information aimed at clarifying the submitted project.

- lack of compliant offers required for renting the goods.

Being in Muntenia, Bucharest - Ilfov Region includes the city of Bucharest and the counties: Calarasi, Ialomita and Ilfov. A total of 15 projects were evaluated in this region, of which 10 projects covered sub-measure 16.4 and 5 projects under sub-measure 16.4a. Regarding the distribution by counties of the submitted projects reached the evaluation stage in the Bucharest - Ilfov region and in this case the distribution was uneven, as follows: Bucharest 7 projects, Ialomita 4 projects, Calarasi and Ilfov 2 projects each. Subsequently, only one project from Bucharest and one from Ialomita reached the contracting stage.

Following the analysis of the selection reports, we identified the main eligibility criteria that were not met, which led to the rejection, in proportion of 87%, of the funding projects. The high proportion of projects rejected from funding is the same as in the North-East Region, with the two regions recording the worst results in contracting projects on the two sub-measures. Regarding the Bucharest - Ilfov Region, the reasons that were the basis for granting the ineligibility of the projects were the following:

- various deficiencies regarding the submitted documents: those related to agricultural lands, the documents of the legal representative, the certifications attesting that the production is obtained in an ecological system, etc.

- marketing plans that do not present in a clear, concise, detailed and personalized way the proposed activities.

- the lack of authorized NACE codes for the activities that the partners declare to carry out within the framework of the Cooperation Agreement.

- the requirements of the applicant's guide were not taken into account in drawing up the Funding Application.

- the eligibility criteria were not met.

- the members of the Cooperation Agreement also hold membership in other agreements relating to several projects submitted for support in order to promote the same categories of products, considering that the necessary artificial conditions have been created to benefit from multiple support.

CONCLUSIONS

The two sub-measures of financing through which support is provided for horizontal and vertical cooperation between actors in the supply chain in the agricultural and fruit sectors have attracted the interest of farmers working in the surrounding areas of large cities. Possible explanations for this situation are:

- the level of education of farmers in peri-urban areas which gave them the opportunity to develop long-term relationships with partners in various fields.

- easy access to information and the specialist consultancy market.

- reaching a certain degree of entrepreneurial maturity.

At the moment, small farmers are not yet ready to cooperate and do not understand the real advantages of joining a functional associative form. The costs of joining an associative form, in the perception of farmers, are not reflected in the advantages offered by it. In this context, the emergence of a funding competition to support cooperation between actors in the supply chain is welcome, as project results can become models of good practice for local communities.

The mountainous area of Romania includes 658 teritorial units, totaling an area of 71,341 km2, respectively 30% of the country's territory (238,391 km2). As agriculture is the main economic activity in the mountainous rural area, 18.5% of the people directly involved in agriculture work here. The vulnerability of small farms in the mountain area, with limited prospects for improving economic performance, can only be counteracted by stepping up the process of cooperation in agriculture. In this way the disruptive effects can be successfully inhibited, allowing the increase of the production yield as well as the optimization of the production capitalization.

Taking into account the particularities of the rural mountain area of Romania, through sub-measures 16.4 and 16.4a real progress can be obtained in terms of consolidating the agri-food sector even in the competitive conditions of the market economy. This could reduce the gap in terms of economic and social development, creating a favorable climate in which young people no longer seek easier living conditions and higher incomes, in urban areas or in other countries.

The involvement of the Romanian Academy through the National Institute for Economic Research "Costin C. Kiritescu" and the Romanian Mountain Forum in supporting the establishment and development of cooperation between actors in the supply chain in the agricultural and fruit sectors in the mountain area is appreciated. However, it should be noted that in the context of a funding competition with clearly established and quantifiable rules, special attention must be paid to eligibility criteria, which will lead to superior results in terms of the ratio between the number of projects reached in the evaluation phase and the number of which were also contracted.

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AGRICULTURAL INPUTS AND FOOD SECURITY

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Abstract: *Food security is a broad interdisciplinary process with multi-sectoral implications that go beyond the food production, supply and procurement needs. Ensuring consumption availabilities has lately gained particular importance due to the evolution of the prices of production factors. The analysis of annual indices for energy, agriculture and food processing shows that energy prices (coal, crude oil and natural gas) have registered spectacular increases. The common responses to problems related to the scarcity of resources include higher prices, while the common responses to the management of resources involve their more efficient use, introducing alternatives and recovery of resource after use, involvement of public factors in supporting agricultural production.*

Key words: *food security, agricultural inputs*

JEL Classification: Q12, Q18

INTRODUCTION

Food production stability has a multidimensional character. Food system productivity is closely linked to economic and social conditions, as well as to the climatic factor. As it results from the conclusions of specialist studies, the impact of changes in climate variables on crop yields is different by crop species and regions, so that it is quite difficult to reach an understanding of the influence of annual inter-climatic variations on crop yields in different regions. When there is a dynamic balance between the environmental and management factors, stable crop yields can be obtained. In this sense, the evolution of the consumption of fertilizers and pesticides as well as of their prices are of crucial importance in reaching food security.

MATERIAL AND METHOD

Various sources from literature have been studied, such as: forecasts of potential world nitrogen, phosphorus and potassium balances, demand projections based on agronomic considerations (for example, cultivated area and fertilizer application rate), market feedback, estimates of industrial associations, growth models, econometric models and other assessments by experts. The evolution of annual indices for energy, agriculture and food processing on the global market, the fertilizer consumption, the evolution of prices and price indices of the agricultural production means, of agricultural products on the European market and in Romania were also analyzed.

The data sources come from FAO, World Bank, Eurostat and national statistics.

RESULTS AND DISCUSSIONS

The green revolution led to high productivity of crops by the increase of cultivated areas, use of high-yielding hybrid seeds, excessive use of inorganic fertilizers and pesticides, emergence of new irrigation equipment and methods and agricultural machinery.

There have been many challenges since the phosphorus, nitrogen and potassium began to be used on farmland. Phosphorus is a non-renewable resource, like oil. Various studies state that at the current extraction rates, the global commercial reserves of phosphate will be exhausted in the next 50-100 years, and the remaining potential reserves are of lower quality or more expensive to extract (Dana Cordel et al.).

The use of phosphorus fertilizers becomes increasingly efficient, mainly in Europe. According to the European Fertilizer Manufacturers' Association, the farmers from Europe and North America are increasingly avoiding overfertilization and they incorporate straw and manure instead in agricultural soils, partially in order to recycle phosphorus.

The pesticides are substances or a mix of substances mainly used in farming or in the public health protection programs to protect crops from weeds, pests or diseases. This category includes herbicides, insecticides, fungicides, rodenticides and plant growth regulators. Several authors discussed the advantages of pesticide use. For instance, it was found that, over time, there is a positive relationship between economic development and pesticide use. Jerry Cooper and Hans Dobson (2007) identified 26 immediate and undeniable primary benefits and 31 secondary benefits on the longer term, which are less intuitive and for which it is more difficult to establish causality. Lewis, Nancy M. and Ruud, Jaime (2005) attributed the doubling of US blueberry production and the subsequent increase in consumption mainly to herbicide use that improved weed control.

Other authors associated numerous negative effects upon health of chemical pesticides.

Box 1. Summary of reviewed studies on the effects of pesticides upon health

Health effect	No. of studies found	No. of studies included *	Summary of results	Average global score of included studies *
Dermatological effects	11	10	7/10 positive studies for dermatitis due to pesticide exposure	4.50
Neurotoxicity	60	41	39/41 positive studies for the development of 1 or more neurological anomalies due to pesticide exposure	4.99
Reproductive outcomes	64	59	Congenital defects: 14/15 positive studies; time to pregnancy: 5/8 positive studies; fertility: 7/14 positive studies; altered growth: 7/10 positive studies; fetal death: 9/11 positive studies; other results: 6/6 positive studies	4.83
Genotoxicity	15	14	11/14 positive studies for increased chromosomal aberrations with pesticide exposure †	5.03

*Reviewers scored each study on a 7-point scale for methodological quality from 1- very weak to 7-excellent. The studies with a score <4 were excluded.

Source: Non-cancer health effects of pesticides, Systematic review and implications for family doctors (2007), PMID

According to FAO forecasts conducted until 2022, taking into account the maximum achievable production (supply) and the total demand, there is a potential balance for nitrogen, phosphorus and potassium. The demand projections are based on agronomic considerations (for instance, cultivated area and fertilizer application rate), market feedback, estimates of industrial associations, growth models, econometric models and expert judgement. Unforeseeable factors such as raw material limitations, logistical problems, unscheduled suspension of activities due to technical problems, natural disasters (e.g. earthquakes, mine flooding) have not been taken into consideration. The forecasts of potential world balances of nitrogen, phosphorus and potassium, until 2022, are presented below.

Compared to the global capacity, Europe's production capacity is 23% for nitrogen, 10% for phosphorus and 40% for potassium; of the global demand, Europe accounts for 16% for nitrogen, 8% for phosphorus and 11% for potassium.

Table 1. World supply, demand and balance of nitrogen, phosphorus and potassium, 2016-2022 (thousand tons)

Specification	Capacity	Supply	Other uses	Fertilization availability	Demand	Potential balance
Nitrogen – World	190397	163219	40660	122559	111591	10968
Nitrogen – Europe	43589	37621	9595	28026	17552	10474
Phosphorus – World	63702	52066	7734	44332	43562	770
Phosphorus – Europe	6639	5688	1131	4557	3620	937
Potassium –World	64553	54197	6363	47834	40232	7602
Potassium - Europe	25790	22021	869	21152	4453	16699

Source: World fertilizer trends and outlook to 2022**,** Food and Agriculture Organization of the United Nations, Rome, 2019

Asia Pacific was the largest region in the global chemical fertilizer market, accounting for 41% of the market in 2020. North America was the second largest region, accounting for 18% of the global chemical fertilizers market. Middle East was the smallest region in the global chemical fertilizer market.

The main companies on the chemical fertilizer market include Nutrien Ltd.; Yara International; Mosaic Company; CF Industries Holdings Inc. and Israel Chemicals Ltd.

A current issue is the evolution of *fertilizer prices*, which sharply increased in 2021 and maintained or continued to increase in 2022, to reach levels close to those during the global financial crisis of 2008-2009:

- phosphate rock – 173.1 $/ton in January
- DAP – 699.4 $/ton in January
- triple superphosphate – 687.5 $/ton in February
- urea – 846.4 $/ton in January
- potassium chloride – 391.8 $/ton in February

As compared to 2020, in the year 2021 the price for phosphate rock (P2O5) increased by 59%, for the diammonium phosphate (DAP - (NH4)2HPO4) by 89%, and for triple superphosphate (TSP) by 100%; the largest price increase was for urea from Ukraine (E. Europa $CO(NH_2)_2$) by108%. The potassium chloride price decreased by 5% in 2021 (Figure 1).

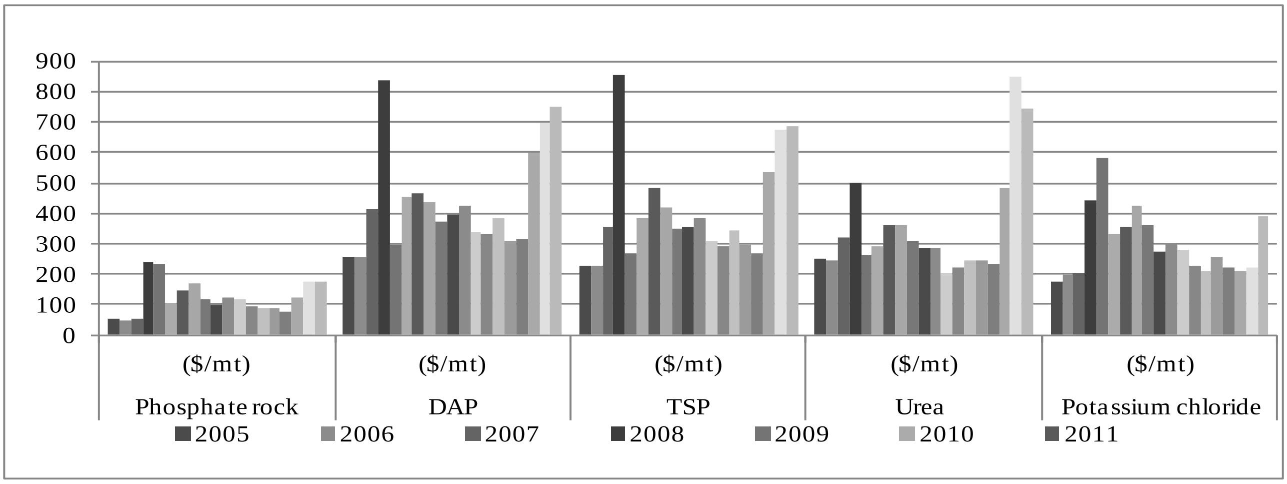

Figure 1. Evolution of chemical fertilizer prices ($/mt)
Source: World Bank Commodity Price Data (The Pink Sheet)

According to Mosaic Company, the largest American producer of potassium and phosphate fertilizers, each essential element has its own set of reasons why prices are high:

Box 2. Reasons behind the increase of fertilizer prices

- ✓ Nitrogen – supply interruptions due to weather events in 2020 and the increase of gas prices caused many facilities to shut down production, which led to significant increases of nitrogen prices globally. It is expected that these shutdowns will not be permanent, as gas prices return to more normal levels, production should increase and put less pressure on nitrogen prices in 2022.
- ✓ Phosphates – higher input prices, in the case of ammonia and sulfur; these two are critical inputs for phosphate production and their prices increased by 313% and 194% respectively from year to year – compared to 2020. In addition, the whole supply chain was deeply affected by the drastic increase in transport costs.
- ✓ Potassium – deliveries were limited due to unforeseen production disruptions in several mines, and the higher demand caused the increase of prices globally. The geopolitical situation in Eastern Europe might further complicate the interruptions of supply in 2022, leading to the increase of prices throughout the year.

Source: https://www.mosaicco.com/Article/What-Is-Driving-Fertilizer-Prices

In Europe, the increase of natural gas prices led to a large-scale reduction in ammonia production, an important input for nitrogen fertilizers. The natural gas crisis forced several factories producing nitrogen fertilizers to limit or stop their production, including companies like *Yara International ASA* from Norway and the most important European manufacturer of chemicals, the German group *BASF SE*. Natural gas accounts for 80% of the production costs of fertilizers, and currently prices are four to five times higher than normally, according to Fertilizers Europe.

According to World Bank methodology, the price indices for natural gas and fertilizers increased in 2021 compared to 2010 by 29.93 % in natural gas and by 31.4% in fertilizers (Figure 2).

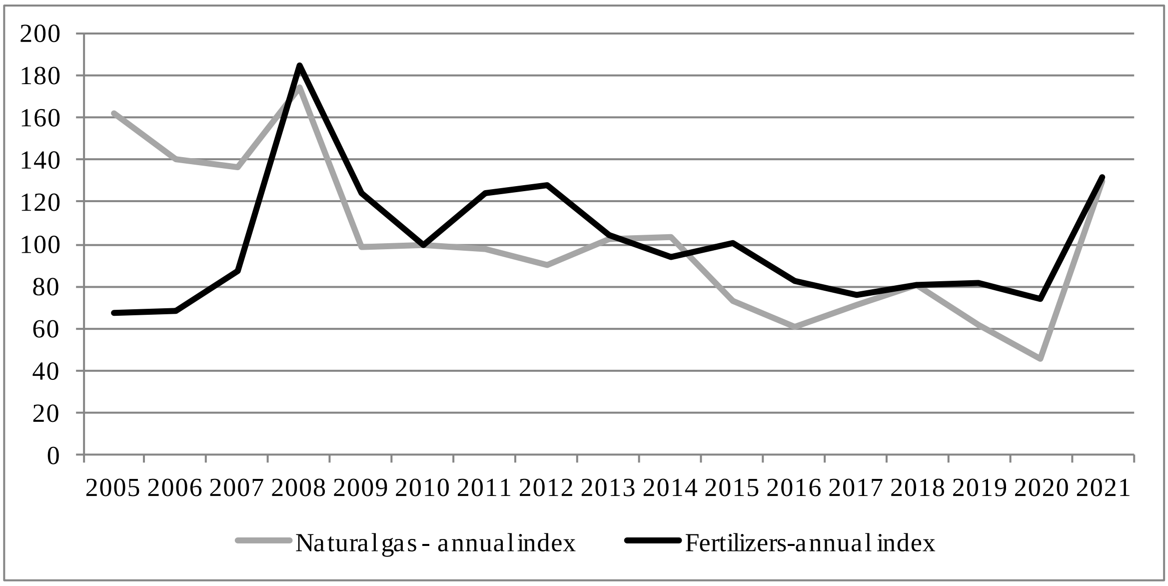

Figure 2. Evolution of annual index of natural gas and fertilizers, 2010=100
Source: World Bank Commodity Price Data (The Pink Sheet)

China is a key manufacturer of fertilizers, supplying urea and phosphates to the agricultural sector. China's DAP (diammonium phosphate) and urea exports represents about one third and one tenth respectively of global trade. In 2021, China announced the suspension of diammonium phosphate (DAP) and urea exports. At the same time, Russia announced restrictions on the nitrogen and phosphate fertilizers starting with the last month of the year 2021.

The analysis of annual indices for energy, agriculture and food processing reveals that energy prices (coal, crude oil and natural gas) in 2021 were down by 6% compared to 2010. However, in agriculture the price index increased by 8%, and in food industry the price index increased by 21% compared to 2010.

Compared to the year 2020, in 2021 the energy price increased by 79%, the price of agricultural products by 22%, while food price increased by 29% (Figure 3). The sharper increase in food prices is explained by the share of energy expenses in total expenses, i.e. 27% in food industry compared to 14% in agriculture.

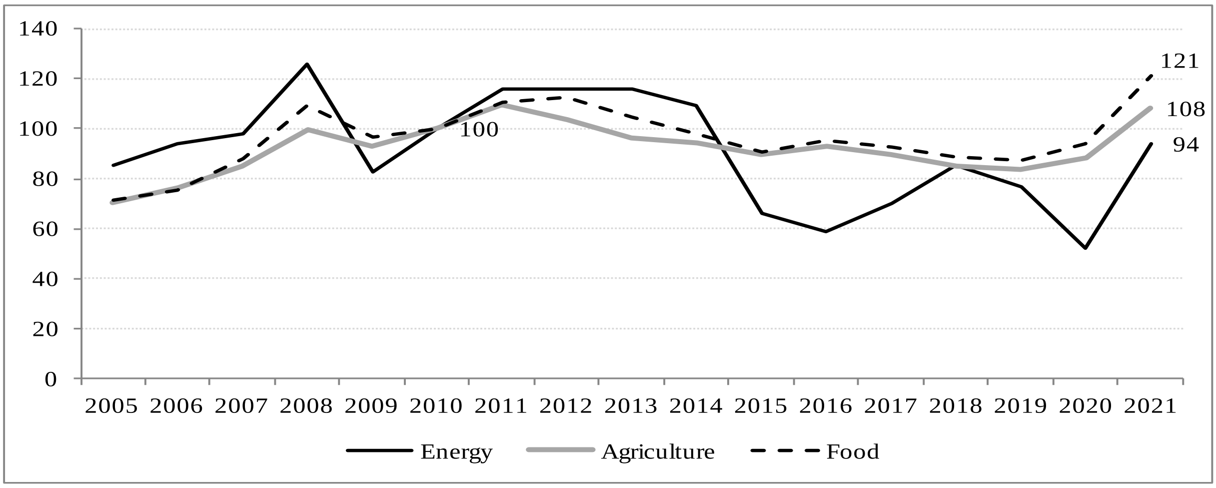

Figure 3. Evolution of annual indices in energy, agriculture and food industry, 2010=100
Source: World Bank Commodity Price Data (The Pink Sheet)

According to fertilizerseurope.com., the total fertilizer consumption in the EU amounted to 20 million tons in 2019. The share of imports in total consumption represented 40%. Fertilizer consumption (% of fertilizer production) in Romania was reported at 129% in 2018, according to the World Bank's collection of development indicators.

In Romania, the consumption of chemical fertilizers amounted to 738453 tons active substance, out of which 63% nitrogen fertilizers, 25% phosphate fertilizers and 11% potash fertilizers.

As compared to 2010, the total fertilizer consumption has increased by 54%, more consistently since 2018. The consumption of natural fertilizers reached 18680226 tons active ingredient in 2020, up by 23% compared to 2010.

The land area on which chemical and natural fertilizers were applied was 7522224 hectares, up by 6% compared to 2010 (Figure 4).

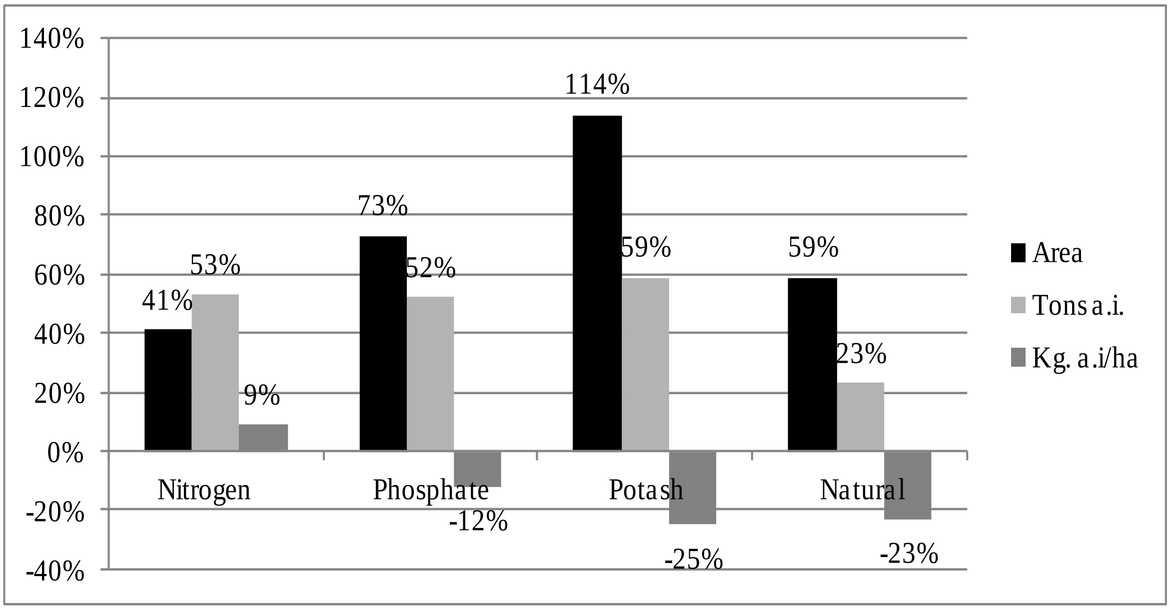

Figure 4. Evolution of area on which chemical fertilizers were applied, of total consumption and of consumption per hectare, 2020/2010 %

Source: Tempo online

Although the total fertilizer consumption increased, if we refer to consumption per hectare, we find that the amount of active ingredient per hectare increased only in the case of nitrogen fertilizers, while for the remaining fertilizers it decreased.

Table 2. Consumption of fertilizers in kg active ingredient / ha

	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	2020/2010
Chemical	**67.8**	**70.6**	**69.1**	**79.4**	**67.7**	**81.0**	**79.2**	**80.0**	**104.3**	**101.7**	**98.2**	45%
Nitrogen	71.0	71.2	65.0	76.3	64.5	76.7	71.2	73.1	85.4	74.7	77.4	9%
Phosphate	58.2	56.5	46.9	49.0	45.1	50.8	47.0	52.4	60.2	54.0	51.2	-12%
Potash	55.1	57.0	36.7	34.8	29.4	40.4	37.0	43.2	46.2	48.2	41.1	-25%
Natural	25384.0	23021.3	21946.1	21789.6	20454.2	17602.4	17310.3	17822.9	18912.9	18762.2	19615.1	-23%

Source: Tempo online

Table 3. Fertilizer price index in Romania and in the EU-27, 2015=100

	EU-27	Romania
Nitrogenous fertilizers	120.24	129.79
Phosphatic fertilizers	118.22	129.79
Potassic fertilizers	109.12	129.79
Compound fertilizers	110.01	130.80
NP fertilizers	109.35	140.18
PK fertilizers	113.73	130.80
NPK fertilizers	109.87	128.88

Source: Eurostat [apri_pi15_ina]

The price indices of the means of agricultural production (fertilizers, plant protection products and herbicides) increased more sharply in Romania than on the European market as compared to 2015. Overall, the price of fertilizers increased by 16% in the EU, while in Romania the fertilizer price increased by 30%. In the EU, the price increase is significant for nitrogen fertilizers, while in Romania the highest increases were noticed in complex fertilizers of NP type (Table 3).

The general price increase index for plant protection products and herbicides compared to that in the year 2015 was 103.12 in the European Union and 143.98 in Romania. While in the EU the price of herbicides increased by 5.13%, in Romania the increase was significantly higher, by 56.23% in insecticides and by 55.3% in herbicides (Table 4). The impact of inputs used in agriculture on the price of agricultural products is different on the two markets and by types of products, with the mention that lower increases are maintained in the EU compared to Romania. The highest impact for the Romanian market was found in vegetables, fruits and potatoes (Table 5).

Table 4. Evolution of price indices for plant protection products and herbicides, 2015 = 100

	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
European Union - 27 countries (from 2020)							
Fungicides	100.00	101.34	101.81	101.14	100.25	99.82	100.63
Insecticides	100.00	101.01	101.93	103.41	103.54	104.39	105.57
Herbicides	100.00	100.88	101.58	102.80	102.44	101.69	105.13
Romania							
Fungicides	100.00	144.33	142.80	108.63	91.71	111.02	118.00
Insecticides	100.00	102.50	118.83	156.41	142.17	154.33	156.23
Herbicides	100.00	117.97	101.39	125.65	118.61	124.62	155.30

Source: Eurostat[apri_pi15_ina]

Table 5. Evolution of price indices of agricultural products in the year 2021, 2015 = 100

	EU 27	Romania
Cereals (including seeds)	137.03	139.97
Industrial crops	131.98	134.69
Forage plants	124.39	133.96
Vegetables and horticultural products	122.35	166.36
Potatoes (including seeds)	134.88	146.49
Fruits	136.31	158.59

Sursa: Eurostat [apri_pi15_outa]

There are four pillars to food security: availability of food (food supplied from domestic production of imports, food aids inclusively); access to food (rights); utilization of food through adequate diet, clean water, food hygiene; stability (of food supply). The stability concept may refer to both food supply and access.

According to FAO, there are four groups of factors that put food security at risk: 1) natural factors (pests, diseases, drought, fire), 2) market factors (falling prices, unemployment, increase of interest rates), 3) public and state factors (reduced spending on public health, increased taxation, fewer nutritional programs) and 4) other (displacement of communities as a result of war or embargoes).

