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CONTENT

TECHNOLOGICAL TRANSFER OF AGROBIOLOGY RESEARCH RESULTS IN THE NATIONAL ECONOMY OF THE REPUBLIC OF MOLDOVA

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Abstract: *At the beginning of 2024, the Academy of Sciences of Moldova began hearings on reports on the results of scientific research in the field of agriculture, biology and food security for the period 2020-2023. Major importance was given to the results of the technological transfer, achieved during this period, which includes: the implementation of the "Soil Register of the Republic of Moldova" and the "Program of land improvement in order to ensure the sustainable management of soil resources for the years 2021-2025". An important leap was made in the wine complex by increasing the commodity production of table grapes to about 100 thousand tons, of which 80 thousand tons for export to the EU states, Ukraine, Belarus and the Russian Federation. Projects have been carried out in the technology of grape processing and the production of competitive wines on the world market, including the EU, China, the USA, Canada, and the UK. A new technology was implemented to produce high-quality food vinegar from apple and grape concentrates, spiced and sherry. A new strain of acetic bacteria was used at the base of the production line. Thanks to the high result of the selection of fish from the surface lakes "Crap de Mândâc" and "Crap de Telenesti", ensuring 100% the market of the Republic of Moldova with fry and fresh fish. Animal science has achieved the first technological transfer of new breeds and lines of goats, sheep and milking cows "Bălțata", ensuring 100% of the branch with high quality semen. The "Selecția" Institute secured 70% of the seed market of the soybean culture on the entire area of 50 thousand ha annually.*

Keywords: *agricultural science, food security, technological transfer, agro biology*

JEL classification: Q00

INTRODUCTION

Moldavia's agriculture was a primary occupation of its people, ensuring its budding existence.

The development of the agro-industrial complex of the Republic of Moldova has experienced stages of ascent, but also periods of decline. One of the causes of the decrease in the volume of agricultural production was the privatization of agricultural land in the variant, when each inhabitant of the communes was allocated a share of land with fractionation into plots of plantations with trees, vines, or small arable land. The breakup of the Soviet Union deprived Moldova of the market for agricultural production in former importing countries: The Russian Federation, Kazakhstan, Belarus, Ukraine and the Baltic states.

The political conflicts that arose as a result of the collapse of the Soviet empire, generated numerous embargo situations on most agro-industrial products in the country. The first case of a total export ban in the Russian Federation, at the beginning of 2006, generated considerable financial losses due to the non-reimbursement of economic agents – suppliers of fruits, vegetables, meat, eggs, wines and spirits. With the participation of scientists from the country, a new strategy for exiting the crisis was developed, based on which the decision was made to reform the structure of agri-food products with orientation to the markets of the

European Union, North American states, China and Japan. The agro-industrial branch obtained the necessary credits for the restructuring of the agricultural domains strictly oriented towards the production demanded mainly on the markets of Germany, the Czech Republic, Romania, Great Britain and Asian countries and the Far East. (Cucereanu Gh., 2023)

Within these colossal and costly changes, the center of gravity was placed on the new elaborations of technical-scientific progress, made both in the country and abroad. New varieties of agricultural crops, animal crosses, high-performance technologies in their cultivation and breeding have been implemented. For their production, agro-industrial sectors were equipped with high-performance equipment, produced primarily in the countries of the European Union. The agro-industrial production in the country was subjected to a rigorous phyto-sanitary and medico-sanitary control with its certification by the competent bodies of the Republic of Moldova, as well as those of the European Union (Gaina B., 2023). Special attention was paid to the technologies for growing products and "bio" industrial production, the demand for which was and is very high in the European Union, the USA, Canada and Japan.

MATERIAL AND METHODS

Based on the systemic analysis of the economic indices from the main branches of the national economy of the Republic of Moldova in the last 10 years, the impact of the implementation of the results from the field of Research/Development in the country's economy was assessed. The materials and the report on the state of science in the Republic of Moldova in 2023 developed by the Academy of Sciences of Moldova, of the Life Sciences Section, reports of the National Vine and Wine Organization of Moldova for the period 2020-2023, statistical data, etc. were used. The statistical processing of the obtained data allowed us to trace the development trend of one of the most important branches - viticulture and winemaking.

RESULTS AND DISSCUSION

In recent years the path to global sustainability has been guided by the International Scientific Council which works at the planetary level to convene and catalyze scientific expertise, advice and influence on issues of major interest to both science and society. Representing the global voice of science, the International Scientific Council played an important role in the process of initiating and promoting the International Decade of Science for Sustainable Development (2024-2033), proclaimed by the United Nations General Assembly on 25 August 2023. We are honored that the Academy of Sciences of Moldova also contributed to the process of promoting the International Decade of Sciences for Sustainable Development. (Report, 2023)

In the realization of the decisions of the authorities of our state, a primary role belongs to science, research, implementations and technological transfer of the most effective technologies and technological processes from the arsenal of recent elaborations of profile institutions from the Republic of Moldova, from the European Union as well as those from the USA, Canada, Japan, China and other countries. The high potential of the new achievements brought their considerable contribution to the fundamental restructuring of the branches of the

national economy, especially agriculture and the food industry, which currently contribute substantially to the formation of the country's budget.

A "significant leap" in the economic reform in the Republic of Moldova (in the words of academician Prof. Valeriu Tabără, president of the Academy of Agricultural and Forestry Sciences in Romania) is currently being witnessed in the wine sector, the potential of which is currently 121 thousand ha of vine plantations vineyard with 88 thousand ha of massive young trees planted as part of the reforms and bearing fruit. Along the way, the republic annually produces 350-370 thousand tons of grapes for industrial processing, makes use of 15-17 million dal of wines and exports about 10 thousand tons of table grapes, for fresh consumption. The main varieties are: *Moldova, Suruceni Alb, Leana, Arcadia, Codreanca* and others. Wine production has expanded considerably on the markets of Germany, Romania, the Czech Republic, Great Britain, China, the USA and Canada, the volume of which is on a permanent rise. (Gaina B., 2022)

These results are largely due to the indisputable contribution of research and development institutions that ensured the transition to new varieties of agricultural crops, implementing them in production and exporting to the most requested markets of the European Union. We mention in the first place: seeds and oil of sunflower, rapeseed, certified "Bio" cereals, fruits and vegetables, wines and distillates, pastry products and others. In the re-use of raw material processing enterprises, the researchers from the Republic of Moldova tested through screening the most efficient technological equipment, procured from the European Union and installed practically at all entities of the agro-industrial branch (canning, winemaking, processing of cereals, livestock products, oil extraction and others). Figure 1.

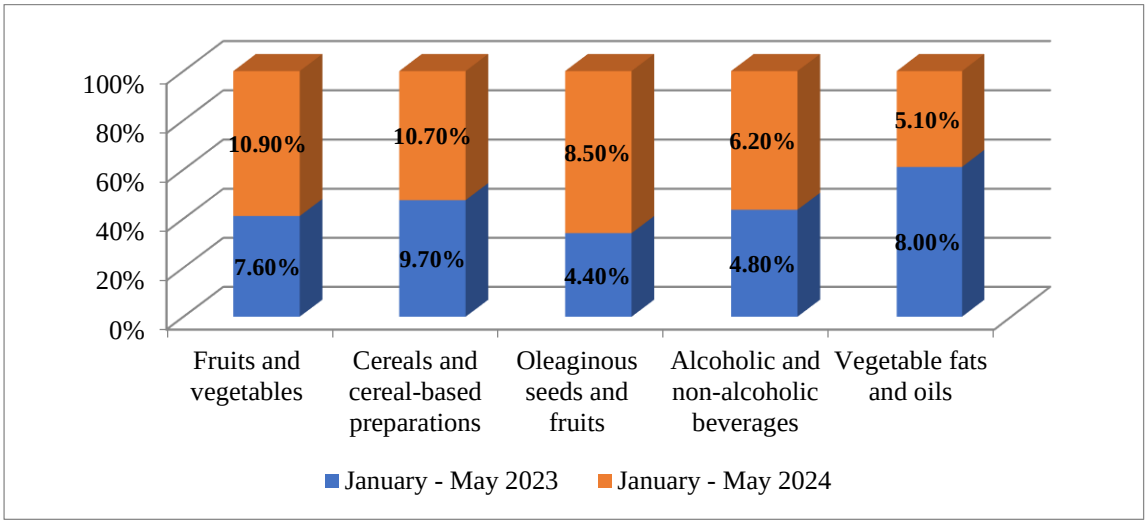

Figure 1. Share of agri-food products in the export structure of the Republic of Moldova

Source: Created by authors based on data https://statistica.gov.md/ro/comertul-international

As for the viticulture branch, we note a reorganization of the assortment of varieties for wines, widely implementing Romanian varieties (*Feteasca Albă, Feteasca Regală, Feteasca Neagră*), local ones (*Rara Neagră, Codru, Plavai*), but also with great success the new ones, obtained through intraspecific selection at the National Vine and Wine Institute of Moldova (*Viorica, Legenda, Riton, Luminița* and others.) (Dobrei A-G, 2021). The activity in

the field of scientific-practical assistance in this branch was carried out through great human efforts and financial instrument by scientists and researchers from the State Agricultural University of Moldova, the Technical University of Moldova (recently united by absorption at UTM), the Cooperatist-Commercial University from Moldova, the State University of Moldova, but also scientists from the agrobiological institutes of the Academy of Sciences of Moldova: The Institute of Genetics, Physiology and Plant Protection, the Scientific-Practical Institute for Horticulture and Food Technologies, the "Selection" Field Crops Institute, the "Porumbeni" Maize and Sorghum Research Institute, the Institute of Pedology and Agro-chemistry, the Scientific-Practical Institute for Biotechnologies in Animal Husbandry and Veterinary Medicine, the Institute of Zoology, the Institute of Ecology and Geography, the Institute of Chemistry, the "Acvagenresource" Center and others.

Tangible achievements are also due to the scientific schools in the Republic of Moldova, such as the wine school, previously created by corresponding member of the Academy of Sciences of Moldova P. Ungurean (P. Ungurean, 1960), by academician Gh. Cimpoies, academician B. Gaina, corresponding member of the Academy of Sciences of Moldova V. Ungureanu, professor A. Balanuță, professor N. Taran, Ph.D. G. Arpentin, Ph.D. Gh. Savin, dr. hab. E. Alexandrov, doctor G. Musteață, doctor C. Olaru and others. The achievements of the genetic school of intraspecific selection of grapevine culture are due to the well-known breeders corresponding member of the Academy of Sciences of Moldova N. Guzun, professor D. Verderevchii, C. Voitovici, G. Savin, doctor T. Cazac and others, the varieties of which demonstrated a high organoleptic quality and increased resistance to the biotic and abiotic factors of the vine vegetation conditions life of Moldova. Nowadays the National School of Crop Protection Scientists with a Specialization in Viticulture is represented by the team of corresponding member of the Academy of Sciences of Moldova M. Vronskikh, professor L. Voloshchuk, doctor V. Ciobanu and others. As a result, a new spectrum of phytosanitary products was implemented in the protection of vines, mainly produced in the European Union, the USA, China and Japan, which ensure a high effect of the treatments and a high horticultural sanitation. A considerable contribution to the revitalization of the viticulture complex was made by the Scientific School of corresponding member of the Academy of Sciences of Moldova I. Hăbășescu, professor L. Volconovici, dr. hab. V. Cerempei, doctor I. Pasat and others.

An important place in the economy of Moldova is held by the creation of a network of wine tourism (Gaina B., 2004). Over 10 years, an integrated system of wine tourism has been created and approved by the National Bureau of Vine and Wine, in which about 26 economic agents in the sector are involved. Each entity is accredited on the basis of meeting the European requirements for each wine tourism point: the presence of massifs of vines in excellent condition, road access, modern grape processing enterprise, high level sanitation, production and storage halls, rich collections of wines, restaurant certified by the Ministry of Health and the National Food Safety Agency, (Law 352 RM, 2006, Sturza R., 2017) parking lots for transport, sanitary blocks, etc.

An important role in the improvement of the legislation of the Republic of Moldova regarding tourism in general and wine tourism in particular was and is being played by the Academy of Economic Studies of Moldova, the Academy of Sciences of Moldova, the Institute of Cultural Heritage and other entities in the field of research and innovation.

In this way, the practice of wine tourism in the Republic of Moldova has grown in recent years, attracting approximately 250-300 thousand visitors, mainly from the European Union, Great Britain, China, Japan and South Korea.

Only this sector of services in the field of viticulture, oenology, national cuisine and handicraft allowed to pay into the budget of the Republic of Moldova the amount equal to the income from the sale of wines and distillates, valued at 350-500 million US dollars. This international classification, with the location of the Republic of Moldova in second place in the world for the most appreciated wine tourism destinations, testifies once again that as a result of the collaboration of scientists and specialists in the field of viticulture and winemaking, of the implementation of world achievements in new viticulture technologies, it has allowed the achievement of these high performance appreciated worldwide. (Conference, 2024)

Figure 2. Ranking of wine tourism destinations

Source: https://www.moldpres.md/news/2024/10/08/24008011

In 2023, the Republic of Moldova won the 9th place at the prestigious CIFFT (Committee of Tourism Film Festivals) international competition in the "People's Choice" category alongside the countries: Portugal, Peru, Cuba, Bosnia and Herzegovina, Mexico, Poland, Croatia and Spain. The competition promotes and rewards the most successful videos about travel, tourist destinations and the tourism industry, organized by the International Committee of Travel Film Festivals with the support of the World Tourism Organization and the European Commission for Tourism.

In 2023, collective tourist accommodation structures were visited by 391.5 thousand tourists (17.2% more than in 2022) and in January-June 2024, collective tourist accommodation structures were visited by 209.2 thousands of tourists (36.6% more than January-June of the previous year).

The Republic of Moldova has become the European capital of wine tourism by hosting the General Assembly of "INTER-VITIS- *Les Chemins de la vigne*" - the European wine

tourism route that records the landscapes and wine heritage of the member countries, supported by the European Federation ITER VITIS and certified according to the standards of the Council of Europe since 2009.

Another forum of scientific achievement in the field of viticulture and winemaking is "National Wine Day 2024", XXIII edition. This edition was held under the new slogan "Our amazingly good wine", which emphasizes the continuous evolution of the industry, millennial traditions in winemaking and innovation. The format of the event has been improved to give each participant the opportunity to fully enjoy the diversity and quality of wines, alongside the most acclaimed winemakers in the country. This event was attended by over 150,000 visitors, 120000 bottles sold, of which 36000 bottles were tasted, 50,323 tastings based on the "Taster Book", 40 wineries offered tours, wine tastings, of which 8 wineries organized special events, 25,000 tourists visited the wineries within the event, 250 participants in the "Wine School".

CONCLUSIONS

The analysis of the process of technological transfer of research results and innovations in the agro-industrial complex of the Republic of Moldova eloquently testifies that only through the implementation of the achievements of the technical-technological process can an upward growth of the indices of economic activities in the country.

The collaboration of the Republic of Moldova with the states of the European Union and primarily with Romania allows the scientific community in the country to carry out vital projects of the economy of the agro-industrial complex despite the multiple challenges such as global warming, droughts, epiphytosis of agricultural crops, etc.

Investments in wineries and the state's initiative to put Moldova on the map of European wine tourism have led to the creation of itineraries, which allow visiting many fields and wineries. The tourist potential of the Republic of Moldova also derives from the agricultural specifics.

The most astringent problems in dynamism wine tourism are: improving the financial climate, improving infrastructure, roads, access roads, raising the sanitary level of routes and agro-pensions, training staff, increasing the quality of services of any kind (accommodation, translations, food, currency exchange, tastings, procurement of souvenirs and gifts, etc.).

Focusing efforts on protecting the environment and the rural beauty of the vineyards so that the region retains its charm and its rationale for being a wine destination.

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PROCESSING OF MEDICINAL HERBS: ECONOMIC ANALYSIS

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Abstract: *Medicinal and aromatic plants have been usually used in traditional way of curing people for centuries, while their essential oils are mainly applied in medicine, pharmacy, dentistry, cosmetic industry, light chemistry, and other sectors. Besides, possibilities to use essential oils as plant protection agents or veterinary medicaments have been also increasingly studied. Considering the number of alternatives for using essential oils and growing tendency to increase the appliance of natural compared to synthetic products in many areas, the main goal of paper is to analyze the economic profitability of essential oils production based on exploitation of ten medicinal plants' species previously produced in plantation system of production. Analysis was performed according to data gained form coal mine Pljevlja, while dynamic methods of investment analysis (net present value, internal rate of return, payback period and annuity method) were used in assessment of economic effects of investing in essential oils production (processing of medicinal plants). Performed analysis has showed that investment in observed processing capacities is economically justified, as well as that economic effects of medicinal herbs processing mainly depend on production structure available at plantations, i.e. on volume and structure of available raw material used in processing capacities.*

Key words: *medicinal herbs, essential oils, costs, investments.*

JEL classification: Q0

INTRODUCTION

Medicinal herbs collected in natural habitats have been used in folk medicine for prevention and treatment since ancient times (Pan et al., 2014). With the increase in the need (demand) for medicinal herbs and emergence of modern systems for their growing (in addition to their collection from nature), there comes to constant increase in areas under plantation production (Sheldon et al., 1997; Van Wyk, Prinsloo, 2018). Riaz and associates (2021) have noticed following issues for medicinal and aromatic plants (MAPs) adaptation as arable crops, such are "lower prices, non-availability at transit markets, underdeveloped cultivation technology, poor availability of cultivation resources and genetic materials, etc.".

Discussing international trade of medicinal herbs (Vasisht et al., 2016) there are determined that in period 2001-2014. "annual average growth rate (AAGR) of 2.4% in volume and 9.2% in value of export item was observed". Analyzing market of medicinal and aromatic plants Parvin et al. (2023) have been listed China, India and Canada as the main exporters, while USA, Japan and Germany as the main importers. Mentioned authors have been also determined that "the USA, Hong Kong, Germany, the Republic of Korea, and China are the five main trade hubs for MAPs worldwide". Similar conclusion concerning the most important trade centers for medicinal and aromatic plants were reached by Tripathi et al. (2017) and Vasisht et al., (2016).

Increasing attention has been paid globally to the possibilities for medicinal herbs processing, as well as the opportunities of applying the products gained in this way. Medicinal plants

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are processed in different ways, either by drying individual plants' parts, or by distillation, or by various types of processing in pharmaceutical industry (Ahad et al., 2021).

Due to the modern lifestyle (which includes less and less movement, high levels of stress and diet with insufficient level of nutrients), it is obvious that consumer's affinity to use products based on medicinal plants instead synthetic drugs has been becoming more pronounced. That is the reason why the use of pure medicinal plants is increasing, as well as the invention and production of new products that include them (Radojković et al., 2017). Medicinal plants, as was stated by Turudija Živanović (2016), have an advantage over synthetic drugs, as they rarely cause side effects.

In line to active substance inside the medicinal plants grown and cultivated within the Balkans, they can be divided into: alkaloid species, heteroside species, glycosidic species, species rich in tannins, or species rich in essential oils, mucus and vitamins. A group of medicinal plants particularly important for processing are plants rich in essential oils that can be found as wild or as cultivated plants (Stevanović, 2022).

Composition of etheric essential oil highly depends on specified medicinal herb species. Composition of essential oils was studied by Mašković and associates (2017), while they presented in detail the chemical composition of lavender (*Lavandula angustifolia*) and thyme (*Thymus serpyllum*) essential oils. According to them, performed research (observed content of essential oils) could be significant both for pharmaceutical and food industry. Trifunović and Tojić (2022) state that "essential oils are complex mixtures of a large number of organic compounds, such are aliphatic, alicyclic and aromatic hydrocarbons, different alcohols, aldehydes, ketones, carboxylic acids, lactones, esters, phenols, etc.".