Regarding the market factors, it should be mentioned that in the new global context, in the first place it is the increase in the prices of agricultural inputs that contributes to the increase of prices of agricultural products, being a serious threat to food security, if we take into account their transmission in the food chain.

CONCLUSIONS

Common responses to the problems related to resource scarcity include higher prices, more efficient use of resources, introducing alternatives and recovery of resource after use. Besides the natural factors (pests, diseases, drought), price increases in fertilizers and pesticides on the domestic and global market as well as the non-involvement of public factors in supporting farms can seriously affect a large part of the population.

As regards the consumption of fertilizers in our country, the consumption of active ingredient per hectare increased only for nitrogen fertilizers, and it decreased for the remaining fertilizers compared to the year 2010, these accounting for 63% in crop fertilization.

The recent increases in fertilizer prices are due to several factors, such as fluctuating natural gas costs, rising commodity prices driving global demand for fertilizers, supply disruptions, fertilizer export restrictions to ensure self-supply.

The high fertilizer prices put inflationary pressure on food prices, exacerbating food security concerns, while the restriction of fertilizer and pesticide use through environmental policies is another force that will shape the market in the next years.

In the years to come, the market will focus on organic products that contain live micro-organisms, such as bacteria, fungi and algae, able to fix atmospheric nitrogen of to transform the soluble phosphate and potassium from soil into forms available to crops. As regards pesticides, if the ecological principles are not taken into account, the outcomes can be harmful and irreversible in the long term.

Without denying the negative impact of the use of inorganic fertilizers and pesticides on soil and human health, reality shows that the transition to alternative methods must take place over a sufficiently long period of time, so that the supply of fertilizers and organic products will be sufficient, should not affect farmers' incomes and the availability of food on the market as well as the accessibility of healthy foods for all.

The main threats to food security are the prices of foodstuffs and the disappearance of the variety of crop species. Just as during the Green Revolution the cultivation of indigenous crop varieties was reduced, an alternative is to encourage the production of local varieties of fruits and vegetables in the kitchen gardens, using clean methods, a practice by which people are directly interested in the family's food security. At the same time, the consistent support through subsidies to the cultivation of local varieties on farms with green technologies would allow the increase of supply, facilitating consumers' access to healthy products.

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CARRYING CAPACITY IN DANUBE'S DELTA - LINK BETWEEN LOCAL ECONOMY DEVELOPMENT AND ENVIRONMENTAL RESOURCES PROTECTION

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Abstract: *During COASTAL project, financed through Horizon 2020 program, research team carried out a modelling activity, for the three main economic activities for Danube's Delta study case area: agriculture, aquaculture and tourism. Regarding the tourism in Danube's Delta region, we wanted to find the answer to the following question: How far can be developed Danube's Delta area without damaging the environment?To achieve one of the main objective of modelling activity, several parameters with which the model operates where used, such as carrying capacity, variable of interest both for generating income within the tourist activity and to ensure the sustainability of the area from environment perspective. Therefore, Carrying capacity represent the central theme of this paper and we used different approaches from a conceptual, mathematical and logical point of view. Also, we presented elements of tourist demand and supply in the Danube Delta, in order to be able to compare the currently existing carrying capacity of the study case area with the hypothetical value, calculated among this paper.*

Keywords: *Danube's Delta, tourism, carrying capacity, rural development, tourism marketing*

JEL classification: O13, Q18

INTRODUCTION

Within the project with COASTAL acronym, financed through Horizon 2020 program, under Grant Agreement no. 773782, was carried modeling activity out, using the VENSIM program, for the 3 main economic activities in Danube's Delta area: ecological agriculture, aquaculture and rural tourism. Regarding tourism,, the dynamic system created in VENSIM tries to provide the solution to the following problem: *How much can the Danube Delta area be developed, without damaging the environment?* Finding the answer to the above question is a challenge, and also a necessity, especially for Danube's Delta area. The peculiarities of Danube's Delta ecosystem represents the main attraction for which tourists, both national and foreign, choose the Danube Delta as their holiday destination. Statistical data of the National Institute of Statistics shows that, the Covid-19 pandemic has obviously affected tourism practiced in areas all over the world, the Danube's Delta "threshold" has been further crossed by national tourists, perhaps even more than in others years, precisely because of the mentioned characteristics. Returning to the modeling activity, in order to be able to get closer to the truth, regarding the maximum supported level of Danube's Delta rural development, and the corresponding level for the safety of the environment, we used a series of parameters and variables, such as: tourist duration stay, obtained incomes from tourism activities, marketing budget, the impact on water quality, tourism workforce, attractiveness degree of t tourist area, number of tourists, ***carrying capacity***. Last mentioned parameter shows a particular importance, both in achieving the goal of the model created within the COASTAL project, and in substantiating European and national strategies in order to establish sustainable economic development directions, in terms of tourism activity

MATERIALS AND METHODS

In order to create the model from which the parameter were withdrawn, specific techniques where used, from qualitative analysis field (workshop meetings, in which experts from fields such from tourism domanin, agrarian economy, rural development, the dissemination of the literature of specialty), but also elements related to quantitative's analysis scope (statistical data were processed, in order to outline a current overview of Tulcea county area, implicitly the Danube's Delta region, mathematical and logical formulas and algorithms establishment).

Regarding the present paper, in order to analyze the major interest parameters, the carrying capacity in the Danube Delta, a multidisciplinary approach was applied, by analyzing reference national and international publications, from different fields, such as statistics, mathematics, socio-economics, tourism management and marketing. Statistical data of interest, published by the National Institute of Statistics, were also processed

RESULTS AND DISSCUSION

The present paper starts from the following question "What does carrying capacity means and how can it be quantified?" and specialized publications and studies were analyzed, in order to establish the mathematical dimension of carrying capacity, but also the social dimension of this indicator.

Table 1 presents the main definitions regarding tourism carrying capacity, in specialized publications:

Table 1 – Carrying capacity's conceptual definition

No.	Definition	Source
1	*The maximum tourist number allowed in a tourist area, at the same time, so that there are no negative consequences from an ecological, economic, social point of view.*	Danube Parks Network, Association of Ecotourism in Romania, 2010
2	*Totalitatea activităților umane pe care o zonă turistică o poate găzdui, fără a deteriora zona respectivă și fără a provoca disconfort la nivelul comunității rurale.*	Middleton & Chamberlain, 1997
3	*Organizația Globală de Turism definește capacitatea de cazare ca fiind un anumit nivel de utilizare al unei zone turistice de către totalitatea utilizatorilor, ce se poate înregistra sub aceleași coordonate temporale și spațiale.*	Buckley, R., 1999
4	*Densitatea sau dimensiunea medie a populației unei specii sub care numărul său tinde să crească și peste care numărul său tinde să scadă din cauza lipsei de resurse.*	Enciclopedia Britannica, 2019
5	*The average population density or size of a species below which its numbers tend to increase and above which its numbers tend to decrease due to resources lack.*	M.E. Geores, 2001
6	*Coming from the ecological point of view, carrying capacity is a suitable concept for reflecting the environment limits for a certain socioeconomic system.*	Zekan, B., Weismayer C., Gunter, U., Scuh, B., Sedlacek, S., 2022
7	*Carrying capacity of a tourist area has been applied in the context of the tourist activities impact on the environment, especially in the case of management of natural resources and protected areas, such as national parks*	Seidl & Tisdell, 1999

Source: processing specialist literature publications, according to the indicated sources

Analyzing some of the many definitions for the carrying capacity concept, it can be seen the three types of potential types approaches, regarding this term: from the ecological, experience of the consumer in tourism services and from the socio-economic point of view. Thus, the specialists recommends that the carrying capacity value estimation be carried out in an integrated manner, analyzing the parameter's generated impact, through the number of tourists correlated with the average length of their staying, bul also with the area's specific seasonality. Also, the tourist services consumer's behavior and its customs, the type of tourism carried out mainly within the analyzed tourist destination and the specific tourist offer, the performance measurement system at the administrative level and the characteristics of the decision-makers, are also important in terms of establishing the proper value for carrying capacity.

From a mathematical point of view, to establish the value of the optimal carrying capacity, specialists use a series of algorithms, depending on its typology: physical, real, effective (Table 2):

Table 2 – Calculations for determing the carrying capacity level, depending on its type

No.	**Carrying capacity tipology**	**Semnification**	**Calculation formulas**	**Observations**
1	*Physical* ***(Ccf)***	The maximum number of visitors that can be in the same place and time.	$\mathbf{Cc_f = S_{touristic} / (S/T) / F_r}$ **(1)** $\mathbf{F_r}$ **= average duration of tourist stay (2)**	(1) S touristic =surface of the area; S/T = the required space per visitor, so that he does not bump into another visitor, usually this parameter has the 1 m^2 value; Fr = rotation factor;
2	*Real* ***(Cc$_r$)***	The maximum number of visitors for a tourist destination taking into account the limiting factors (ecological, biophysical, social, legislative) resulted from the specific area's conditions.	$\mathbf{Cc_r}$ = Cc_f * ((100 – F_1)/100) * ((100 – F_2)/100) *((100 – F_3)/100) **(3)** **F** = M_1 / M_+ *100 **(4)**	(3) CC_f = physical carrting capacity; F1,F2,F3 = restrictive factors,of analyzed area; (4) M_1 = superior limit of one certain variable; M_+ = the total amount of the analized variable;
3	*Effective* ***(Cc$_e$)***	The maximum number of visitors for a tourist destination that can be managed by the current administration of the area.	$\mathbf{Cc_e}$ = Cc_r * M_c **(5)**; M_c = (100 - F_m)/100 **(6)**; F_m = (($M_{c\ ideal}$ - $M_{c\ effective}$)/ $M_{c\ ideal}$) *100 **(7).**	(5) Cc_r = Real carrying capacity; (6) M_c = management capacity; (7) $F_{m\ =}$ management factor; M_{cideal} = optimal management capacity; $M_{ceffective}$ = effective management capacity.

Source: after Kourandeh H., Fataei M. (2013).

The size of physical carrying capacity of the area for the present work, in Danube's Delta, will be estimated, using the presented calculation algorithms, in table 2. According to *Organization and Operation Statute of the "Danube Delta" Biosphere Reserve Administration*, (published in the MO in 18th April 2002), but also with *ARBDD Report on the state of the environment in the Danube Delta biosphere reserve.*, in Danube's Delta case, the economic activities, including tourism, can only be carried out in the **"buffer zones"** of the Danube Delta; more precisely, on the territory of *Matița-*

Merhei-Letea, Şontea, Caraorman, Lumina-Vătafu, Dranov, Sărături-Murighiol, Lac Rotundu, Popina Island, Cap Doloşman, Zmeica-Sinoie, Lac Potcoava, Periteașca Leahova, Marine area up to the isolated of 20m. These mentioned areas measures a *222 996 hectares surface*. Therefore, the surface of the Danube Delta, on the territory of which economic activities can be carried out, is 222,996 hectares. From the latest Report's data provided on the state of the environment in the Danube Delta Biosphere Reserve (2017), the agricultural land totals 61,453 ha, thus remaining, on average, an area of **161,543 ha**. According to the same indicated source, from the total active population, a share of approximately **16% works in tourism**, transport, communications field. Keeping the proportionality with this aspect, it can be hypothetical declared for this paper that a area of 25,846 hectares, **(representing 258,460,000 m2) (1)** has the tourism activities as main purpose.

From the specialized literature, it follows that the needed space for a tourist, so that he does not interact physically with other people or phenomena, measures 1m^2. Of course, the size of this surface may differ, depending on the particularities of the certain human or according to other restrictions. For the present paper we will use this value, of **S/T = 1m^2 /tourist for the S/T value (2)**.

Regarding the rotation factor value, in the present case it is reported according to the average length of stay of a tourist in the Danube Delta area. Following the meetings with tourism stakeholders held within the COASTAL project (university professors, researchers, economic operators), but also from various specialized publications, it follows that the duration of a tourist stay in the Danube Delta is 2.5 days, Thus, the rotation factor applied for the calculation of the formula in the present paper is **2.5 tourist days. (3)**

Thus, the maximum possible threshold of carrying capacity for the Danube Delta area can be calculated as follows:

Ccf = 25,846 (ha) / 1(m2 /tourist) / 2.5 (tourist days) = 258,460,000 (m2) / 1(m2 /tourist) / 2.5 (tourist days) = ***103,384,000 (persons)***

The calculated value for carrying capacity in Danubețs Delta area, respectively, 103,384,000 persons, reflects the maximum number of people who can be simultaneously on the entire tourist surface of the area of interest, taking into account the average length of stay of 2.5 days. But this approach doesn't take into account the other determining factors, for example, the resident population of the Danube Delta region or the regulations regarding the Methodological Norms for different accomodation forms (MT Order 415/2016; MT Order 798/2018).

Considering this, in accordance with the Methodological Norms for the operation and classification of accommodation units, published under Order no. 65/2013 (*Annex no. 1, Definitions and mandatory minimum criteria regarding the classification of tourist reception structures with accommodation functions of the hotel, hotel-apartment and motel type*), the average area for providing a place of accommodation should be 13 m2 (room area for one person), to which 3.5 m^2 is added (area allocated to own sanitary group). Therefore, in order for a tourist accomodation, is necessary to allocate a space of at least 16.5 m2. Taking these requirements into account, the physical carrying capacity can be calculated for Danube's Delta area, depending on the average duration of a tourist's stay, but also depending on the legislative regulations as follows:

Ccf *= 25,.846 (ha) / 16.5 (m^2 /tourist) / 2.5 (tourist days) = 258,460,000 (m^2) / 16.5 (m^2 /turist) / 2.5 (tourist days) =* ***6,265,697 (person)***

These resulted values for carrying capacity parameter, are hypothetical and more than permissive. However, taking as a reference the threshold of 6,265,697 maximum tourist and based on the surface area of the tourist part of Danube's Delta, the duration of a tourist stay, but also the average areas necessary to ensure an accommodation place, we can make a parallel between the hypothetically possible situation and the current situation regarding tourism in Danube's Delta. From the provided data by the National Institute of Statistics, emerges the informations (figure 1). The provided statistical data don't fully reflect the situation of the number of visitors in the Danube Delta or the accommodation capacity. According to the statements of the representatives of the Administration of the Danube Delta Biosphere Reserve from Tulcea, some of the tourists choose to stay in the houses of the locals from localities such as Sulina, Sfântu Gheorghe, Crișan, thus practicing rural tourism.

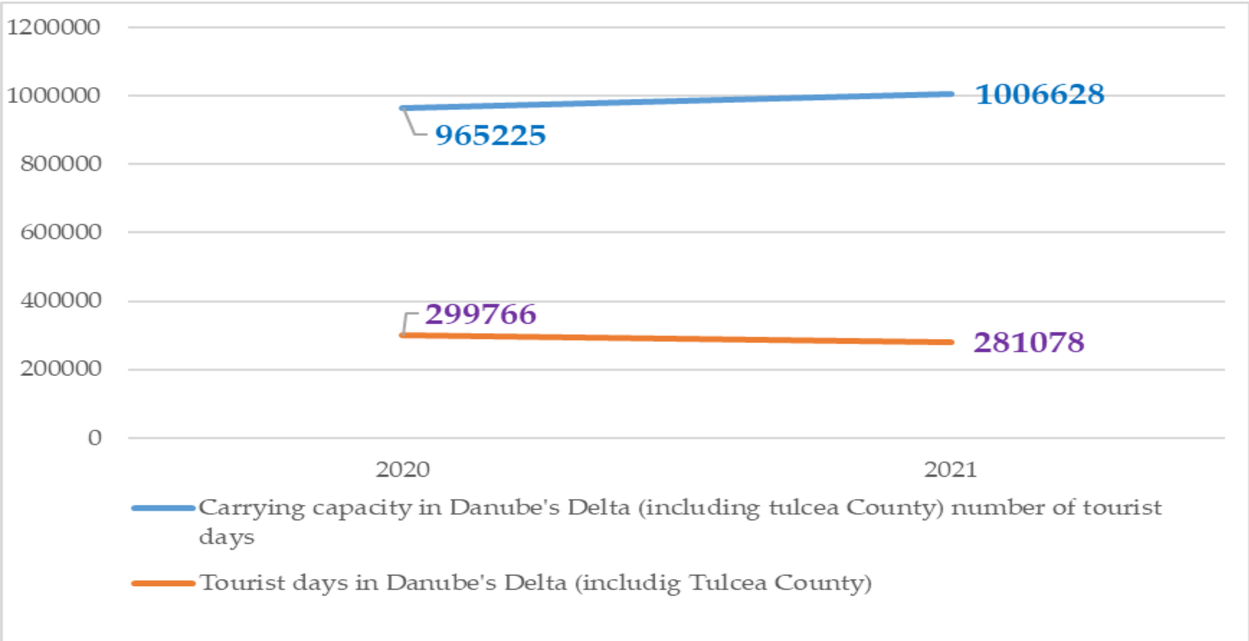

Figure 1 – Danube's Delta number of visitators and the carrying capacity, in 2020-2021

Source: INSSE data processing, available at http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-

Tourist demand was higher when the tourist services offer was lower, (accommodation capacity of 965,225 tourist days in 2020 and 1006628 tourist days available in 2021. The main cause of this imbalance situation in terms of the ratio between supply and demand, it probably originates in the adjustment element of the market, price.

Therefore, we can compare the two values, representative of a hypothetical situation, calculated, respectively, for the current situation in the Danube Delta area (figure 2):

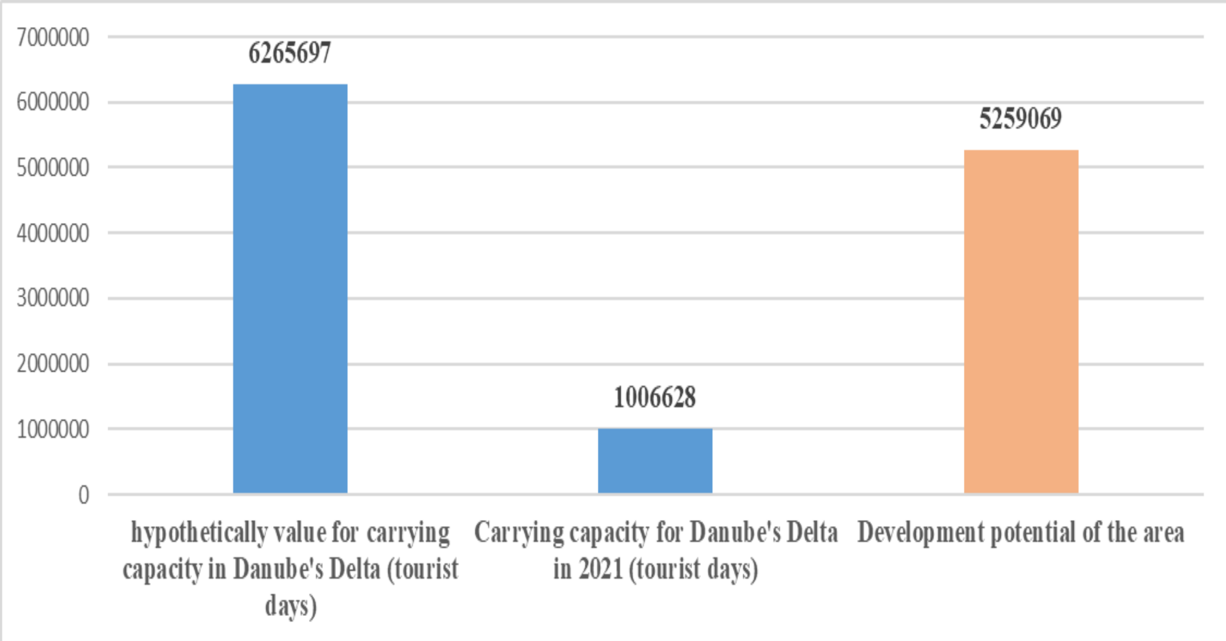

Figure 2 - Parallel between a hypothetically situation and the current situation, regarding the potential development for tourism in Danube's Delta

Source: after INSSE data processing and present paper calculations

Although the resulting carrying capacity value (expressed in tourist days) far exceeds the descriptive reference parameters for the current situation in the Danube Delta, it is necessary to mention that this value does not take into account the other restrictive factors, referring - especially *to environmental factors*. From a physical point of view, we can say that the development of tourism in the area is allowed (taking into account the tourist area of the Danube Delta area and the average length of stay of a tourist), but in order to ensure the sustainability of the development of the region, it is imperative to include other factors: the degree of pollution of the area, water quality, the evolution of climate change and others.

CONCLUSIONS

In the present work, the carying capacity related to the tourist destination in Danube's Delta was analyzed as a parameter, thus going through publications of specialized interest in order to present a series of mathematical algorithms to define an estimated value of the mentioned indicator. This paper starts from the conceptual definition of the term, with several approaches examples founded in the specialized literature (ecological, social perspective), as well as the carrying capacity typology (physical, real, effective). Depending on the used approach and tipology,, several calculation formulas were presented, in order to establish the value of the maximum physical carrying capacity. The used formula took into account the duration of a tourist's stay in the area and the tourist area of Danube's Delta on which economic activities can be carried out. Danube's Delta is an area with a specific legislative framework but also with specific methodological norms.

In the last part of this paper, reference statistical data were presented for the description of the demand and tourist offers in the Danube Delta area. There is a major difference between the hypothetical value calculated for the carrying capacity in Danube's Delta and the existing one, in the sense that calculated value is higher than the real one. However, it is necessary that the carrying capacity threshold be established according to the current situation and the estimated evolution of some important phenomena, such as climate change, the impact of the pressure of tourism activity on the environment, water quality, etc. Moreover, in the present work, the modeling activity of tourism in the Danube Delta area, carried out within the COASTAL project (H2020), was mentioned, operating with the phenomena mentioned above, the value of the accommodation capacity being much lower, in comparison with the one calculated in the present work, being estimated at 2,120,000 tourist days. In this manner, the indisputable influence of environmental factors on taking the correct decision, in establishing the accommodation capacity threshold, can be observed..

Ultimately, to estimate a certain threshold of the optimal carrying capacity is very ambitious, a value for which the balance between the economic development of the area and the surrounding environment would certaintly favor. Instead of numbers, a social and consumer behaviour profile of can be outlined, for of each of us, in relation to the natural resources, so important in general and especially in terms of the tourist attractiveness of the Danube Delta area. It is desirable to facilitate the transition, from conventional tourism, practiced today in the area, to a slower tourism, which corresponds to a longer duration of a tourist's stay in the area. Such an approach in Danube's Delta area could bring important benefits for the sustainable use of environmental resources, such as: decreasing the consumption rate, a less harmful impact on the environment, changing the perception of the area's inhabitants regarding the presence of tourists, in the sense in which they will perceive the development of tourism in the area as a positive factor, bringing income, and not as a threat in terms of the quality of their standard of living.

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THE FUTURE OF ROMANIAN TOURISM AFTER COVID 19 PANDEMIC

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Abstract: *The present paper aims to analyse the evolution of tourism activity in Romania, in the period 2010-2021, focusing on the analysis of the effects that the COVID 19 pandemic has had on the Romanian tourism.*
To reach this objective, a set of indicators were analysed, such as tourism supply, tourist circulation and the supply-demand relationship. The analysis was conducted at national level, for the most important tourist receival structures, and for the number of tourist arrivals and overnight stays, both Romanian and foreign tourists were considered, using data from the national official statistics.
The main conclusions of the study indicate that the COVID 19 pandemic has modified tourists' behaviour. This has had an important impact on the sector, reducing tourist flows, resulting in a low degree of occupancy of tourist structures, with a lower impact on those located in the rural area, in the middle of nature, namely tourist and agro-tourist boarding houses, which can be considered the "survivors" of the recent period.

Key words: *tourism, Romania, COVID 19 pandemic, agro-tourist boarding houses*

JEL Classification: Z30, L83

INTRODUCTION

Tourism industry has had a favourable evolution in recent decades as a consequence of people's higher living standard, as well as of their stressful lifestyle. Tourism has thus become a form of leisure, as well as a form of entertainment.

However, there are a number of unpredictable events, such as epidemics, pandemics, earthquakes, flooding, which are increasingly part of our lives. These types of events, we learn to live and be able to manage the situation as well as possible (Păvăliuc, Brînză, Anichiti, Butnariu, 2020). In consequence, "understanding, managing and responding to these risks must be an integral component of sustainable tourism management" (Shakeela, Becken, 2015).

Unquestionable, the coronavirus pandemic is unique in scale and constitutes a blend of several disaster and crisis typologies (Ritchie, Jiang, 2019) and "it is a combination of a natural disaster, a socio-political crisis, an economic crisis and a tourism demand crisis" (Zenker, S., Kock, F., 2020).

The COVID-19 pandemic has put tourism industry in difficulty and has radically changed tourists' options, "the coronavirus pandemic can create deep marks in the tourist's thinking and feeling, and change how tourists travel" (Zenker, S., Kock, F., 2020).

According to the United Nations World Tourism Organization - UNWTO, tourism grew 4% in 2021, but remains far below the pre-pandemic levels. UNTWO estimated that in the year 2030, the number of international tourists will total 1.8 billion, yet these estimated should be revised, given the major impact of the COVI-19 pandemic on the sector. "Tourism is especially susceptible to measures to counteract pandemics because of restricted mobility and social distancing" (Gossling, S., Scott, D., and Hall, M., 2021). In this case, domestic tourism and travel close to home, as well as open-air activities, nature-based products and rural tourism are among the major travel trends that will continue shaping tourism in 2022 (UNWTO, 2022).

The tourism indicators analysed in the present study to reveal the tourism activity level in a given country were used by numerous authors, both Romanian, such as Minciu, R., (2004), Urban, V., Melnic, A.S., (2012), Popescu, A., Huntus, A., Stanciu, M. (2020), and foreign: Tanguay, G.A, Rajaonson, J., Thierrien, M.C., (2013), Liu, Y.M., Dong, Y.D., WU, J., (2014), Dash, A.K., Suresh, K.G., Tiwari, A.K., (2015), Mansor and Ishak (2015). Thus, indicators are considered as useful tools that allow tourism managers to diagnose the situation of the destination, and to identify and evaluate issues that need to be addressed to improve the level of sustainability of tourist activities (Lozano-Oyola, M. et al., 2012).

According to the latest official data, the gross domestic product in tourism represented 1.82% of Romania's GDP in the year 2010, with an upward trend, to reach 2.98% in the year 2019. In the period 2010-2019, the gross value added in tourism industries had an upward trend, with the largest share coming from the "road passenger transport", followed by the "food and beverage services". As regards the direct value added from tourism, the highest shares were noticed in the food and beverage services, which accounted for more than one-third of total, followed by the accommodation services, which accounted for one quarter of total, in the period 2010-2019.

Tourism is among the "most affected economic sectors" (UNWTO, 2020), as a result of restrictions imposed by the COVID 19 pandemic, as well as of tourism consumers' reticence to travel.