Essential oils can be used in a wide range of products gained from different industries such are food, pharmaceutical and cosmetic industry. Their use has beneficial effects on human body, such as soothing, anti-inflammatory, diuretic, expectorant, antiseptic and antibacterial, antispasmodic, etc. Before the use of certain essential oils, there has to be checked the optimal concentration for its appliance towards avoiding potential unwanted health issues. In medicine, essential oils can be also used as active substances or as auxiliary substances in process of drugs production (Djilani, Dicko, 2012; Govindaraj, 2019; Fatemeh, 2021; CEMFIK, 2024).

Essential oils have been stored in special conditions, as they behave as antioxidants, while they could be decomposed quickly. They need to be stored in dark and aired space in dark glass or porcelain containers with appropriate lids (glass or silicone). In accordance to plant species, essential oils can be extracted from different plant parts. From some of them, oils are extracted from the whole plant, or just from above-ground or underground plants' parts (Sovilj, Spasojević, 2001; Turek, Stintzing, 2013; Mathe, 2015).

The use of essential oils is diverse, while they are also used in dentistry. As stated Mirković (2002) "In dentistry and medicine, they are used towards their aromas, as aromatics, but also as antiseptics, analgesics, spasmolytic, expectorants, and carminatives". The usually used aromatic medicinal plants in dentistry or medicine are mint, chamomile, juniper, or lavender (Valnet, 2015).

Importance and possibility of using essential oils is multiple, while there come to increase in number of researches focused to efficient application of essential oils in agriculture and veterinary medicine. More precisely, researches are being performed towards reduction of pesticides use or decrease in veterinary drugs appliance, with possibility of changing them with essential oils (Benchaar et al., 2008; Pavela, Benelli, 2016). Duduk and associates (2010) experimented with alternative use of essential oils in plant protection, while they managed

thyme, cinnamon and cloves essential oils in controlling strawberry anthracnosis, as was verified that these products of extraction have anti-fungal effects. Grahovac and associates (2015) has been investigated the use of oregano essential oils in suppressing the appearance of Monilia fructigena on apple fruits. Performed research involved the use of four types of oregano essential oils that differ by geographical origins, while there was recorded that tested oils have the potential of bio-fungicide. Certain testing in veterinary medicine were done by Štrbac and associates (2022a; 2022b), as well as in the field of food safety, trying to assess the impact of essential oils on selected pathogenic bacteria isolated in meat production (Vidaković Knežević, 2022).

In line to huge importance and different ways of use of essential oils derived from medicinal plants, research serves to present economic analysis of investment in equipment for medicinal plants processing, i.e. essential oils production on the example of the Pljevlja coal mine.

METHODOLOGICAL FRAMEWORK

In paper were used data collected form number of scientific and professional literature sources, as well as data of Coal mine enterprise from Pljevlja (Montenegro) that plans launching the facility for medicinal plants processing and essential oils production. This public company is planning the investment in distillery that will serve for processing the medicinal plants produced at 100 ha of company's plantation. Investment relates to required fixed assets (equipment) and permanent working capital (PWC), while the assessment period is 10 years.

In order to assess the economic effects of planed investment there are used common dynamic methods, as are Net Present Value, Internal Rate of Return and Payback Period (Ivanović, 2013; Gogić, 2014; Ivanovic, Marković, 2018; Gogić, 2021; Nastić et al., 2023; Nastić et al., 2024). In addition, there were applied method of annuities (Gogić, 2014), as intention was to determine and compare average annual incomes (B) and costs (T):

$$B = \left(\frac{b_1}{r} + \frac{b_2}{r^2} + ... + \frac{b_n}{r^n} + \frac{B_n}{r^n}\right) \cdot \frac{r^n(r-1)}{r^n - 1},$$

$$T = \left(A_0 + \frac{u_1}{r} + \frac{u_2}{r^2} + ...+ \frac{u_n}{r^n}\right) \cdot \frac{r^n(r-1)}{r^n - 1}.$$

Where,

b_1, ..., b_n – incomes that derived from investment exploitation in certain years,

u_1, ..., u_n – costs made for investment exploitation in certain years,

A_0 – overall investment,

Bn – salvage value,

r – discount factor $1+\frac{p_k}{100}$, while p_k is discount rate,

n – period of investment exploitation.

If there are $B - T \geq 0$ or $\frac{B}{T} \geq 1$ investment is economically justified.

RESULTS AND DISCUSSIONS

Essential oils production is planned based on processing 10 medicinal plant's species, such are: Lavandula Grosso, Lavandula Angustifolia, Sage, Thyme, Hyssop, Wild Oregano, Heather, Parsley, Sweet Wormwood and Lovage. From mentioned 10 medicinal plants, there are gained 11 products (essential oils), because two different essential oil are extracted from Lovage (one from herb, while second from root).

Overall investment amounts 344,300 EUR. Within the structure of overall investment (Table 1.) permanent working capital (PWC) accounts to 9.09%.

Table 1. Overall investment in medicinal plants processing (in EUR)

No.	Element	Overall investment	Share in overall investment (in %)
I	**Fixed assets**	**313,000**	**90.91**
1.	Equipment	313,000	90.91
II	**PWC**	**31,300**	**9.09**
Total (I+II)		**344,300**	**100.00**

Source: CMEP, 2023.

Investment in fixed assets entirely overlaps with investment in equipment, where investment in production equipment dominates (95.8%). In investment structure, other elements have much smaller share (laboratory equipment, apparatus for determining content of essential oil, etc.), (Table 2).

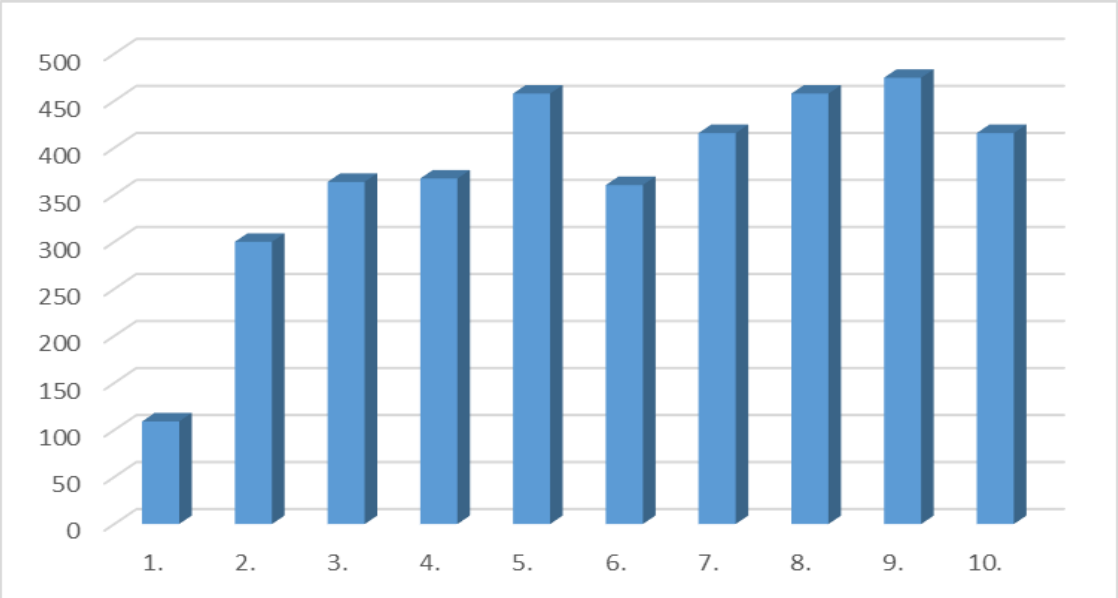
Table 2. New investment in fixed assets (in EUR)

No.	Element	Value without VAT	Value in %
I	**Equipment**		
1.	Production equipment	300,000.00	95.8
2.	Laboratory equipment (settled in master laboratory)	6,500.00	2.1
3.	Apparatus for determination of content of essential oils by Clevenger (heating pad or calotte)	1,500.00	0.5
4.	Apparatus – Digital densimeter	3,000.00	1.0
5.	Apparatus – Digital (refractometer and polarimeter)	2,000.00	0.6
Total (1+2+3+4+5)		**313,000.00**	**100.0**

Source: CMEP, 2023.

Investment in fixed assets is financed from own funds, while permanent working capital will be financed from short-term loan. Formation of total incomes from the planned investment over the observed period is shown in Graph 1., while it is based on the market value of produced essential oils from 10 medicinal plants' species. Income variability in certain years derived from characteristics of previously organized medicinal plants production (volume of different medicinal plants' species used in processing vary over the years). Planned prices are constant throughout the entire ten-year period.

Graph 1. Overall income forming per years of exploitation (in 000 EUR)



Source: CMEP, 2023.

Lavandula Angustifolia has the greatest importance (the largest share in formation of total income) during the most of observed production period. So, for example, the essential oil of mentioned plant during the 6th year of the investment exploitation participates in formation of total income with 42.9%, while the least impact of this medicinal plant is in the second year with share of 9%. On the other hand, the essential oils of Lovage (either gained from herb or root) have the weakest significance for incomes gaining, as they are even not produced in certain years (Table 3.).

Table 3. Share of certain products in overall incomes forming (in %)

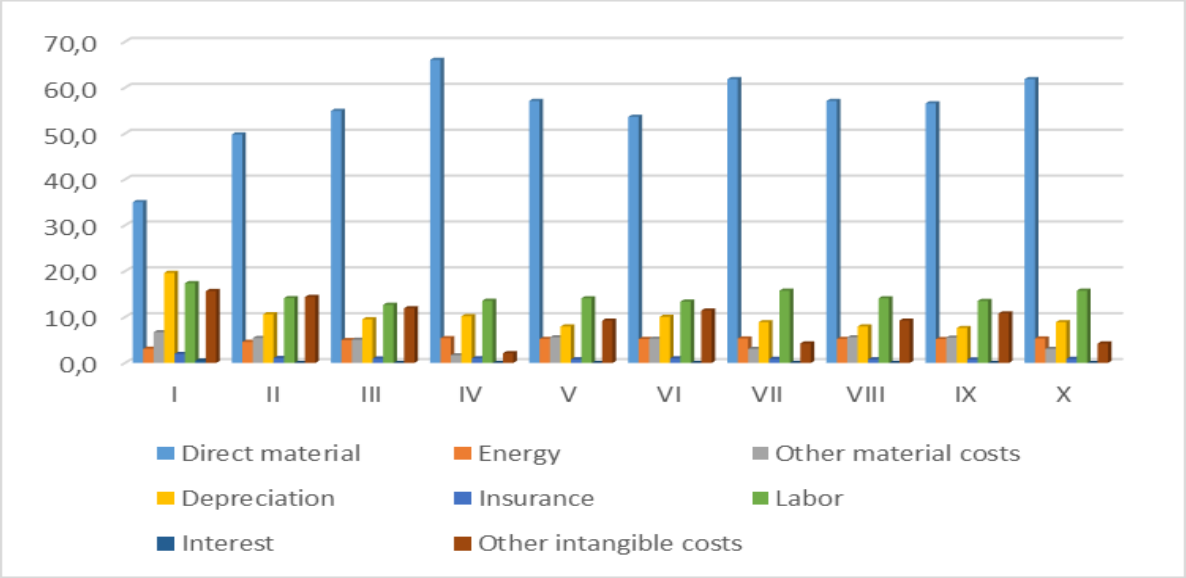
Product (essential oil)	Minimal share		Maximal share	
	Share in %	Year	Share in %	Year
Lavandula Grosso	2.7	II	10.5	VI
Lavandula Angustifolia	9.0	II	42.9	VI
Sage	3.8	VI	22.7	II
Thyme	0.6	VI	3.9	II
Hyssop	2.3	VI	7.5	II
Wild Oregano	5.6	VI	12.4	II
Heather	8.7	VI	16.9	II
Parsley	3.4	IX	5.4	II
Sweet Wormwood	3.5	IX	5.6	II
Lovage (herb)	0.0	IV, VII and X	14.0	II
Lovage (root)	0.0	There are no essential oils from root in several years II, IV, V, VII, VIII and X	4.7	VI

Source: CMEP, 2023.

The presentation of total costs that follow planned investment within entire period of exploitation is given in Graph 2. Direct material is the crucial element considering the structure of total costs, while they include only the costs of used raw material (medicinal herbs). Within the overall

costs, direct material has a share between 35.1% and 66.1% (considering the 1st or the 4th year of the investment exploitation). Besides, labor costs are also significant, as they participate with share from 12.7% to 17.4% within the sum of overall costs (considering the 3rd or the 1st year of investment exploitation), while the least important are the costs of interest, as they occurred just in the first year, or costs of insurance, as they range between 0.8% and 2%).

Graph 2. Share of certain costs in the structure of total costs (in %)



Source: CMEP, 2023.

According to previously mentioned data there was performed investment analysis that involves determining the value of dynamic indicators presented in Table 4. Considering that the Net Present Value of investment in production of essential oils is positive, while that the Internal Rate of Return is over the preset discount rate (7%), and that Payback Period of investment is shorter than the assumed lifetime of investment (10 years), it could be concluded that observed investment is economically justified for realization.

Table 4. Indicators of economic effectiveness of investment in medicinal plants processing

Dynamic indicators	Value
Net Present Value	131,433.43 EUR
Internal Rate of Return	12.62%
Payback Period	7 years and 9.84 months

Source: CMEP, 2023.

As additional method for assessing the economic effectiveness of planed investment, there was applied annuity method. According to its use, following results were obtained: B = 360,375.31 EUR and T = 341,662.15 EUR. Further applying of adequate formulas, B-T = 18,713.16 EUR, what is over than zero, or B/T = 1.05, what is over than 1, have been showed than observed investment could be also considered economically justified.

CONCLUSION

There is sharp increasing in number of consumers that are interested, or begin to use medicinal plants, in form of fresh or semi-processed (mainly dried), or in form of fully processed products (essential oils, tinctures, etc.), either as tool for disease and shortage in body functions prevention or their medical treatment. In line to mentioned market trends, there comes to increase in number of agricultural producers that have been interested for organizing the plantation production of medicinal plants, and later their processing into the wide range of final products. One of the most attractive way of processing is production of different essential oils. Therefore, performed research aimed to assess the economic efficiency of investing in medicinal plants processing, i.e. production of essential oils from previously in plantation system grown different plants.

Made investment analysis showed that the profit achieved in process of medicinal plants processing differs in certain years mainly due to specificities of preplanned sowing structure of medicinal plants in plantation production, i.e. it depends from volume and type of available raw material from which the essential oils are produced. Meanwhile, it was shown that in costs structure linked to medicinal plants processing, material costs are dominating. So, they deserve processors special attention. All values of indicators (dynamic methods and annuity method) used to assess the economic effectiveness of planed investment in medicinal plants processing (production of essential oils) show that observed investment could be considered economically justified.

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ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING APPROACHES FOR SMART AGRICULTURE

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Abstract: *The integration of Artificial Intelligence (AI) and Machine Learning (ML) in agriculture has transformed traditional farming into a more efficient, data-driven, and sustainable practice. Smart agriculture leverages AI-driven techniques such as predictive analytics, image processing, and Internet of Things (IoT) sensors to optimize crop monitoring, irrigation management, pest detection, and yield prediction. Machine learning models enhance decision-making by analyzing vast datasets related to soil health, weather conditions, and plant diseases. This review explores various AI and ML approaches in smart agriculture, highlighting their applications, benefits, and challenges. It also discusses advancements in deep learning, computer vision, and automation technologies that are shaping the future of precision farming. Despite the significant progress, issues related to data availability, model accuracy, and implementation costs remain barriers to widespread adoption. The study concludes with future research directions and the potential of AI-driven smart agriculture to enhance global food security and sustainability.*

Key words: *Smart agriculture, Artificial Intelligence, Machine Learning, Precision farming, Crop monitoring, IoT in agriculture*

JEL Clasiffication: Q0

INTRODUCTION

Agriculture plays a fundamental role in ensuring food security, economic stability, and sustainable development worldwide. However, traditional farming practices face significant challenges, including climate variability, soil degradation, water scarcity, pest infestations, and labor shortages. Additionally, the increasing global population demands higher agricultural productivity, requiring innovative approaches to optimize resource utilization and enhance crop yields. To address these challenges, AI and ML have emerged as transformative technologies in smart agriculture, enabling data-driven decision-making, automation, and precision farming techniques[1].

Smart agriculture, also referred to as precision agriculture, integrates AI, ML, the Internet of Things (IoT), remote sensing, robotics, and big data analytics to optimize various agricultural processes. These technologies facilitate real-time monitoring, predictive modeling, and autonomous farming, improving efficiency while reducing environmental impact. AI and ML-driven solutions have demonstrated their potential in crop health monitoring, disease detection, yield prediction, irrigation management, pest control, and soil analysis, offering a scientific and data-centric approach to modern farming. This manuscript provides a comprehensive review of AI and ML applications in smart agriculture. The primary focus is to explore various AI-driven techniques, their impact on agricultural efficiency, key benefits, existing challenges, and future research directions. The study aims to highlight how AI-

powered innovations are reshaping traditional farming while addressing sustainability and food security concerns. AI and ML have transformed the agricultural landscape by providing intelligent automation, predictive analytics, and decision-support systems[2]. These technologies have found applications in diverse domains within agriculture, including:

Crop Monitoring and Disease Detection: AI-powered computer vision and deep learning models analyze images captured by drones, satellites, or on-field sensors to detect diseases, pests, and nutrient deficiencies at an early stage. These insights allow farmers to take timely corrective actions, preventing large-scale crop damage.

Precision Irrigation and Water Management: Smart irrigation systems integrate AI, IoT-based sensors, and weather forecasting to optimize water usage based on real-time soil moisture data and climatic conditions. This minimizes water wastage while ensuring adequate hydration for crops.

Yield Prediction and Crop Forecasting: Machine learning models analyze historical yield data, soil properties, and meteorological parameters to predict future crop yields. These forecasts help in strategic crop planning, storage management, and market pricing.

Autonomous Farming and Robotics: AI-driven autonomous machines, including robotic harvesters, self-driving tractors, and automated weeding systems, enhance efficiency, reduce labor dependency, and lower operational costs.

Pest and Weed Management: AI-based image recognition and predictive modeling techniques help detect pest infestations and weed growth patterns, enabling targeted pesticide application and sustainable farming practices.

Soil Health Monitoring and Fertilization: AI-driven spectral imaging and ML algorithms assess soil properties, suggesting optimal fertilizer application to maintain soil fertility while preventing overuse.

OVERVIEW OF AI AND ML TECHNOLOGIES IN SMART AGRICULTURE

AI and ML are revolutionizing the agricultural sector by enabling intelligent decision-making, automation, and predictive analytics. These technologies help farmers analyze complex datasets, optimize resource utilization, and improve sustainability. AI encompasses various techniques such as machine learning, deep learning, computer vision, and natural language processing, all of which play a crucial role in modernizing agriculture. Machine learning, a subset of AI, allows systems to learn from data and improve performance over time, making it an essential tool in precision farming [3]. Deep learning, which utilizes artificial neural networks, enhances the accuracy of image-based applications such as disease detection and crop classification. Computer vision enables automated monitoring of plant health, pest detection, and harvesting, while natural language processing is used in voice-assisted farming advisory systems and the analysis of agricultural reports and weather forecasts.