MATHERIAL AND METHOD

In order to determine the current stage and evolution of tourism activity in Romania, mainly of tourist and agro-tourist boarding houses, a number of statistically representative indicators were analysed: indicators of tourism supply: number of tourist receival structures and existing accommodation capacity by the number of accommodation places; indicators of tourist demand or of tourist circulation: number of arrivals, number of overnight stays, average length of stay (Al); utilized formula: Al = No / Na, where No = number of overnight stays registered, Na = total number of tourist arrivals in the period selected for analysis; indicators of supply-demand relationship: the index of net using the touristic accommodation capacity (In); the formula is: In = (No / Co) x 100, where No = number of overnight stays registered, Co = tourist accommodation capacity in operation, in the period chosen for analysis.

The analysis was made at national level, for all tourist receival structures; given that there are several categories in the official statistics, these were grouped as follows: the category hotels includes: hotels, hostels and apartment hotels; the category motels and inns includes both types of tourist receival structures; the category touristic villas includes: villas, chalets, bungalows, holiday villages, campsites, tourist stops and tourist cottages; the category other includes: accommodation facilities on river and sea ships and student camps.

The tourist and agro-tourist boarding houses are the only categories that appear in official statistics. There are similarities between the two tourist receival structures: both operate in citizens' homes or in independent buildings, which provide accommodation to tourists in specially equipped spaces and conditions for preparing and serving meals; but there are also fundamental differences: tourist boarding houses have up to 15 rooms in total, with maximum 60 places, while agro-tourist boarding houses have an accommodation capacity of up to 8 rooms, with the possibility of tourists' participation in household or craft activities.

For the number of arrivals and overnight stays, both the Romanian and the foreign tourists were taken into consideration. Data from official statistics were used, provided by the National

Institute of Statistics, through TEMPO Online database and from periodical publications: Romanian Tourism – statistical abstract and Tourism Satellite Account (TSA). The obtained data were centralized and processed using the Excel program.

The main hypothesis on which the present analysis was based was that in the first year of the COVID-19 pandemic, i.e. 2020, the tourist and agro-tourist boarding houses were preferred by tourists for spending their shorter or longer vacations.

RESULTS AND DISCUSSIONS

In the period 2010-2021, the tourism supply in Romania, in terms of tourist receival structures maintained its upward trend, with the exception of the category *other*, which included student camps, as tourist receival structures whose number was down by half in the period under analysis. In the year 2010, in Romania, there were 5222 tourist receival structures in total, whose number increased by 75% by the year 2021. In the year 2021, as compared to 2010, the greatest increase was noticed in the number of agro-tourist boarding houses, followed by tourist boarding houses and hotels.

Table 1. Evolution of the number of tourist receival structures

– number –

	2010	2012	2014	2016	2018	2020	2021	Changes 2021/2010 -% -
Total	5222	5821	6130	6946	8453	8610	9146	75.1
Hotels	1360	1578	1677	1817	1955	1927	1938	42.5
Motels and inns	155	209	217	221	235	217	218	40.6
Tourist villas	1305	1138	1177	1282	1647	1640	1708	30.9
Tourist boarding houses	949	1247	1323	1530	1709	1729	1745	83.9
Agro-tourist boarding houses	1354	1569	1665	2028	2821	3022	3460	155.5
Other	99	80	71	68	86	75	77	-22.2

Source: authors' processing based on NIS database, www.tempoonline

In the year 2010, 20% of the total number of tourist receival structures was found in each of the following areas: mountain area, on the Black Sea Coast, and in Bucharest municipality and county capital cities, the most numerous being found in other localities and tourist routes (more than 30% of total number). In the year 2021, there were changes in this hierarchy, namely: the mountain area had 27.2% of the total number of tourist receival structures, Bucharest municipality and the county capital cities had 16.9%, the resorts on the Black sea coast 8.4%, spa resorts 6.9%, the Danube Delta 5.8%, but the most numerous tourist accommodation structures were found in other localities and tourist routes, summing up 34.8% of total.

Table 2. Evolution of the number of accommodation places in the tourist receival structures

– thousand places –

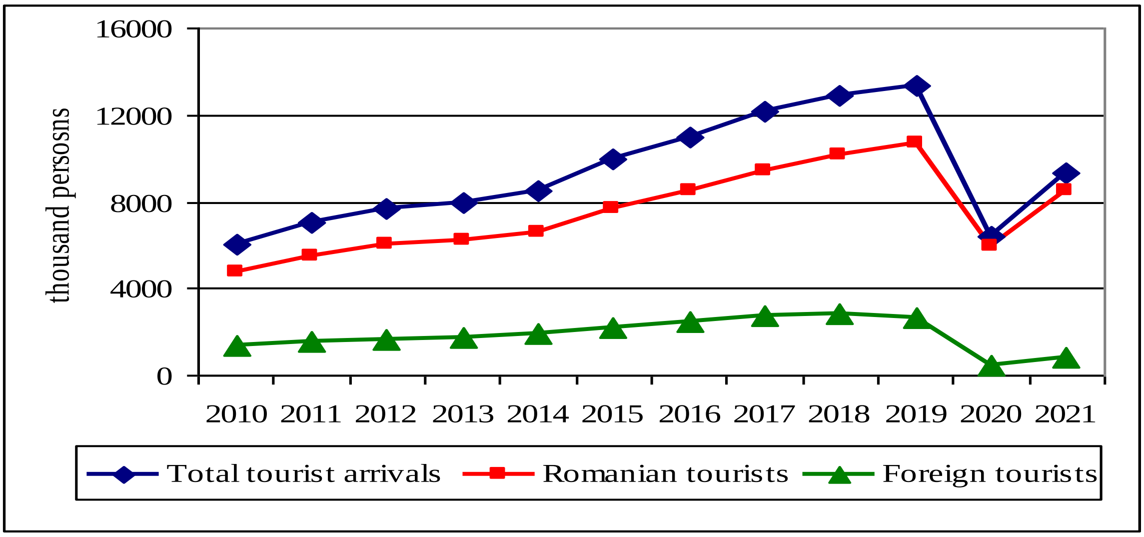
	2010	2012	2014	2016	2018	2020	2021	Changes 2021/2010 - %
Total	311.7	301.1	311.3	328.9	353.8	358.1	364.5	16.9
Hotels	190.7	189.3	195.4	202.8	211.5	211.4	214.4	12.4
Motels and inns	6.2	8.2	8.0	8.5	9.0	8.7	8.9	43.5
Tourist villas	58.8	39.8	39.9	40.4	41.4	43.8	43.4	-26.2
Tourist boarding houses	18.4	25.0	27.3	32.6	35.8	35.3	35.4	92.3
Agro-tourist boarding houses	20.2	27.5	30.5	37.4	48.6	52.4	55.7	175.7
Other	17.3	11.4	10.2	7.2	7.6	6.6	6.6	-61.8

Source: authors' processing based on NIS database, www.tempoonline

The total number of accommodation places was higher by 16.9% in the year 2021 compared to 2010, with the highest increase in the number of places in agro-tourist boarding houses (by 175.7% more numerous in the year 2021 as compared to 2010). It is worth noting that the greatest decline was in the number of accommodation places in other categories of tourist receival structures, due to the diminution in the number of student camps, followed by the tourist villas, because many of these have closed, being declared non-conform.

In the year 2021, there were more than 364.5 thousand accommodation places in Romania, most of these being found in hotels (214.4 thousand places), most in the 3-star category (53.8% of total hotels), followed by 4-star hotels (23.7%) and 2-star hotels (18.4%). The agro-tourist boarding houses come next (55.7 thousand places), followed by tourist villas (43.4 thousand places).

In the period 2010-2021, both the number of tourist arrivals and the number of overnight stays in the tourist receivals structures maintained an upward trend, an exception being the year 2020, the first year of the COVID-19 pandemic.

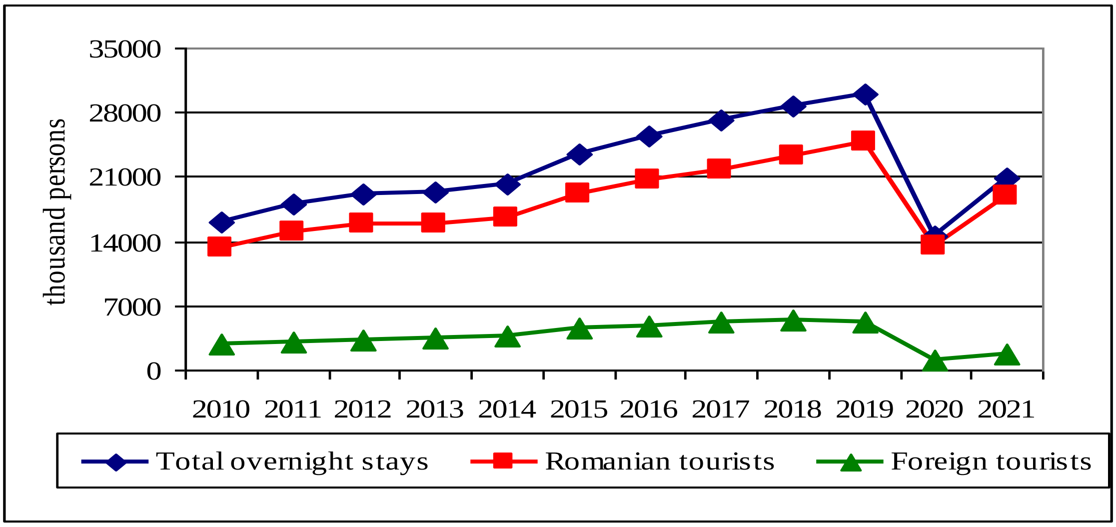


Graph 1. Evolution of the number of Romanian and foreign tourist arrivals, in the period 2010-2021

Source: authors' processing based on NIS database, www.tempoonline

Throughout the investigated period, the Romanian tourists prevailed, both in terms of number of arrivals and of overnight stay in tourist receival structures.

In the year 2010, the foreign tourists who arrived in tourist accommodation structures represented only 22.2% of the total number of tourists, and in the year 2021 they represented only 8.9% of total; the foreign tourists who stayed overnight in tourist accommodation structures represented 17.2% and 8.8% respectively. The foreign tourist circulation in Romania was seriously affected due to travel restrictions during the COVID-19 pandemic. Thus, both foreign tourist arrivals and overnight stays in the year 2020 represented less than one third of those in the year 2010, a situation that slightly recovered in the year 2021.



Graph 2. Evolution of the number of overnight stays of Romanian and foreign tourists, in the period 2010-2021

Source: authors' processing based on NIS database, www.tempoonline

As a result of the COVID-19 pandemic, in the year 2020, the total number of tourists who chose to stay overnight in the tourist receival structures in Romania was below the number recorded in the year 2010, both the number of Romanian tourists and the number of foreign tourist who made this choice being lower. In the year 2021, the number of overnight stays of tourists had an increasing trend, yet much lower than that in 2019.

The hotels were tourist accommodation structures where the most tourists arrived. In the year 2010, the percentage of tourists arriving in hotels was 77.4%, while in the year 2020 it was 67.9%, and 69.8% in the year 2021. The tourist and agro-tourist boarding houses were the tourist accommodation structures that attracted an increasing percentage of tourists, from 6.7% in the year 2010 to 9.5% in 2021 and from 4.8% to 11.6% respectively in the same period.

Table 3. Evolution of the number of tourists'arrivals in tourist receival structures

– thousand persons –

	2010	2012	2014	2016	2018	2020	2021
Total	6072.7	7686.5	8465.9	11002.5	12905.1	6398.6	9370.2
Hotels	4698.5	5933.6	6515.4	8290.2	9450.5	4347.3	6528.0
Motels and inns	205.2	231.7	233.1	267.5	270.9	144.1	211.9
Tourist villas	398.0	429.2	404.0	563.7	715.5	488.7	646.3

	2010	2012	2014	2016	2018	2020	2021
Tourist boarding houses	406.6	586.1	704.1	1020.6	1234.3	654.4	893.8
Agro-tourist boarding houses	289.9	447.1	549.3	813.5	1173.5	755.4	1087.3
Other	74.5	58.8	59.9	47.1	60.5	8.7	12.6

Source: authors' processing based on NIS database, www.tempoonline

In terms of overnight stays, the hotels were also the tourist accommodation structures that attracted the most tourists, yet their percentage in total tourists was down from 80.9% in 2010, to 73.7% in 2021.

Table 4. Evolution of the number of overnight stays in the tourist receival structures

– thousand persons –

	2010	2012	2014	2016	2018	2020	2021
Total	16051.1	19166.1	20280.0	25441.0	28644.7	14579.1	20835.3
Hotels	12984.8	15515.4	16388.3	20032.8	21923.0	10485.0	15359.4
Motels and inns	344.9	373.9	367.5	441.0	436.4	239.2	318.0
Tourist villas	946.0	1032.4	930.5	1292.3	1583.8	1114.3	1424.6
Tourist boarding houses	802.2	1083.8	1273.1	1881.8	2229.5	1201.7	1605.7
Agro-tourist boarding houses	604.6	906.5	1081.5	1597.9	2255.3	1515.3	2089.7
Other	368.6	254.0	239.1	195.1	216.8	23.7	37.6

Source: NIS database, www.tempoonline

The tourist and agro-tourist boarding houses were the accommodation structures preferred by tourists to stay overnight, their percentage increasing from 5% of total tourists in the year 2010 to 7.7% in the year 2021, and from 3.8% to 10.1% respectively.

In three categories of tourist receival structures there was an increase in the share of tourists who chose to get there or stay overnight, namely: in tourist villas, in tourist boarding houses and agro-tourist boarding houses. Agro-tourist boarding houses had the highest increase in the share of tourists who chose to arrive there or stay overnight.

In order to highlight the effects that the COVID 19 pandemic had upon tourist flows, the changes produced in the number of tourist arrivals and overnight stays were calculated for the year 2020, the first year of the pandemic, compared to the year 2019. Thus, in the year 2020, both the number of tourist arrivals and the number of overnight stays was down by half (in the year 2020 there were by 52.2% fewer arrivals and by 51.5% fewer overnight stays than in the year).

The tourist accommodation structures that had the lowest reductions in tourist flows in the year 2020 as compared to 2019 were tourist villas and agro-tourist boarding houses. These categories of tourist accommodation structures met the conditions that tourists preferred for a getaway.

In the year 2021, the situation was slightly better compared to 2019, tourists' arrivals and overnight stays in the tourist accommodation structures being only one third below the level of those in the year before the pandemic.

Table 5. Changes in the structure of tourist circulation

- % -

	Modifications in 2020 versus 2019		Modifications in 2021 versus 2019	
	Arrivals	Overnight stays	Arrivals	Overnight stays
Total	-52.2	-51.5	-29.9	-30.8
Hotels	-55.4	-54.1	-33.0	-32.8
Motels and inns	-48.5	-46.1	-24.3	-28.3
Tourist villas	-36.5	-36.8	-16.0	-19.2
Tourist boarding houses	-47.8	-48.3	-28.8	-30.9
Agro-tourist boarding houses	-40.7	-39.8	-14.6	-17.0
Other	-83.4	-88.1	-76.1	-81.0

Source: authors' processing based on NIS database, www.tempoonline

In the year 2021, in the tourist and agro-tourist boarding houses, the number of tourists' arrivals and overnight stays were quite close to their number in 2019. These were the tourist accommodation structures in the top of tourists' preferences, for the very conditions they provided, in accordance with social distancing as well as with the proximity to nature.

The average length of stay in total tourist receival structures decreased from 2.6 days in the year 2010, to 2.2 days in 2021. The agro-tourist boarding houses were the only tourist accommodation structures in which the average length of stay of tourists did not undergo major changes in the investigated period, which was also the trend in tourist boarding houses.

Table 7. Average length of stay in the tourist receival structures, by categories of structures

	2010	2012	2014	2016	2018	2020	2021
Total	2.6	2.5	2.4	2.3	2.2	2.3	2.2
Hotels	2.8	2.6	2.5	2.4	2.3	2.4	2.4
Motels and inns	1.7	1.6	1.6	1.6	1.6	1.7	1.6
Tourist villas	2.4	2.4	2.3	2.3	2.2	2.3	2.2
Tourist boarding houses	2.0	1.8	1.8	1.8	1.8	1.8	1.8
Agro-tourist boarding houses	2.1	2.0	2.0	2.0	1.9	2.0	2.0
Other	4.9	4.3	4.0	4.1	3.6	2.7	2.9

Source: authors' processing based on NIS database, www.tempoonline

The degree of use of tourist accommodation structures in Romania in all categories of tourist accommodation had an upward trend in the investigated period, except for the year 2020, when it collapsed. Thus, the index of net using the touristic accommodation capacity increased from 25.2 in 2010, to 32.2 in 2018, while in the year 2020 the index value was lower than in 2010. It is only in the year 2021 that the index of net using the touristic accommodation capacity in operation was slightly above the value recorded in the year 2010.

Table 8. Evolution of index of net using the touristic accommodation capacity in operation, by categories of structures, in the period 2010-2020

	2010	2012	2014	2016	2018	2020	2021
Total	25.2	25.9	26.1	30.5	32.2	22.8	26.3
Hotels	22.4	31.3	25.0	33.6	36.3	24.8	29.9
Motels and inns	21.9	12.7	12.4	15.8	13.5	9.7	10.4
Tourist villas	12.7	15.0	13.9	18.4	19.6	20.4	20.1
Tourist boarding houses	14.6	14.8	15.4	19.4	20.9	16.5	18.3
Agro-tourist boarding houses	12.4	13.2	13.2	15.5	18	16.5	17.2
Other	45.5	38.9	13.0	21.1	20.2	16.9	16.5

Source: authors' processing based on NIS database, www.tempoonline

In the period 2010-2018, the idex of net using of the hotels steadily increased. A favourable evolution of this index was also noticed in the case of tourist villas, tourist boarding houses and agro-tourist boarding houses.

The smallest difference between the net usage index in the year 2020 and in the year 2021, as compared to 2019, was found in tourist and agro-tourist boarding houses; this proves that these tourist receival structures continued to receive tourists, only a smaller contraction of tourist flow being noticed compared to the other accommodation structures.

CONCLUSIONS

In the period 2010-2021, the highest increase was noticed in the number of agro-tourist boarding houses and of tourist boarding houses, compared to the total number of tourist accommodation structures. As regards the number of accommodation places, the highest increase was also noticed in the case of the two tourist accommodation structures mentioned above, compared to the total number of accommodation places in all tourist accommodation structures. The number of tourists who arrived and of those who stayed overnight in tourist and agro-tourist boarding houses had an increasing trend in the period 2010 – 2018, similarly to that in all tourist accommodation structures. In the year 2020, the first year of the COVID-19 pandemic, the tourist flow was down by half compared to the year 2018. The accommodation structures preferred by tourists in the year 2020 were tourist and agro-tourist boarding houses, because only these structures met the conditions that tourists preferred for a getaway. These two tourist accommodation structures had the most spectacular recovery in terms of tourist flows. The average length of stay in these two tourist accommodation structures was maintained at a constant level even in the pandemic period. The efficiency of use of these tourist accommodation structures was lower in the year 2020 compared to that in 2018, trend existing in all tourist accommodation structures, mainly in the case of hotels, for instance. In the year 2021, both tourist accommodation structures, i.e. tourist and agro-tourist boarding houses, had an index of net using close to its value before the pandemic, which reveals a high efficiency of the accommodation capacity utilization.

In spite of the diminution of tourist flows in the pandemic period, due to circulation and health restrictions, which led to the change of tourism consumer behaviour, two tourist receival structures, namely tourist and agro-tourist boarding houses, were less affected, compared to the others, and thus they can be considered the "survivors" of this period.

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ECONOMIC-SOCIAL STRATIFICATION BETWEEN EXTRAVAGANCE AND HARMONY

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Abstract: *The work highlights the fact that the ordering of individual values is supported by the act of Divine creation. The Star of David is the source of inspiration and action strategy for achieving an optimal structure of human society based on cooperation. The hexagon in the Star of David is an ancient symbol that points directly to high concepts and valences, with magical force and special energy charge. The powerful energy of this symbol – associated with perfection, peace, tranquility, fulfillment and eternity – generates a special state of well-being, a balance between the physical body and the spirit, a harmony between the outside and the inside. Deciphering the meaning of the Hexagon of Harmony represents the path to the pure consciousness of good. Recognizing the meaning of such a symbol, man becomes aware and discovers his role in the great universe and on earth. We worship, by relating to the Hexagon of harmony, the great and the small universe and become aware of the finite and infinite limits of our destiny. The Star of David symbol instills in us the strength and wisdom of the hexagon, being in sacred geometry one of the most powerful, fascinating and beneficial symbols. Both the rich and those who populate the base of the social pyramid can campaign for the elimination of excesses using the sources of the Hexagon of harmony as a source of shaping the spirit. This also taking into account the context of the abusive realities faced by the contemporary social system. "And what is chosen of the poor"? Foreign support can be helpful, but, like fortune falling from the sky, it can also harm. It can discourage effort and instill a crippling sense of incapacity. According to the African proverb, "The hand that receives is always below the hand that gives"(Havinden and Meredith,2013).*

Keywords: *Star of David, social pyramid, earnings pyramid, social harmony*

JEL Classification: Z13, J16, J28

INTRODUCTION

Hierarchies represent the externalization of the biological substrate, present throughout the universe of the living world. Consequently, hierarchies can be solutions for mobilizing biological energies in making leaps and bounds. The question with an objective substratum that concerns enlightened minds is: "why does economic stratification get wild accents?" (Merce E., Merce C. C., Mihaela Mihai, 2015). The natural answer for any connoisseur of human nature is the absence of education. Man himself, dominated only by the instincts with which the creator endowed him, is an animal dominated by slips to cultivate characteristics that undermine social harmony, such as: pride, greed, debauchery, waste, pride, zeal, anger, hula, confrontation, flattery, quarrel, murmur. Man can become a "SOCIAL MAN" only through education, a mission through which he can acquire constructive qualities, among which the most important are: temperance, altruism, modesty, tolerance, and patience.

Starting from this fundamental reality regarding the organization of the living world, the work is elaborated on the principles of universal harmony, which the Star of David consecrates. The Star of David is considered a symbol of divine protection, harmony, and peace.

Literally called the Shield of David or the 6-pointed Star, the shape of the star is an initiatory symbol of the macrocosm. Symbolism promotes the union of the forces of heaven with those of earth, under a great power of divine protection with beneficial effects on the design and organization of social and economic systems.

The six corners of the two overlapping triangles in the Star of David symbol correspond to the six days of creation. They also represent the six gifts offered to man by God: **love, power, wisdom, mercy, greatness and justice** (Genesis 1:26) and which by cutting and inserting the soul represent the way through which we can discover the Hexagon of social harmony.

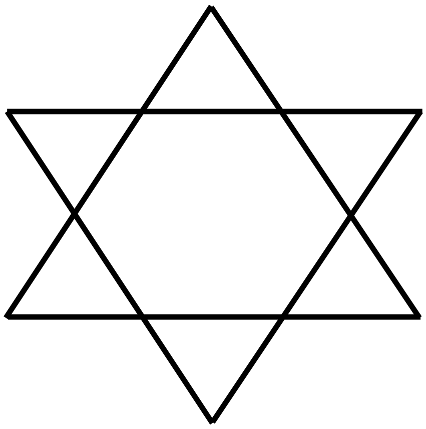

Fig. 1 - Star of David

Even the organization of the living world is dominated by its presence by the hexagon of universal harmony. Molecular structure, the relationship between molecules, respects this symbol! Nature, through countless examples such as honeycombs in beehives, by placing all the molecules in the chemical structure of matter convinces us of the energy carried. Through this sacred symbol, through the awareness of its power, it can guide us in the design of development strategies, based on behavioral harmony. Any initiative penetrated by the presence of the hexagon as a symbol of universal and social harmony can become an option with positive effects on all levels of our existence.

MATERIAL AND METHOD

Man is free to choose between the two classes of qualities, to choose between harmony and confrontation, between beneficial stratification and tension-generating stratification. The analysis of statistical data from the last centuries proves, unfortunately, that the human species is not fully capable of ensuring moderation and altruism in significant proportions. As a consequence, at one pole of society, an increasing number of people have an increasing wealth, and at the other pole an increasing number of people become more and more needy. Worryingly, as the world's population becomes increasingly interdependent, with increasingly sophisticated technological and computer tools, monopolized and used by a minority, polarization is gaining alarming accents. *"In 1820, the average standard of living in the richest country in the world, then the Netherlands, was about three and a half times higher than in the poorest countries in Africa and Asia. But in 1910 the distance between the richest and the poorest increased to more than 800%.* (Angus Maddison, 2003).

To mitigate such excesses, man has received throughout his existence, through intuition, several symbols. The Star of David is a form of association of balanced solutions for the development of a harmonious society. A source of inspiration in this regard is that of the Jewish people. In order to reveal the levers of action in order to design a breathable society, the Star of David was built on the basis of the two triangles encountered within the contemporary social system, triangles susceptible to socio-economic improvements. It is about the triangle of social hierarchy (figure 2) and about the triangle of social gains (figure 3),(Stegăroiu C. Dan,2018).

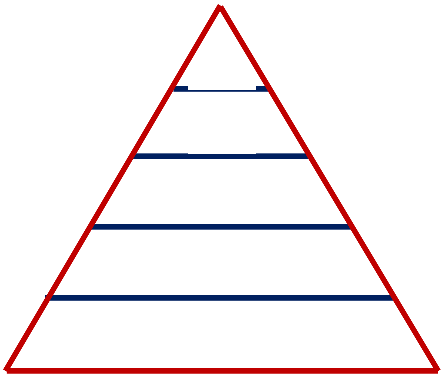

Fig. 2 - The triangle of social hierarchy

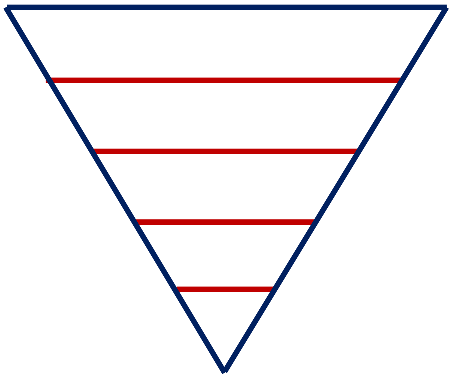

Fig. 3 - Earnings triangle

RESULTS AND DISCUSSION

The juxtaposition of the two triangles in the shape of the Star of David highlights the major trends of the contemporary social system, as can be seen from the legend of triangles that exceed the hexagon as a symbol of harmony.