Machine learning approaches in smart agriculture can be broadly categorized into supervised learning, unsupervised learning, and reinforcement learning. Supervised learning algorithms, which rely on labelled datasets, are commonly used for crop yield prediction, disease detection, and soil fertility assessment [4]. Techniques such as Support Vector Machines (SVM), Random Forest (RF), and Artificial Neural Networks (ANNs) have been widely adopted to classify crops, detect pests, and predict soil properties [5]. On the other

hand, unsupervised learning identifies patterns in unlabelled data, making it useful for clustering soil types, predicting pest outbreaks, and analysing market trends. Algorithms like K-Means Clustering and Principal Component Analysis (PCA) help group agricultural zones based on climate conditions and soil fertility. Reinforcement learning, which involves learning from trial and error, is particularly beneficial for optimizing autonomous farming robots and smart irrigation systems, ensuring efficient navigation and water usage strategies.

Data acquisition plays a critical role in AI-driven smart agriculture, as accurate predictions and automation depend on high-quality, real-time information. The integration of the Internet of Things (IoT) has enabled seamless data collection through sensor networks, drones, and satellite imaging. IoT devices monitor key environmental parameters such as soil moisture, temperature, humidity, and nutrient levels, providing farmers with actionable insights for improving crop management. Drones equipped with AI-powered image recognition capabilities assist in field mapping, plant health monitoring, and pest surveillance, enabling precision agriculture practices. Additionally, satellite imaging offers large-scale agricultural monitoring, helping predict climate patterns and detect changes in crop conditions. By combining AI, ML, and IoT, smart agriculture is transitioning towards a more data-driven and automated approach, ensuring higher efficiency, reduced resource wastage, and improved sustainability in the farming sector [6].

AI-DRIVEN APPLICATIONS IN SMART AGRICULTURE

The integration of AI and ML into agriculture has led to significant advancements in farming practices, enabling precision agriculture, real-time monitoring, and data-driven decision-making. AI-driven applications are transforming various aspects of agriculture, including crop monitoring, precision irrigation, yield prediction, pest and disease management, autonomous farming, and supply chain optimization [7]. By leveraging AI technologies, farmers can improve productivity, optimize resource utilization, and enhance sustainability while minimizing environmental impact. These intelligent systems provide accurate predictions and automation, allowing for more efficient farming operations and better crop management.

One of the most impactful applications of AI in agriculture is crop monitoring and disease detection. AI-powered crop monitoring systems utilize remote sensing, drones, and computer vision to assess plant health in real-time. High-resolution images captured by satellites or unmanned aerial vehicles (UAVs) are processed using deep learning algorithms to detect signs of disease, pest infestations, nutrient deficiencies, and water stress. Convolutional Neural Networks (CNNs), a form of deep learning, have been highly effective in identifying disease symptoms based on leaf discoloration, texture changes, and growth patterns. These AI-driven solutions allow farmers to take timely action by applying targeted treatments, reducing crop losses, and minimizing the excessive use of pesticides and fertilizers, which in turn supports sustainable farming practices [8][9].

Water management is another critical area where AI is making a significant impact through precision irrigation systems. Water scarcity poses a major challenge in agriculture, and efficient irrigation management is crucial for sustainability. AI-driven precision irrigation integrates real-time sensor data, weather forecasts, and soil moisture analysis to optimize water

usage. Machine learning models analyze historical and real-time data to determine the exact amount of water required for different crops, preventing over-irrigation or under-irrigation. IoT-enabled smart irrigation systems automatically adjust water supply based on climatic conditions and soil moisture levels, ensuring efficient water distribution. These AI-based approaches not only conserve water but also enhance crop growth and yield, contributing to improved efficiency and reduced resource wastage.

Yield prediction and crop forecasting have also been significantly improved by AI and ML technologies. Accurate yield prediction is essential for agricultural planning, market pricing, and food security. AI algorithms analyze various parameters such as soil properties, weather conditions, past yield data, and crop variety to predict future agricultural output. Supervised learning models, including Support Vector Machines (SVM) and Random Forest (RF), have been widely used for crop forecasting. Deep learning techniques further improve prediction accuracy by identifying hidden patterns in complex agricultural datasets. These AI-driven insights help farmers make informed decisions regarding planting schedules, resource allocation, and risk mitigation strategies, ultimately leading to increased productivity and profitability [10].

Pest and weed management is another area where AI is making significant contributions. AI-based pest and weed management solutions use image recognition and predictive modeling techniques to identify harmful pests and weeds, enabling targeted interventions. Computer vision algorithms analyze field images to detect pest outbreaks and classify weed species, allowing for precise herbicide and pesticide application. AI-powered robotic systems equipped with smart cameras and deep learning models can autonomously detect and remove weeds, reducing the need for chemical herbicides. These intelligent solutions not only improve pest control efficiency but also promote environmentally friendly farming practices by minimizing chemical use [11].

CHALLENGES AND LIMITATIONS OF AI AND ML IN SMART AGRICULTURE

Despite the transformative potential of Artificial Intelligence (AI) and Machine Learning (ML) in agriculture, several challenges and limitations hinder their widespread adoption and effectiveness. The implementation of AI-driven solutions requires a combination of advanced technology, substantial investment, and skilled expertise, which may not be readily available in many agricultural regions. Factors such as data availability, technological infrastructure, computational complexity, and ethical considerations present significant obstacles to the large-scale deployment of AI in smart farming. Additionally, farmers may face difficulties in integrating AI-based solutions due to the lack of proper training and awareness regarding these advanced technologies.

One of the most critical challenges in AI adoption for agriculture is the availability and quality of agricultural data. AI and ML models require large volumes of high-quality, structured datasets to function effectively. However, in many developing regions, agricultural data is often fragmented, inconsistent, or unavailable. Data related to soil conditions, weather patterns, crop diseases, and yield history is crucial for training AI models, yet such information is either not collected systematically or stored in formats that are not easily accessible. Additionally, variations in climate, soil composition, and farming practices across different

geographical locations make it difficult to develop AI models that can be universally applied. The absence of standardized data collection methods further complicates AI-driven decision-making, leading to reduced accuracy and reliability of predictions [12].

The technological infrastructure required to implement AI in agriculture poses another major challenge. AI-powered solutions depend on Internet of Things (IoT) devices, high-speed internet connectivity, cloud computing, and edge computing technologies to process vast amounts of data in real time. In many rural and remote farming areas, access to reliable internet and power supply is limited, making it difficult to deploy AI-based precision farming techniques. Additionally, the cost of implementing AI solutions, including acquiring drones, sensors, and AI-powered machinery, is often too high for small and medium-scale farmers. Without adequate financial support and government incentives, the adoption of AI in agriculture remains constrained, particularly in developing countries where farmers operate with minimal resources.

The computational complexity of AI models and the need for skilled expertise further limit the widespread application of AI in smart agriculture. Training and deploying ML algorithms require significant computational power and expertise in data science, machine learning, and agricultural sciences. Many farmers lack the technical knowledge required to operate AI-driven systems effectively, leading to underutilization of these technologies. While AI solutions can provide valuable insights, their success depends on the ability of farmers to interpret and act on these recommendations. Bridging the skill gap through educational programs, farmer training workshops, and user-friendly AI interfaces is essential for maximizing the benefits of AI in agriculture.

Another key concern in AI-driven agriculture is data privacy and security. The collection and processing of vast amounts of agricultural data raise questions about ownership, confidentiality, and misuse. Farmers may be hesitant to share their data with technology providers due to concerns over intellectual property rights, competitive disadvantages, and potential misuse of personal and farm-related information. Ensuring robust data protection measures, transparent data governance policies, and secure cloud storage solutions is essential to building trust among farmers and encouraging wider AI adoption.

Ethical and environmental considerations also pose challenges to AI implementation in agriculture. The increased use of AI and automation in farming has raised concerns about job displacement, particularly for laborers engaged in traditional farming practices. The replacement of human labor with AI-driven machinery could lead to socio-economic challenges in rural communities, where agriculture is the primary source of employment. Additionally, the over-reliance on AI and machine learning for decision-making without human intervention may lead to unintended consequences, such as excessive use of agrochemicals, unsustainable farming practices, or biased AI predictions that favor certain crop varieties over others. Striking a balance between AI automation and human expertise is necessary to ensure ethical and sustainable agricultural practices.

Despite these challenges, ongoing research and technological advancements are continuously improving AI adoption in agriculture. Government initiatives, public-private partnerships, and international collaborations are playing a crucial role in addressing infrastructure limitations and making AI technologies more accessible to farmers. Developing cost-effective AI solutions, improving data collection methods, enhancing internet connectivity

in rural areas, and providing training programs for farmers will be essential in overcoming the limitations of AI in smart agriculture.

FUTURE PROSPECTS AND OPPORTUNITIES FOR AI AND ML IN SMART AGRICULTURE

The future of AI and ML in smart agriculture holds immense potential for transforming traditional farming practices into highly efficient, sustainable, and technologically driven operations. As advancements in AI continue to evolve, new opportunities are emerging to address existing challenges, enhance productivity, and improve resilience against climate change and global food security concerns. The integration of AI with emerging technologies such as the Internet of Things (IoT), blockchain, robotics, and edge computing is expected to further revolutionize the agricultural sector. The development of cost-effective, scalable, and farmer-friendly AI solutions will enable widespread adoption, bridging the gap between technology and traditional farming methods.

One of the most promising future applications of AI in agriculture is the development of fully autonomous farming systems. AI-powered autonomous tractors, drones, and robotic harvesters are expected to play a crucial role in automating labor-intensive tasks such as plowing, planting, weeding, and harvesting. These intelligent machines will not only increase efficiency but also address labor shortages in the agricultural sector. Advancements in reinforcement learning and deep learning will enable robots to perform complex tasks with greater precision, reducing the need for manual intervention. The integration of computer vision and AI-driven decision-making will allow robotic systems to assess crop health, detect pests, and optimize farm operations in real time.

AI is also expected to enhance precision agriculture by leveraging big data analytics, real-time monitoring, and predictive modeling. The increasing deployment of IoT sensors and AI-powered drones will provide continuous monitoring of soil moisture levels, crop growth patterns, and environmental conditions. Advanced ML algorithms will process this data to generate highly accurate recommendations for irrigation, fertilization, and pest control, reducing resource wastage and enhancing sustainability. The use of AI-driven climate models will enable farmers to predict and mitigate the impact of extreme weather events such as droughts, floods, and heatwaves, thereby increasing agricultural resilience in the face of climate change.

Blockchain technology combined with AI is another area with significant potential in smart agriculture. The integration of blockchain in supply chain management will ensure transparency, traceability, and security in agricultural transactions. AI-powered predictive analytics can optimize supply chain logistics by forecasting demand, reducing post-harvest losses, and improving market access for farmers. Smart contracts powered by AI and blockchain will facilitate fair trade practices, ensuring that farmers receive fair compensation for their produce. Additionally, AI-driven risk assessment models can help financial institutions provide better credit and insurance services to farmers, reducing financial risks associated with unpredictable weather conditions and market fluctuations.

Another emerging opportunity for AI in agriculture is the development of plant phenotyping and genomics-based farming. AI and ML are being used to analyze plant traits,

genetic variations, and breeding patterns to develop high-yield, climate-resilient, and disease-resistant crop varieties. AI-driven genetic research is expected to accelerate the breeding process, reducing the time required to develop new crop strains suited to changing environmental conditions. This will be particularly beneficial in addressing food security challenges by ensuring the availability of nutritious and high-yielding crops capable of thriving in diverse agro-climatic regions.

The adoption of AI in urban and vertical farming is also gaining momentum as cities look for sustainable solutions to meet growing food demands. AI-powered hydroponic and aeroponic farming systems optimize nutrient delivery, monitor plant health, and adjust environmental conditions such as light and humidity in controlled environments. These AI-driven indoor farming techniques maximize space utilization, reduce water consumption, and provide fresh produce throughout the year, making them a viable solution for urban food production.

Despite the promising future of AI in agriculture, addressing key challenges such as high implementation costs, data privacy concerns, and the digital divide between developed and developing regions remains crucial. Collaborative efforts between governments, research institutions, and private enterprises will be essential in making AI technologies more accessible and affordable to farmers worldwide. Developing AI-powered solutions that are easy to use, scalable, and compatible with existing agricultural practices will encourage greater adoption among small and marginal farmers. Investments in farmer education, digital literacy, and AI-driven extension services will further enhance the effectiveness of AI in agriculture.

CONCLUSION

The integration of Artificial Intelligence (AI) and Machine Learning (ML) in agriculture has ushered in a new era of smart farming, revolutionizing traditional agricultural practices and improving efficiency, sustainability, and productivity. AI-driven applications such as crop monitoring, precision irrigation, yield prediction, pest and disease management, and autonomous farming have demonstrated their potential to enhance decision-making, reduce resource wastage, and optimize agricultural output. By leveraging real-time data, predictive analytics, and automation, AI has enabled farmers to make informed choices that lead to higher yields, cost savings, and better resilience against climate change and environmental uncertainties.

Despite its numerous advantages, the adoption of AI in agriculture still faces significant challenges. Limited access to high-quality data, inadequate technological infrastructure, high implementation costs, and the need for skilled expertise are some of the major barriers preventing widespread AI adoption, particularly in developing regions. Additionally, concerns regarding data privacy, ethical implications, and the socio-economic impact of AI-driven automation on agricultural labor require careful consideration. Addressing these challenges through government initiatives, public-private partnerships, and continued research and development is essential to ensuring that AI technologies are accessible, affordable, and beneficial for farmers of all scales.

Looking ahead, the future of AI in agriculture holds immense promise. The convergence of AI with other emerging technologies such as the Internet of Things (IoT),

blockchain, robotics, and genomics is expected to further transform the agricultural landscape. AI-powered precision agriculture, autonomous farming, smart supply chains, and genetic crop improvement will play a crucial role in meeting the increasing global food demand while promoting environmental sustainability. With continued advancements in AI-driven solutions and greater efforts toward digital literacy and technological inclusivity, smart agriculture has the potential to create a more productive, efficient, and resilient food system.

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COMPARATIVE ANALYSIS OF THE ECONOMIC EFFICIENCY OF EGGPLANT CULTIVATION IN GREENHOUSES: ORGANIC AND CONVENTIONAL AGRICULTURE SYSTEM – FORECASTS 2024/2025

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Summary: *Cultivation of vegetables in sheltered areas has become a common practice, due both to the possibilities of extending the vegetable growing season into the off-season and to the control of extreme climatic conditions (e.g. low temperatures and excessive rains) that can cause substantial damage . Because of these challenges, farmers are looking to implement new farming methods that not only support productivity, but also protect the environment. Eggplant stands out among vegetable crops due to the demand found on the market but also due to its high nutritional value. In the context of global concerns about sustainability and health, the organic farming system is gaining ground in front of the conventional system. This article proposes to carry out a comparative analysis of the economic performance of eggplant cultivation in greenhouses in the two farming systems, organic and conventional, with the aim of providing forecasts for the agricultural year 2024-2025. The production costs involved in the technological process, the capitalization prices and the degree of profitability per product unit will be analyzed. The results of the study will provide valuable information that can support greenhouses eggplant growers to improve existing farm-level strategies to meet both economic and environmental needs.*

Keywords: *economic efficiency, break-even point, eggplant culture, conventional system, ecological system*.

JEL Classification: Q12,Q14,Q57

INTRODUCTION

In the context of global warming and the growing need for organic food, agriculture has an essential role both in ensuring food security and in protecting the environment. Growing eggplant in greenhouses is a viable choice for vegetable growers due to the fact that this vegetable can cope with different environmental conditions with the possibility of obtaining high yields.

The evaluation and comparison of the economic efficiency of eggplant cultivation in greenhouses in conventional and ecological systems is important from several aspects. Initially, consumption of organic agricultural products has increased over the past 10 years, reflecting a shift in consumer choice for nutritious and sustainably produced food options.Based on a study conducted by Meticulous Research and mentioned by Frozen Food Europe, the global organic food market is expected to expand substantially. Therefore, until 2031, the sector is expected to experience an annual growth of approximately 10.1% in the coming years (Frozen Food Europe, 2024). This trend is not only influencing marketing and distribution strategies, but is driving farmers to adopt cultivation methods that meet this need.

Subsequently, both nationally and internationally, policies have begun to be implemented to support the shift to more sustainable farming methods. Recently, financial incentives for organic farming have become more common, which shows the commitment of the authorities to support agricultural practices that protect the environment. The EU Agricultural Policy (CAP) includes special provisions for organic farming, providing subsidies

and assistance for the conversion of conventional land to organic land. In this sense, the European Commission proposes that by 2030, 25% of agricultural land in the European Union will be dedicated to ecological practices, a significant increase compared to the 10.5% estimated for 2022. However, the Court of European Accounts has signaled that the EU strategy does not include clear and measurable objectives, recommending its improvement, as the funds of more than 12 billion euros allocated for the period 2014-2022 have not succeeded achieve the anticipated effect on environmental and economic objectives(European Court of Auditors, Report, 2024).

Cultivating eggplants in protected spaces brings multiple benefits, including the possibility of more efficient management of environmental conditions, control of irrigation systems and ensuring optimal ventilation. Consequently, heat and light regulation are vital for growing eggplants in greenhouses. According to Nelson (2003), the use of advanced greenhouse management technologies helps maintain an optimal temperature, which protects plants from heat stress and supports a more efficient photosynthesis process. Research has shown that a controlled environment can increase both yield and quality of vegetables. Irrigation also plays an essential role in growing vegetables in greenhouses, and modern irrigation systems can provide much more precise water management according to the needs of the plants. In another study, Jones et Tardieu (1998) showed that the use of controlled irrigation systems in protected spaces helps to save water and to use it more efficiently, a crucial aspect for growing vegetables in variable environmental conditions. In addition, ventilation in protected spaces plays an equally important role, guaranteeing sufficient air circulation to prevent the accumulation of moisture, which can lead to the spread of fungal diseases. Boulard (2006) highlighted how crucial ventilation is for maintaining a stable microclimate in greenhouses, an essential aspect for increasing the yield of eggplant culture.

In addition, the FAO report (2021) points out that organic farming brings considerable environmental benefits, such as protecting soils and reducing water pollution. However, these advantages involve higher production costs and lower returns in the short term compared to the system of conventional agriculture. Another FAO report from 2023 points out that the transition to more sustainable agriculture, including organic farming, is supported by international policies that promote the use of innovative technologies and efficient farming methods. These initiatives not only meet environmental standards but also contribute to improving food security in the long term. Gomiero et al. (2011) draw attention to the fact that current agricultural practices have a negative impact on the environment. However, there are alternatives that emphasize resource efficiency and soil conservation, thus ensuring long-term sustainability. These alternatives require important socio-economic and value changes to meet future requirements related to food security and protection of natural resources.

According to the research carried out by Foteinis et al. (2021), the comparative study on eggplant cultivation in conventional and organic farming systems and the environmental impact, carried out in the Mediterranean climatic conditions of northern Greece, highlights the significant differences in terms of environmental performance between the two cultivation methods. The organic farming system has a 24.15% lower total ecological footprint per unit area, while the conventional system is 28.10% more efficient. The main environmental challenges for both systems are irrigation and chemical fertilizer application, which underlines the need to implement strict nutrient application guidelines.

The study by Balode et al. (2024) highlighted the challenge that the European Union has in reducing emissions from agriculture. They suggest that organic farming could be an effective solution to achieving climate goals. Even though this type of farming has lower yields and higher production costs, the advantages include reduced operational costs and higher prices for products sold, which may suggest an increase in income for farmers.

This work aims to carry out a comparative analysis of the economic efficiency of eggplant cultivation in greenhouses, investigating the differences between the organic and conventional farming systems, with forecasts for the year 2024/2025.

MATERIAL AND METHOD

The working methodology focuses on the analysis of the income and expenditure budgets for eggplant cultivation in greenhouses, differentiated according to the technologies used, the way production factors are allocated and the yields obtained per surface unit. This approach offers the possibility to compare the two farming systems - conventional and ecological -, highlighting the economic results specific to each system. The production technologies for eggplant cultivation in greenhouses in conventional and organic farming systems have been adapted according to the existing resources and conditions in the vegetable basin in the Buzău area. The estimates were made for the period 2024/2025. The income and expenditure budgets include all the elements necessary for the economic evaluation of the eggplant cultivation in greenhouses in conventional and ecological systems, including the final technical-economic indicators, such as costs, profitability and price estimates. These indicators are essential in evaluating the economic efficiency of each individual system.

RESULTS AND DISCUSSIONS

I.Analysis of the budget of income and expenses for the cultivation of eggplant in greenhouses in the conventional farming system, estimate 2024/2025

For eggplant cultivation in conventional greenhouses systems, the average production is estimated at 45 tons/ha, which determines a gross production value of 253,236.9 lei (51,169 euros). The estimated price for the domestic market is estimated at 5.63 lei/kg (approximately 1.14 euro/kg). This indicator reflects the gross income obtained from the sale of production, an essential component in the evaluation of profitability (Table 1).

The subsidies represent 4.6% of the production value, having a direct impact on the profitability of the eggplant culture in the conventional greenhouses system. The subsidies planned for 2024/2025 are worth 11,740.6 lei (2,372 euros). Estimates show that, without these subsidies, the net income is 35,818.7 lei/ha (7,238 euros). With subsidies included, the income increases to 47,193.8 lei/ha (9,536 euros/ha).

Total production costs are estimated at 211,030.8 lei/ha (42,641 euros/ha). Of these, variable expenses constitute approximately 61% of total expenses, while fixed expenses represent approximately 39% of the total. This ratio indicates that most costs are directly related to production and may vary depending on production volume.

The analysis of the revenues for the eggplant culture in the conventional greenhouses system shows that the total value of the production is 253,236.9 lei/ha, and by adding the

subsidies of 11,740.6 lei/ha it resultsa gross product of 264,977.5 lei/ha. The taxable income is 42,206.2 lei/ha, representing 15.93% of the gross product, and the net income plus subsidies reaches 47,193.8 lei/ha, (17.81% of the gross product). The rate of taxable income is 20% and the rate of net income + subsidies is 22.4%.

For the 2024/2025 period, the production cost for the eggplant culture in a conventional greenhouses system is 4,689.6 lei/ha, equivalent to 948 euros/ha. The predictable domestic market price is 5,627.5 lei/ha (1,137 euros/ha), which shows that the estimated revenues exceed production costs.

Table 1. Budget of revenues and expenses for eggplant cultivation in greenhouses, conventional system – estimated average production 45,000 kg/ha, calculations per hectare, estimate 2024/2025

Indicators	Value	
	lei	Euro**
A. Value of production, of which:	253,236.9	51,169
B (+). Grants*	11,740.6	2,372
C (=) Gross product	264,977.5	53,542
D (-) Total expenses	211,030.8	42,641
I. Variable expenses	129,282.1	26,123
II. Fixed expenses	81,748.7	16,518
E (=) Taxable income	42,206.2	8,528
E.1(-) Taxes and fees	6,753.0	1,365
F (=) Net income + subsidies	47,193.8	9,536
F.1 (=) Net income	35,453.2	7,164
G. Rate of taxable income	20.0	20.0
H. Rate of net income + subsidies	22.4	22.4
H.1 Net income rate	16.8	16.8
Production cost	4,689.6	948
Domestic market price predictable	5,627.5	1,137

Note:

*Planned grants:

The APIA subsidy planned for 2024 through the National Strategic Plan of Romania (264.32 euros/ha) = BISS: Basic support for income for the purpose of sustainability (97.85 euros/ha), CRISS: Complementary redistributive support for income for the purpose of sustainability (51.42 euros/ha), PD-04: Environmentally beneficial practices applicable to arable land (56.28 euros/ha), Payment for young people farmers (47 euros/ha), ANT-1: Transitional national aid (11.7734 euros/ha);

The planned APIA subsidy for the coupled support for income – Vegetables grown in greenhouses/greenhouses year 2024 = 2,108 euros/ha;

**Euro exchange value: 4,949 lei

Source:processing own calculations

II. Analysis of the budget of income and expenses for the cultivation of eggplant in the greenhouses system in the organic farming system

For the eggplant culture in the ecological greenhouses system, the average production is estimated at 35 tons/ha, which determines a gross production value of 238,791 lei (48,250 euros). The estimated price for the domestic market is 6.83 lei/kg (approximately

1.37 euros/kg). This indicator reflects the gross income obtained from the sale of production, an essential component in the evaluation of profitability (Table 2).

The subsidies represent 5.8% of the production value, having a direct impact on the profitability of the eggplant culture in the ecological greenhouses system. The subsidies planned for 2024/2025 are worth 13,873.6 lei (2,803 euros). Estimates show that, without these subsidies, the net income is 35,453.2 lei/ha (7,164 euros). With the subsidies included, the income increases to 49,692.3 lei/ha (10,041 euros/ha).

Total production costs are estimated at 198,992.6 lei/ha (40,209 euros/ha). Of these, variable expenses constitute approximately 66% of total expenses, while fixed expenses represent approximately 34% of the total. This ratio indicates that most costs are directly related to production and may vary depending on production volume.

The analysis of the revenues for the eggplant culture in the ecological greenhouses system shows that the total value of the production is 238,791.1 lei/ha, and by adding the subsidies of 13,873.6 lei/ha, a gross product of 252,664.7 lei.ha results. The taxable income is 39,798.5 lei/ha, representing 15.75% of the gross product, and the net income plus subsidies reaches 49,692.3 lei/ha, (19.66% of the gross product). The rate of taxable income is 20% and the rate of net income + subsidies is 25%.

For the 2024/2025 period, the production cost for the eggplant culture in the ecological greenhouses system is 5,685.5 lei/ha, equivalent to 1,149 euros/ha. The predictable domestic market price is 6,822.6 lei/ha, equivalent to 1,379 euros/ha, which shows that the estimated revenues exceed production costs.

Table 2. Budget of revenues and expenses for eggplant cultivation in greenhouses, ecological system - estimated average production 35,000 kg/ha, calculations per hectare, estimate 2024/2025

Indicators	Value	
	lei	Euro**
A. Value of production, of which:	238,791.1	48,250
B (+). Grants*	13,873.6	2,803
C (=) Gross product	252,664.7	51,054
D (-) Total expenses	198,992.6	40,209
I. Variable expenses	130,542.7	26,378
II. Fixed expenses	68,449.8	13,831
E (=) Taxable income	39,798.5	8,042
E.1(-) Taxes and fees	3,979.9	804
F (=) Net income + subsidies	49,692.3	10,041
F.1 (=) Net income	35,818.7	7,238
G. Rate of taxable income	20.0	20.0
H. Rate of net income + subsidies	25.0	25.0
H.1 Net income rate	18.0	18.0
Production cost	5,685.5	1,149
Domestic market price predictable	6,822.6	1,379

Note:

*Planned grants:

The APIA subsidy planned for 2024 through the National Strategic Plan of Romania (264.32 euros/ha) = BISS: Basic support for income for the purpose of sustainability (97.85 euros/ha), CRISS: Complementary redistributive support for income for the purpose of sustainability (51.42 euros/ha), PD-04: Environmentally beneficial practices applicable to arable land (56.28 euros/ha), Payment for young people farmers (47 euros/ha), ANT-1: Transitional national aid (11.7734 euros/ha);
The planned APIA subsidy for the Coupled Income Support - Vegetables grown in greenhouses/greenhouses year 2024 = 2,108 euros/ha
Organic agriculture subsidy – maintenance of DR-06 certification = 431 euros/ha
**Euro exchange value: 4,949 lei
Source:processing own calculations

III. Analysis of the economic indicators of synthesis for the cultivation of eggplant in the greenhouses system in conventional and ecological aquiculture system

The evaluation of the economic indicators for the cultivation of eggplant in greenhouses, by conventional and ecological methods, highlights the following conclusions (Table 3):

- The average production per hectare is 45 tons in the conventional system and 35 tons in the organic system, representing a 22% reduction for organic farming.
- The production value per hectare is higher in the conventional system, reaching 253,237 lei compared to 238,791 lei in the organic system, which indicates a difference of approximately 6%.
- Total production expenses are higher in the conventional system (211,031 lei/ha) compared to the organic system (198,993 lei/ha), resulting in a 6% decrease in expenses for the organic system.
- The variable costs are lower in the conventional system (129,282 lei) compared to the ecological one (130,543 lei), with a difference of approximately 1%. The expenses for raw materials and consumables are 95,367 lei for conventional and 99,141 lei for organic, marking an increase of 4% in the case of organic culture.
- The unit production cost is 4.69 lei/kg for the conventional system and 5.69 lei/kg for the organic system, indicating a 21% increase in organic farming.
- The recovery price for eggplant is higher in organic farming, reaching 6,823 lei/ton, compared to 5,628 lei/ton in the conventional system, which represents a difference of 21%.

Table 3. Economic indicators of synthesis for eggplant cultivation in greenhouses, conventional and ecological system – 2024/2025 estimate

Economic indicators of synthesis	Conventional	Ecological	deviations	
			UM	%
Average production per ha (to/ha)	45	35	-10	78
Production value per ha (lei/ha)	253,237	238,791	-14445.8	94
Production expenses per ha (lei/ha)	211,031	198,993	-12038.2	94
Variable expenses (lei)	129,282	130,543	1260.6	101
Raw materials and materials (lei)	95,367	99,141	3774.3	104
Permanent labor costs (lei)	72,340	59,420	-12920.2	82
Fixed expenses (lei)	81,749	68,450	-13298.9	84
Unit production cost (lei/kg)	4.69	5.69	1.0	121

Economic indicators of synthesis	Conventional	Ecological	deviations	
			UM	%
Capitalization price (lei/ton)	5,628	6,823	1195.1	121
Labor productivity in physical expression (man-hours/ton)	45.2	64.0	18.8	142
Profit or loss per production unit (lei/ha)	42,206	39,799	-2407.7	94
Profit or loss per product unit (lei/ton)	938	1,137	199.2	121
Rate of return (%)	20	20	0	100
The profitability threshold in value units (lei)	167,011	150,997	-16013.4	90
The profitability threshold in physical units (to)	29.7	22.1	-7.6	74
Exploitation risk rate (%)	66.0	63.2	-2.8	96
Security Index (Is)	0.3	0.4	0.1	133

Source: processing own calculations

- The profit per product unit is higher in the organic system (1,137 lei/ton) compared to the conventional one (938 lei/ton), suggesting a profit of 21% for the organic system.

- The break-even point is lower in the ecological system both in value units (150,997 lei) and in physical units (22.1 tons), which indicates a 10% and 26% lower break-even point respectively

- The operating risk ratio is an indicator that estimates the financial stability and ability of an agricultural holding to cope with market fluctuations and unforeseen expenses. For the conventional system, the operating risk rate is 66%, which means that 66% of the revenues obtained are needed to cover fixed and variable expenses. This indicates moderate vulnerability to market changes and variations in production costs. For the ecological system, the exploitation risk rate is 63.2%, suggesting a slight improvement in financial stability compared to conventional methods. In this case, 63.2% of the earned income is needed to cover expenses, which indicates a better ability to withstand market fluctuations and unforeseen costs.

- The safety index is a financial indicator used to assess economic stability and the ability of a business to withstand external fluctuations, such as changes in prices, costs or unpredictable income. For the conventional cropping system, the safety index is 0.3 which indicates a lower level of financial stability compared to the organic system. For the ecological system the safety index is 0.4, which shows a greater capacity to manage risks and vulnerabilities, reflecting a 33% higher financial stability

CONCLUSIONS

The comparative analysis of the economic efficiency of the cultivation of eggplant in greenhouses within the two farming systems – conventional and organic – emphasizes the importance of farmers' adaptation to market needs and environmental challenges. In the context of a growing demand for organic food products and policies increasingly favorable to organic farming, farmers need to adjust their strategies and invest in innovative technologies. These initiatives not only support sustainability and environmental protection, but also contribute to increasing competitiveness in an increasingly demanding market.

Production costs are important in assessing the viability of each type of farming system. Consequently, the total production expenses in conventional agriculture involve higher

costs (211,030.8 lei/ha) compared to organic agriculture (198,933 lei/ha), which represents a difference of 6%. Variable expenses represent an important share of the total costs, constituting 61% in the conventional system and 66% in the ecological one.

Another important factor in ensuring the economic viability of both farming systems is subsidies. The analysis showed how much they influence the net income and profitability of farmers, having a significant impact on the activities of the vegetable sector.

Although production and production value are higher in the conventional system, the organic system stands out with higher net income and profitability due to higher selling prices and subsidies allocated. Thus, the net income including subsidies in the ecological system is 5.29% higher compared to that in the conventional system. In terms of profitability, the ecological system turns out to be more economically advantageous, with a percentage of 25% compared to 22.4% in the conventional system.

Finally, the estimated analysis of the synthetic economic indicators for eggplant culture in greenhouses, bouth conventional and ecological systems, underlines the role of subsidies in improving the profitability and sustainability of the vegetable sector. The study shows that, through adequate financial support, high costs can be balanced and the promotion of ecological practices becomes much more accessible to farmers.

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BERRIES - BENEFITS FOR HUMAN HEALTH AND THE CIRCULAR ECONOMY

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Abstract: *The aim of this paper is to explore the evolution of the market for berries and their benefits, both fresh and processed. The market for fresh berries is reserved for high quality berries and is growing. For the other qualities there is a whole food industry producing valuable products. The recovery of valuable compounds from the by-products of the juice industry (tescovine) contains phytochemicals important for human health. This process leads to a chain closure of the food industry's secondary chains, specific to the circular bio-economy.*
Keywords*: berries, market, valorisation*
JEL classification: Q 11, Q 12.

INTRODUCTION

Bilberry (Vaccinium myrtilus) is a fruit-bearing shrub, mainly found in mountainous areas. Its fruits contain antibacterial, antiseptic substances and are a natural equivalent of insulin. The fruits contain many minerals and vitamins. and retain their qualities even frozen.

Raspberry (Rubus idaeus) is a shrub that grows wild in temperate countries. The fruits have a specific flavor, are rich in organic acids, vitamins, carotene, copper, iron, iron, potassium, magnesium and phosphorus.

The blueberry was first cultivated in North America in 1890, and in Europe since 1930. In Romania, the first cultivation was established in 1968 at the Bîlcești Argeș research base (Nicolae Tănăsescu, 2005). It makes good use of acid soils with a pH between 4.2 and 4.8.

The UN has declared blueberries one of the five healthiest foods for humans. For the industry, researchers are focusing on minimizing the negative consequences of processing conditions.

Thermally, raspberries have moderate requirements but are water-demanding. It needs humus-rich, permeable soil with a pH between 5.6 and 6.5.

MATERIAL AND METHOD

Relevant literature on the crop's agro-technical characteristics was consulted. A literature searches specific to processed products was carried out using PubMed, Google Scholar databases. Various relevant reports and journal websites were also consulted.

RESULTS AND DISCUSSIONS

Blueberries can still be productive 30 years after planting. One blueberry plant can produce up to 8 kg of fruit at maturity if well maintained. In the last 6 years, production is estimated to have increased by 172% in Europe (Table 1).

Table 1. Evolution of supply of blueberries grown in Europe, thousand tons

	2015	2016	2017	2018	2019	2020	2021	2021/2015
Europe*	61,1	66,92	86,48	106,32	133,98	154,58	166,25	172%
Spain	21,06	24,95	35,36	43,52	53,38	48,52	61,23	191%
Poland	14,10	14,72	16,34	25,30	34,77	54,10	55,40	293%
Portugal	4,44	6,57	9,84	11,06	15,16	15,42	17,14	286%
Germany	11,95	10,71	13,81	12,76	14,85	11,30	15,64	31%
Netherlands	7,37	7,70	8,30	9,30	11,06	9,20	8,50	15%

Source: Eurostat, (* including estimations)

In 2021 world cranberry production was 1,113,261 tons.

Table 2. World blueberry production, tons-2021

	Blueberry production - tons	% of total
SUA	351.130	32%
Peru	227.971	20%
Canada	146.551	13%
Chile	122.795	11%
Mexic	66.482	6%
Spania	61.230	6%
Total lume	1.113.261	100%

Source: FAOSTAT

In 2021 world raspberry production was 887 thousand tons. Worldwide there are four major producers, which account for more than 64% of production (Table 3)

Table 3. World raspberry production, thousand tons-2021

	Raspberry production - tons	% of total
Rusia	198	22%
Mexic	166	19%
Polonia	104	12%
SUA	101	11%
Total lume	887	100%

Source: FAOSTAT

The global blueberry market is expected to grow at a considerable pace during 2023-2030. Health-conscious customers prefer foods containing blueberries. Health food products, for example yogurt, are preferred as they are lower in fat and lower in calories and are also a rich source of protein and calcium. The upward market trend is also driven by growing demand for fruit-based drinks.

In our country there is no statistical data on blueberry production, the information being taken from various sources on the internet. It is estimated that over 2000 hectares are cultivated in Romania. Romanian blueberry growers do not manage to sell through the big stores, only through agri-food markets or to various intermediaries. To be exported, the blueberries must

meet certain conditions: 14-22 mm, they are harvested in suspended crates and stored in cold rooms.

According to ZF Romania exported in 2020 almost 7000 tons of berries worth €25 million, the amount of blueberries being 2000 tons. We have chosen, as an example, two producers of cultivated blueberries in Brașov county.

AGROINTENS S.A. - BRAȘOV COUNTY

- owns two farms, 60 ha, 22 employees;
- is GAP (GLOBALGAP) certified, an internationally accepted and retailer recognized standard for primary production covering the entire production process up to the departure of the product from the plantation and from there to the processing facilities and from there to the final consumer;
- packaging capacities (125g to 2,5 kg);
- has fresh fruit storage capacity;
- cooperates with major companies that ensure optimal transportation of fresh blueberries.

Table 3. Economic data of AGROINTENS S.A. company

Year	Turnover	Net profit	Debts
2022	11.143.742	0	12.700.980
2021	8.078.048	0	8.314.937
2020	8.215.102	0	9.344.903

Source: termene.ro

AFIN LUCRI SRL – BRAȘOV COUNTY

- works under the VALEA CU AFINE brand, currently distributed through METRO
- is GAP certified
- production, packaging and marketing
- processing and packaging
- logistics services related to the affine trade
- advice and support in setting up and developing a plantation, marketing fresh fruit

Table 4. Economic data of AFIN LUCRI SRL company

Year	Turnover	Net profit	Debts
2022	544.114	196.821	897.555
2021	401.225	13.268	990.639
2020	412.443	124.461	723.335

Source: termene.ro

Table 5. The price paid by the consumer when buying online from the manufacturer and the trader

Product	Price/UM online trade directly from the manufacturer including transportation (29,99 lei)	Price/UM at retailer including transportation (10 lei)	Conclusion
Organic dried blueberries - 100 g	52,49	32,5	Disadvantage buying from the producer
Organic cranberry juice - 350 ml	23,33	29,00	Disadvantage buying from the producer

Source: www.merryberry.ro; www.comenzi.farmaciatei.ro

There are other companies that capitalize on the fruits of wild flora. Biodac is a company from Timisoara specialized in the production and marketing of jams and jams, etc. It offers pasteurized products without preservatives, for example blueberry jam 340g at a price of 25 lei/jar (Table 6).