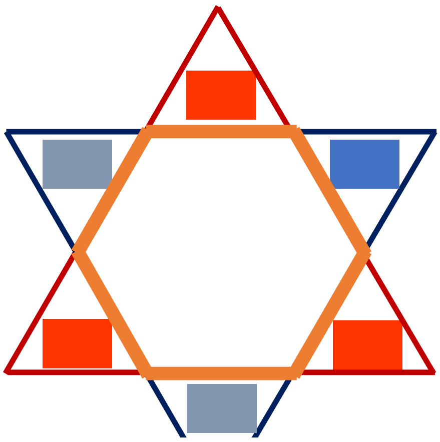

Fig. 4 - The legend of triangles that exceed the hexagon

1. Excess power
2. Excessive subordination
3. Excessive subordination
4. Excessive poverty
5. Excess wealth

"Of course, people favored by globalized capitalism want it to be perpetuated. However, the course of history, including in the current era, is not done according to these desires, but according to the requirements of economic and social progress at each stage. Or, in the current era, a huge mass of negative effects generated by globalized capitalism is already accumulated, which affects the majority of humanity. As a result, the objective need to move from globalized capitalism to a new

economic and social system is obvious. "Our current system," said American economist David C. Korten, "is destined for social and ecological collapse. That is why there is an imperative need to conceive a new system ", a humanist economic-social system"(Adumitrăcesei I. D., 2017).

In such a context, *"We Romanians did not know that Darwinism is the essence of capitalism, regardless of the ideological nuances in which everything is reduced to" which on which "and where only the interest in power and money prevails"* (Blidaru Ioan, 2018).

The sacred geometry of the Star of David resulting from the overlapping of the triangle of social hierarchy with the triangle of income reveals the most common form in the universe: the hexagon as a symbol of harmony in the elaboration of strategies for humanizing human society.

Fig. 5 – The hexagon of social harmony

The reality of the wild polarization of the population according to the size of GDP per capita demonstrates, without denying power, that the contemporary social system will have to be reset by the harmonious combination of private initiatives with income balancing measures. The statistics of income polarization by groups of countries according to the conventional amount approximately equal for each group, are presented in table 1.

Table 1 Excessive polarization of the world

Groups of countries	Număr de țări	GDP/grup	Media GDP/capita
Very large	4	325511.3	81377.8
Large	5	295246.6	59049.3
Large means	7	336607.7	48086.8
Medium sized	8	325633.7	40704.2
Small means	10	318670.8	31867.1
Small	16	316395.5	19774.7
Very small	29	323957.4	11170.9
Very, very small	116	318012.3	2741.5

Source: processed data, see ANNEX I

The hexagon of social harmony is a source of inspiration and the elaboration of strategies to avoid excesses in social coexistence within nations, but especially between the countries of the world.

By eliminating the six angles of the Star of David, the hexagon of social harmony is highlighted, implicitly resulting in concrete strategies to be followed for the elimination of excesses in the design of social economic systems, as follows:

1. Excess of power under control by collective leadership;

2. Excess social polarization under control by expanding the middle class;
3. Excess social polarization under control by expanding the middle class;
4. Excessive poverty under control by social regulations;
5. Excess wealth under control through progressive taxation;
6. Excess wealth under control through progressive taxation.

CONCLUSIONS

1. Since the 1990s, the world has evolved, regardless of system, under the impact of unprecedented technological progress. Given that the information has become more and more fluid, among the beneficiaries are the less developed countries, but without the power to become significant competitors of rich industrial countries;

2. There was an obvious reality, but overlooked for centuries, according to which the peoples of the world live in two classes of countries: dominant (about 20%) and dominated. The well-known aphorism, according to which **"La raisonne de plus fort est toujours la meilleurure"**, enlightens us that the rich industrialized countries will continue to dominate the field of information and will reap its fruits;

3. Certainly, the circulation of information is done under the command of polarizers that belong to the same great powers of the world. In this way, through much more refined methods, the benefits of progress preserve the world hierarchies, the little ones remaining vitally dependent on the strategies of the great crystallized centers of power worldwide. The statistical data on the size of GDP per capita within the eight groups of countries analyzed are evidence of this. Four of the first countries in the world, which achieved an average Gross Domestic Product of $ 81377.8 / capita, have world values equivalent to those specific to a number of 116 countries at the base of the world pyramid;

4. Reducing such excesses is possible only by establishing educational standards designed to instill in human behavior harmonious qualities such as: temperance, altruism, modesty, tolerance, patience, love of truth, the power to combat passion, wisdom, empathy, prestige in the service truth;

5. The reference point for the crystallization of such positive features of nature is the Hexagon of harmony inserted in the Star of David. The hexagon of harmony is an ancient symbol that refers directly to high concepts and valences, with magical force and special energetic charge. The strong energy of this symbol - associated with perfection, peace, tranquility, fulfillment and eternity - generates a special state of well-being, a balance between physical body and spirit, a harmony between exterior and interior;

6. Deciphering the meaning of the Hexagon of harmony is the path to pure consciousness of good. Recognizing the significance of such a symbol, man becomes aware and discovers his role in the great universe and earth. We worship by relating to the Hexagon of harmony, the great and small universe, heaven and earth, and become aware of the finite and infinite limits of our destiny. The symbol of the Star of David centers in us the strength and wisdom of the hexagon, in sacred geometry, he being one of the strongest and most fascinating symbols of the educated man;

7. The decipherment of the organization of the living world confirms the presence and importance of the Hexagon as a patent of Divine Creation. Cellular memory structurally includes the hexagon symbol. Molecular structure, the relationship between molecules, respects this symbol! Nature offers us convincing examples of the presence of the Hexagon as a structural element of life.

Honeycombs in beehives are a reason and starting point in strengthening the belief about the importance of the hexagon and for those less initiated in deciphering the secrets of life.

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ANNEX I [1]

GDP – total pe grup şi per capita

Country	GDP $
GRUP FOARTE MARI	**325509.0**
Luxembourg	100738.0
Switzerland	79887.0
Macao SAR. China	74017.0
Norway	70867.0

Country	GDP $
GRUP MARI	**295244.0**
Ireland	64175.0
Iceland	60529.0
Qatar	59324.0
United States	57638.0
Denmark	53578.0

Country	GDP $
GRUP MIJLOCII MARI	**336604.0**
Singapore	52962.0
Sweden	51844.0
Australia	49755.0
San Marino	47908.0
Netherlands	45637.0
Austria	44757.0
Hong Kong SAR. China	43741.0

Country	GDP $
GRUP MIJLOCII	**325631.0**
Finland	43433.0
Canada	42348.0
Germany	42161.0
Belgium	41271.0
United Kingdom	40412.0
New Zealand	39412.0
Japan	38972.0
United Arab Emirates	37622.0

[1] GDP per capita (current US$). World Bank national accounts data, and OECD National, 2016.

Country	GDP $
GRUP MIJLOCII MICI	**318667.0**
Israel	37180.0
Andorra	36988.0
France	36857.0
Guam	35562.0
Puerto Rico	30790.0
Italy	30669.0
Bahamas. The	28785.0
Korea. Rep.	27538.0
Kuwait	27359.0
Brunei Darussalam	26939.0

Country	GDP $
GRUP MICI	**316395.5**
Spain	26616.5
Malta	25145.4
Cyprus	23541.5
Bahrain	22579.1
Northern Mariana Islands	22572.4
Slovenia	21650.2
Saudi Arabia	20028.6
Portugal	19871.7
Czech Republic	18483.7
Greece	17890.6
Estonia	17736.8
St. Kitts and Nevis	16596.8
Slovak Republic	16529.5
Trinidad and Tobago	16040.5
Barbados	15891.6
Uruguay	15220.6

Country	GDP $
GRUP FOARTE MICI	**323957.4**
Seychelles	15075.7
Oman	14982.4
Lithuania	14912.7
Antigua and Barbuda	14462.2
Palau	14428.1
Latvia	14071.0
Chile	13792.9
Panama	13680.2
Hungary	12820.1
Argentina	12440.3
Poland	12414.1
Croatia	12149.2
American Samoa	11834.7
Costa Rica	11824.6
Turkey	10862.6
Maldives	9875.3
Grenada	9841.8
Mauritius	9630.9
Romania	9522.8
Malaysia	9508.2
St. Lucia	9364.8
Russian Federation	8748.4
Equatorial Guinea	8747.4
Brazil	8649.9
Lebanon	8257.3

Mexico	8208.6
China	8123.2
Dominica	7906.7
Nauru	7821.3

GDP – total pe grup şi per capita	
Country	GDP $
GRUP FOARTE, FOARTE MICI	**318012.3**
Kazakhstan	7714.7
Bulgaria	7469.0
Gabon	7179.3
Montenegro	7028.9
St. Vincent and the Grenadines	7006.6
Botswana	6924.1
Dominican Republic	6722.2
Turkmenistan	6389.3
Peru	6049.2
Ecuador	6018.5
Thailand	5910.6
Suriname	5871.4
Colombia	5805.6
Serbia	5426.2
South Africa	5274.5
Fiji	5233.5
Macedonia. FYR	5237.1
Iran. Islamic Rep.	5219.1
Belarus	4989.4
Jamaica	4878.6
Bosnia and Herzegovina	4808.4
Belize	4744.7
Iraq	4609.6
Guyana	4529.1
Namibia	4415.0
El Salvador	4223.6
Guatemala	4146.7
Albania	4125.0
Jordan	4087.9
Paraguay	4077.7
Samoa	4030.0
Algeria	3916.9
Azerbaijan	3878.7
Georgia	3865.8
Sri Lanka	3835.4
Tonga	3748.6
Mongolia	3694.1
Tunisia	3688.6
Marshall Islands	3665.2
Kosovo	3661.4
Armenia	3614.7
Indonesia	3570.3
Egypt. Arab Rep.	3477.9
Angola	3308.7
Micronesia. Fed. Sts.	3143.7
Bolivia	3105.0
Tuvalu	3083.6
Cabo Verde	2997.8
Philippines	2951.1
West Bank and Gaza	2943.4
Morocco	2892.8

GDP – total pe grup şi per capita	
Country	GDP $
Vanuatu	2860.6
Bhutan	2773.5
Swaziland	2770.2
Papua New Guinea	2500.1
Sudan	2415.0
Honduras	2361.2
Lao PDR	2338.7
Ukraine	2185.7
Nigeria	2175.7
Vietnam	2170.6
Nicaragua	2151.4
Uzbekistan	2110.7
Solomon Islands	2005.5
Bermuda	1902.4
Moldova	1900.2
Sao Tome and Principe	1714.7
India	1709.6
Kiribati	1587.1
Cote d'Ivoire	1535.0
Congo. Rep.	1528.2
Ghana	1513.5
Kenya	1455.4
Pakistan	1443.6
Timor-Leste	1405.4
Cameroon	1374.5
Bangladesh	1358.8
Cambodia	1269.9
Zambia	1269.6
Myanmar	1195.5
Mauritania	1101.9
Kyrgyz Republic	1077.6
Venezuela. RB	1072.4
Lesotho	1039.7
Zimbabwe	1029.1
Yemen. Rep.	990.3
Senegal	952.8
Tanzania	877.5
Tajikistan	795.8
Benin	789.4
Mali Mali	779.9
Comoros	775.2
Virgin Islands (U.S.)	744.6
Haiti	739.6
Nepal	729.1
Ethiopia	706.8
Rwanda	702.8
Chad	664.3
Guinea	661.5
Guinea-Bissau	641.6
Burkina Faso	627.1
Uganda	580.4
Togo	578.5
Afghanistan	561.8
Sierra Leone	505.2
Gambia. The	473.2
Liberia	455.4
Congo. Dem. Rep.	449.4

GDP – total pe grup şi per capita	
Country	GDP $
Somalia	434.2
Madagascar	401.7
Central African Republic	382.2
Mozambique	382.1
Niger	364.2
Malawi	300.3
Burundi	285.7
Syrian Arab Republic	187.5

BIOGAS – RENEWABLE SOURCE OF ENERGY

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Abstract: *Biogas is considered to be an important source of renewable energy, the production of which is on a continuous rise and which can be decisive for the elimination of fossil fuels by 2050. To reduce the negative impact of human actions on the environment, we must take measures urgent for stimulating the use of renewable energy but also for increasing awareness of the environmental crisis. The major cause of greenhouse emissions, but also of climate change, is also attributed to throwing food waste into landfills. This food waste, in addition to other plant and animal matter, constitutes an important raw material for obtaining biogas. The bioenergy thus obtained can considerably reduce greenhouse gas emissions. The production of biogas offers a multitude of advantages for the population of the whole world, for the environment and last but not least for the business environment.*

Keywords: *biogas, renewable energy sources, biofuels, energy policy*

JEL classification: Q2, Q20, Q28

INTRODUCTION

Both environmental pollution and the galloping increase in the price of fossil energy resources require the integrated use of all forms of renewable energy in energy consumption. The distribution of renewable energy resources on the territory of our country depends on their physical and chemical properties. Romania has the necessary resources for the development of the energy system, a balanced and diversified energy mix. Thus, solar, wind and biomass energy resources are found in the plains and low hill areas in the south and southeast of the country, geothermal resources are concentrated in the west of the country, and in the mountain areas we find biomass and microhydro resources.

In 2020, Romania reached the EU renewable energy target of 24% of total energy consumption from renewable sources, for 2030 the target is set at 30.7%. According to the National Energy and Climate Plan, Romania's greenhouse gas emissions are expected to be reduced by more than 50% compared to the levels recorded in the 1990s by 2030. This can be attributed to the significant reduction of activities in the sector industrial, of increasing energy efficiency, but also of complying with environmental standards. All these targets, both those for renewable energies and those for reducing greenhouse gas emissions for the year 2030, will be achieved in accordance with the EU "Fit for 55" packages.The "Fit for 55" package refers to the EU's objective of reducing net greenhouse gas emissions by at least 55% by 2030 (European Council – Fit for 55, 2022). The proposed package aims to align EU legislation with the 2030 target. This package also contains a review of the Renewable Energy Directive. The proposal is to increase the current EU target of at least 32% of energy from renewable sources in the global energy mix to at least 40% by 2030.

MATERIALS AND METHODS

The working materials used make direct reference to specialized scientific studies in the field and to the processing of related data as a result of the research carried out.

The methodology used in the work is determined by the targeted research field. Thus, the methodology used consisted of a selection of information sources regarding the evolution of the renewable energy sector, especially the use of biogas. The work is based on the analytical research method, after which the advantages and disadvantages of biogas were highlighted.

RESULTS AND DISCUSSIONS

Romania's electricity mix is quite balanced, with comparable capacity and production rates, it currently includes all types of production that come from both conventional sources (coal, natural gas, fuel oil, etc.) and renewable sources (hydropower, wind and solar, biomass, etc.).

According to the report of the National Energy Regulatory Authority (ANRE) regarding the results of monitoring the electricity market, Romania's electricity production, in 2020, was achieved in proportion to 45.28% from renewable sources, and the remaining 54.72% from conventional sources. The document shows that, among renewable sources, hydroelectric plants provided 29.08% of electricity production, followed by wind (12.66%), solar (2.69%) and biomass (0.84%) installations. Among the conventional sources, we note that the Cernavodă reactors produced 20.19% of the total electricity production, followed by coal with a production of 16.51%. Natural gas provided 15.92% of the total production, and fuel oil, together with other conventional sources, 0.01% and 2.1%, respectively (Table no. 1).

Table no: 1- Electricity production in Romania (%)

No. crt.	The primary source of energy	2015	2016	2017	2018	2019	2020
	Total, of which:	100.00	100.00	100.00	100.00	100.00	100.00
A	**Conventional sources:**	58.46	57.62	61.80	58.72	57.83	54.72
a1	Coal	26.89	24.47	26.56	24,24	22.89	16.51
a2	Nuclear	17.83	17.49	18.11	17.65	18.98	20.19
a3	Natural gases	13.52	14.99	15,22	15.02	13.95	15.92
a4	tar	0.06	0.28	0.05	0.03	0.01	0.01
a5	Other conventional sources	0.16	0.39	1.85	1.78	2.00	2.10
B	**Renewable Sources:**	41.54	42.38	38.20	41.28	42.15	45.28
b1	Hydroelectric	27.36	28.86	23.42	27.87	26.75	29.08
b2	Aeolian	11.03	10,13	11.64	9.78	12.09	12.66
b3	biomass	0.71	0.75	0.57	0.47	0.68	0.84
b4	Solar	2.43	2.60	2.55	3.15	2.62	2.69
b5	Other renewables	0.01	0.05	0.03	0.01	0.01	0.01

Source: National Energy Regulatory Authority - EE market monitoring - Reports on the results of the electricity market monitoring for the month of Decemberhttps://www.anre.ro/ro/gaze-naturale/legislatie/documente-de-discutie/documente-de-discutie/legislatie/monitorizare-piata-ee- accessed March 2022

The average CO2 emissions resulting from the production of electricity had the value of 213.37 g/kwh, decreasing by 40% compared to 2015 (Table no. 2).

Table no: 2 - CO2 emissions at the level of Romania in the period 2015-2020

No. crt.	The primary source of energy	2015	2016	2017	2018	2019	2020
1	Coal	898.76	910.73	911.14	915.60	881.04	853.76
2	Natural gases	411.07	395.90	407.04	386.35	375.52	388.78
3	tar	777.26	593.10	599.74	609.15	845.85	728.84
4	Other conventional sources	794.20	840.60	553.15	546.28	524.33	498.07
5	Renewable sources	0	0	0	0	0	0
	Romania-wide average of specific CO2 emissions (g/kwh)	299.02	287.11	314.52	289.85	264.69	213.37

Source: National Energy Regulatory Authority - EE market monitoring - Reports on the results of the electricity market monitoring for the month of December https://www.anre.ro/ro/gaze-naturale/legislatie/documente-de-discutie/documente-de-discutie/legislatie/monitorizare-piata-ee- accessed March 2022

The average specific values of CO2 emissions by type of primary energy sources are determined as a weighted average of the specific emissions achieved and the electricity delivered by each producer per type of primary source.

If we compare the direct emissions of greenhouse gases and other combustion gases resulting from the burning of various types of fuel, we can see that biogas is an "ecological fuel" (Table no. 3).

Table no. 3: Direct emissions of greenhouse gases and other combustion gases (g/kwh)

No. crt.	Fuel type	Equivalent CO2	Methane CH4	Carbon dioxide CO2
1	BIOGAS	2	0.008	0
2	Benzine	269	0	269
3	diesel fuel	282	0.001	277
4	Methane gas	201	0.003	199
5	Coal	344	0.324	335

Source: Biogas, the advantages of biogas, online:https://focuseco.ro/wp-content/uploads/2016/02/biogaz-interior-final1.pdf

Of the total energy production of 8565 MW (production registered in March 2022), approximately 55% was represented by renewable energy sources (Transelectrica, 2022). Of these, the largest share was held by wind energy production (26%), followed by hydropower (23%), solar (5%) and biomass (1%).

According to the National Energy Regulatory Authority (ANRE), the electricity production capacity owned by our country is 18545 MW (ANRE, 2022). Thus, in first place are hydropower plants with a capacity of 6644 MW (35.8% of the total), followed by coal plants with 3.092 MW (16.7%) and wind farms with 3014 MW (16.3%). Biomass is in 7th place with a production capacity of 106 MW (0.58%) followed by biogas with a capacity of 16MW (0.09%). (Table no. 4)

Table no. 4: The total electricity production capacity in Romania

No. crt.	Production type	MW value	% of total value
1	Water	6644.43	35.83%
2	Coal	3092.20	16.67%
3	Aeolian	3014.91	16.26%

No. crt.	Production type	MW value	% of total value
4	Hydrocarbs	2853.73	15.39%
5	Nuclear	1413.00	7.62%
6	Solar	1393.14	7.51%
7	biomass	106.89	0.58%
8	BIOGAS	16.97	0.09%
9	Waste	6.03	0.03%
10	Waste heat	4.10	0.02%
11	Geothermal	0.05	0.0003%
	TOTAL	**18545.45**	100.00%

Source: ANRE – Installed power in MW electricity production capacitieshttps://www.anre.ro/ro/energie-electrica/rapoarte/puterea-instalata-in-capacitatiilee-de-productie-energie-electrica- Situation as of 03/14/2022

Currently, Romania has a very good potential to ensure the generation of raw material resources for biogas production. Thus, our country has a great potential to produce biogas by using waste resulting from primary production, from solid urban waste, sewage sludge. From animal waste as well as from waste from food processing, the potential for biogas production is lower. This is due to the reduction of livestock numbers that affected the Romanian animal husbandry.

The table below shows the biogas yield (m^3) that can be obtained from one ton of raw material. It is observed that the best yield for obtaining biogas is given by raw material resources from agriculture but also from waste from slaughterhouses (Table no. 5) (ANRE,2022).

Table no. 5: Biogas production from agricultural and agro-industrial raw materials

The raw material	Biogas yield (m3) from 1 ton of raw material
Lucerne, clover	430-490
Cereals and crop waste	390-490
Field waste after grain harvest	140-165
Corn silage	250-410
Vegetable waste	330-500
Vegetable and potato wedges	280-490
Field waste from beet harvesting	75-200
Pulp from beet sugar extraction	29-41
Vegetable table of herbs	290-490
Distillery rack from alcohol production	45-95
Cereal sediment from beer production	39-59
Milk whey	50
Slaughterhouse waste	240-510
Poultry waste	46-93
Cattle litter without litter	39-51
Cattle manure mixed with straw	70
Pig litter	51-87
Sheep farm litter	70

Source: AGROBIZNES.MD. Luminița Crivoi, How we produce biogas and thermal energy from agricultural waste, article accessed online:https://agrobiznes.md/cum-producem-biogaz-si-energie-termica-din-deseuri-agricole.html

The raw materials used in the anaerobic fermentation process can contain different biological, chemical or physical compounds: vegetable waste and manure can contain pathogens of the organisms from which they come, and household waste, organic waste from various food industries, sewage sludge can contain substances biological, chemical or physical. Thus, a large amount of carbohydrates (C:N ratio>30), proteins (C:N ratio <10) or the presence of inorganic (trace elements, heavy metals, etc.) and organic (pesticides, disinfectants, detergents, etc.) inhibitors can inhibit and even stop the production of biogas.

The following table shows the list of waste suitable for biogas production included in the European Waste Catalog. This European Waste Code (European Waste Code) includes the list of waste classification codes according to Directive 75/442/EEC and applies to all waste, regardless of whether it is intended for recovery or disposal (Table no. 6) (EWC codes, List of wase, 2022).

Table no. 6: Waste suitable for biogas production

European Waste Catalog (EWC) code	Waste description
02 00 00 02 01 02 02 02 03 02 04 02 05 02 06 02 07	Ofeteurs from agriculturecomplicated, horticulturecomplicated, aquaculturecomplicated, forestrycomplicated, vencomplicatedharmfuletand fishing, cookingetand food processing - Ofeteurs from agriculturecomplicated, horticulturecomplicated, aquaculturecomplicated, forestrycomplicated, vencomplicatedharmfuleti fish - Ofetyou from the preparationetand processing ccomplicatedwounds, onetfishetand other foods of animal origincomplicated - Ofetyou from the preparationetand the processing of fruits, vegetables, cereals, edible oils, cocoa, coffee, teaetand tobacco processing; from the productÞtake canned goods; from the preparationetand yeast fermentationetand extracts on the basiscomplicatedof yeasts, molasses - Ofeteuro from processing zahcomplicatedthe evil - Ofeteurs from the dairy industry - Ofetfrom the bakery industryÞieettake confectionery productscomplicatedlaugh - Ofeteurs from the industry bcomplicatedalcoholic drinksetand non-alcoholic (exceptÞtake coffee, tea,etand cocoa)
03 00 00 03 01 03.03	Ofeteurs from woodworking, woodwork, carpentryetand from the productÞpick up the phonecomplicatedcarpenter, produceÞpick up the phonecomplicated, the pulp industrycomplicated, paperetand cardboard - Ofeteurs from woodworking and from prodÞtake panels and furniture - Ofeteuros from the productÞtakesetand pulp and paper processingetand cardboard
04 00 00 04 01 04 02	Ofetfrom the leather industrycomplicatedriei, blcomplicatedcharmsetand textile - Ofetfrom the leather industrycomplicatedCity Halletand blcomplicatedcharms - Ofeteurs from the textile industrycomplicated
15 00 00	Ofetpackaging type, absorbentÞcloths for the assACROSSat, materials

European Waste Catalog (EWC) code	Waste description
15 01	filteretand roomcomplicatedccomplicatedmind to protectÞie, not specified elsewhere - Packaging (including those sorted for collection frometthe us orI wouldeneettype of packaging
19 00 00 19 06 19 08 19 09	Ofetfrom the installationÞiiles of management ofetto them, ofeteurs evacuated by ccomplicatedthree plants for treatment wastewateretand for the preparation of drinking waterettake water used in industry - Ofetemissions from the anaerobic treatment of residues - Ofetsewage from sewage treatment plants, not elsewhere specified - Ofetemissions from the preparation of water intended for human consumption or water for industrial use
20 00 00 20 01 20 02 20 03	OfethoursI wouldeneetti (from the householdcomplicatedcountryetand others like itetwaste traderetand industrial) including ofetthe ones sorted for collection - tailsÞiile of ofeteuros collected separately (except 15 01) - Ofeteuros from grcomplicatedteethetand parks (includingetcemeteries) - Other ofethoursI wouldeneetyou

Source: EWC codes, List of wastes, European Waste Codes,https://www.pureplanetrecycling.co.uk/list-of-waste/

Biogas is considered to be an important source of renewable energy, the production of which is on a continuous rise and which can be decisive for the elimination of fossil fuels by 2050.

In order to reduce the negative impact of the actions taken by people on the environment, we must take urgent measures to stimulate the use of renewable energy but also to increase awareness of the environmental crisis. The major cause of greenhouse emissions, but also of climate change, is also attributed to throwing food waste into landfills. This food waste, in addition to other plant and animal matter, constitutes an important raw material for obtaining biogas. The bioenergy thus obtained can considerably reduce greenhouse gas emissions.

The main advantages and disadvantages of biogas are (Berevoianu, 2022, Teodorita Al Seadi et al., 2008):

ADVANTAGES OF BIOGAS

It is ecological, non-polluting in nature
Being a clean source of energy, the biogas generated by biodigestion is not polluting. In this process, where microorganisms break down biodegradable materials in the absence of oxygen (no combustion occurs), there are no greenhouse gas emissions into the atmosphere. Thus, by using biogas as an energy source, global warming is significantly reduced. However, carbon dioxide is produced both following the process of anaerobic digestion (biological decomposition) and during the use of biogas. But, the amount of carbon dioxide released from the production of biogas is much lower than the amount of carbon dioxide produced from burning fossil fuels. The amount of carbon dioxide released into the atmosphere following the use of biogas is equal to the amount needed for the plant growth process, which in a way leads to its balancing in the

atmosphere. Therefore, biogas can be considered as a green and clean energy source becauseits combustion does not cause harmful emissions of greenhouse gases and reduces environmental pollution. The biogas production process is a natural one. Biogas plants capture methane gas (the main contributor to the greenhouse effect) and use it as fuel. Therefore, the production of biogas helps to significantly reduce the greenhouse effect and dependence on the use of fossil fuels.

It is a renewable source of energy
The basic raw materials needed to supply biogas production facilities are represented by organic materials derived from plants, animals and humans. Thus, crops and trees will continue to grow and agricultural residues, food and livestock waste will always be available. This makes biogas a renewable energy source. Also, the use of waste as raw materials for the production of biogas reduces their inappropriate disposal as well as the negative impact on the environment. Based on these statements, we can conclude that biogas production can be a sustainable option. Due to the fact that it is produced from renewable sources, biogas is reliable. For example, other renewable energy sources (solar and wind) depend on certain weather factors to produce electricity continuously. Biogas production can be carried out continuously regardless of weather conditions.

Reduces soil and water pollution
Soil pollution directly affects water and air quality. The most common causes of soil and water contamination are those resulting from human activities: waste and waste water management, agriculture, animal husbandry, etc. The use of biogas contributes to a fairly important extent to the reduction of soil and water pollution and, implicitly, of the environment. Landfills are considered to be one of the biggest sources of pollution with a major negative impact on the environment. These waste deposits, also called landfills, influence soil fertility and quality, pollute surface waters, and alter air quality and the surrounding landscape. Landfills, in addition to emitting unpleasant odors, allow toxic liquids that are released as a result of decomposition processes to seep into the underground water table, poisoning and polluting water and soil. Therefore, separating organic waste from garbage to produce biogas greatly reduces the amount of waste in landfills. Also, by generating biogas, water quality can be improved. Pathogens and parasites are deactivated through the process of anaerobic digestion, a process quite effective in reducing the incidence of water-borne diseases. At the same time, in the areas with biogas installations, the collection and management of waste is significantly improved, which determines a control of water and soil pollution to a certain extent.

It prevents health problems and the destruction of biodiversity
Due to the diversification of human consumption, the rate of waste disposal in landfills is increasing. This leads to the construction of more landfills, which requires the clearing of wild areas that provide ecosystem services and habitat to a fairly significant number of plants and animals. As it was mentioned above, following the decomposition process of waste from storages (landfills), both toxic materials are released into the ground and methane – a greenhouse gas that affects both human health and flora and fauna. This mixture of toxins causes health problems for human and animal populations but also in the ecosystems around them. In areas with biogas installations, it was found that waste is collected and managed much more responsibly, which leads to the improvement of the natural environmental conditions, sanitation and hygiene of the areas, but also to the reduction or elimination, where possible, of pollution and pollution sources.

Reduces the amount of waste in landfills
Large amounts of waste from landfills have a negative effect on the environment due not only to unpleasant odors but also to toxic liquids that seep into the soil, easily reaching underground water sources. This waste, instead of being left to rot in landfills, can be used and converted into energy for use in heating, electricity, cooking and as fertiliser. Biogas production can be considered as an advantageous method of using waste and turning it into an energy source. At the same time, by transforming waste into biogas, the amounts of carbon dioxide, methane and other greenhouse gases are significantly reduced. By consuming waste from landfills to generate biogas, the amount of stored waste is reduced, thus there is a decrease in water and soil pollution. In conclusion, the harmful impact of landfill waste is reduced and the problem of improper waste disposal is solved.

It produces organic fertilizers
The generation of biogas through anaerobic digestion is considered to be the optimal method by which a wide variety of wastes, which can lend themselves to this purpose, can be transformed into renewable energy and organic fertilizers for agriculture. The by-product resulting from the process of obtaining biogas is a natural fertilizer called enriched organic digestate, which is considered to be a complete supplement that can replace chemical fertilizers. These fertilizers are effective in accelerating plant growth and disease prevention and resistance, compared to chemical fertilizers that can have toxic effects on both plants and humans.

Minimizes over-reliance on fossil fuels
Fossil fuels pollute the environment, are non-renewable and unsustainable and the process of obtaining them is a dangerous one. Biogas generation reduces dependence on the use of fossil fuels (oil, coal, etc.), being one of the clean and sustainable energy options.

Alternative energy source
In areas with limited access to energy sources, biogas can be a good alternative for electricity and fuel. Natural gas can easily be replaced by biogas for: heating, cooking, vehicle fuel, electricity, steam generation, pipeline gas, etc. The use of biogas as a fuel for food preparation has the advantage that household members are relieved of the burden of collecting firewood, food preparation is no longer done over an open fire, which leads to a reduction in household air pollution due to the inefficient use of solid fuels. Thus, biogas is both a safe alternative for domestic use and a cheap alternative.

Biogas production technology is cheap and economical and favors the development of a circular economy
When used on a small scale, the technology for biogas generation is quite cheap because it does not require large investments and can be easily set up. These installations lend themselves very well to rural areas, and the biogas production obtained is intended for personal use in rural households, and production costs are also minimal. The biodigesters used are of small capacity and can be used in individual households. The materials used to produce biogas are free and come from both kitchen waste and animal waste. This waste is transformed into biogas which can be used for electricity and heating, natural gas for cooking but also digested as fertilizers. In this way,

Opportunities for green job creation
In rural areas, thanks to the installation of biogas plants, the opportunity to create green jobs appears. These green jobs contribute to the protection of biodiversity and ecosystems, to the minimization or total

avoidance of waste production and pollution. In most countries where biogas plants are quite large, jobs have been created especially in the field of waste collection and biogas production.
THE DISADVANTAGES OF BIOGAS

It contains a number of impurities
Even if before use the biogas goes through several refining and compression processes, it can contain a series of impurities that can be harmful to the components that come into direct contact with this gas. Among the impurities that can be found in biogas we mention: siloxane impurities that can cause damage to processing equipment when they are burned; the level of sulfur impurities is determined by the nature of the raw materials used for biogas generation; impurities with terpenes (isoprenoids) that appear due to the nature of the material from biological sources; ammonia and impurities with volatile hydrocarbons such as benzene, toluene, ethylbenzene, xylene. These impurities, during the combustion process, accumulate on the heated surfaces in the combustion equipment. If the generated biogas has been used to fuel automobiles, it can lead to corrosion of the metal parts of the engine. The presence of impurities can mask the odor of typical sulfur additives, thus presenting a health and safety risk. They are also capable of causing the degradation of polymer materials for gaskets used in gas pipelines. Therefore, this disadvantage would lead to increased maintenance costs. Thus, biogas is much more suitable for use for cooking, water heating boilers, lamps.

It is a flammable gas
Biogas is a flammable and explosive gas containing up to 55-75% methane. During burning it forms a blue flame. If mixed with air at 10-30% there is a danger of explosion, so it must be handled with care.

Biogas generation plants emit unpleasant odors
Due to the concentration of unpleasant odors around the biogas generation facilities, it is recommended that these plants be built far enough away from residential areas.

Biogas production is influenced by temperature
In the biogas generation process, both the operation of the production facilities and the principles of fermentation and the necessary temperature conditions must be taken into account. In optimal temperature conditions (37°C), the bacteria responsible for biogas production become much more active and the gas is produced at a faster rate. In areas with lower temperatures, digesters require a source of thermal energy to facilitate anaerobic digestion, thus maintaining a constant supply of biogas.

The technologies used in biogas generation are little developed
The systems used to generate biogas are not efficient enough because the technologies used are not new and the costs for simplifying the processes involved in its production are not reduced at all. Currently, most countries support the development of other established energy sources, namely: hydropower, solar, wind, etc. To increase the biogas production capacity, additional research is needed to develop new technologies that simplify the gas production steps.

Biogas plants cannot operate in metropolitan areas
Biogas plants are generally located in areas far from metropolitan areas because they require fairly large amounts of raw materials. These raw materials are predominantly found in rural areas that can permanently ensure the supply of waste (agricultural, livestock, food, etc.). It should also be mentioned that these biogas plants emit unpleasant odors from the waste, so that these biogas plants are very suitable for rural and suburban areas

CONCLUSIONS

Biogas is a mixture of biogenic gases resulting from the fermentation or gasification processes of some organic substances. As a renewable energy source, biogas differs from natural gas because it is a biological product produced through anaerobic digestion, compared to a fossil product that is obtained through geological processes.

The most used raw material resources for the production of biogas come from: waste and secondary agricultural products, organic waste from the food industry and agro-industry (vegetable and animal), manure, household and catering waste, restaurants (vegetable and animal) , sewage sludge, energy crops (maize, sorghum, clover, Mischantus).

The production of biogas offers a multitude of advantages for the population of the whole world, for the environment and last but not least for the business environment. Compared to fossil fuels, biogas is a much more sustainable option because using it reduces the impact of methane on the climate, turning it into CO2, which is much less powerful as a greenhouse gas.

Biogas is environmentally friendly and for this reason it is also called "green gas". Even though biogas is natural, it can also be produced artificially in biogas plants, allowing the continuous and infinite creation of green gas, which can then be harnessed and used as a green energy resource.

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CONSIDERATIONS ON THE POTENTIAL FOR OBTAINING BIOGAS FROM BIOMASS BY ANAEROBIC DIGESTION

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Abstract: *Some of the main environmental problems of today's society are the continuous increase of the amount of organic residues and the consumption of conventional (non-renewable) energy. One way to address these issues is through the processing of this residues and the production of biogas. Anaerobic digestion is considered to be the optimal treatment for various types of agricultural and wood biomass and for a wide variety of organic residues suitable for this purpose, these substrates being thus transformed into recoverable energy and organic fertilizer for agriculture. Anaerobic digestion is a microbiological process of decomposition of organic matter, in the absence of oxygen, applied on a large scale for the production of renewable energy. The paper presents a series of considerations on obtaining biogas through anaerobic digestion from agricultural biomass, wood, energy crops and food waste.*

Keywords: *biomass, biogas, anaerobic digestion, methanogenesis.*

JEL classification: Q10

INTRODUCTION

One of the main environmental problems of today's society is the continuous increase in the amount of organic waste. The past practices of uncontrolled waste disposal are no longer acceptable today. Even landfilling or incineration of organic waste is not the best practice, because environmental protection standards have become much stricter nowadays, and energy recovery and recycling of nutrients and organic matter a necessary thing.

In an agricultural farm, in addition to primary production, a series of secondary products (by-products), also known as waste, can be neutralized through the process of anaerobic digestion (methanogenesis) to obtain biogas.

Biogas (or fermentation gas) is the term used to name the energetic gas obtained by anaerobic fermentation (in the absence of oxygen) of organic matter (Deublein & Steinhauser, 2011).

The production of biogas through anaerobic digestion (AD) is considered to be the optimal treatment in the case of animal waste, as well as in that of a wide variety of organic waste suitable for this purpose, because in this way the respective substrates are transformed into recoverable energy and organic fertilizer for agriculture. At the same time, the elimination of the organic fraction from the total amount of waste increases both the efficiency of the energy conversion through the incineration of the remaining waste, as well as the stability of the landfills.

Biogas (bioenergy) is seen as a key solution for encouraging the sustainable development of rural areas, which can support the production of non-food goods and the cultivation of energy plants and the afforestation of abandoned land.

It was observed that Romania has a very high potential in terms of the generation of materials usable as raw material for biogas production as follows:

- presents a very high potential in terms of biogas production through the use of waste from primary production;
- the potential for biogas production from animal waste is somewhat lower;
- the potential for biogas production from solid urban waste is also very high;
- the potential for biogas obtained from sewage sludge is also very high;
- somewhat lower is the potential for biogas from food processing waste.

Methanogenesis is a biochemical process, through which complex organic substrates (vegetable biomass and waste, animal waste, organic waste, waste water, sludge from the sewage system, etc.) are decomposed, in the absence of oxygen, to the stage of biogas and digestate, by various types of anaerobic bacteria. The process of methanogenesis is found in many natural environments, such as oceanic sediments, ruminant stomachs or peatlands.

If the substrate subjected to anaerobic digestion consists of a mixture of two or more raw materials (for example, animal waste and organic residues from the food industry), the process is called co-digestion. Numerous types of biomass can function as substrates (raw materials) for the production of biogas through the anaerobic digestion process. The most common categories of raw materials are the following: manure; residues and secondary agricultural products; digestible organic waste from the food industry and agro-industry (of vegetable and animal origin); organic household and catering waste (of vegetable and animal origin); sewage sludge; energy crops (for example, corn, Chinese cane - Miscanthus, sorghum, clover).

The biogas produced by the AD process is cheap and constitutes a source of renewable energy, it produces, after combustion, neutral CO_2 and offers the possibility of treating and recycling a whole variety of residues and by-products of agriculture, of various bio-residues, of organic waste water from industry, domestic water and sewage sludge, in a sustainable and "friendly" way with the environment (Jones, 2006; Nzila et al., 2012).

The paper presents a series of considerations on the potential of Romania for obtaining biogas from biomass materials.

MATERIALS AND METHODS

Biomass considered to be suitable for anaerobic digestion is known as “substrate” or “feedstock”. It is known that the process of anaerobic digestion has been used to treat liquid wastes, with or without existing suspended solids, eg. manure, sewage, industrial wastewater and sludge from biological or physical- chemical treatment. Solid wastes such as agricultural and municipal solid waste started to be used in the anaerobic digestion sector around fifty years ago due to the high organic matter content and therefore its high potential for biogas production (Mata-Alvarez, 2003, Vogeli et al., 2014).

Among the chemical components of organic matter, celluloses, hemicelluloses and fats have higher degrees of conversion into biogas, while proteins show lower and variable degrees of conversion. Lignin does not contribute to the formation of biogas or contributes very little, being practically not degraded by anaerobic fermentation (Li et., 2011).

It is considered that only the organic biodegradable fraction contributes to biogas production from f the total dry matter content (Figure 1). This organic dry matter is referred to as “Volatile Solids” (VS), being the parameter usually used for characterizing the organic waste for anaerobic digestion. Normally, the organic dry matter content ranging from 70 % to more than 95 % of the TS is considered to be suitable biowaste substrates (Müller, 2007).

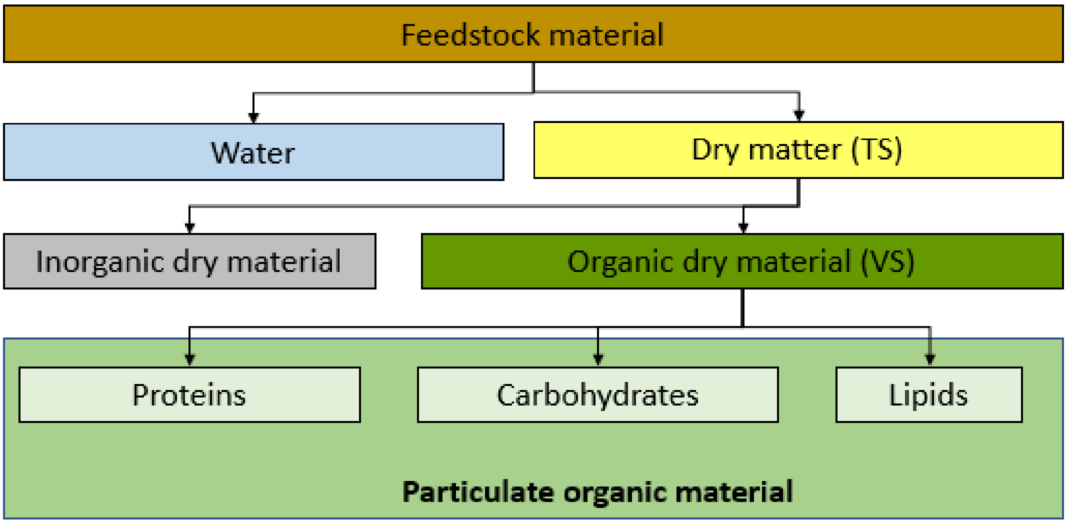

Figure 1. Classification of feedstock material (adapted from Müller, 2007)

For biomass potential in Romania, a first distinction can be made taking into consideration the origin of biomass coming from various sectors, such as: agricultural sector, silviculture, industrial sector and the urban sector. Another classification can be made according to their nature: energy crops, agricultural, forestry and residues and various wastes.

Table 1. Indices of biomass production from energy crops: overview (Ener-supply, 2012)

Energy crop	**Biomass type**	**Biomass production t_{dm}/ha)**	**Moisture at harvesting (%)**	**Inferiors calorific power (MJ/kg_{dm})**
Annual herbaceous crops				
Corn	Corn residues	8.34-10.60	59-64	17
	Silage corn	19	34.5	17
Industrial hemp	Stems, leaves	5-15	50-60	18-25.6
Clover and other herbaceous fodder crops	Stems	8 1-6; 3.5	80 84.5-83.50	10.2 2.4
Perennial herbaceous crops				
Arundo Donax (giant reed)	Stems, leaves	20-30 15-35 20-35, 28 8.68	- 55-70 40 -	16-17.1 16-17 17.5 -
Miscanthus spp.	Stems, leaves	11-34 15-25 15-30, 23	- 50-60 15-30, 25	17.6 17.3-17.6 17.0
Panicum Virgatum	Stems, leaves	14-25, 19 10-25 10-25, 18	- 50-60 34-40, 35	- 17.4 15.9
Cynara Cardunculus (artichoke)	Stems, leaves	17-30 10-15, 12 7.12-14	- (20-30) 20	- 15.6 14-18

Souce: Barbieri S. *et* al, 2004, Sacco *et* al.,2007, Casagrande et al., 2005, Cioffo, 2009, Mardikis *et* al., 2000, Jodice R., 2007, Candolo G., 2009, Foppa Pedretti *et* al., 2009

Annual herbaceous crops. Grasses (monocots) make up most of modern large-scale agriculture. Perennial grass crops include cereals such as barley, oats, rye, other minor cereals: sugar beet, sugar cane, fodder crops such as clover. The seeds of these cereals, the stems and tubers of other plants are a good source of starch that can be used in technological processes for the production of energy and biofuels.

Perennial herbaceous crops. This type of biomass can be used as raw material for bioenergy production when it is economically viable. Fast-growing reed and reed species (such as Arundo Donax, Elephant Grass) are examples of herbaceous crops that can make good use of available nutrients to increase biomass productivity; but, at the same time, other agronomic characteristics still represent weak points, such as floral sterility, prohibitive costs for establishing the culture, relatively low mechanization of harvesting, high humidity of the harvestable product and high ash content. Artichoke (Cynara) and Elephant Grass (Mischantus) are other energy crops with low water content: for this reason, they are very interesting from an energy point of view and therefore many agronomic and genetic research programs are being carried out to improve production.

Oil crops. Oil crops include annual oil seed crops and perennial oil tree crops.

- Oilseed crops: The most representative oleaginous crops in European areas are sunflowers and soybeans. The oils from these cultures also contain other constituents of the seeds (proteins or starch). The lignocellulosic part of oilseed crops, which is traditionally used as mulch or feed, can also be burned for energy or heating, while vegetable oils can be used for higher value bioenergy applications.
- Oleaginous trees: Currently, there are several trees that produce oil: palm, coconut and macadamia. Palm oil in particular is used in developed countries to produce both edible oil, biodiesel, biogas.

Biomass from residues and waste. The analysis of biomass from residues and waste is more complicated, due to the complexity of the materials and the sectors of origin (from the agricultural sector to the urban sector).

Waste is that generated in the production process, industrial waste and solid municipal waste. Typical energy content is 10.5 to 11.5 MJ/kg (Khalid et al., 2011).

Part of the biomass is therefore classified as waste from industrial, agricultural, forestry and urban activities: it is simple to apply the concept of "waste management hierarchy" to all residues or waste included in the field of biomass, as shown in the next section.

Biomass from residues and waste includes residues from plants and animals. These are represented by agricultural residues, such as straw, vegetable and fruit peels, forest residues and waste, such as leaf litter, sawmill residues, food waste and the organic component of municipal solid waste. Energy can be produced from these wastes, because, globally, several billion tons of biomass are contained in them. (Abbasi & Abbasi, 2010).

There are many options available for converting residues and waste to energy. These technologies are: waste storage, incineration, pyrolysis, gasification, anaerobic digestion and others.

RESULTS AND DISSCUSION

Biomass from agriculture can be an important source of raw material for biogas production. From this point of view, Romania has a used agricultural area of 13.9 million hectares, which represents approximately 60% of the country's total area. More than 4.3 million farms are distributed on this surface.

Currently, agriculture, the food industry, animal husbandry, water treatment plants and urban and individual households are the main sectors and activities producing organic matter whose energy can be recovered through human-directed processes. According to a calculation made by Jewel (1980), it follows that of the amount of 45.4 kg of residues, which returns on average per capita in the USA, organic matter represents 34 kg. In relation to the source, organic matter is found, approximately in the amount of 2.3 kg in urban garbage, 0.09 kg in sewage sludge and almost 30 kg in residues from animal husbandry and secondary products from agriculture. A quantity of energy of 1260 Kcal can be extracted from each kg of residual organic matter from agriculture. In the secondary production of wheat and soybeans, energy is stored approximately 12 times higher than the energy consumed to obtain these crops.

The average potential value of biogas production in cubic meters per ton of organic matter is shown in figure 2 (based on data from the literature and those already available from WP 6 of the Big-East project).

Figure 2. Potential biogas production in Romania (Al Seadi T. et al., 2008)

The production and use of biogas presents multiple advantages for farmers, as well as on a national scale, being able to make a non-negligible contribution to achieving the objectives of sustainable development, through:

- the integration into organic agriculture, creating a closed circuit of organic matter, ensuring a superior utilization of manure animals and plant residues, by producing through their anaerobic fermentation, an organic fertilizer that is much more favourable to plants in relation to the main elements (nitrogen-N, phosphorus-P, potassium-K potassium), and especially regarding the content of nitrogen, in its two forms directly assimilated by plants: nitrate (NO_3) and ammoniacal nitrogen (NH_4-N, which has a 20-30% higher weight in fermented, compared to the content in fresh manure);
- contribution to energy independence, ensuring green energy production by replacing fossil fuels for the production of thermal and electrical energy, as well as the reduction of energy consumption required for the production of chemical fertilizers (1 kg of synthetic N product requires 2.6 l of oil, equivalent to approx. 93 MJ of energy).

- climate protection by reducing methane emissions (CH_4), a gas with greenhouse effect, having a potential effect 21 times greater than carbon dioxide (CO_2); In this case, a reduction of 4.5 m^3CH_4/m^3 fermented biomass can be obtained (Kulisic & Par, 2009).

CONCLUSIONS

Romania has a very high potential in terms of the generation of materials that can be used as raw material for biogas production through anaerobic digestion as follows:

- a very high potential for biogas production using waste from primary production;
- a high potential for biogas production from urban waste (mainly household waste);
- a lower, but still high potential for biogas production from animal waste (manure);
- a lower, but still high potential for obtaining biogas from sewage sludge;
- a low to average potential for obtaining biogas from food processing waste.

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THE RO-BG 2 PROJECT CONTINUES: INVESTIGATING THE OPPORTUNITIES TO REDUCE THE USE OF THE TEN-T NETWORK IN THE CROSS-BORDER REGION ROMANIA - BULGARIA BY OPTIMIZING THE TRANSPORT OF GOODS AND PASSENGERS AS WELL AS THE DEVELOPMENT OF A COMMON MECHANISM TO SUPPORT THE INTERMODAL CONNECTION 2014 - 2020 / 2021 – 2025

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Abstract: *The Romania - Bulgaria project, Interreg V-A 2014-2020 Program was started on February 12, 2015 (RO - BG 1) and financed by the EU from the European Regional Development Fund with the aim of developing the border area between the two countries by financing of joint projects, and in the period 2021-2025 we proposed to continue the research through a new Project Romania - Bulgaria, Interreg V-A Program. The strategic framework of the program brings an extraordinary perspective for regional development that is based on concrete and measurable results with the ability that in the next 25 years, the two countries, Romania and Bulgaria, offer the most modern infrastructure and perspectives to settle the active population from the 18-55 age segment, benefiting from numerous living and working conditions and at the same time the growth of competitive and sustainable communities through the efficient use of resources and the capitalization of growth opportunities related to belonging to the Danube and Black Sea regions. Our project is a very well-articulated guide that will continue the documentation that will also help to start the work necessary to build an economic interconnection platform to ensure the consistency of the 12 states located between the Adriatic, Baltic and Black Seas with what is meant by the Danube Corridor. The main economic fields in which the I3M member countries are interested are defined by three major pillars: Energy, Transport, Digitization. We are strongly engaged, both I, in the position of coordinator, Prof. Dr. Eng. Cristiana Sirbu, president of the GIEDD Foundation, as well as our partners from the Association of Danube Municipalities "Dunărea" in Bulgaria, to correlate the data processed through the Romania - Bulgaria Project 1, Interreg Program V-A 2014-2020 with a new Project Romania - Bulgaria 2 2021 - 2025 which we propose to connect the main Danube corridors, as well as the Black Sea to the I3M Mega Project.*

Keywords: *energy, transport, digitization, infrastructure, Danube corridors;*

JEL classification: R0, R4

INTRODUCTION

The Romania - Bulgaria project, Interreg V-A 2014-2020 Program was started on February 12, 2015 (RO - BG 1) and financed by the EU from the European Regional Development Fund with the aim of developing the border area between the two countries by financing common projects. The programming document developed jointly by the two countries, thanks to the long partnership with the interested parties at national, regional and local level, was approved by the European Commission on February 10, 2015. The strategic framework of the program brings an extraordinary perspective for regional development that is based on concrete and measurable results with the ability that in the next 25 years, the two countries, Romania and Bulgaria, offer the most modern infrastructure and perspectives to settle the active population in the 18-55 age segment, benefiting from numerous living conditions, work and at the same time the growth of competitive and sustainable communities through the efficient use of resources and the capitalization of growth possibilities related to belonging to the Danube and Black Sea regions. [5]

MATERIALS AND METHODS

The "Ecological initiative and sustainable development group" foundation, whose president is Prof. Dr. Eng. Cristiana Sirbu, and the Association of Danube Municipalities "Dunărea" from Bulgaria undertook an extensive research that was based on the total budget of the Interreg V-A Romania - Bulgaria Program with a value of 1 428 765,73 euros, of which 1 214 450,87 euros from the European Regional Development Fund, 185 739,54 euros co-financing by the national budgets of Romania and Bulgaria and 28 575.32 euros represents the beneficiaries own contribution. [2]

The program activated five priority axes and technical assistance, as follows:

1. A well-connected region
2. A green region
3. A safe region
4. A qualified and favorable region for inclusion
5. An efficient region
6. Technical assistance

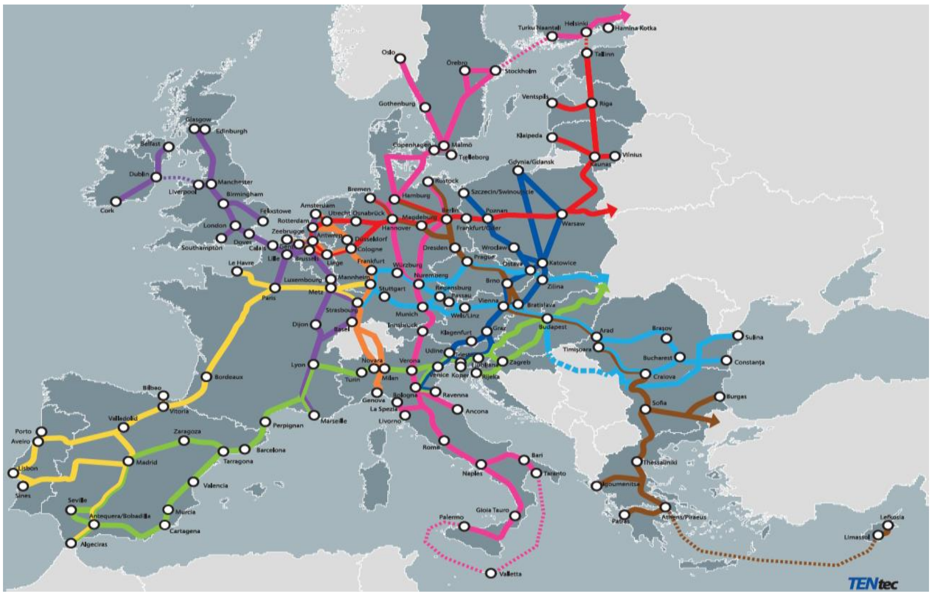
Investigating the opportunities to reduce the use of the TEN-T network in the Romania-Bulgaria cross-border region by optimizing the transport of goods and passengers, as well as the development of a common mechanism to support the intermodal connection is a desired goal that we want, in the period 2021-2025, by continuing its project we manage to significantly improve the process of planning, development and coordination of transport systems for a better connection to the TEN-T network in the cross-border region, using the capacity of intermodal nodes.