Table 6. Economic data of AFIN LUCRI SRL company

Year	Turnover	Net Profit	Debts
2022	23.791	0	83.799
2021	51.798	3.230	90.493
2020	26.378	0	97.875

Source: termene.ro

The content of antioxidants, vitamins and other elements is particularly important.

A study carried out in Poland using samples from wild flora and samples from cultivated blueberries determined the concentration of 13 elements. Higher levels of Ca, Na and Mg were observed in fruit picked from the forest. Similar levels of Cu, Cr, Fe and Ni were detected in both wild and cultivated plants. The significantly higher Fe and Cd content in cultivated blueberries was related to the metal content of soil samples collected from the same sites.

Table 7. Element content of different cranberry samples mg/kg (mean+ SD, n=3) (W-wild, C-grown)

	Al	Ca	Cd	Cr	Cu
W1	14,8 ± 0,55a	185 ± 9,7a	0,004 ± 0,0003a	0,039 ± 0,002a	0,31 ± 0,017a
W2	12,4 ± 0,60b	164 ± 7,9b	0,002 ± 0,0001b	0,174 ± 0,008b	0,26 ± 0,012b
W3	15,1 ± 0,67a	203 ± 8,9ac	0,001 ± 0,0005c	0,023 ± 0,001c	0,24 ± 0,013b
W4	16,3 ± 0,73a	192 ± 8,7ac	0,003 ± 0,0001d	0,084 ± 0,004d	0,41 ± 0,016d
C1	13,3 ± 0,91	112 ± 5,1d	0,013 ± 0,0006e	0,033 ± 0,006e	0,28 ± 0,011abce
C2	17,9 ± 0,8	162 ± 6,1b	0,04 ± 0,0015f	0,014 ± 0,001e	0,32 ± 0,014ac

	Fe	K	Mg	Mn
W1	8,38 ± 0,33a	880 ± 27a	84,2 ± 6,92a	17,1 ± 1,03a
W2	7,82 ± 0,39a	1036 ± 51b	75,1 ± 3,09a	5,82 ± 0,16b
W3	5,31 ± 0,25b	1090 ± 52b	96,9 ± 2,11b	29 ± 1,35c
W4	12,7 ± 0,64c	1105 ± 53b	90,1 ± 3,42b	18,5 ± 0,88a
C1	5,44 ± 0,27d	825 ± 15a	51,4 ± 2,60c	4,47 ± 0,03d
C2	10,7 ± 0,52d	1031 ± 28b	48,1 ± 2,07c	2,94 ± 0,015e

W- sălbatic
C- cultivat

	Na	Ni	Pb	Zn
W1	52,7 ± 1,93a	0,26 ± 0,019ε	0,556 ± 0,063a	6,07 ± 0,75a
W2	54,0 ± 1,78a	0,25 ± 0,012ε	0,373 ± 0,018b	5,26 ± 0,26ab
W3	54,9 ± 2,03a	0,25 ± 0,011ε	0,266 ± 0,013b	4,22 ± 0,17bcd
W4	61,6 ± 2,97b	0,31 ± 0,015t	0,396 ± 0,018ab	3,83 ± 0,15c
C1	48,1 ± 2,12c	0,17 ± 0,008ε	0,276 ± 0,014b	2,95 ± 0,15ce
C2	49,2 ± 2,63c	0,3 ± 0,015ε	0,315 ± 0,015b	3,79 ± 0,15ce

Source: Paulina Drozd et al, 2018

Colour is one of the major attributes affecting consumer perception. A study on the influence of light as a function of anthocyanin concentration in blueberry fruit shows the properties of natural nontoxic colorant extracted from fresh blueberry (Vaccinium Myrtillus) fruit under the influence of different types of light (Table 8). The colours were measured in CIELAB system using a standard white. The samples differed in dye concentration (M. Pop et al, 2010)

Table 8. Anthocyanin content in the analysed samples of blueberries

	A1	A2	A3	A4	A5
Anthocyanin content (mg/mL)10^{-3}	0,86	1,23	1,65	2,36	4,78

Source; M. Pop et al, 2010

The authors concluded that the brightness is quite independent of the nature of the standard light source (D65 daylight simulator, colour temperature approx. 6500 K). The standard light F2 (cold white fluorescent simulator) and A (incandescent bulb simulator, colour temperature approx. 2856 K) cause small colour shifts that shift slightly towards yellow and red respectively (M. Pop et al, 2010).

The scientific community is exploring new ways to capitalize on blueberries. For example, the potential health benefits of fermented blueberry are being explored. A review of the current scientific evidence presents a thorough understanding of cranberry polyphenols and the role of fermentation in increasing their bioavailability, with further studies expected to provide a much clearer perspective on fermentation as a value-add (Nilushni Sivapragasam, 2023).

Another study evaluated the bioavailability of phenolic substances and plasma antioxidant capacity in vivo after consumption of blueberries with and without whole milk. The results show that the ingestion of blueberries in combination with milk affects the in vivo antioxidant properties of blueberries and reduces the absorption of caffeic acid, (Mauro Serafini et al., 2008).

The role of fibres in digestion is well known. It is important to note that insoluble fibres are usually better for preventing constipation because they do not ferment in the intestines. Soluble fibres ferment in the stomach producing bloating and gas (Anna-Marja Aura et al., 2015). Tescovin from the cranberry and raspberry juice industry is a valuable by-product, rich in polyphenols, dietary fibres, vitamins, minerals and unsaturated fatty acids. In a study on healthy women, 30% of gluten-free flour used in cakes was replaced with dried and ground blueberry and raspberry tescovin. It was observed significant changes in the composition of serum phospholipids of fatty acids, decrease of LDL cholesterol level (20,16%,) increase of adiponectin level (25,52%) and decrease of ALT and AST - liver enzymes (Popovic T et al. 2022). In a randomized study, 59 overweight or abdominal obese subjects with mild hyperinsulinemia or hypertriglyceridemia consumed daily 280g/day of frozen raspberries with maintenance of usual diet for 8 weeks. Several functional pathways were enriched following dietary supplementation with raspberries, a major part of which were involved in the regulation of cytotoxicity, cell trafficking, protein signal transduction and interleukin production; 10 serum metabolites were significantly altered. The study demonstrated that a raspberry-rich diet positively impacts immunity and phospholipid metabolism (Maxillien Franck et al, 2020).

In vitro and in vivo studies have revealed different mechanisms by which anthocyanins and elegitannins from red raspberries and red raspberry extract might reduce the risk of developing or reverse metabolically associated pathophysiological pathophysiologies (Burton-Freeman et al, 2016).

Treatment with cranberry phenolic extract has also been shown to ameliorate genetic and diet-induced metabolic syndromes (Guo J. Han et al, 2019), and in vitro studies have shown the ability of cranberry extract to inhibit the growth and decrease of cell adhesion and migration of various cancer cell lines in vitro (Lamdan H, et al 2020).Biological properties of cranberry include neuroprotective effects through antioxidant and anti-inflammatory actions; cranberry extract has antidepressant-like effects (Luiza Spohr et al, 2022)

Table 9. Changes in blueberry fruit quality in terms of selected bioactive compounds and quality properties depending on a pretreatment and processing method

Pre-Treatment Method		Influence on the Product Quality	Reference
Storage	Modified atmosphere	Total phenolics (↑)	[74]
		Antioxidant capacity (–)	[8]
		Vitamin C (–)	[76]
Thermal	Freezing	Total phenolics (↑)	[71]
		Total anthocyanins (–)	[69]
		Delphinidin glucoside (↑)	[77]
	Blanching	Total anthocyanins (↑)	[83–85]
		Total anthocyanins (–)	[36,69]
		Antioxidant capacity by ORAC (↓)	[36,69]
Mechanical	Cutting (halves/quarters)		
	Scarification		
	Abrasive skin removal	Total phenolics (↓)	[86]
		Vitamin C (↓)	[46]
Chemical	Chemical substances	Organoleptic properties (↓)	[87]
	Natural substances	Total phenolics (–)	[88,89]
		Total anthocyanins (–)	[88,89]
		Antioxidant capacity (–)	[88,89]
Processing Methods		**Influence on the Product Quality**	**Reference**
Juicing		Total monomeric anthocyanins (↓)	[69,70]
Dehydration	Osmotic dehydration	Total phenolics (↓)	[8,90]
		Total anthocyanins (↓)	[90]
	Freeze-drying	Vitamins A, C and niacin (↑) *,**	[11]
		Polyphenols (ellagic acids, quercetin, naringin, kaempferol) (↑) *,**	[11]
		Antioxidant capacity (↑) *,**	[11]
	Hot air drying	Total phenolics (↓) ***	[11]
		Total anthocyanins (↓) ***	[11]
		Antioxidant capacity (↓) ***	[11]
	Fluidized bed drying	Total phenolics (↓)	[91]
		Total anthocyanins (↓)	[91]
	Heat pump drying	Total monomeric anthocyanins (↑)	[92]
	Vacuum drying	Volatile compounds (↑) **	[93]
		Total phenolics (↑) **	[93]
		Total anthocyanins (↑) **	[93]
	Radiant zone drying	Total phenolics (–) ***	[94]
		Total anthocyanins (–) ***	[94]
		13 Identified anthocyanins (–) ***	[94]

Source: Anna Michalska - Ciechanowska, Grzegorz P. Lysiak, 2015

Researchers' attention has been extended to improving the nutritional aspects and, at the same time, to mitigating the negative consequences of processing conditions. Some results are contradictory, with the authors concluding that a thorough analysis at the molecular level of the blueberry components is needed.

CONCLUSIONS

Researchers' attention on blueberries and raspberries has been directed towards improving the nutritional aspects and at the same time, minimizing the negative consequences of processing conditions. Regarding the changes undergone by processing some results are contradictory, the authors conclude that a thorough analysis at the molecular level of the blueberry components is needed.

Tescovin from the cranberry and raspberry juice industry is a valuable by-product, rich in polyphenols, dietary fiber, vitamins, minerals and unsaturated fatty acids. Being a product rich in insoluble fibers, they close the production cycle through their use in food.

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SUSTAINABLE DEVELOPMENT OF THE VEGETABLE SECTOR IN THE CONTEXT OF ENSURING FOOD SECURITY IN THE REPUBLIC OF MOLDOVA

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Abstract: *The vegetable sector of the Republic of Moldova plays an important role in ensuring the food security of the population. The physical availability and economic access to vegetables are of particular importance for provision of the population with the necessary dietary norms. In the context of the more acute effects of climate changes, the sector faces important challenges in its development, and more issues – in ensuring its sustainability. The paper aims to analyze the current state of the vegetable sector of the Republic of Moldova and provide recommendations for its further sustainable development in the context of ensuring food security of the country. The methods applied are the analytical ones, synthesis and comparison, aimed at describing the sector's evolution. The paper concludes that the underdevelopment of the vegetable sector is affecting the food security in a specific way, especially the vulnerable groups of the population, and important steps are to be taken in order to efficiently contribute to increasing its added value through development of the processing branch, organic agriculture, production of frozen vegetables, introducing new varieties of vegetables and creation of profile associations aimed at representing the interests of producers.*
Keywords: *agriculture, vegetables, Republic of Moldova, food security, sustainable development*
JEL classification: Q01, Q18

INTRODUCTION

Taking into account the most recent crises that the Republic of Moldova is facing nowadays, which are related to geopolitical situation, climate changes, input price increases, scarcity of water resources, etc., ensuring the food security of the population becomes an important imperative for the agricultural policy decision makers. They are the ones who have an important influence on the development of the agricultural sector and the economy and general (Istudor et al, 2014) and are among the responsible ones for ensuring population with necessary and qualitative food products.

Food security arises from a series of existing prerequisites which are based on the five pillars like availability – meaning the production, supply, imports, etc.; access – analyzed in terms of financial access to food products; utilization – safety and qualitative aspects; stability – constant availability; sustainability – production and use of resources over time (Balan et al, 2022). All the five components mentioned have a great contribution to the development of an integrated food security system.

Vegetable consumption represents an important aspect in ensuring food security, as well as the wellbeing of population in general and takes the pressure off the healthcare system, to a certain extent. The nutritional security offered by vegetables in the shape of vitamins, minerals, proteins and fibers contributes to reducing risks for emergence of some diseases (Noopur et al, 2023) and to maintenance of a good level of health (Keatinge et al, 2011).

During the years, for the Republic of Moldova, growing of vegetables has represented an important occupation for rural population, as a form of ensuring the own household with

necessary provision, as well as gain some economic benefits during the season of vegetable harvest. Therefore, combination of economic benefits from growing vegetables and nutritious aspects of their further consumption represents the key for a balanced development of the vegetable sector. At the same time, reduction of arable land per inhabitant (Racovita, 2023), as well as of the soil quality contribute to the diminish of the vegetable production and growing of limited traditional varieties, with a low degree of penetration of innovation and technology transfer.

Taking into account the importance of the vegetable sector in ensuring food security, the paper aims to analyze the current state of the vegetable sector of the Republic of Moldova and provide recommendations for its further sustainable development.

MATERIALS AND METHODS

The quantitative data used for assessment of the development of the vegetable sector in the context of ensuring food security in the Republic of Moldova has been extracted from the database of the National Bureau of Statistics, UN Comtrade and WITS database. For a better presentation of the evolutions of the sector, time series included in the analysis begin with 2005 for some indicators and 2015 for others, and end with the most available period – 2023. The paper is analyzing indicators related to vegetable production, sown areas, external trade, consumption and self-sufficiency levels.

At the same time, the sector is analyzed through the five pillars of the food security, namely: availability, access, utilization, stability and sustainability – the most recently introduced pillar.

Calculation of the Revealed Comparative Advantage has been added in order to assess the competitiveness of Moldovan vegetables at the international level and SWOT analysis has been performed for pointing on the strengths, weaknesses, opportunities and threats for the sector's sustainable development.

RESULTS AND DISSCUSION

The vegetable sector of the Republic of Moldova is to be further analyzed in terms of the five pillars of the food security: availability, access, utilization, stability and sustainability.

Availability

For assessing the degree of ensuring food security in terms of physical availability of vegetables, important indicators have been approach, such as sown areas, production, consumption, self-sufficiency level and foreign trade.

During 2005 – 2023, the sown area with vegetables has undergone important changes, with the minimum level of 28 thous. ha reached in 2015 and the maximum of 39,7 thous. ha in 2020. The last 5 years are marked with a general stabilization of indicators for sown area with vegetables in the open field, with significantly higher values that during the period of 2015 – 2018. The share of field vegetable areas in the sown areas in the country varies between 1.9% in 2015 and 2.5% in 2023.

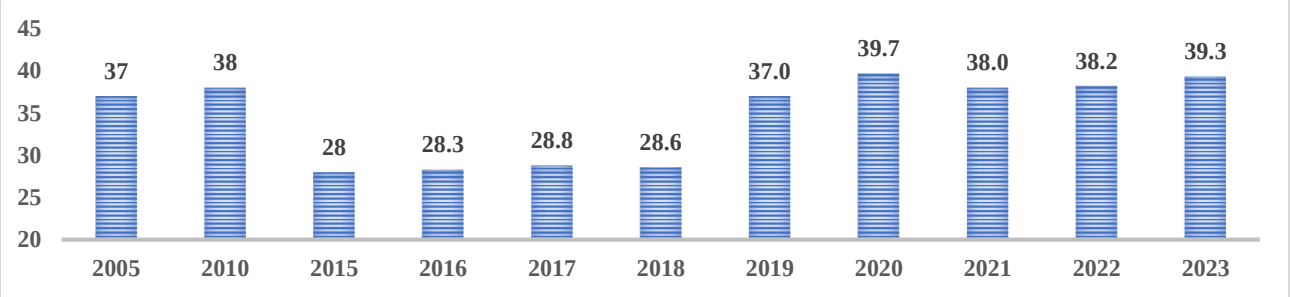

Figure 1. Sown area with vegetables in the Republic of Moldova, thous. ha

Source: developed by author based on (National Bureau of Statistics, 2024)

At the same time, by types of producers, the share of sown areas in agricultural enterprises has decreased from 21.6% in 2005 to 7.6% in the total vegetable areas in 2023 (or from 8 thous. ha to 2,5 thous. ha). On the opposite side, there is noted an increasing trend for growing vegetables within households from 78.4% in 2005 to 81.7% of the total sown area in 2023 (or from 29 thous. ha to 31,8 thous. ha). The remaining surface (3.9 thous. ha in 2023) belongs to peasant farms.

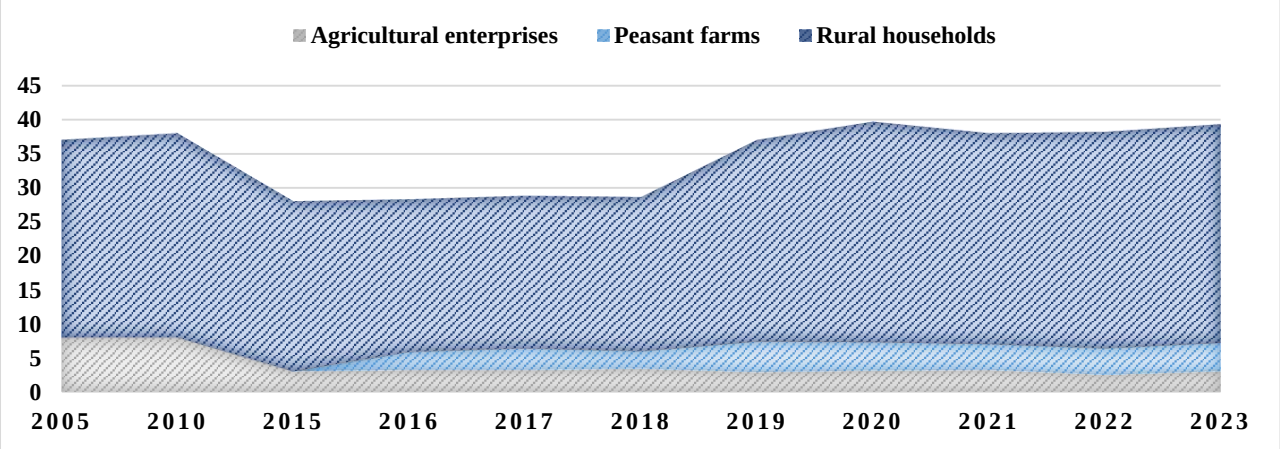

Figure 2. Sown area with vegetables in the Republic of Moldova by types of producers, thous. ha

Source: developed by author based on (National Bureau of Statistics, 2024)

Although the sown area with vegetables has relatively stable values in the last years, with an important increase with respect to 2018, production of field vegetables during 2005 - 2023 has decreased from 384 thous. tons to 269,7 thous. tons. In 2023, the field vegetable production is concentrated in rural households, with a share of 63% of total vegetable production and 169,8 thous. tons (compared to 83,9% and 323 thous. tons in 2005). In agricultural enterprises, production decreased from 61 thous. tons in 2005 to 58.4 thous. tons in 2023, but the share has changed from 15,8% to 21,7% in the same period. The main causes for the diminish of production volumes, especially in rural households are the lack of innovation and technologies in the field, poor management, lack of irrigation, insufficient association in the sector, old or traditional agricultural practices and others.