To significantly improve the planning, development and coordination of the cross-border area through utilizing the intermodal nodes’ capacity. Institutions and organizations involved in the planning, formulation and implementation of transport policies and the transport sector management in both countries; representatives of the business and the non-governmental sector; transport experts; local and regional authorities in the cross-border region; potential investors.

The aim of TEN-T is to build a transport network that would facilitate the flow of goods and people between EU countries. The aim is to ensure that, progressively, and by 2050, the large majority of Europe’s citizens and businesses will be located no more than 30 minutes’ travel time from this extensive network.

The core Trans-European transport network functions through 9 transport corridors:

- Baltic-Adriatic Corridor;
- North Sea-Baltic Corridor;
- Mediterranean Corridor;
- Orient/East-Med Corridor;
- Scandinavian-Mediterranean Corridor;
- Rhine-Alpine Corridor;
- Atlantic Corridor;
- North Sea-Mediterranean Corridor;
- Rhine-Danube Corridor.



Main transport corridors

Two of the nine transport corridors pass through the territory of the Romania-Bulgaria cross-border area, namely:

- The Orient/East-Med Corridor, which connects the North, Baltic, Black and Mediterranean Seas, thus optimizing the use of the relevant ports and Motorways of the Sea;
- The Rhine-Danube Corridor, with the Main and Danube waterway as its backbone, which connects the central regions around Strasbourg and Frankfurt to Vienna, Bratislava, Budapest and finally the Black Sea, with an important branch passing through South Germany.

The core network will connect: [4]

- 94 main European ports with rail and road connections;
- 38 key airports with rail connections into major cities;
- 15,000 km of railway line upgraded to high speed;
- 35 cross border projects to reduce bottlenecks.

RESULTS AND DISSCUSION

Air transport is a sector of strategic importance with significant contribution to the EU employment and economy. The aviation employs, directly and indirectly, 5,1 million people and its contribution to the European GDP is EUR 365 billion, or 2,4%. The road transport remains the main means of transport of passengers and freight in Europe and its has increased steadily in the past decades. The same applies to Romania-Bulgaria cross-border area, although the density of the public road network (22.95 km/100 sq. km.) is considerably lower than the European average (110 km/100 sq. km.). [3] The lack of connectivity between the Danube region and the interior of the country is the main impediment to the development of logistic centers and harbours, and therefore for the economic development of the cross-border region. The railway transport is the cross-border area lags behind the European trends in the sector. The density of the active railway network is approximately 46.1 km per 1000 sq. km. in Romania and 38.9 km per 1000 sq. km. in Bulgaria. The Danube River is a central factor for the regional economic development and cross-border cooperation in the region. Through the development of combined river and sea transport (Danube River and the Black Sea) the harbor cities in the cross-border area have the potential of turning into significant logistic centres and contributing to the socio-economic growth of the region.

It was clearly proven that the first project contributed significantly to the extensive study of the I3M Mega Project - the Three Seas Initiative which aims to be a flexible platform that brings together 12 EU member states geographically positioned between the Adriatic, Baltic and Black Seas, the countries that have engaged in this project being Romania, Bulgaria, Austria, Hungary, Slovakia, Slovenia, Croatia, Czech Republic, Estonia, Latvia, Lithuania and Poland. The initiative of the Big Three thus becomes the third project of the European Union which is perfectly linked to the Strategy of the European Union for the Danube Region.

The objectives that the project sets will significantly contribute to a well-planned and sustainable development of the transport infrastructure and the organization of the networks for the four modes of passenger and freight transportation (road, water, air and rail). The overall result of the project will be an enhanced transport connectivity of the Romania-Bulgaria cross-border cooperation of the relevant actors in the formulation of transport policies and investment decision-making.

The documents developed in the framework of the project will be distributed to all stakeholders and will be available to the broad public. It is expected that the project results will influence the transport policy formulation, the development and investment planning in the intermodal nodes in the cross-border area. The project will contribute to the overall economic and social development of the cross-border region. Smarter, faster, safer and “greener” transport infrastructure and communications are key preconditions for economic growth and higher employment.

CONCLUSIONS

Our project is a very well-articulated guide that will continue the documentation that will also help to start the work necessary to build an economic interconnection platform to ensure the consistency of the 12 states located between the Adriatic, Baltic and Black Seas with what is meant by the Danube Corridor. [1] The main economic fields in which the I3M member countries are interested are defined by three major pillars: Energy, Transport, Digitization.

We are strongly engaged, both I, in the position of coordinator, Prof. Dr. Eng. Cristiana Sirbu, president of the GIEDD Foundation, as well as our partners from the Association of Danube Municipalities "Dunărea" in Bulgaria, to correlate the data processed through the Romania - Bulgaria Project 1, Interreg Program V-A 2014-2020 with a new Project Romania – Bulgaria 2 2021-2025 which we propose to connect the main Danube corridors, as well as the Black Sea to the I3M Mega Project.

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EDUCATION IN RURAL AREAS – A STATISTICAL APPROACH

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Abstract: *An overall picture of the education system in the countryside reveals that there are still schools that are not connected to the drinking water and sewerage systems, where the toilet is in the school yard. There are still schools where children stay in classrooms dressed up with outdoor clothing in winter, with caps and gloves, due to inadequate heating and outdated school infrastructure. The simultaneous learning system is still in place (due to the relatively small number of enrolled pupils, which is steadily declining); this system does not benefit pupils, on the contrary, as these do not have the full attention and guidance of the teacher, as is the case in normal classes, they fail to acquire knowledge and skills, like those who study in the normal system, and thus they are disadvantaged. Due to the misunderstanding of the major importance that education has in in personal development of individuals and of society implicitly, there are not few schools that do not benefit from funding, support or interest from local councils. The local councils do not provide support either in terms of ensuring adequate infrastructure for a quality education or at least comparable to that in the urban area – clean classrooms, endowed with specific equipment for each subject of study, equipped with utilities (heating, indoor toilets, water), or in terms of supporting teachers in rural areas who do not have the residence there (by paying for transport, for instance). Local councils do not find or are not interested in finding levers to attract teaching staff in rural localities.In this context, the present paper aims to analyse the current situation (latest data available) of education in the rural area, using specific indicators, in terms of the education system resources and population's participation in education, such as: participation rate in education, school population, by levels of education and residence areas, classrooms/laboratories/workshops/gyms/sports fields/PC/IT equipment, by levels of education and residence areas, number of graduates by levels of education and residence areas.*

Key words: *education, disparities, residence areas, rural, urban*

JEL Classification: I21, I24, I25, R10

INTRODUCTION

Over the years, rural education has been in the focus of authorities, the existing gaps between education in the urban and rural localities have continuously deepened, and thus, from the very start, rural people are in a disadvantaged position in future access to labour market, compared to urban population. All these, despite the fact that one of the fundamental objectives in terms of equity is to reduce the gaps between the learning opportunities provided to disadvantaged groups, compared to those provided to the majority. Although according to the Educated Romania Report, from the year 2021, "the state offers national support programmes for the pupils and students from disadvantaged areas", the measure of the Minister of Education adopted at the beginning of the school year 2022/2023 (Order no. 5379/2022 for approving the General Criteria of awarding scholarships to pupils from pre-tertiary education) has as consequences the deepening of already existing gaps between the urban and rural areas – which directly affects pupils from the rural area, who need to go to high-school/vocational school in another locality, as they do not have such an educational establishment in the locality of residence. Thus, the right of each pupil to have equal chances of access to quality education is violated, regardless of their place of residence or social background.

The evaluation of the education system situation cannot be made in the absence of a context analysis, based on precise, quantifiable criteria, on primary and derived indicators. The present study analyses the current situation of the Romanian education system (in the school year 2021/2022) and the main trends in the period 1996/1997 – 2021/2022, from the perspective of the education system resources and of population's participation in education, through the descriptive analysis of indicators and causal analysis. The indicators concerning the resources of the education system take into account the human resources (number of teaching staff, by levels of education and residence areas) and the material resources (number of educational establishments, by levels of education and residence areas, material base of educational establishments: number of classrooms, gyms, laboratories, school workshops, equipped sports fields, swimming pools, computers, Internet connection). As regards the participation in education, primary and derived indicators were analysed (school population, number of graduates, degree of inclusion in education, by training levels and residence areas, etc.), to complete the picture of the education system situation.

MATERIAL AND METHOD

One of the methods used to prepare the raw analysis material was the custom query of available official databases, followed by author's own processing.

The statistical analysis uses primary and derived indicators included in the National System of Education Indicators (NSEI), compatible with the international systems of indicators (European statistical system EUROSTAT, OECD, UNESCO, World Bank system). The set of indicators selected for this analysis was calculated both at national level and by each residence area, by levels of education (ante pre-school, primary, lower secondary, high-school, vocational, post-high school and foremen education, higher education). For the calculation of indicators, we used data from Tempo Online database and from specific publications concerning education of the National Institute of Statistics (NIS). National reports, strategies and plans of action concerning education have been consulted. For documentation purposes, the national and international literature, various studies and analyses of economic institutions of national and international reputation, represented useful benchmarks. Information contained in various statistical surveys, analyses, reports and non-official studies, as well as in regional development strategies, were also used.

Another method used in this study was filtering, collection and analysis of complementary information (Internet, written publications).

RESULTS AND DISCUSSIONS

Current situation of the Romanian education system – disparities by residence areas. In the period 1996-2021[1], as the education system was coordinated by a succession of ministers (27), each with their own vision on the future of Romanian education, more or less constructive and innovating, this was subject to restructuring without much coherence and correlation, from one ministerial period to another.

The latest available data[2] outline a clear picture on the present education system, both in terms of the participation in the educational process (its beneficiaries), of the resources involved in the educational process (material resources – educational establishments and human resources – teaching staff), as well as in terms of current infrastructure.

[1] data available in Tempo Online database
[2] for certain indicators – the school year 2020/2021, for other indicators – the school year 2021/2022

The restructuring of the education system and the new regulations in this field led to the reorganization of the network of education establishments in Romania. Thus, in the investigated period, the number of educational establishments decreased more than 4 times at national level, the most significant decline being noticed in the rural areas, where the decrease was almost 7 times.

By levels of education, the most dramatic situation can be noticed in the ante pre-school and pre-school education (nurseries, kindergartens). While at the beginning of the analysed period, i.e. 1996, there were 12,951 ante pre-school and pre-school educational establishments in operation, their number continuously decreased, the decrease rate accelerating after 2004, when their number was down to less than half, and ten years later there were only about 1200 establishments left, this number being maintained until the school year 2021/2022. The previously mentioned situation of ante pre-school and pre-school education units, at national level, can be also noticed in the rural areas, yet the situation is more dramatic in this case: while at national level, in the year 2021, there were about 10% of the number of ante pre-school and pre-school education units, in the rural area there were only 1% of the number of existing units at the beginning of the analysed period.

The diminishing trend of the number of education units can be explained by the fact that several schools or kindergartens/nurseries were merged or closed down, due to the increasingly reduced number of pupils, mainly in the rural area.

This trend is complemented by the continuous decline of the school population, both at national level and by the two residence areas.

Yet, in the last school year, 2021/2022, the school population in the national education system increased by about 1200, compared to the previous school year. By *residence areas*, this increase of the school population is due to the increase of school population in the rural area (by 5600 persons) and the diminution of school population in the urban area (by 4500 persons). The distribution by *levels of education* reveals the increase of school population in two educational levels – in ante pre-school and pre-school education (by 3.3% at national level, 4.1% in the urban area and 2.1% in the rural area), and in primary and lower secondary education (by 1.3% at national level, 1.8% in the urban area and 0.6% in the rural area).

At the beginning of the analysed period, there were 4.69 million children enrolled in Romania's education system; 25 years later, their number decreased to 3.49 million. Thus, in the school/university year 2021/2022, at national level, the school population represented only three quarters of the school population at the beginning of the investigated period.

The dynamics of the school population and its distribution by *levels of education*[1] shows small decreases in the ante pre-school and pre-school education (around 20%) in the investigated period, compared to the other educational levels, where the temporal changes are extremely important, revealing a significant decline: in vocational training (decrease by almost two-thirds), followed by primary and lower secondary education (decrease by about one third) and high school education (decrease by one quarter of the school population in this level of education at the beginning of the investigated period). Although the revitalizing and reinventing vocational education and training has been debated for quite a long time, as a solution to many of the problems in the labour market, it still does not enjoy the expected success, on the contrary.

Unlike this negative evolution, yet far from being the most positive evolution, the school population in the post-high school and technical foremen education has significantly increased;

[1] the distribution of children/pupils/students by areas of residence (urban/rural)is based on the geographical location of school units and not on their domicile or residence

although this does not have a high share in total school population (only 2.6% in 2021/2022), the number of pupils in this level of education being up by almost one quarter compared to their number at the beginning of the analysed period.

The analysis by *residence areas* reveals negative trends, much stronger than those at national level and in urban area (that are quite similar to those nationwide). In the school/university year 2021/2022, the rural school population represented only two-thirds of the rural school population at the beginning of the investigated period, both overall and in almost all levels of education. The most dramatic situation can be noticed in the school population enrolled in vocational training, which in 2021/2022 accounted for only one third of that at the beginning of the investigated period.

In the school year 2021/2022, out of total school population, only slightly over one third came from rural areas. The correlation between the distribution of school population by residence areas and levels of education reveals that the share of rural population is more significant (having about the same structure as that of total population, by residence areas) in primary and lower secondary education (with 42.2% of total school population in this level of education) and in ante pre-school and pre-school education (with 40.2% of total school population in this level of education). On the other hand, in the other levels of education, the share of rural school population is low – the rural population enrolled in vocational training being 13.9% in the rural area and almost insignificant in the school population enrolled in high school education – 6.1% and in post-high school education and technical foremen education – 2.5%.

The distribution by *levels of education* reveals that almost half of the school population was enrolled in primary and lower secondary education, the remaining being distributed, almost in equal shares, between high school education, tertiary education and ante pre-school and pre-school education (only 5.6% of school population being enrolled in post-high school education and vocational training) (Figure 1).

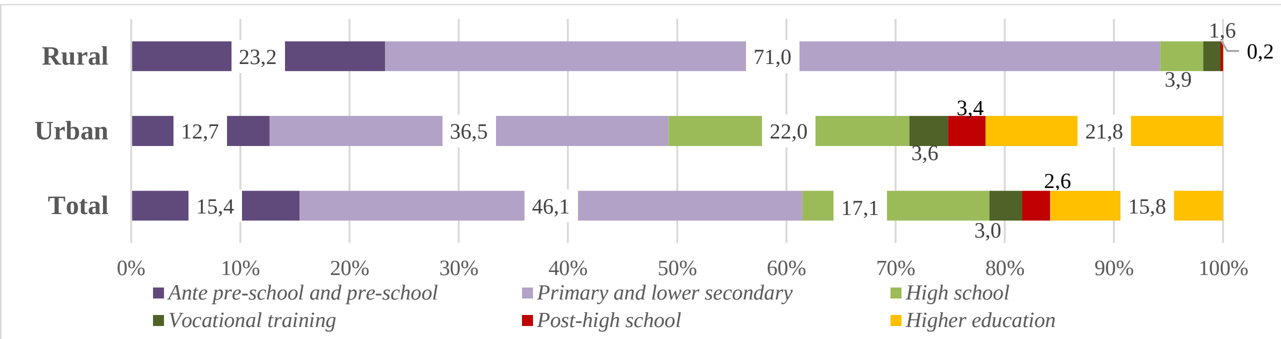

Figure 1. Share of school population, by levels of education and residence areas, in the school year 2021/2022

Source: NIS, Tempo Online, author's own processing

By *residence areas*, a differentiation in this distribution can be noticed – while the urban area has a distribution similar to that at national level, in the rural area the situation is different, the largest part of the school population (almost three quarters) being enrolled in primary and lower secondary education and about one quarter in ante pre-school and pre-school education.

There are multiple reasons for the overall decline of school population, but the main factor is the demographic decline, both nationwide and by residence areas. Thus, the evolution of demographic phenomena (number of live births, birth rate, number of child emigrants) provides for a continuation and an aggravation of the declining trend of young population, aged 0-19 years, with obvious consequences on the education system as well, by school population decline. Thus, the continuous diminution of the number of live births (by more than 50 thousand, in the investigated period – the lowest level in the last 25 years being noticed in the year 2021), of the birth rate (from 10.1‰ live births in 1000 inhabitants, in 1996, to 8.2‰, in 2021), as well as the massive emigration of population, of children implicitly, in the investigated period (more than 107 thousand children aged 0-19 years permanently emigrated[1] from Romania, which adds to the temporary emigrants[2]/those who de facto went abroad, with their families, over 547 thousand) are the determining factors of the young population decline, with implications not only on the demographic situation (imbalanced age structure of the population), but also on the social situation.

In order to obtain a most complete picture of the situation of the education system, of the dynamics and trends manifested at the level of various correlated characteristics, derived indicators have been also used in the analysis, along with primary indicators.

One of these is the gross enrolment rate in education at all levels, which represents the number of school population, regardless of the level of education in which it is included, as percentage of the total resident population of school age (corresponding to all levels of education)[3]. Thus, in the school year 2021/2022, 72.1% of the population of school age (0-23 years) was included in a form of education. Significant disparities can be noticed by residence areas, the gross enrolment rate in the rural area being almost 3 times lower than that in the urban area. The values of this indicator, both nationwide and by residence areas, were maintained relatively constant.

The decrease in the general number of the school population is also found in the decreasing trend of the number of graduates, both nationwide and by the two residence areas. In the school year 2020/2021, the number of graduates totalled 477 thousand pupils and students, down by 7.5% compared to the previous school year. In the urban area, the graduates of the lower secondary school accounted for about 60% of total graduates at this level, while only 40% of graduates were from the rural area.

In the period 2002/2020, a significant trend was noticed in vocational training (the number of graduates representing only 30% of that of primary and lower secondary education, where the number of graduates at the end of the investigated period was less than half of that from the beginning of the investigated period. The diminution of the number of graduates was also noticed in the case of high school education, yet to a lower extent.

A downward trend, similar to that mentioned before, of school population, is also noticed in the number of teaching staff from the education system. At national level, in the school year 2021/2022, there were 238 thousand teaching staff, slightly increasing compared to the previous year, but less by one quarter compared to those existing at the beginning of the analysed period.

The distribution of teaching staff, *by levels of education*, reveals that, at national level, out of total teaching staff, almost one half is found in the primary and lower secondary education (special education inclusively), slightly more than one-fifth in high school education, 16% in ante pre-school and pre-school education, 11% in tertiary education. The lowest shares of teaching staff are found in vocational training and education and in the post- high school and foremen education.

By residence areas, there are also significant discrepancies in the distribution of teaching staff. While in the urban area, the teaching staff has a similar distribution to that at national level, in

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[1] according to NIS, Tempo Online official data: permanent emigrant – Romanian citizen who established his/her permanent domicile abroad;

[2] temporary emigrant – person who emigrates to a foreign country for a period of at least 12 months.

[3] the population segment 0-23 years was considered (age group that, theoretically, covers all persons that can be included in a form of education, from ante pre-school and pre-school to higher education).

the rural area the largest share of teaching staff – more than three quarters of total – works in primary and lower secondary education (including special education), followed by ante pre-school and pre-school education (17%) and high school education (5%) (Figure 2).

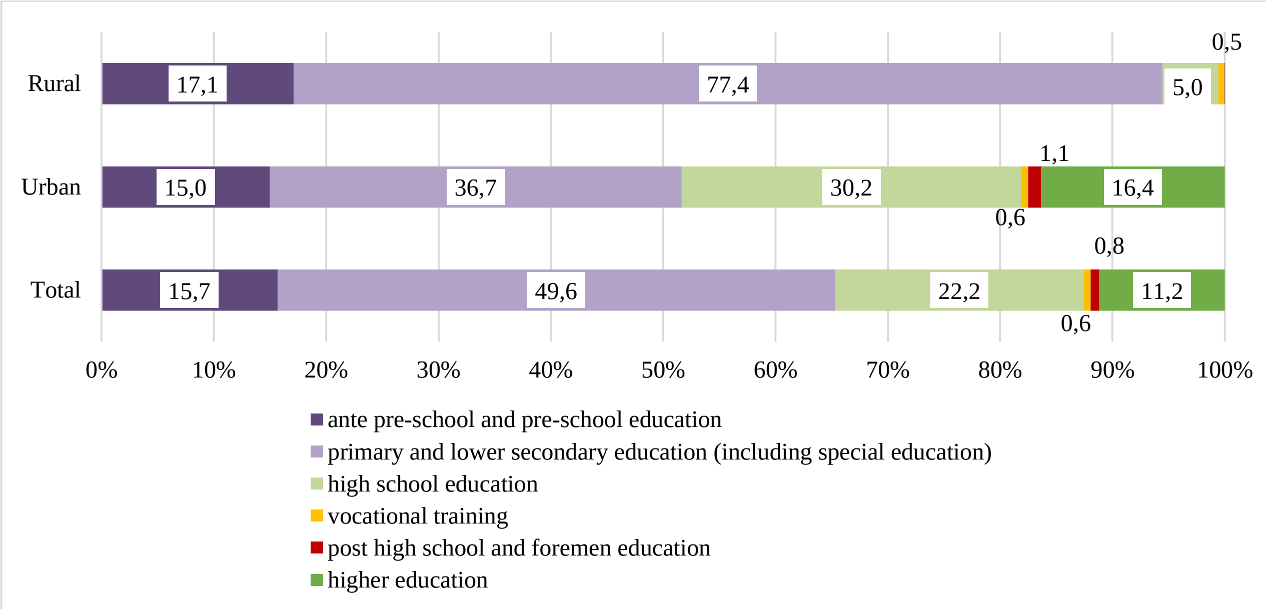

Figure 2. Distribution of teaching staff, by levels of education and residence areas, in the school year 2021/2022

Source: NIS, Tempo Online, author's own processing

The increasing trend of school population in certain levels of education (ante pre-school and pre-school, primary and lower secondary education), in the in the school year 2021/2022, compared to the previous year, may be considered as a beginning of revitalisation. The same trend is also noticed in the evolution of the teaching staff, from these types of education.

The differences by residence areas in the distribution of teaching staff have been reduced, but the rural area is still at a disadvantage in this respect.

The average ratio of school population per teaching staff, derived indicator of human resources in education, had an oscillating evolution, both nationwide and by residence areas, in each level of education. Thus, there were 15 pupils/students per teaching staff in the school year 2021/202; the gap between the two residence areas was maintained, like in the case of the other analysed indicators (there were 16 pupils/students per teaching staff in the urban area, and only 13 pupils/students per teaching staff in the rural area).

Compared to the previous school year, the number of pupils per teaching staff remained relatively constant in most levels of education; only in vocational training the number of pupils per teaching staff increased, while in the post-high school and foremen education the number of pupils per teaching staff decreased.

Over the years, the analysis reveals major disequilibria in vocational training and post-high school and foremen education, as result of re-organisation measures implemented in the education system. Thus, in the school year 2009-2010, the places intended for vocational training were transformed into places for vocational and technical high schools, and the school enrolment rate in high school education increased, by taking over the places from the schools of arts and crafts, the latter being abolished.

This measure determined a disequilibrium between these levels of education, mainly in the case of pupils included in this education segment, who were unable to continue their studies due to the new conditions[1] and abandoned school. Although later on, the measure of re-establishing the vocational training courses (since 2011) intended to support and bring back this training level in the education system, pupils and their families continued to be less confident in the system, which generated confusion.

By *levels of education*, in the school year 2021/2022, high school education continued to have the lowest ratio of pupils per teacher (11 pupils/teacher), at national level. This indicates that the measures regarding human resources in education and their training, as well as the diminution of the school network in the rural area must take into account to a larger extent the current differences in the education system, in terms of average number of pupils in class.

At the same time, in another time segment, following the measure to introduce the preparatory class in primary education, the number of children/kindergarten teacher decreased.

The residence area continues to be an important factor of differentiation of this indicator values. In the school year 2021/2022, the number of pupils/teaching staff is significantly higher in the urban area than in the rural area (16 children, compared to 13 children per teaching staff). In the primary and lower secondary education, this ratio is reversed, and the value of indicator is higher in the rural area. The difference by residence areas, in lower secondary education, has remained constant compared to the previous year.

CONCLUSIONS

The existing gaps in terms of education by the two residence areas, between those who have and those who do not have access to resources, have continued to grow larger, so that from the very start the rural people are at a disadvantage in future access to labour market, compared to the urban people. The educational inequalities between the residence areas, in terms of access and participation in higher levels of education of school population, as well as in terms of (human and material) resources of the education system, further highlight that belonging to the rural area has become a stigma for many children coming from this area of residence. Limiting the right to education by not ensuring the necessary levels for real participation in all the forms of education and training makes belonging to the rural area be associated with major disadvantages[2] - rural children/young people's access to education at levels 3, 4, 5 or 6 (ISCED) is almost absent: out of total school population, only 4.1% of children from the rural area end up attending high school (school year 2020/2021). However, the reported number is that of pupils from high schools in the rural area. There are also pupils from the rural area who study in the high schools from the urban area, and hence these are reported by the high schools in the urban area. A more obvious situation in this sense is noticed in the tertiary education.

One of the factors that lie at the basis of school performances is the average number of pupils per teaching staff, indicator that reveals the quality of education. In this sense, the analysed data reveal significant differences between the two residence areas, to the disadvantage of rural areas.

[1] mainly because families could not cover the costs of 4 years of schooling, which is a noticeable phenomenon in the case of rural pupils in particular, in the conditions in which the high school network is weakly developed compared to the urban area – as specified in the National strategy for the protection and promotion of children's rights for the period 2014-2020.

[2] the situation is different for the rural areas in the proximity of urban areas, yet with no precise data, due to the multiple rural/urban residences.

Furthermore, as the education establishments in the rural area tend to have fewer pupils and smaller classes, the attractiveness for highly qualified personnel is limited.

The abolition of a level of training, i.e. vocational training, has created significant imbalances in the education system, with noticeable effects on the labour market.

The correlation of the factors determining imbalances in the education system requires the prioritization of actions at national and local level, in terms of education, understanding the importance of education and its role for the entire society and, implicitly, an assumed restructuring.

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RURAL DEVELOPMENT IN THE CONTEXT OF INTERNAL POPULATION MOVEMENT

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Abstract: *According to the possibilities offered by the existing resources, rural development in Romania is still difficult to achieve. The economic-social gaps between the urban and rural areas are among the highest in the EU and relatively at the same amplitude for many years. The recent period, marked by multiple crises (of a sanitary, economic and social nature) has shown that the development of the rural area is reduced, on the one hand due to the economic structure and labor resources inadequate to changes and shocks, and on the other hand due to income inequality, respectively of the low remuneration in agriculture, compared to non-agricultural activities. The demographic developments in recent years, relatively contradictory, flows of young population to certain localities in the rural areas, simultaneously with a more pronounced aging in many other rural areas, require differentiated policies and programs for each area depending on the specific local demographics. The lack of an approach adapted to local demographic developments reduced the effectiveness of rural development programs. The study will highlight the dependence of demographic developments in rural areas on the level of development; in the rural environment of the less developed counties, the aging of the population is accentuated by the emigration of young people. The more developed areas benefit from an influx made up mostly of the young population who have migrated from the urban environment and contribute to the development of the adopted localities. After 2015 the rate of internal migration from urban to rural was high in relation to the flow between rural and urban. For example, in 2020, the peak pandemic year, the migration rate from urban to rural was 12.1 per 1000 inhabitants compared to only 6.2 per 1000 inhabitants the migration rate from rural to urban. The study also highlights the correlation between the specifics of demographic developments and progress in the employment of rural labor resource. In this context, we underline the fact that the incomes of rural households were around 62% of the average income per person in urban households.*

Keywords: *rural development, gaps, demographic developments, income, labor force.*

JEL classification: J60, O13, R11, R21

INTRODUCTION

The European Commission supports rural areas, to help them become dynamic and sustainable, developing in this sense programs to support member countries in order to achieve rural development objectives such as: knowledge transfer and innovation in rural areas; competitiveness in the field of agriculture through innovation, technology and sustainable management of the forest fund; efficient use of resources and support the transition to a low-carbon and climate-resilient economy in the agriculture, food and forestry sectors; and last but not least to promote social inclusion, poverty reduction and economic development in rural areas.

On the other hand, the European Partnership for Innovation on Agricultural Productivity and Sustainability (PEI-AGRI) supports rural development objectives by encouraging innovation in agriculture and rural communities.

According to the European Commission, for a sustainable future, rural development actions need to be able to adapt more easily to current and future challenges such as climate change and the renewal of generations, and at the same time support farmers, sustainability and competitiveness in agriculture.

However, it is important to emphasize that the agricultural sector can play an important role in the economies of many countries, including by ensuring food security and exporting agricultural products. In addition, the industrial sector can be an important driver of economic growth through job creation and technological innovation.

It is important to note that there are many factors that influence economic growth, including government policies, natural resources, the level of investment and exports, education and technological innovation. In addition, different countries and regions may have unique priorities and conditions, which can lead to significant differences in the impact of economic factors.

At the national level, both changes of residence in the rural or urban environment, as well as the salary level, determine significant influences on economic growth.

Labor migration plays a special role in the evolution of the demographic situation and continues to be an important problem in the medium and long term.

Internal migration in Romania is a complex and dynamic process that has been influenced by a number of political, economic and social factors. Prior to 1989, internal migration was heavily controlled by the regime at the time, and movement between towns and villages was limited by the housing allocation regime and labor mobility regulations.

However, after the 1989 Revolution, internal migration in Romania accelerated. In the first years of transition, migration focused mainly on movement from rural areas to cities, as a result of economic restructuring and the closure of some agricultural and industrial enterprises. At the same time, the increase in unemployment and poverty caused a migration of workers from Romania to other European countries.

In recent decades, internal migration in Romania has also been influenced by the process of decentralization and regionalization, which has led to an increase in regional disparities and economic and social inequalities between the different regions of the country (Pîrvu et al, 2022). At the regional level, in the North-West and Bucharest Ilfov regions, internal migration had a positive influence leading to economic growth and contributing especially to the development of rural areas. Thus, in recent years, there has been an increase in migration from poorer regions such as South-West Oltenia to more developed ones, such as Bucharest Ilfov where the average age of the population according to residence in the rural area decreased in 2020 by 0, 2 years compared to the one registered in 2012.

Studies on growth poles in Romania (Ionescu-Heroiu et al, 2014; Burduja et al, 2014) have identified the fact that the distance from developed cities influences the level of development of the administrative-territorial units in the vicinity. Thus, it is estimated that the migrant will opt for the destination locality (referring to the rural area) depending on its distance from the most developed city in the region (Sandu, 2017).

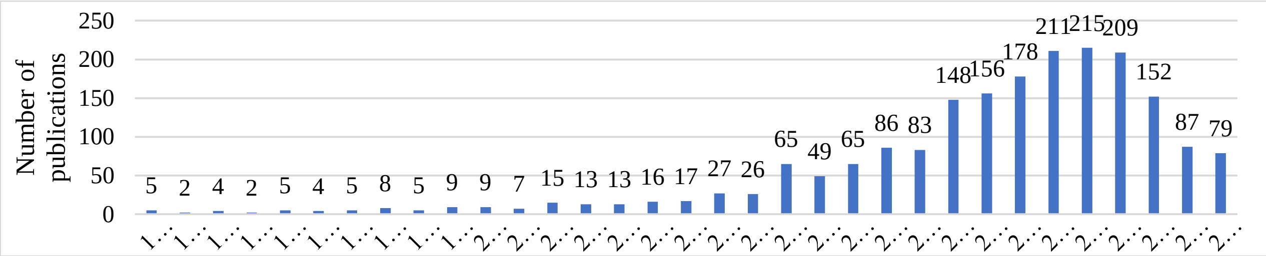
Due to wage inequalities and, sometimes, due to the lack of employment opportunities, the people who chose to migrate from the city to the village mostly kept their jobs, that is why among the main selection criteria of the destination include distance from the city, access to public transport, infrastructure and time spent in traffic.

In this sense, one of the 17 objectives of the 2030 Agenda for Sustainable Development refers to the reduction of inequalities (Objective no. 10) both within countries and between EU member states.

A BRIEF BIBLIOMETRIC ANALYSIS OF LENS PUBLICATIONS

Over time, researchers have tried to identify links between the development of rural areas and migration. The number of publications between 1990 and 2022 was quite low compared to other themes. According to figure 1, the trend is very irregular, increasing and decreasing and then repeating the pattern at random points. It can only be described in general terms. From 1990 to 2008, interest in the topic was rare, with less than 30 publications being released each year. From 2009 to 2013, there was a newfound interest in the topic, with more than 30 but less than 100 publications coming out every year. From 2014 to 2020, the number of publications exceeded 100, reaching the highest value in 2018. Then the number started to decline from 2019 to 2022.

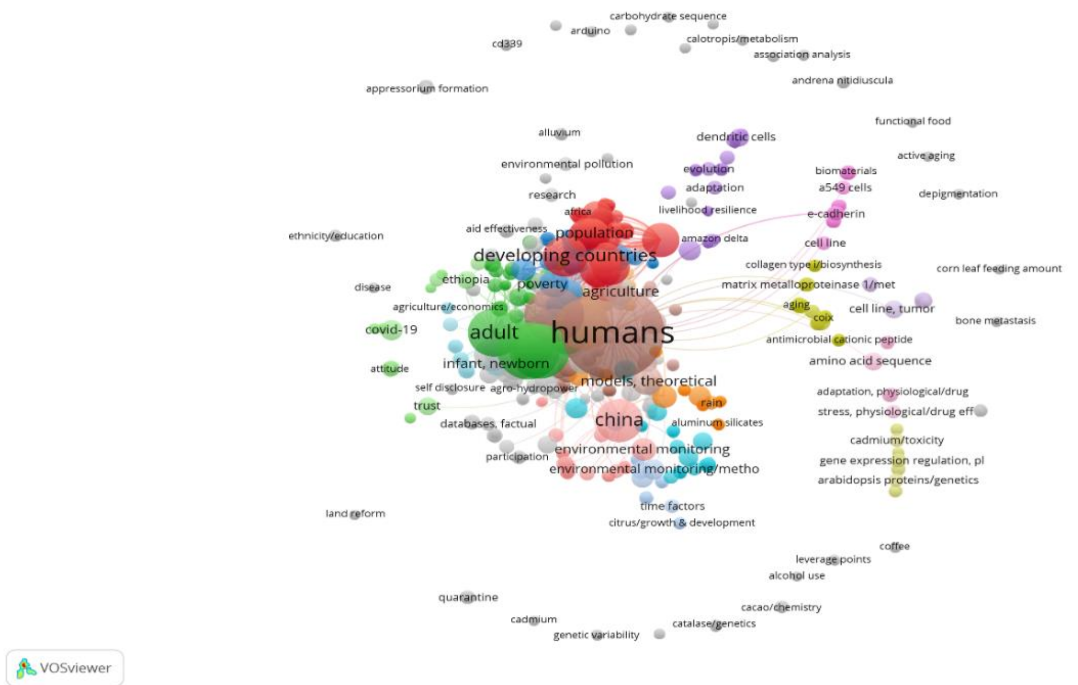
Figure 1. The annual evolution of the number of publications on rural development and migration/internal movement/population movement (excluding animals and birds) from 1990 to 2022



Source: Author's own research based on a Lens database in the Excel program.

Figure 2 shows that the clusters with the most relevant terms are brown, green and red.

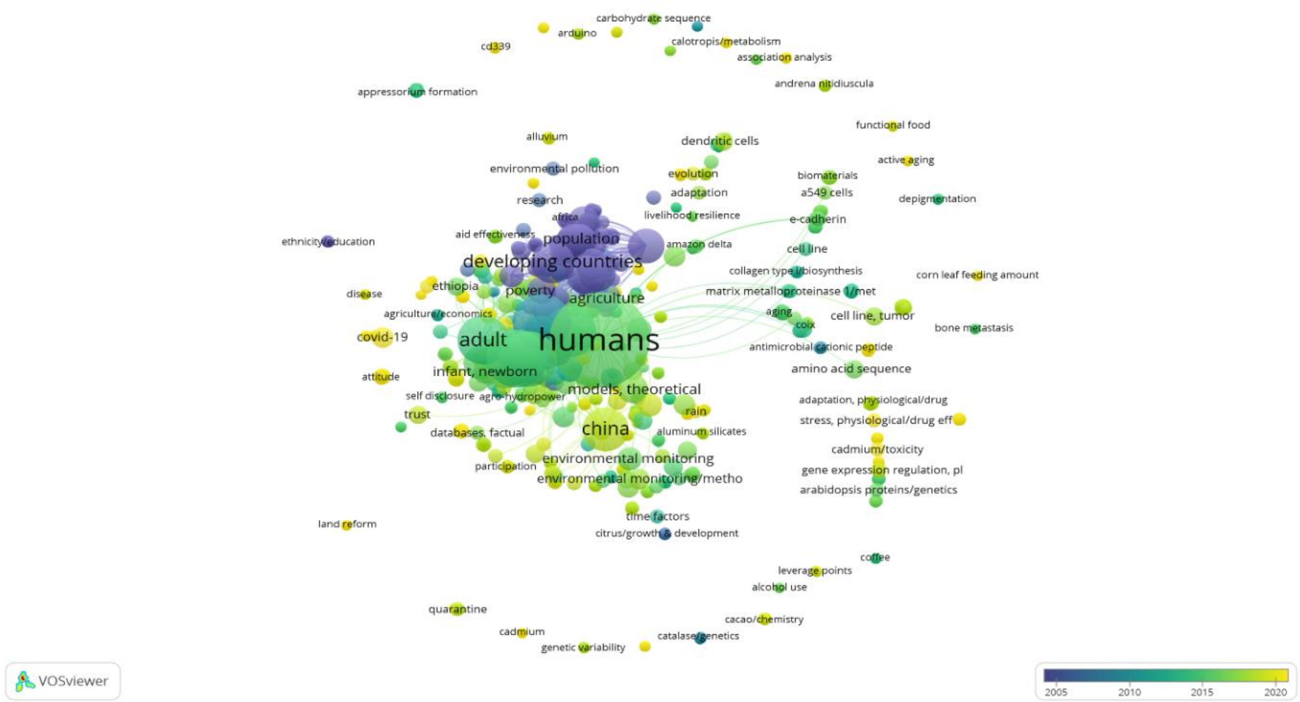
Figure 2. Network map of the most relevant topics, with all 1258 items sorted by clusters



Source: Author's own research based on Lens in VOSviewer.

According to Figure 3, the most relevant subtopics appear in the publications released from 2015 to 2020, while the least relevant appear in the publications released from 2005 to 2010.

Figure 3. Network map of the most relevant topics, with all 1258 items sorted by year



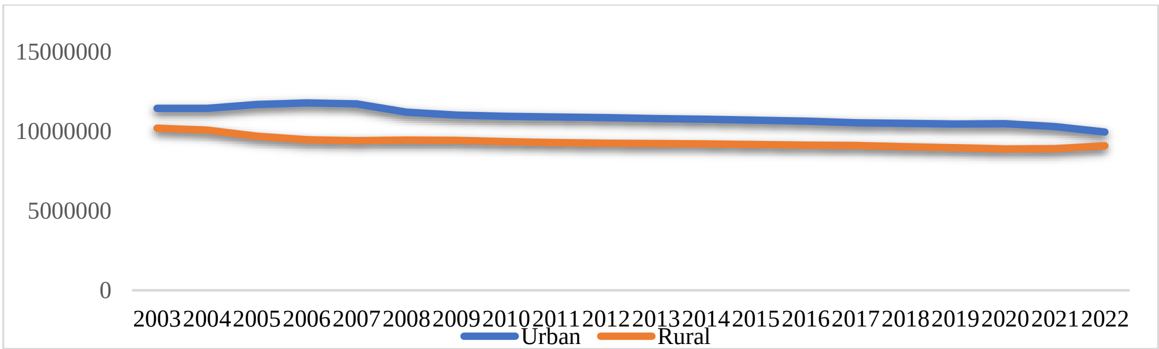
Source: Author's own research based on Lens in VOSviewer.

RESULTS AND DISCUSSION

The population by residence in Romania has changed significantly over time. In the 1990s, with the transition to the market economy and the integration into the European Union, there were significant changes in the structure of the population by residence. Although the urban population continued to grow, there was also a significant migration of people from the cities back to the countryside (Sandu, 2018). This was largely caused by economic problems in the cities and rising unemployment.

In general, Romania went through several phases of economic and social development, which significantly influenced the structure of the population by residence (Figure 4).

Figure 4: Resident population on January 1 by residence averages 2003-2022 (people)



Source: INS data.

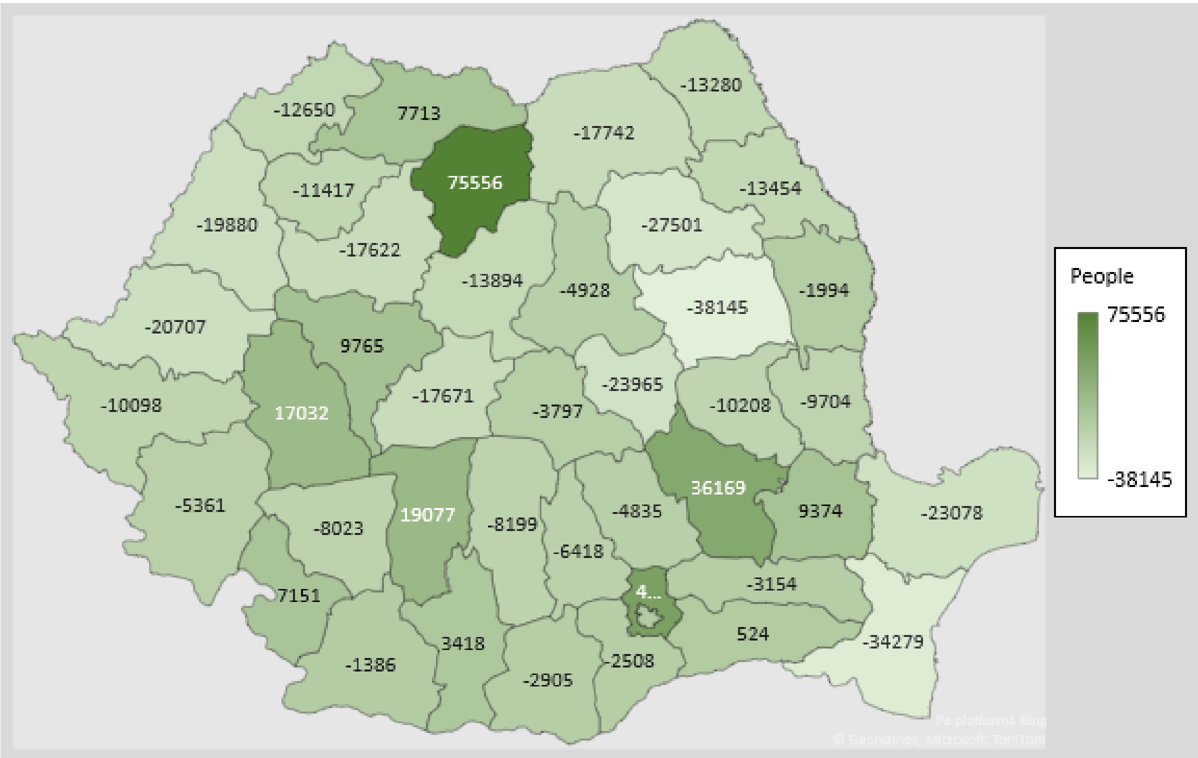
The difference between the population resident in the urban environment between 2003 and 2022 is over 1.47 million people, while in the rural environment it is 1.11 million people, with over 0.3 million people less than in the urban environment.

If in 2003 the difference between the urban and rural population is more than 1.24 million people, while in 2022 this difference is reduced substantially, reaching 0.87 million people, a fact due among other things to the internal movement of the population dominated by the desire to live in the village.

The average age of the resident population increased in 2021 compared to the values recorded in 2012 at the level of the entire country, by residence, but the biggest differences are found in the urban environment.

The number of resident population in the counties has changed over time (Figure 5), influenced among others by economic reasons. Economic development can often lead to an increase in the number of inhabitants, while economic decline can lead to a decrease in population. Intra-county migration has the highest proportions, in counties undergoing economic expansion through the emergence and development of economic growth poles that attract labor from less economically developed counties.

Figure 5: The balance of the resident population by county in 2022 compared to 2012 (people)



Source: Author's calculations based on INS data.

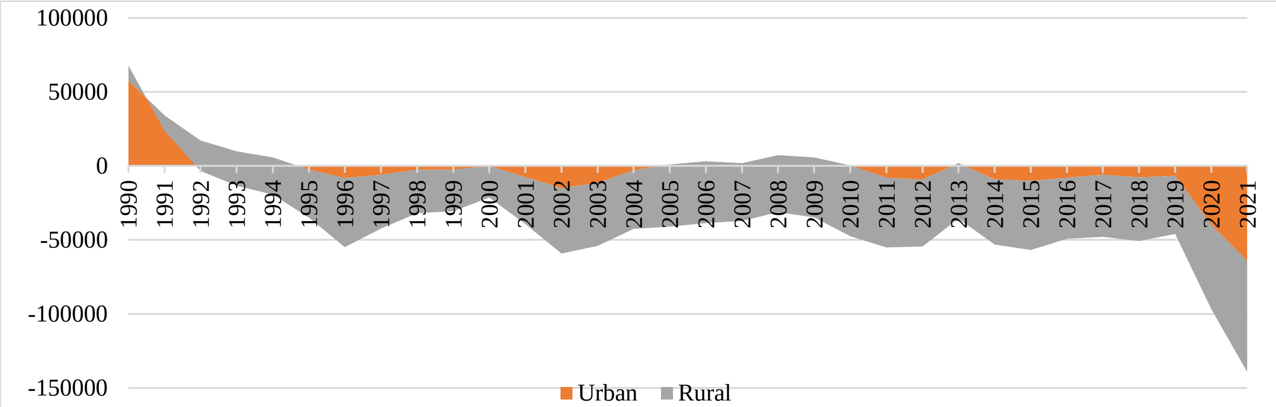
At the level of 2022, the resident population of counties such as Ilfov, Cluj and Timiș has increased compared to 2012, while on the opposite side are the counties of Teleorman and Olt whose population has decreased by over 34,000 people.

Natural population decline has much more complex causal factors and mechanisms than migration, with economic, social, cultural, medical and environmental origins, factors and mechanisms that shape population birth and death rates over time.

In recent decades, the birth rate has steadily declined while life expectancy has increased, resulting in an aging population. This phenomenon is caused by several factors, such as urbanization, migration, increasing education levels, changing values and lifestyles.

Starting from 1992 until 2021, our country registered a negative natural increase (Figure 6), caused by the low number of births and the high number of deaths, although over time solutions have been identified in order to treat diseases that often led to high mortality (INS, 2012). In 1990, Romania had a positive natural increase of over 67,000 people, but over 30 years later, in 2021, it has a negative value of approximately 139,000 thousand people.

Figure 6: Natural increase by residential area (people)



Source: INS data.

Another important cause of the decrease in natural growth is the fact that the number of families with only one child has increased significantly. Many parents choose to have only one child for financial reasons or to focus more of their attention and resources on raising and educating that child. In addition, women choose to have children later in life, which can also affect fertility.

In contrast to the mortality rate that was higher in rural than in urban areas, in the period 1990-2020, the birth rate was lower in urban areas compared to the value recorded in rural areas.

Due to the emigration of mainly young people of working age, the aging process in certain areas of the country is accelerated. As a result, demographic decline, especially among the young population, can lead to lower incomes and higher poverty rates, with a negative impact on living standards.

Both external migration and internal population movement (from village to city) have contributed over time to the depopulation of the rural environment. The socio-economic impact of emigration, especially of temporary migration contributes to the massive depopulation and reduction of the resident population due to the large number of people who choose to leave the country for at least 12 months, without knowing when and if they will return.

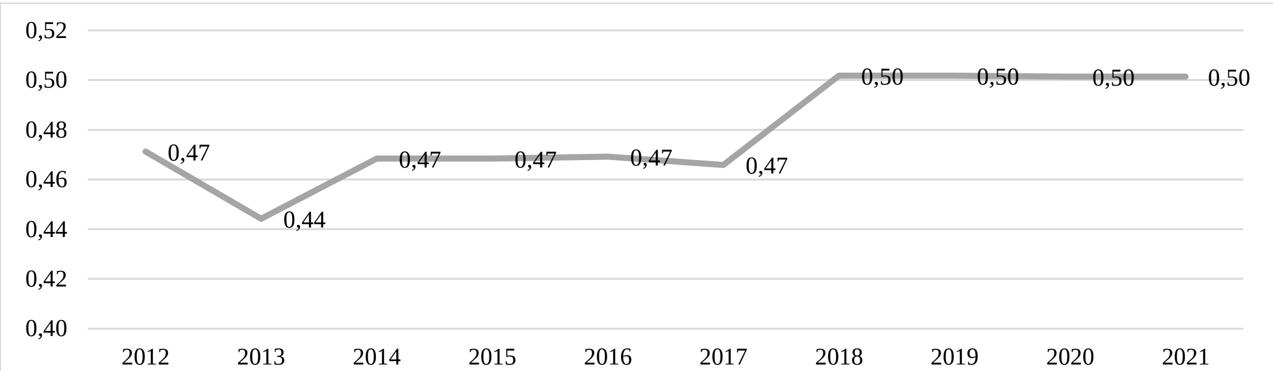
In some regions there is a higher rate of urban-rural migration than in others due to the short distance to the nearest city, developed infrastructure, etc., which allows people to have access to jobs, educational opportunities and an environment more culturally diverse. The evolution of the population in the Bucharest-Ilfov region does not fit into the general trend. According to INS data, in the period 2007-2021, the share of people living in rural areas in this region increased, a fact due to the trend of increasing the number of people from rural areas and not necessarily the decrease in the number of people from urban areas. At the level of 2021, the share of the urban population in the total resident population was approximately 88%, while the share of the population living in this environment exceeded 90%.

In general, rural-urban migration can be associated with greater accessibility to jobs and services, which can lead to increased productivity and income. Also, better wages can lead to a resizing of consumption and investments, contributing to economic growth.

In counties such as Bacau, Iasi, Vaslui, Braila, Constanta, Galati, Alba, Bistrita-Nasaud, Covasna located in the regions where the migration processes were the most intense in the last 20 years, there was a greater migration trend in among young women than among men, which led to deficits in the female population. The departure of these young women from the villages is due to the lack of jobs for women and the lack of age-specific services and facilities.

Although the share of the rural resident population in the total population (in 2003 – 47%, 2012 – 46%, 2021 – 46%) is lower than that of the urban environment, the number of temporary emigrants from the rural environment generally has close values from those in the urban environment (Figure 7).

Figure 7: Share of temporary emigrants from rural areas in total temporary emigrants 2012-2021 (%)



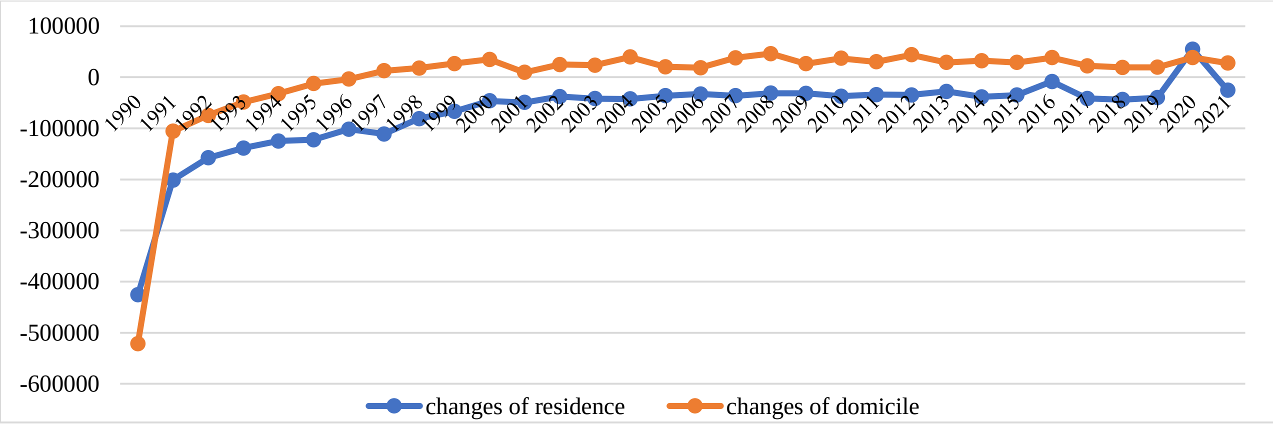
Source: Author's calculations based on INS data.