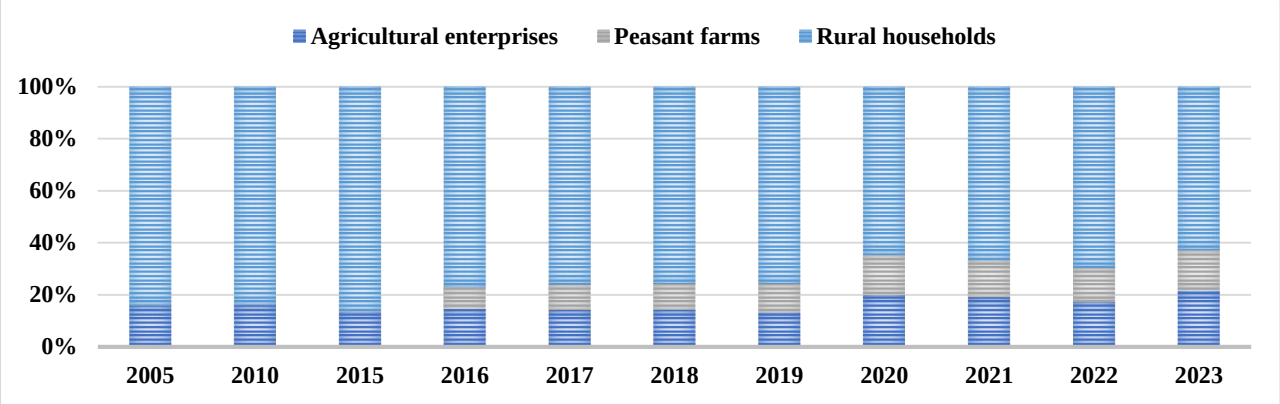

Figure 3. Share of vegetable production by types of producers, %

Source: developed by author based on (National Bureau of Statistics, 2024)

The level of self-sufficiency with vegetables is continuously decreasing, thus accounting for values below 100% during 2016 – 2022. In 2022 it reached the figure of 81%. At the same time, as a positive trend for the population, as well as for the healthcare system, the vegetable consumption is increasing from 94.7 kg per capita in 2016 to 118.7 kg per capita in 2022.

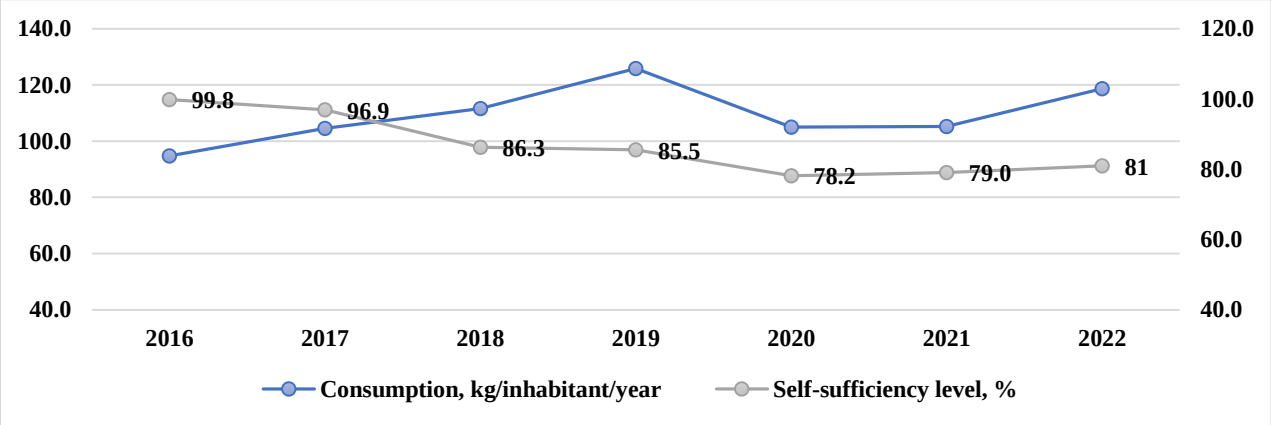

Figure 4. Consumption and self-sufficiency level for vegetables

Source: developed by author based on (National Bureau of Statistics, 2024)

During 2015 – 2023, the foreign trade with vegetables has a net negative trade balance, with some important periods of accentuation of the trade deficit during 2020, 2022 and 2023. The exports of all types of vegetables have increased by 19.7%, while imports – by about 3.5 times (from 25528.4 thous. USD to 89603.6 thous. USD). The trade deficit accounted for its maximum value of -78612,5 thous. USD in 2023. Due to the limited varieties of vegetables produced in the Republic of Moldova, their seasonality and insufficient quantities, imports have a constant increasing trend in the last years.

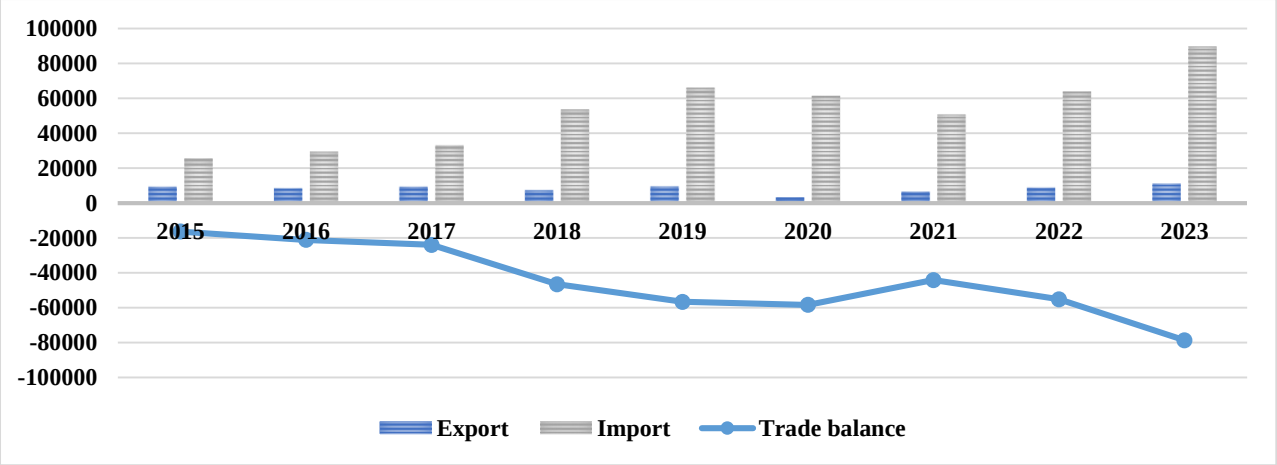

Figure 5. Foreign trade with vegetables, thous. USD

Source: UN Comtrade, Database, 2024

As for the foreign trade partners by countries, during 2018 and 2023, the Republic of Moldova exported small quantities of vegetables to Ukraine, Romania, United Arab Emirates, North Macedonia, the Netherlands, Italy and other countries.

Imports of vegetables during the same period have been mainly from Turkey, Ukraine, Belarus, the Netherlands, Romania, Spain, Russian Federation and Poland.

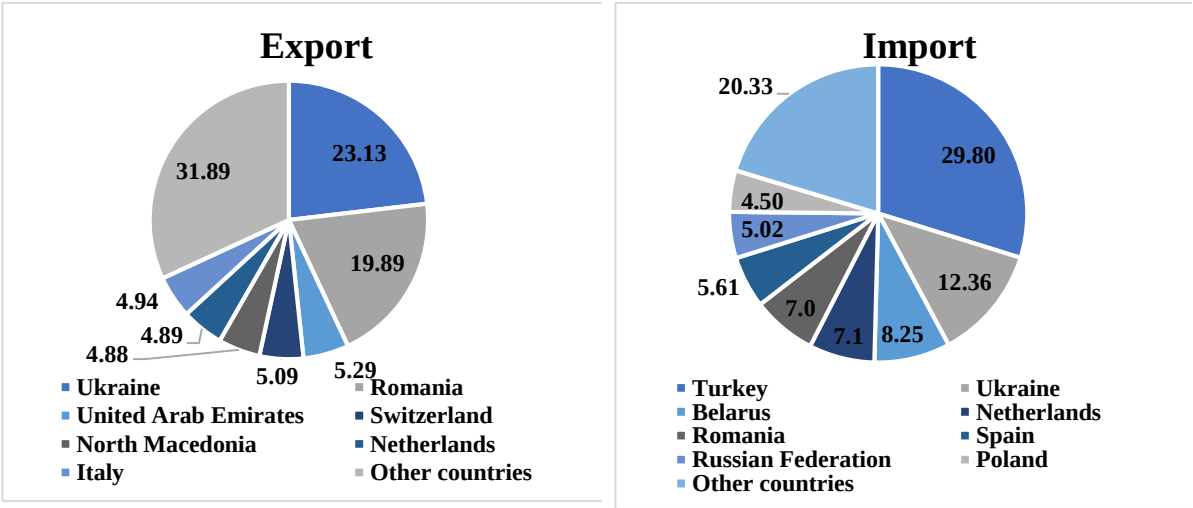

Figure 6. Main economic partners for foreign trade with vegetables, 2018 – 2023, %

Source: UN Comtrade, Database, 2024

In order to evaluate the competitiveness of Moldovan vegetables at the international level, the RCA indicator has been approached and calculated. Values less than 1 mean a low degree of competitiveness or its absence. Therefore, during 2025 – 2023, RCA values fluctuate between 1,1 and 0,6 (minimum value of 0.3 reached in 2020) pointing on the lack of competitive advantage of Moldovan vegetables with respect to the world countries.

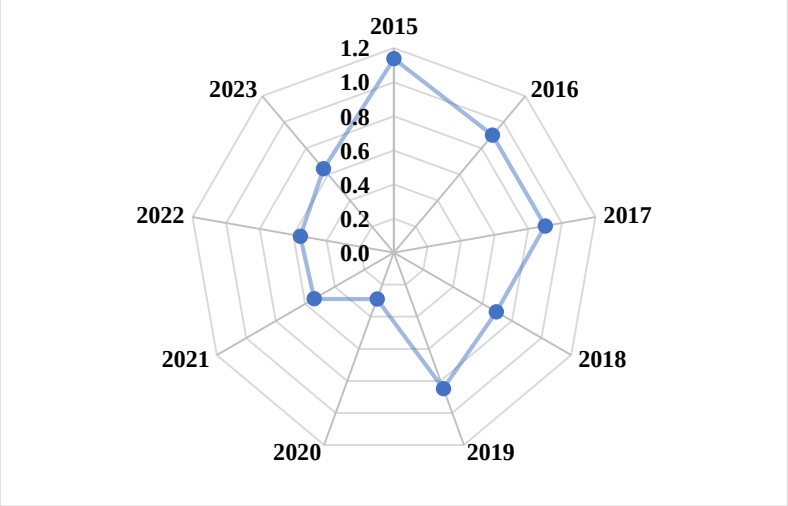

Figure 7. RCA values for vegetables with respect to world countries, 2015 – 2023
Source: developed by author based on (World Bank, 2024)

At the same time, availability of vegetables may also be affected by a series of factors like introducing of specific phytosanitary measures, insufficient use of organic fertilizers, soil degradation, unbalanced quantities of microelements in soil, lack of drought resistant varieties, etc. (Soldatenko et al, 2019).

As a result of the carried-out analysis, due to the current challenges, the low level of production and the low self-sufficiency rate, the physical availability of vegetables can be qualified as *partially satisfactory*.

Access

Between 2014 and 2023, vegetable prices have increased from 3201 MDL per ton to 5856 MDL per ton. The rising food prices have a great impact on the financial situation of population and their capacities of affording certain types of products (Sakovici & Cazacu, 2022). The most dramatic increase in price index for vegetables was in 2022, when, as a result of a series of endogenous and exogenous factors, the indices have reached 155,2% compared to the previous year.

Based on the relatively low consumption of vegetables among population and self-supply in rural areas, economic accessibility can be assessed as *satisfactory*. However, the population in low-income urban areas is one of the most affected by the price increases in vegetables and their food security is put at risk.

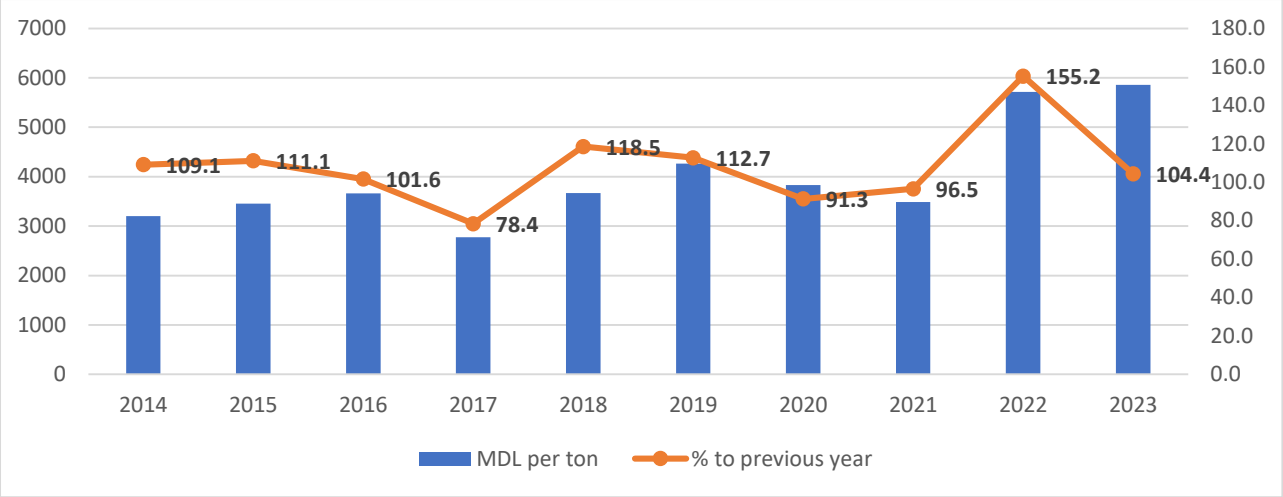

Figure 8. Prices and indices of prices for vegetables

Source: developed by author based on (National Bureau of Statistics, 2024)

Utilization

Compliance with the food safety standards and requirements is of particular importance when discussing about vegetable products. Meeting quality requirements and sanitary standards is done through a certificate of conformity issued by the National Food Safety Agency. Nevertheless, taking into account that the lion's share of production of vegetables belongs to rural households and large quantities are sold in open air markets, the lack of certification of products imposes certain concerns in terms of ensuring a safety use of vegetables by the population, especially in rural areas.

Stability of vegetable production supposes the cumulative existence of the 3 above-mentioned pillars. Due to the low productivity levels (Staver & Erhan, 2023), relatively good access and some issues in utilization with respect to food safety requirements, as well as the influence of other exogenous factors, the stability for vegetables can be assessed as partially satisfactory.

Sustainability of vegetables takes the shape of production in adequate and necessary quantities, for ensuring food security, taking into account qualitative aspects of safety standards, with a sustainable food consumption, reduction of food waste and without having a negative effect on the environment (Juroszek et al, 2008).

In the Republic of Moldova, issues of sustainability are only recently addressed and the perspectives for actions for its improving are still to be assessed and forecasted. The vegetable sector in the Republic of Moldova has a sustainable future once the development of a framework of adequate conditions for its evolution. Effects of climate changes and current intensive agricultural practices will impose to adopt in the future sustainable models of production that will satisfy both, producers' and consumers' needs.

The following SWOT analysis is to summarize the above-mentioned aspects in vegetable insurance of security and presents opportunities for a better and sustainable development of the sector.

Table 1. SWOT analysis for the vegetable sector of the Republic of Moldova

Strengths	**Weaknesses**
- Existing national and international demand for vegetables as nutritional products and their special importance in nutrition (due to vitamins, minerals, fibres, etc.); - Availability of public support for growing of vegetables on protected fields and greenhouses; - Proximity to EU market; - The significant role they play as a staple product in ensuring food security.	- A sector in decline in term of production and increased competitiveness from vegetable imports; - Concentration of production in rural households; - Seasonality of most vegetables produced in open field; - An insufficient number of greenhouses, solarium, tunnels for ensuring a better self-sufficiency level; - Unstable domestic market, with fluctuating prices; - Underdeveloped irrigation and marketing infrastructure.
Opportunities	**Threats**
- Ensuring a strategic level of self-sufficiency in vegetables; - Developing the frozen vegetable sector, processing sector, organic production etc. - Opening new opportunities through new crops: lettuce, parsley, etc. - Associating vegetable growers in product associations; - Stimulation of involvement of youth in women in the sector.	- Uncertain and negative climatic conditions; - Growing prices for inputs: - Unfair competition from countries in the region; - High costs for introducing HACCP and Global GAP standards.

Source: developed by author based on (Lucasenco, 2024)

CONCLUSIONS

Vegetable growing plays an important role in the agriculture of the Republic of Moldova, especially due to the impact of this branch on ensuring the country's food security and their special importance in the nutrition of the population.

Taking into account insufficient development of the sector, confirmed by a low level of self-sufficiency, it becomes necessary to revitalize the vegetable growing of the Republic of Moldova, both in the open field and in greenhouses. Also, in the Republic of Moldova there are natural climatic and soil conditions quite favorable for organic farming with vegetables. Over the past few years, the share of organic farming in the agricultural system has been increasing. Therefore, it may have a great contribution to long-term economic development and play an important role in improving the environmental condition, soil preservation, improving water quality, biodiversity and nature protection.

At the same time, the underdevelopment of the vegetable sector is affecting the food security in a specific way, especially the vulnerable groups of the population, and important steps are to be taken in order to efficiently contribute to increasing its added value through:

- development of the processing branch;
- development of organic agriculture;
- production of frozen vegetables;
- introducing new varieties of vegetables;

- stimulating the development of new modern types of agriculture for vegetable production;

- creation of profile associations aimed at representing the interests of producers.

ACKNOWLEDGEMENT

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SUNFLOWER CROP PERFORMANCE IN ROMANIA: A COMPARATIVE ANALYSIS AT THE EUROPEAN LEVEL

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Abstract: *This study aims to present and analyze the sunflower culture, aiming to highlight Romania's position at European level. The analyzed statistical data have as source the national database INSSE and the European database Eurostat, for the period 2019-2023. In order to create a larger image of the sunflower crop, the following indicators were analyzed: surfaces, yields, average yields, import and export of sunflower at national and European level. Sunflower culture plays an important role globally, being cultivated in most states, with areas varying depending on the region and the climate. The main products (seeds), as well as secondary products (turts, stems, leaves) are of great importance, being valued in various fields and industries. In 2023, Romania ranked first among European countries in terms of cultivated area and sunflower production. The performances recorded in recent years have strengthened Romania's position as a leader in terms of sunflower culture, emphasizing how it manages to exploit and effectively capitalize on this agricultural resource*

Key words: *sunflower, indicators, surfaces, productions*

Clasificare JEL: Q10

INTRODUCTION

Sunflower crop is widely spread worldwide, ranking fourth in the world after corn, wheat and rice, and its expansion is due to various uses. Alongside soybeans and rapeseed, it constitutes one of the essential oil crops in the European Union [8].

Sunflower (Heliantus annuus) is grown in more than 72 countries located in temperate climates. In the ranking of oilseeds, which include plants such as soybeans, rapeseed, cottonseed and peanuts, sunflower is ranked 5th globally in terms of annual production, according to the report, with a quantity between 32 and 44 million tonnes [2].

Agricultural crops in southern and eastern Europe are at risk of heat stress and drought during development, which can cause significant production losses and changes in the composition of fatty acids, including a reduction in oil content. [7] However, sunflowers have retained their competitiveness through continuous innovation in genetics, cultivation techniques and research for value-added creation, this has led to greater market segmentation. [3], [4].

Although it has moderate drought resistance, sunflower crop is negatively affected by extreme heat conditions, which can lead to significant declines in fertility and yield. In order to ensure sustainable production in the face of climate change, it is crucial to identify and integrate drought resistance traits into breeding programmes. The use of wild species of Helianthus as genetic sources can support the development of more resilient hybrids, thus contributing to the future of sunflower farming. [1].

Climate change will significantly affect European agriculture, causing more frequent and prolonged droughts, which will lead to lower yields in the southern regions, but could improve conditions for cultivation in the northern regions. Sunflower, a drought-resistant crop, is becoming a viable solution for farmers looking to adapt to new climate conditions. [2].

In the face of climate change, farmers have adopted measures to maintain the yield of sunflower crop, choosing hybrids with high performance and drought resistant. They also adjusted the timing of sowing and plant protection strategies. These adaptations are crucial to ensure stable production and meet climate challenges, highlighting the need to analyse the specific conditions of each farm in order to maximise agricultural efficiency. [3], [5].

MATERIALS AND METHODS

This study has the objective of analyzing the sunflower culture, in order to highlight the position of Romania at European level. The statistical data used and processed are based on national and Eurostat data for the period 2019-2023. In order to obtain a more complete picture of the culture taken in the study were analyzed indicators such as: cultivated areas, yields and yields obtained per hectare as well as exports and imports of sunflower.

This type of study has been conducted over the last years, this paper aims to contribute to updating data and to propose new perspectives for sunflower culture. Both sunflower production and trade are a constant topic of interest, given the economic importance of culture at national and European level.

RESULTS AND DISCUSSION

Sunflower, at European level, is one of the most important oilseed plants, with an essential role in the supply of vegetable oil in the European Union.

In the period 2019-2023, EU-27 recorded a continuous increase in sunflower-growing areas, the average period being 4.54 million hectares, with an average production of 9.78 million tonnes, with a yield of 2.16 tonnes per hectare.

Analyzing the areas cultivated with sunflowers at EU-27-member state level, a hierarchy of them can be seen in the figure below. Romania, Bulgaria and France are the main sunflower growers with average areas of 1.14 million hectares, 851.6 thousand hectares, respectively 754.7 thousand ha, with a share of 25.2%, 18.7%, respectively%, 16.6%, respectively%. Countries with areas below 50 thousand hectares are Croatia, Poland, Austria, Portugal and Slovenia, shares of the average total period below 1% (Figure 1).

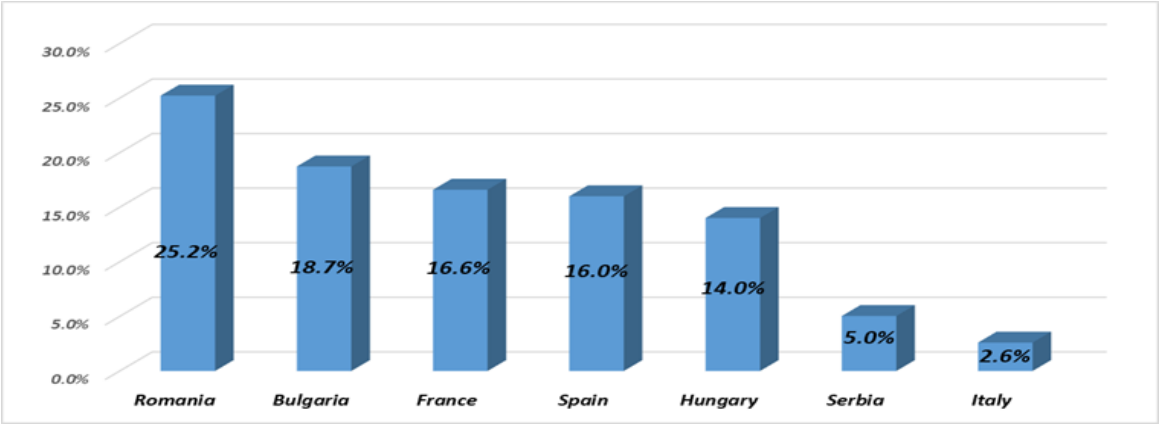

Figure 1. Main sunflower growers at EU-medium-area level (% of the average period)

Source: data processed by the author, Eurostat

As regards sunflower production, it was found from the analysis of the available data that states can be differentiated as follows:

- countries with production over 1 million tons: Romania, Bulgaria, Hungary and France with average values of the period of 2.53 million tons, 1.91 million tons, 1.73 million. tons and 1.68 million tons, with shares of 25.9%, 19.6%, 17.7% and 17.2% (Figure 2).

- States with production between 1mil. tons - 100 thousand tons: Spain, Serbia, Italy, Slovakia and Croatia with values of 830 thousand tons, 624 thousand tons, 290 thousand tons, etc, 162 Thousand tons and 131 thousand tons respectively.

- states with production of less than 100 thousand tons: Slovenia, Poland, Germany and Austria.

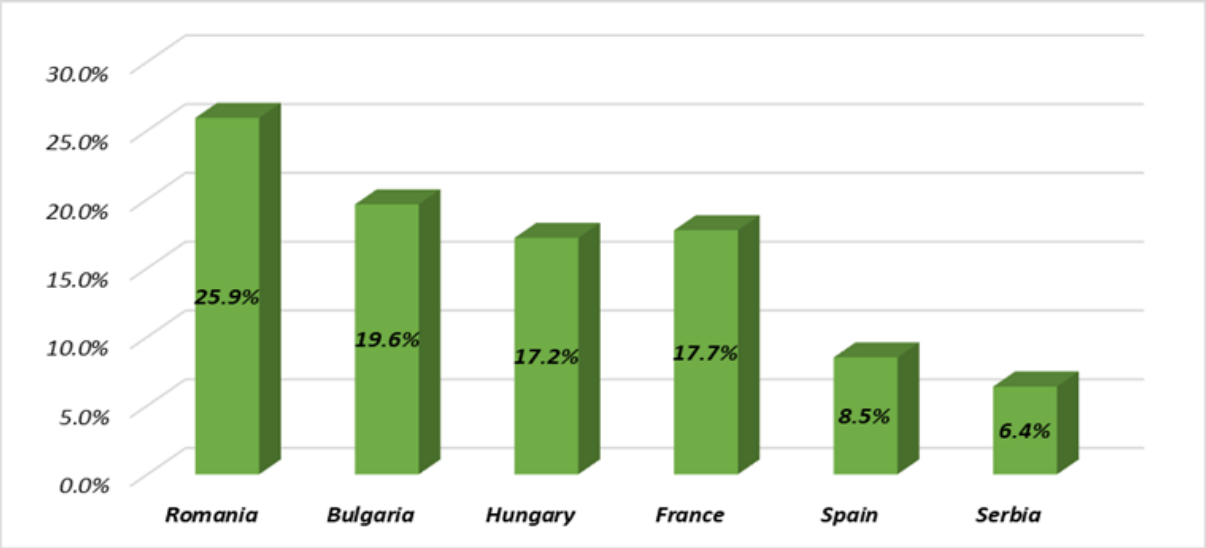

Figure 2. Main sunflower producers at EU-average level
(% of total average production)
Source: data processed by the author, Eurostat

Taking from the study the average yields per hectare was found that states are divided into two groups: average yields below the EU-27 average, of 2.16 thousand tons/ha, respectively, here we refer to Hungary, Portugal and Poland and the group with average productions above the European average: Romania, Germany, Bulgaria, France with values of 2.19 thousand tons/ha, 2.21 thousand tons/ha, etc, 2.25 Thousand tons/ha, The highest average production values are recorded by Austria, Serbia and Croatia: with 2.74 thousand tons, 2.74 thousand tons/ha and 2.94 thousand tons, respectively.

Although the three countries mentioned have small areas, the production is a high fact supported by the high yield per hectare.

A hierarchy of EU-27 member countries according to yield per hectare is shown in the figure below. (Figure 3)

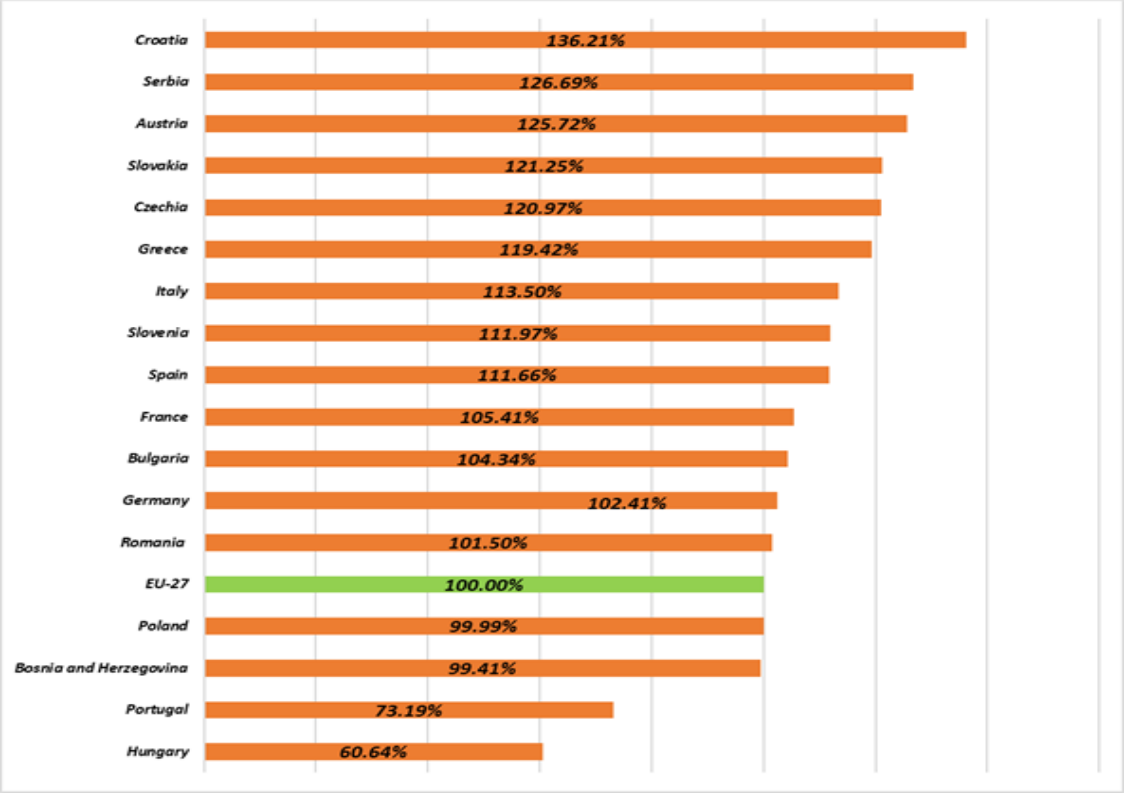

Figure 3. Position of sunflower producers versus average production per hectare at EU-27 level (% of average total yield EU-27)

Source: data processed by the author, Eurostat

Sunflower trade is essential for European agriculture, given that many European Union countries are producers and importers of sunflower products: oil and seeds. European countries are among the largest consumers of sunflower oil in the world, but it is also a relevant exporter in this field.

Analyzing the export of sunflowers at EU-27 level, it was noted that the amount of sunflowers increased by 21.9% in 2022 compared to 2019 (Figure 4).

At the level of 2022, the main exporters of sunflowers in EU-27 were: Romania, Bulgaria and France with values of 1453.46 thousand tons, 660.23 thousand tons and 657.08 thousand tons, respectively. The three countries with special export importance recorded significant differences in 2022 compared to 2019: -29%, -9.81% and +34.18%.

The exporting countries with the lowest quantities are: Ireland, Lithuania and Finland with values of 16.09 thousand tons, 331.03 thousand tons, 362.13 thousand tons.

A significant increase in exports in 2022 was recorded by Poland and Greece, 4.85 times and 6.41 times more than in 2019.

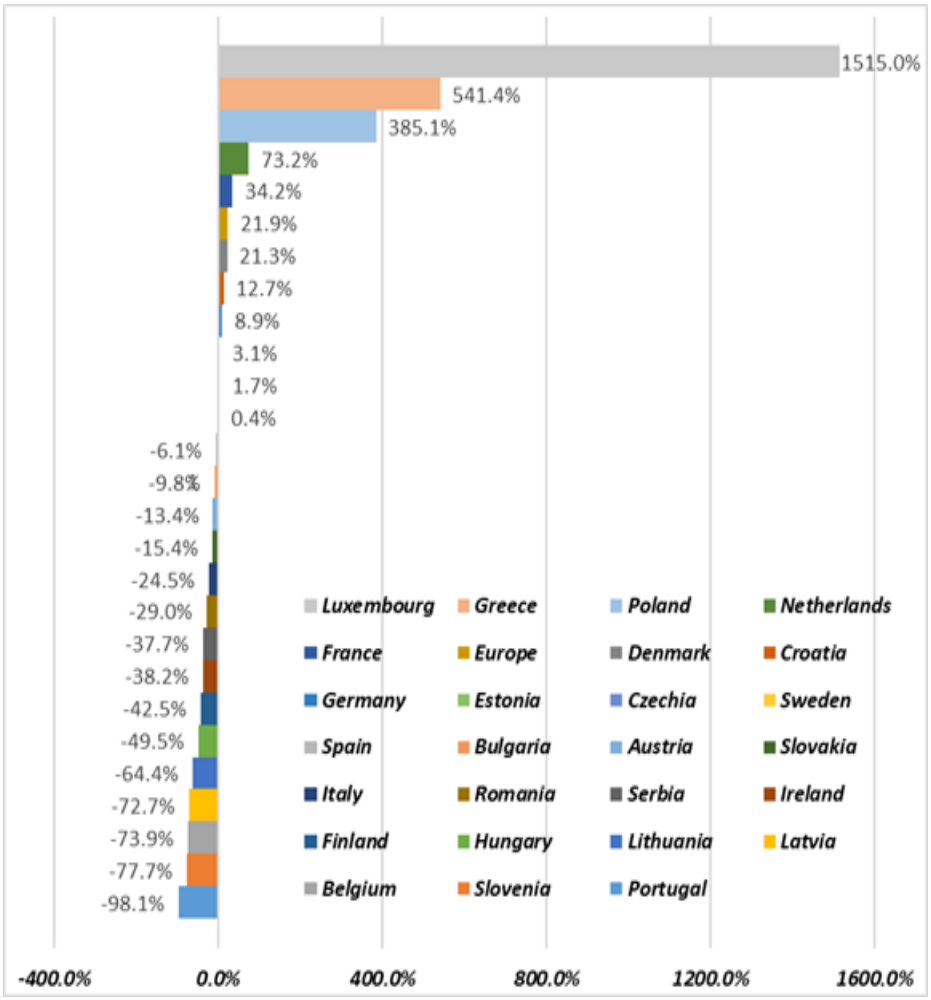

Figure 4. Export (%) 2019 compared to 2022

Source: data processed by the author, Eurostat

As regards the import of sunflower in 2022, at EU-27 level the amount of sunflower increased by 31.94% in 2022 compared to 2019. The highest quantities were recorded in Bulgaria, Hungary, Romania, the Netherlands, Spain and Germany, the latter have experienced fluctuations in the quantity imported according to the need of the country.

Compared to the growth share of sunflower imports at EU-27 level, 2022 compared to 2019 recorded the highest increases in: Croatia, Hungary, Slovakia and Bulgaria. Negative weights were recorded by Ireland, Slovenia, Greece and France.

Romania recorded at the level of 2022, an import of 653.66 thousand tons of sunflower, which is 2 times higher than in 2019 (325.26 thousand tons).

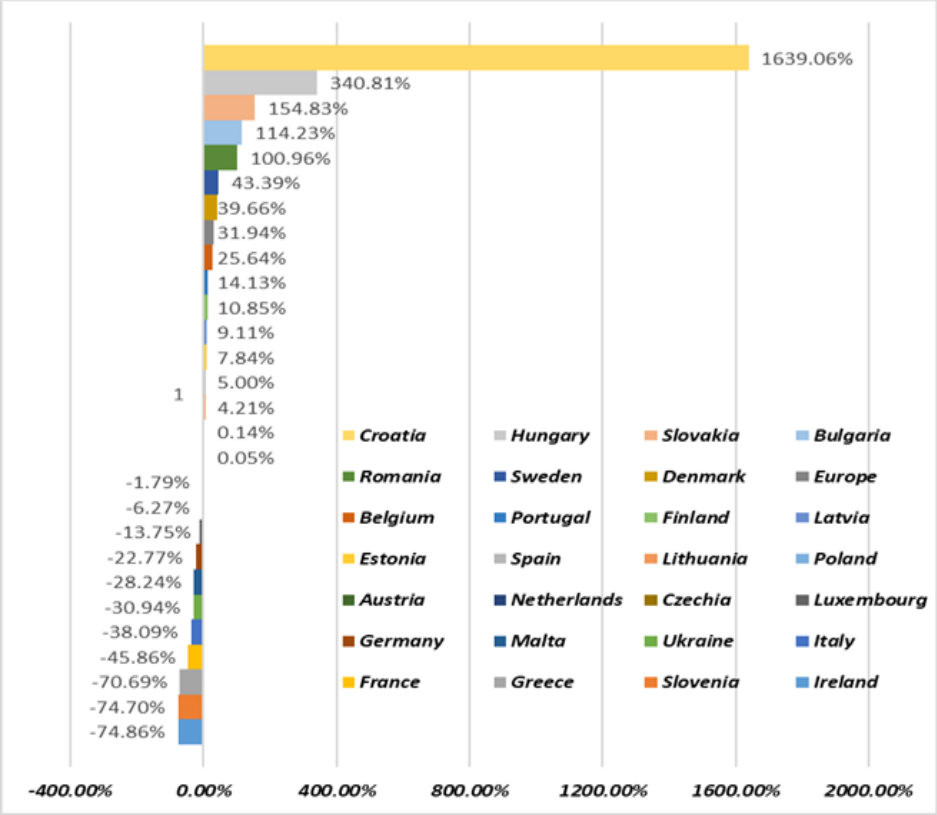

Figure 5. Import (%)2019 compare to 2022

Source: data processed by the author, Eurostat

Romania plays an essential, central and strategic role in the production and trade of sunflowers at EU-27 level, which may be due to agricultural, economic and geopolitical factors. The position of the country is consolidated on the European sunflower market due to the following aspects:

- cultivated area: Romania has one of the largest sunflower-grown agricultural areas, over 1.2 million hectares.

- favorable climatic conditions: some agricultural areas such as South-Muntenia, Dobrogea and Oltenia region have favorable agro-climatic conditions for sunflower culture, and, which helps to get high yields per hectare.

- production obtained annually: In 2023, Romania was the largest sunflower producer in the European Union, contributing with about 30% to the total European production.

- export to the EU and world markets. Romania exports a large amount of sunflower seeds and oil. European countries importing Romanian sunflowers: Germany, Spain, Italy and France. One of the biggest competitors on the sunflower market is Ukraine, but being affected by the war, Romania has taken over part of the market shares, becoming one of the important suppliers. Regarding the demand for sunflower oil, the war in Ukraine led to an increase in oil in Romania, given the reduction of stocks at EU-27 level.

- Agricultural Policy and support for oil crops. Oil crops under the new CAP 2023-2027 are receiving increased attention in order to reduce dependence on imports of vegetable oils from EU-27. Romanian farmers also benefit from this financial support by collecting incentives to continue the cultivation of sunflowers.

- The greatest risk encountered with sunflower culture is climate variability. In 2022 Romania faced extreme drought, while in 2023 there were favorable conditions. In the face of climate challenges and increasing competitiveness in the European market, Romania needs a better management of water resources and investments in innovation and processing of sunflower seeds and products with added value, what could provide a competitive advantage over other European producers.

CONCLUSIONS

Romania has a central position in sunflower production and trade within the EU-27, with one of the largest cultivated areas and being a major supplier of vegetable oil. The steady expansion of cultivated areas between 2019 and 2023 demonstrates the ability of the sector to adapt to market demands and stimulate economic growth. However, yields differ between member states, influenced by factors such as technology, climate conditions and the efficiency of agricultural management.