It can be said that the evolution of internal mobility in Romania in the period 1990-2020 was marked by significant transformations, generally caused by the economic and social changes that took place during this period (Pîrvu et all, 2022).

In the early years after the 1989 Revolution, there was a significant movement of the population from rural to urban areas, primarily due to the economic and social changes that occurred during this period. With market liberalization and privatization of state-owned enterprises, many of them were closed or restructured, leading to job losses in rural areas. At the same time, the opportunities for employment and personal development in the cities attracted people like a magnet.

However, since the 1995s, the internal migration trend has changed and an intensification of urban-rural migration flows has begun to be observed. The shift to urban-rural migration has had significant implications for both urban and rural areas. Urban areas have had to adapt to a declining population and a changing economic landscape, while rural areas have seen an influx of new residents and a shift to service-based industries. This trend has been influenced by a number of factors, including rising costs of living in cities, financial constraints, job shortages and technological developments in recent years that have allowed people to work from home or in rural areas (Figure 8).

Figure 8: Balance of changes of residence and domicile in rural areas 1990-2021 (people)



Source: INS data.

The cause that contributed to the imprinting of the growth trend was, mainly, the cessation of migration to the cities and even the increase of migration to the countryside. Between 1991 and 1997, the number of people who left the city and settled in the countryside increased 3 times. After 1995, the balance became positive in favor of rural areas.

In general, it is a return of the urban population that initially migrated from the countryside, which is not due to the increase in the quality of life in the countryside, but is the consequence of the difficulties faced by the people laid off by the restructuring of the urban economy (Dona et al, 2005).

The crisis caused by the COVID-19 pandemic has affected society at different levels, and beyond the health aspect, it has produced important economic and social effects that vary from one country to another. Although the scale and complexity of the true consequences will be known in time, according to studies to date, the dual health and economic crisis has led to an explosion in unemployment, economic uncertainty (by shrinking business activity and disrupting supply chains) and deepening inequalities social, gender or ethnic (Copley et al, 2020; Lambert et al, 2020; Reichelt et al. 2020; CE, 2020), a fact that contributed to the increase in the number of people who chose to establish their domicile and especially their residence in the countryside.

At the beginning of the 90s, most settlements in rural areas (except for the group of people under 15) were registered for the 20-24 age group, a fact that contributed to the growth and rejuvenation of labor resources in rural areas, constituting an opportunity for the development of the rural economy, however, over time, this trend changed, so that, in 2020 , the highest values were recorded for the age groups 25-29 years, respectively 30-34 years.

Thus, we can conclude that there is a tendency of young people to postpone this decision. The change can be explained by the fact that young people prefer to improve their level of education and find a job. In addition, there are other factors that have contributed to this change, such as the rising costs of buying a property or purchasing a motor vehicle.

As a result, it is extremely important to address labor resource issues and plan for long-term labor resource requirements, as these are essential to ensure a skilled and prepared workforce for current and future labor market needs (Agapiou et al., 1995).

At the same time, salary income differs according to forms of ownership, categories of employees, activities of the national economy, sexes and residential areas. In general, rural earnings are lower than in urban areas and are seen as a barrier to the rural labor market (Monk & Hodge, 1995), as they limit the incomes of those working in this environment and may lead to a reorientation of the population to better paying jobs in nearby cities and may even cause out-migration for work.

The evolution of the population is one of the most frequently encountered subjects in the specialized literature when reference is made to the rural area. In order to facilitate the repopulation of villages and to prevent the loss of labor in favor of developed countries, it is necessary to create employment opportunities for the population in villages and communes.

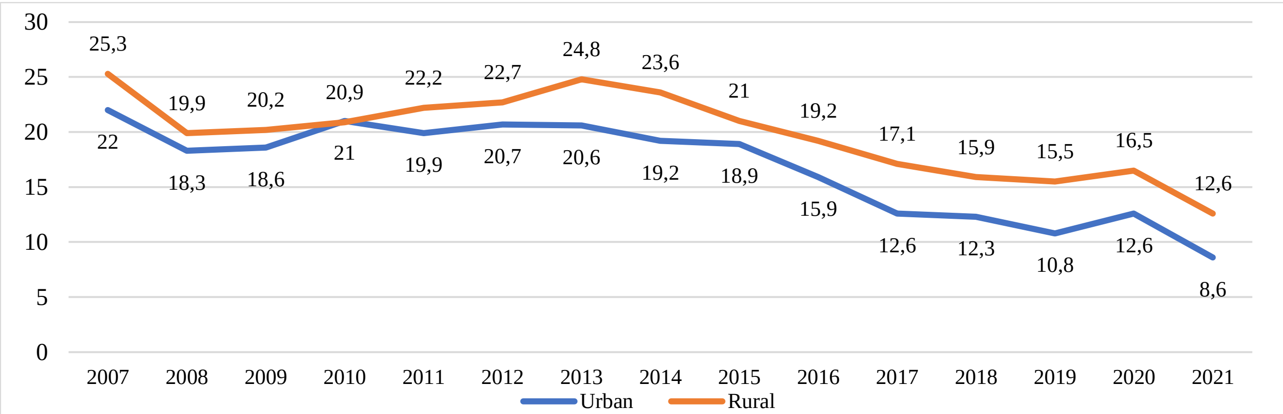
A significant part of the population in rural areas, especially in areas further away from large cities, obtains low incomes, an aspect that has led over time to the migration from the village to the city or even the migration out of the country of the young workforce, situation in which the share of emigrants between the ages of 15-45 in the total of emigrants of working age was over 75% in the period 2012-2019 (Oprea et al, 2021).

In residential areas, a trend of rural population growth is observed, but many rural areas are still facing the phenomenon of depopulation due to poverty and lack of opportunities. At the same time, there is a decrease in the number of people active in the labor market, which has the effect of reducing the number of people who produce income to support the country's economy.

Poverty is the situation in which those people find themselves whose incomes are so low that it is impossible for them to reach a standard of living considered acceptable in the society in which they live, face multiple disadvantages related to unemployment, low incomes, poor housing, inadequate health care and barriers to access to education, culture, sports and leisure.

In rural areas there is a greater number of households that face difficulties in meeting current expenses than in urban areas (Figure 5). This is due to several factors, among which we specify: the low level of income, which in many cases is below the national average; the lack of alternative sources of income, such as those offered by the informal economy or rural tourism; limited access to services and infrastructure, which can lead to higher costs in certain areas (such as transport or utilities); youth and labor migration, which can reduce the number of people contributing to rural household income.

Figure 5: The structure of the facing households with great difficulty current expenses 2007-2021 (%)



Source: INS data.

These problems can be amplified in the case of households located in disadvantaged or geographically isolated areas. In these cases, there is a need for public policies that support the economic and social development of the rural environment, as well as the creation of new sources of income and jobs.

In the context of the analysis of possible alternatives for the development of rural areas, many researchers highlight the importance of tourism in these areas (Haller, 2010) with the help of which the local population can have access to new jobs and, as a result, to additional sources of household income. On the other hand, in addition to the economic effects, over time, social effects have also been identified due to the interaction with other people and the increase in the level of education as a result of the graduation of some forms of professional training for adults.

The main objective of rural tourism is the revitalization and development of Romanian villages by creating new jobs in rural areas. With proper financing, the development of rural tourism can bring direct benefits to rural communities, by creating economic and social opportunities that operate in a balanced, integrated and sustainable way, which justifies the interest in its development as an economic branch.

In order to repopulate and at the same time develop rural areas, it is necessary to increase the level of well-being which could be achieved through: stopping the migration of the population from the village to the city, by creating alternatives that motivate their existence and stimulate their action initiative to ensure the necessities of life; combating poverty; stimulation and diversification of services; ensuring minimum living conditions for the rural population compared to the urban population; the right to a better life, to health protection, education and social protection.

The sustainable development of rural regions must take into account the finding of viable solutions for the multitude of problems identified on a social level, based on the rural infrastructure that allows and outlines a minimum of comfort for the members of a community.

CONCLUSIONS

In general, population decline caused by natural increase and negative migratory increase can have a significant impact on the economy and society. For the sustainable development of rural areas, it should find solutions for many problems identified in the socioeconomic area, based on infrastructure and services that allow a minimum of comfort for the members of a community.

A proper approach to workforce planning can help avoid skills shortages and shortages of skilled personnel, which can lead to problems in terms of productivity, competitiveness and economic growth. Therefore, proper workforce planning can ensure better opportunities for employees and business people and contribute to a healthier and more sustainable economy in the long run.

Also, by training and retraining employees, companies can be more flexible in adapting to changes in the labor market and find solutions to skills shortages and lack of qualified personnel. This can include investing in training and development programs that can help employees develop their skills and improve their chances of finding a job.

In conclusion, proper labor resource planning is essential for a healthy and sustainable economy in the long run. Companies should invest in employee training and reskilling to build a skilled and prepared workforce to meet the demands of an increasingly complex and diverse labor market.

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ECONOMIC MODEL OF REGENERATIVE AGRICULTURE AND FACTORS OF AGRI-FOOD SYSTEM CHANGE

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Abstract: *The basis of regenerative agriculture is represented by its main element, namely the soil. Ensuring good soil health will lead to many beneficial effects on agricultural ecosystems. Among the main beneficial effects of soil health we can list the management of groundwater resources and irrigation systems at large agro-zootechnical farms, recycling of nutrients from and to the soil surface with the help of green, environmentally friendly fertilizers and agroecosystems, maximizing crop yields, sustainability of crops, soil and productivity per hectare, sustainability of agri-food and livestock farms.The fact that through regenerative agriculture, organic carbon in the soil structure can be exploited in order to maximize agricultural productivity and restore soil structure, regenerative agriculture focuses mainly on restoring soils that have suffered great degradation due to their acidification by using large amounts of pesticides and chemical fertilizer products.This article aims to present the economic principles and methods of regenerative agriculture so that these processes combined into a unitary whole lead to the restoration of soil organic matter naturally, the principles of regenerative agriculture practitioners being that nature can regulate automatically the imbalances identified in nature. The less minimal the interventions on the soil, the less the residues from agriculture (reductions resulting from the activity of fertilization and plant protection) will be minimal, the products used will present a minimum invasiveness, which will lead to the acceleration of the recovery processes. soil, to balance the electrolyte balance of the soil and, implicitly, to develop the root system of plants so as to ensure a sufficient amount of mineral elements in the soil, in order to maximize agricultural production.*

Keywords: *organic farming, regenerative agriculture, farm profitability, food system, policy makers.*

JEL classification: Q01, Q34, Q57,

INTRODUCTION

In the current context, at global, regional and implicitly state level, there are certain socio-cultural, economic, political, technological factors that have the role of determining, modeling and transforming agricultural land use, crop models and agricultural processes. Agriculture is one of the most pressing challenges facing the world today: climate change, food security and nutrition, water quality, biodiversity and livelihoods. Agricultural systems emit about 10% of greenhouse gas emissions into the environment, which will affect the yield and value of proteins in basic crops. The Sars-Cov-2 pandemic created great pressure on the development of agricultural production systems, on production systems causing profound disruptions and revealing the fragility of the food system. Key food producers, essential in the food system, have been recalibrated and rearranged on the basic societal values of health and nutrition (Boedeker, *et.all.,* 2020). Beyond this immediate crisis, there is a need to reformulate the way we produce and consume food and ensure that it can restore resilience and productivity while protecting our natural assets. A transition to regenerative practices could bring huge gains for farmers, food companies and the environment and a basis for a truly fit farming system for the future (Ceballos *et.all.*, 2020).

MATERIAL AND METHOD

Our agricultural system is very successful in achieving its current objectives, maximizing profit and driving efficiency on short-term productive crops. However, this is detrimental to soil health, food quality, high carbon emissions and declining farmers' livelihoods. The Romanian agricultural system is a strong force in addressing the most pressing challenges worldwide, restoring ecosystem services, including soil health, water quality, biodiversity, diversification of production systems for all these aspects focusing on the quality of crops, agricultural products and from agri-food chains. Building a better agricultural system is an essential fact, even if monumental (Gava *et.all*, 2019).. The system can be feasible based on the collective effort of farmers, producers and distributors and stakeholders from all corners of our agricultural system, all these aspects being based on cooperation, in order to achieve and achieve important points such as: combating climate change, stopping health crises , especially on the support of farmers (Fava *et.all.*, 2021). The figure below (Figure 1) shows the diagram of the selection criteria that led to the first changes in the agri-food system at European level, each state being responsible for aligning with it. In order to develop these classification criteria, a series of research was conducted in 2012-2020 on agri-food systems (Kirchherr *et.all.*, 2017). In order to implement the principles developed by the European Commission on the support and evolution of agri-food systems, some specialists have proposed methods of recovery and management of residues from the agri-food production industry (biomass) and its conversion into active-functional ingredients which, by hot air drying or by freeze-drying, were converted to soil fertilizers. These powders from vegetable waste can also be used in the food industry as coloring and flavoring ingredients or natural preservatives or can be used to reformulate processed foods to improve their nutritional properties (Francis, *et.all.*, 1986)

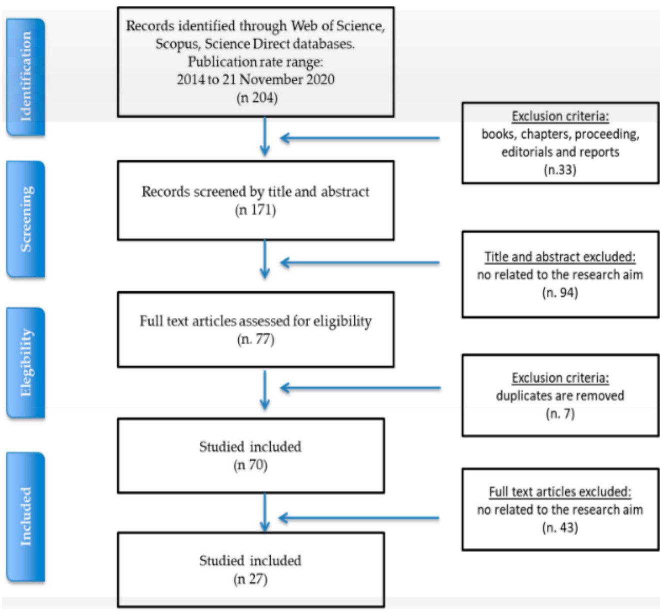

Figure 1. Diagram and flow of the literature search procedure

RESULTS AND DISCUSSIONS

A series of challenges have been identified that are interconnected to agri-food systems, more precisely environmental degradation, economic crises, social problems, extreme weather phenomena, all of which are determined, forecasted and identified possible solutions in specialized agri-food studies. After a (partial) restoration of agri-food systems and the development of the concept of regenerative agriculture, the term was quickly removed from specialized terminology (Francis *et all*., 1986) Regenerative agriculture has been set aside in favor of green, ecological agriculture, a more profitable, sustainable and environmentally friendly agriculture. However, farmers' interest in the regenerative agriculture system has grown significantly since 2015. It is important to note that between 1972 and 2018, regenerative agriculture appears in books much less frequently than other terms such as sustainable agriculture, organic farming, organic farming. and agroecology (Figure 2).

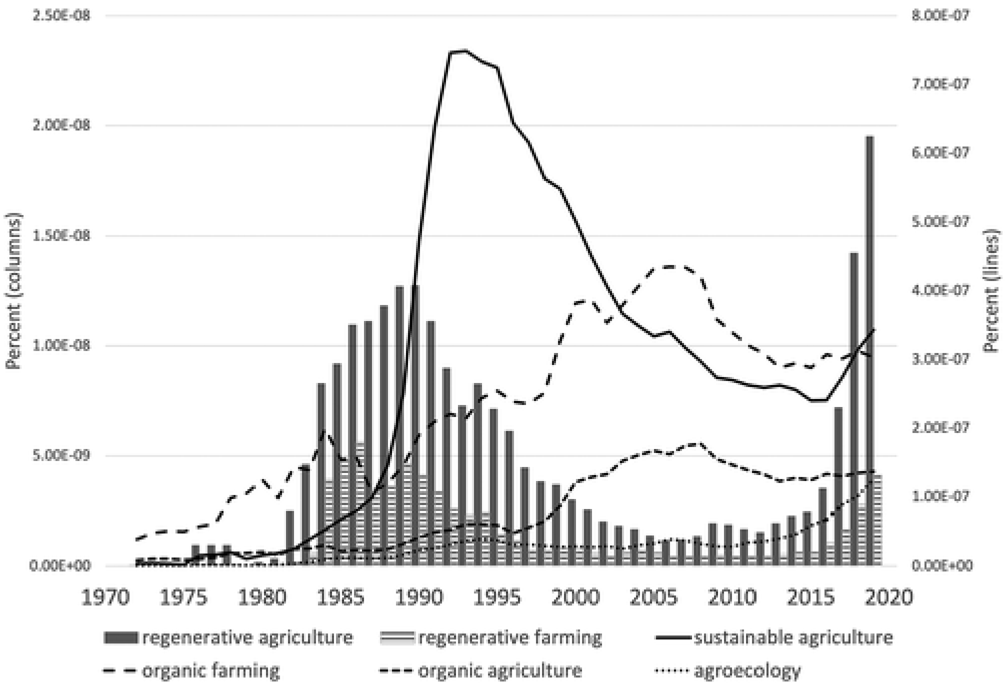

Figure 2. Terminology search results Regenerative agriculture

Thus, while the terms Regenerative Agriculture and Regenerative Agriculture have been used since the early 1980s, they have not been used as widely as other related terms to date, such as sustainable agriculture or organic farming. Since 2016 their appearance in books, news and on the internet has increased dramatically, reflecting the fact that they have now been adopted by a wide range of NGOs (e.g. The Nature Conservancy, World Wildlife Fund, GreenPeace, Friends of the Earth), multinational companies (e.g. Danone, General Mills, Kellogg's, Patagonia, World Council for Sustainable Business Development) and charitable foundations (e.g. IKEA Foundation). In connection with this new popularity, Diana Martin, communications director of the Rodale Institute, warned: "It is [Regenerative Agriculture] the new fashion word (Rodale Institute, 2014).

The most common themes associated with Regenerative Agriculture are improvements in soil health, the wider environment, human health and economic prosperity (Schreefel *et all*., 2020). The authors continue to define regenerative agriculture as "an approach to agriculture that uses soil conservation as an entry point to regenerate and contribute to the multiple supply, regulation and support of ecosystem services, with the aim that it will increase not only the environment but also its size. social and economic aspects of sustainable food production ".

Figure 4 shows what we understand to be the most common current articulation of the theory of change in Regenerative Agriculture. In the sense of this agronomically oriented work, the critical question is: How far and in what contexts do the proposed regenerative practices restore soil health and / or reverse biodiversity loss? Given the diversity of understandings about regenerative agriculture and the different contexts in which it is promoted, it should come as no surprise that a section on regenerative agriculture promotes a wide variety of agronomic practices. We return to these practices later, but first we take a closer look at the two crises that Regenerative Agriculture aims to address.

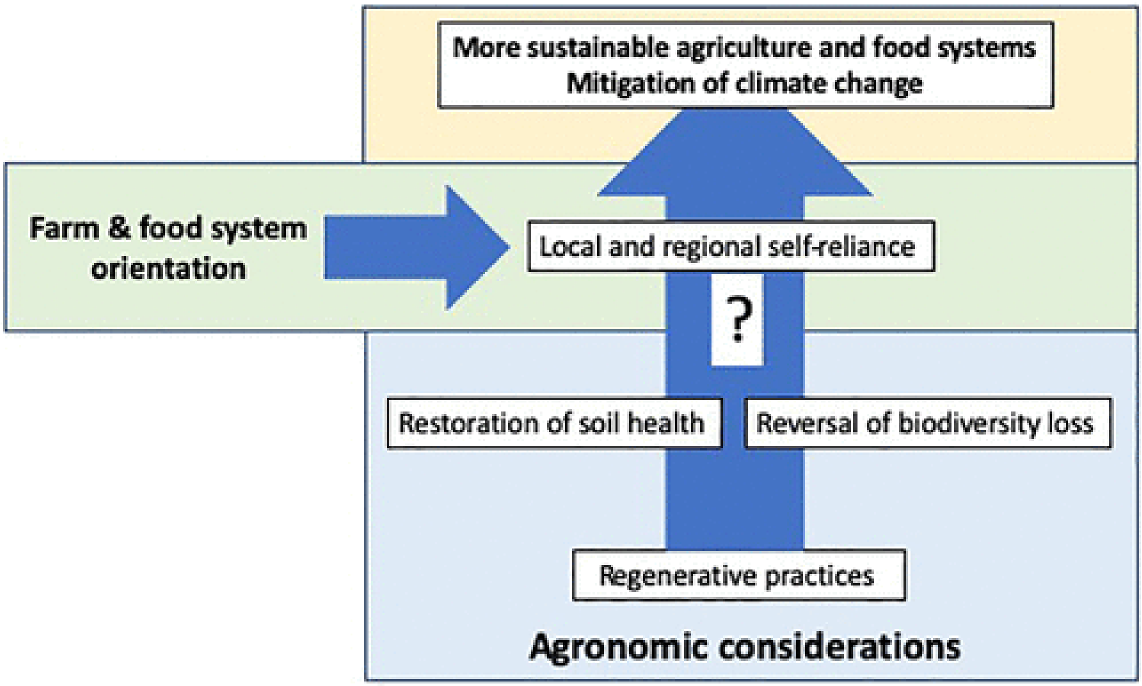

Figure 3. Regenerative Agriculture: Agronomic consideration

The crisis of regenerative agriculture has led to a crisis in soil health. Soil health receives particularly strong attention in the narratives surrounding regenerative agriculture (Schreefel *et all.*, 2020) Indeed, the idea that soil and especially soil life are threatened underpins most, if not all, requires agriculture. regenerative. However, the term soil health is inherently problematic (Powlson, 2020). Like soil quality, soil health is a container concept, which requires disaggregation to be meaningful. Although it can be understood as something to look for, the basic functions of the soil need significant indicators that can be measured and monitored over long periods of time. Moreover, agronomic practices that benefit from an aspect of soil health (such as soil life) often have negative effects on other functions (such as nitrate leaching, primary production, or GHG emissions, (Berges *et all.*, 2019), there is usually not a single direction in soil health, but several trade-offs.

Those who promote regenerative agriculture frame the biodiversity crisis around the widespread use of monocultures, along with a strong dependence on external inputs and a lack of “biological cycle” (Francis *et all.*, 1986). Undoubtedly, large areas of genetically uniform crops can be susceptible to the rapid spread of pests and diseases and add little value to the quality of rural landscapes. Many practices associated with regenerative agriculture, such as crop rotations, cover crops, animal integration, are (or in some contexts have been) generally considered to be "good agricultural practices" and remain an integral part of conventional agriculture. Some are more problematic: conservation agriculture, for example, can be practiced in an organic environment or as a GMO, intensive in herbicides and fertilizers (Giller *et all.,* 2015). Others, such as permaculture, have a rather limited applicability for the production of many agricultural products. Others, such as holistic grazing, are highly controversial in terms of claims made for their wide applicability and environmental benefits in terms of soil C accumulation and reduction of greenhouse gas emissions (Briske *et all.,* 2014; Garnett *et all.,* 2017).Practicile de agricultură regenerativă, criza solului și schimbările climatice. Majoritatea practicilor de agricultură regenerativă se concentrează pe managementul solului, cu un accent deosebit pe creșterea solului C, sub premisa că va crește randamentul culturilor și va atenua schimbările climatice. SOM este un indicator important al fertilității solului (Reeves, 1997), deoarece îndeplinește multe funcții în sol, de exemplu în furnizarea de substanțe nutritive, structura solului, capacitatea de reținere a apei și susținerea vieții solului (Johnston *et all.,* 2009).

Regenerative agriculture practices and the biodiversity crisis. Although reversing biodiversity loss is a central principle of regenerative agriculture, it receives surprisingly little attention in discussions of best practices. The "encourage plant diversity" principle is, of course, central and is one of the means to address the "pesticide avoidance" principle. However, little attention is paid to approaches such as integrated pest and disease management (IPM). The principles of IPM - to minimize the use of chemicals and maximize efficiency when used - are well established. Genetic resistance is essential, and regular crop research is used to trigger receptive spraying when a certain pest and disease threshold is observed, rather than preventive spraying at certain times in the harvest schedule. Recommended practices, such as rotations and cover crops (multi-species) fall within the IPM, as do approaches such as inter-crop and strip-cutting, which are largely ignored in discussions on regenerative agriculture. IPM is knowledge intensive, requires regular crop monitoring and the ability to identify early signs of outbreaks of multiple pests and diseases.

CONCLUSIONS

From the testimonies of many farmers on the Internet, it is clear that their movements towards regenerative agriculture are supported by a philosophy that aims to protect and improve the environment. The main argument is most often around soil health and, in particular, soil biological health, which is seen as threatened and attributed to somewhat mythical properties. Much of the promotional material available in the public domain makes exaggerated claims about the potency and functioning of soil microorganisms, in particular. Instead, for many NGOs that militate, blocking or sequestering carbon in the soil is paramount, with a vision of agriculture without external inputs or GMOs that mimics nature and contributes to solving the climate crisis. Not surprisingly, the claimed potential of regenerative agriculture has attracted considerable criticism aptly captures in his blog “Regenerative Agriculture: Solid Principles, Extraordinary Claims”. It seems unlikely that regenerative agriculture can bring all the positive benefits to the environment, as well as the necessary increase in world food production. The reflective engagement of research agronomists is now extremely important.

The way in which a food start-up has improved innovations in the business model has been investigated, given the importance of social and environmental issues. The researchers said that expanding the innovation of the sustainable business model in the agri-food sector is essential, because the business is linked to the social and environmental dimension. A theoretical framework for innovating sustainable business models in the agri-food industry has been suggested to address the challenges from a sustainable perspective. A combined theoretical vision has been developed to understand the innovations of the business model that lead to improvements in the economic, environmental and social performance of an organization. According to the authors, planning a sustainable business model requires the organization of sustainable value flows between different actors. The authors concluded that taking into account the interests and responsibilities of stakeholders in creating mutual value is imperative to achieve a sustainable business model. Sustainable business models in different sectors were discussed, taking into account the process of building a sustainable business model as an innovative part of a business strategy, in order to provide beneficial solutions to all stakeholders and to meet the requirements of the environment and society.

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