International sunflower trade is essential for the European economy, with a notable increase in demand for sunflower seeds and oil. However, the sector faces major challenges related to climate change that can affect long-term production and sustainability.

Investments in advanced agricultural technologies and water resources management are critical to maintaining the competitiveness of Romania and other member countries in this sector. The Common Agricultural Policy (CAP) provides important support to farmers, facilitating the development of oil crops and reducing dependence on imports.

Despite the challenges encountered, the sunflower sector has considerable growth potential, but in the long run, success depends on implementing innovative strategies that meet market demands and mitigate the impact of climate variability.

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TRENDS AND OUTLOOK FOR ROMANIAN AGRICULTURAL MARKETS FOR WHEAT, SUNFLOWERS AND SUGAR BEET

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Abstract: *Transformations in agri-food systems are driven by changes and adaptations in the way agricultural products are produced, distributed and consumed to respond to current economic, social and environmental challenges. These transformations are influenced by various factors such as climate change, increasing demand for sustainability, technological innovations of precision and automation in production and logistics, as well as the influence of trade policies on the production and trade of wheat, sunflower and sugar beet, etc. The study analyzes trends and prospects of agricultural markets for the three agri-food products and has as its main objective to examine production trends, price fluctuations and determinants influencing these markets. The research methodology is based on the use of the methods: analysis, synthesis and comparison. The results obtained contribute to the formulation of recommendations for adapting producers to new market conditions and trends.*

Keywords: *agriculture, market, production, trade, sustainability*

JEL classification: O52, Q1, Q17, R1

INTRODUCTION

Food systems are undergoing a number of significant transformations in response to technological, economic, social and environmental changes. Transformations related to increased productivity, specialisation of farming systems, optimisation of resources, automation of farming operations, changes in supply chains, changes in consumer preferences, the impact of climate change on agri-food systems, etc. all influence the production, demand, prices and marketing of agricultural products. The adaptation of supply to market stimuli takes place in several stages. In the very short term, when market demand increases, supply remains rigid. In the medium term, supply increases, but rather slowly, as more variable factors (raw materials, longer working hours, etc.) are added, while fixed factors remain unchanged. (Alexandri, C., Davidescu I., Gavrilescu D., 2004)

At the global level, agricultural markets are influenced by numerous trends and factors related to climate change, population growth, technological innovation and trade policy. From this point of view, there was a need for a study on the trends and prospects of the agricultural markets for wheat, sunflower and sugar beet in Romania.

MATERIALS AND METHODS

Taking into account the above-mentioned problems, the following indicators were analysed in order to assess the trends and prospects of the agricultural markets for wheat, sunflower and sugar beet: cultivated areas, production yields, exports, imports, export value, import value, trade balance, producer prices. The research methodology is based on the use of analysis, synthesis and comparison methods. The data used to carry out the study come from

the National Institute of Statistics (NSI) and the Food and Agriculture Statistics Organisation (FAOSTAT). In terms of descriptive statistics, the quantitative values of the indicators were calculated based on the functions: minimum, maximum, mean, standard deviation, coefficient of variability, annual growth rate. (Excel, 2016). The interpretation of the coefficient of variability was based on the course *Descriptive Statistics 1. Central tendency - arithmetic mean, 2. variability.* (Maniu D., 2024).

RESULTS AND DISSCUSION

The supply of products on the market consists of domestic production, stocks and imports. (Țimiraș L. C., 2012). The demand for agricultural products is determined by domestic consumption, which consists of human consumption, intermediate consumption (seed consumption, fodder consumption, industrial processing, industrial processing), etc. (Hotărâre 154, 2002). Given that the aim of this paper is to highlight the trends and prospects of the agricultural markets for wheat, sunflower and sugar beet, we will present some of the indicators that contribute to the formation of these components from a supply and demand point of view.

Table 1: Evolution of wheat production indicators

Indicators	2015	2016	2017	2018	2019	2020	2021	2022	2023	*Average*	*Stdev*	*CV %*
Area	2107	2138	2053	2116	2168	2155	2175	2169	2318	*2155*	*72,3*	*3,4*
Total prod.	7962	8431	10035	10144	10297	6392	10434	8684	9624	9112	1355	14,9
Average prod.	3780	3944	4888	4793	4749	2966	4797	4004	4152	4230	640	15,1

Source: own calculations based on NSI data, Tempo Online (thousand ha; thousand tons; kg/ha)

Table 1 shows the evolution of the indicators in terms of area (thousand ha), total production (thousand tonnes) and average production (kg/ha) of wheat. The three indicators do not show significant variations. In the nine years of production, wheat production exceeded 10 million tonnes for three consecutive years, in 2017, 2018 and 2019. Total wheat production was also influenced by the average yield. The best production year for wheat in the whole period analysed was 2021, with 10.4 million tonnes, with an increase in area (2175 thousand ha compared to 2155 thousand ha cultivated in 2020) and average yield (4797 kg/ha compared to 2966 kg/ha) compared to 2020.

Table 2: Evolution of sunflower production indicators

Indicators	2015	2016	2017	2018	2019	2020	2021	2022	2023	*Average*	*Stdev*	*CV %*
Area	1012	1040	998	1007	1283	1143	1124	1093	1078	1086	90,2	8,8
Total prod.	1786	2032	2913	3063	3569	2123	2844	2107	2016	2495	613,2	24,6
Average prod.	1765	1955	2917	3041	2783	1858	2530	1927	1870	2294	517	22,5

Source*:* own calculations based on NSI data, Tempo Online (thousand ha; thousand tons; kg/ha)

Table 2 shows the evolution of the indicators in terms of area (thousand ha), total production (thousand tonnes) and average production (kg/ha) of sunflower. The three indicators do not show significant variations in terms of area (CV is 8.8%), but the data for total and average production are relatively homogeneous statistically. The representative years for the total production indicators are 2018 and 2019, although the average production in 2019 decreased compared to the previous year (2783 kg/ha compared to 3041 kg/ha). The maximum total sunflower production of 3.56 million tonnes was achieved against the background of an increase in the area under sunflower (1.2 million ha in 2019 compared to 1.0 million ha in 2018).

Table 3: Evolution of sugar beet production indicators

Indicators	2015	2016	2017	2018	2019	2020	2021	2022	2023	*Average*	*Stdev*	*CV%*
Area	26596	24924	28204	25723	22729	21326	19639	8888	12446	21164	6572	31,1
Total prod.	1040827	1012186	1174502	978266	917163	718483	783534	281331	403672	812218	300093	36,9
Average p.	39135	40611	41643	38031	40351	33691	39896	31655	32434	37494	3841	10,2

Source: own calculations based on NSI data, Tempo Online (ha; tons; kg/ha)

The technical production indicators for sugar beet show the most significant changes. The area decreased on average by 9.06%/year, the total production by 11.7%/year and the average yield by 2.32%/year. The best production results were achieved in 2017, when the total production increased to 1.17 million tonnes against the background of the expansion of the area from 26 thousand ha in 2016 to 28 thousand ha in 2017, and the average production from 40.6 tonnes in 2016 to 41.6 tonnes in 2017. Unfavourable results are found in 2022. The cultivated area reaches 8.8 thousand ha compared to 19.6 thousand ha cultivated in 2021, which reduces the total production and the average production. Table 3.

Table 4: Evolution of producer prices (RON/tonne)

Product	2014	2015	2016	2017	2018	2019	2020	2021	2022	*Average*	*Stdev*	*CV %*
Wheat	760	750	640	660	690	730	800	960	1500	832	268	32,1
Sunflower	1290	1510	1530	1380	1330	1310	1520	2010	2900	1642	520	31,7
Sugar beet	160	160	130	130	130	140	140	130	190	146	21	14,2

Source: own calculations based on NSI data, Tempo Online

Prices vary considerably for wheat and sunflower, with a coefficient of variability of 32.1% for wheat and 31.7% for sunflower, and much more stable for sugar beet (14.2%). In bumper years, prices are lower than in years with lower yields. It can be said that prices mechanically drive a corresponding variation in output. There is a mismatch between when production is obtained and when it is brought to market, which creates a mismatch between biological rhythms and price fluctuations, leading to production cycles. Production decisions are influenced by past prices. (Alexandri, C., Davidescu I., Gavrilescu D., 2004)

Analysing production yields

Agricultural supply is determined by natural factors. Climatic factors, diseases and pests affect plant growth and production. The production yield per hectare depends on the type

of seed used, the application of fertiliser, the availability of agricultural machinery and the availability of irrigation (Wik, M., Pingali, P. and Brocai, S., 2008). By analysing and monitoring yields, production technologies can be adapted to cope with climate change and ensure their stability. Variations in the production yields of wheat, sunflower and sugar beet are indicated by the coefficient of variability (CV), which is determined by expressing the standard deviation from the mean for the period 2015-2023. Wheat has a CV of 15.1%, indicating that there is year-to-year variation in wheat yield, the data are relatively statistically homogeneous, and the sample is representative of the mean. The dispersion of the data around the mean (4230 kg) is 640 kg. The exception is the year 2020 when the yield was 2966 kg/ha, 29.9% below the mean. Sunflower has a coefficient of variability of 22.5%, the dispersion of the data around the mean (2294 kg) is 517 kg.

The highest yield stability is found for sugar beet. The coefficient of variability is 10.2%, with a deviation from the mean of 3841 kg. "Yield affects food security. Increased production yields ensure domestic needs and surplus production is exported, reducing import dependency. Production yields play an important role in the achievement of the *Sustainable Development Goal SDG 2: ZERO Hunger*, namely the achievement of the 2030 target: *'Doubling the share of agriculture in Romania's GDP, compared to 2018'*. (INS, 2023). The increase in agricultural yields is one of the additional indicators contributing to the achievement of this goal.

Market and supply chains for cereals, sunflowers and sugar beet

The distribution and marketing of wheat, sunflowers and sugar beet involves agricultural producers, transporters/warehousers, processors, distributors, regulators and government agencies, consumers, etc., all of whom play an important role in the supply chain from production to consumer. Each of the three markets has its own challenges in terms of logistical requirements and obstacles that supply chain actors need to overcome in order to be profitable. Logistical bottlenecks can be caused by inadequate warehousing and poor transport infrastructure in some parts of the country.

Table 5: Storage capacity - total authorised capacity (tonnes)

Total authorised capacity (tonnes)	Silo (tonnes)	Storage (tonnes)	Number of operators
17363926	8453844	8910082	3714
100%	48,7	51,3	

Source: Ministry of Agriculture and Rural Development

According to MADR data, storage capacities are distributed throughout the country, which can be correlated with the production potential for cereals and oilseeds. The total storage capacity is over 17.3 million tonnes, of which 48.7% (8.5 million tonnes) can be stored in silos and 51.3% (8.9 million tonnes) in warehouses. Table 5.

Romania's main modes of transport are rail, road, inland waterways and sea. In this context, we can say that exports require complex infrastructures such as ports and properly equipped logistics terminals. Coordination between producers, distributors, transporters, etc. is necessary to reach the market on time. Logistics prices are directly influenced by fuel prices

and transport demand, which affects the competitiveness of agricultural products. The most developed mode of transport in Romania is road transport. Figure 1.

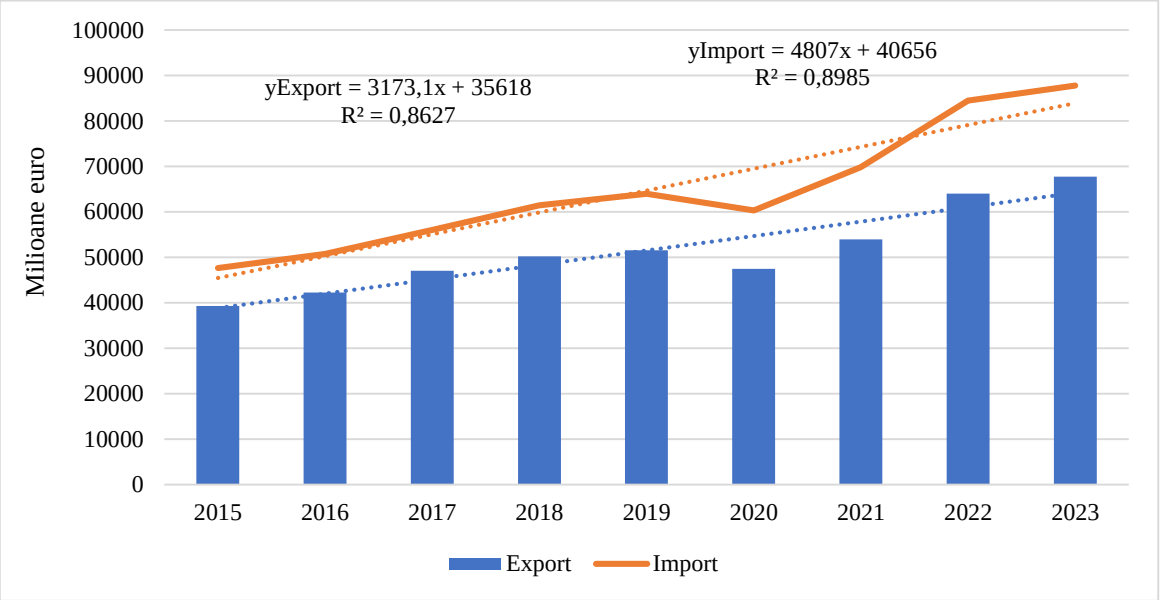

Figure 1: Exports (FOB) and imports (CIF) by road

Source: INS data, Tempo Online

Wheat production per inhabitant shows some stability, with a deviation from the mean (470 kg/inhabitant) of 71 kg, giving a stability of 15.2%, and an average annual increase of 2.90%. Sunflower production per inhabitant varies more widely, from 90.1 kg/inhabitant to 184 kg/inhabitant, with a dispersion of 32 kg/inhabitant around the mean (129 kg), which does not give stability, the data sample being relatively homogeneous from a statistical point of view. The average annual growth is 2.02%/year for the period analysed. Sugar beet has a coefficient of variability of 36.1%, with per capita production varying from 52.5 kg/capita in 2015 to 21.2 kg/capita in 2023, with a negative annual growth rate of -10.72%/year on average. Figure 2, Table 6.

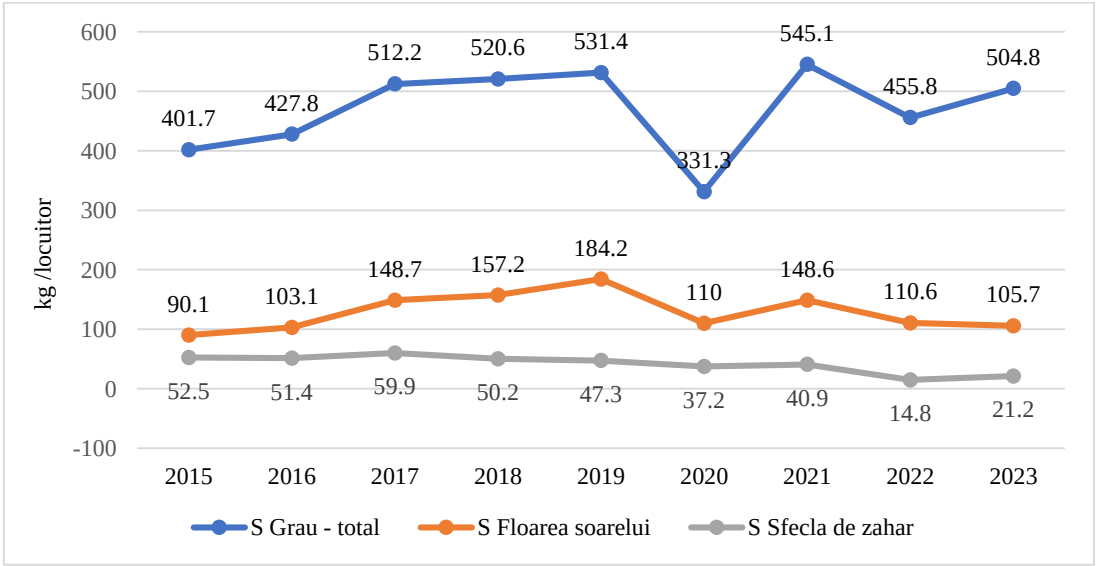

Figure 2: Wheat, sunflower and sugar beet production/population

Source: INS data, Tempo Online

Table 6: Descriptive statistics indicators of output per capita (kg)

Nr. crt.	*The product*	Minim	Maxim	Average	Stdev	Coefficient of variability (%)	*Annual growth rate (%)*
0	1	2	3	4	5	6	7
1	*Wheat*	331	545	470	71	15,2	2,90
2	*Sunflower*	90	184	129	32	24,6	2,02
3	*Sugar beet*	15	60	42	15	36,1	-10,72

Source: own calculations based on NSI data, Tempo Online

Foreign trade

Romania's foreign trade is influenced by climatic conditions, by annual fluctuations in the import and export of cereals and by the lack of export infrastructure accessible to some producers, taking into account their geographical distribution. A characteristic feature of trade in cereals and oilseeds is the difficulty in securing qualitatively homogeneous quantities for international transactions (Zahiu, L., et al., 2010).

Romania trades with both intra-EU and extra-EU countries. Imports and exports are statistically valued at FOB (Free on Board) prices, and imports at CIF (Cost, Insurance, Freight) prices. For exports, the FOB value represents the value at which the goods were sold by the exporter, including transport, insurance and other costs for bringing the goods on the means of transport to the Romanian border. For imports, the CIF value represents the value at which the goods are purchased by the importer, including transport and insurance costs for bringing the goods to the Romanian border. (Gheorghe F., 2014)

Exports of wheat and sunflower have given farmers access to international markets, with the benefits of increasing their incomes, exporting to more markets and protecting them from fluctuations in demand and prices on the domestic market. However, the external market also has to respond to challenges in terms of higher transport costs, compliance with international regulations, risks associated with global international market conditions (economic conditions, trade policies and tariffs) (NSI, 2024).

Table 7: Wheat exports/imports (million tons)

	2015	2016	2017	2018	2019	2020	2021	2022	Average	Stdev	CV %
Export	3,56	6,99	5,77	5,88	6,10	4,30	6,91	5,68	5,65	1,18	21,0
Import	0,65	2,16	1,31	0,69	0,86	1,21	0,95	1,05	1,11	0,48	43,4
Balance +	2,90	4,84	4,46	5,19	5,25	3,09	5,95	4,64	4,54	1,06	23,3

Source: FAOSTAT

Between 2015 and 2022, an average of 5.65 million tonnes will be exported, with significant quantities in 2019 and 2021 (6.10 million tonnes in 2019 and 6.91 million tonnes in 2021). Small quantities of wheat will be exported in 2015 (3.56 million tonnes) and 2020 (4.30 million tonnes). The quantities imported have a high coefficient of variability of 43.3%, which means that the quantities imported in the period under review differ significantly from the

average of the analysed interval (1.11 million tonnes). The quantitative export-import balance is in favour of exports, also with a variation of 23.3%. Table 7. The trade balance indicates a competitive economy in wheat exports.

Table 8: Wheat export/import (billion USD)

	2015	2016	2017	2018	2019	2020	2021	2022	Average	Stdev	CV %
Export	0,77	1,26	1,12	1,23	1,26	0,96	1,80	2,08	1,31	0,43	32,7
Import	0,13	0,37	0,25	0,14	0,18	0,25	0,26	0,32	0,24	0,08	35,5
Balance +	0,64	0,90	0,88	1,09	1,08	0,71	1,54	1,76	1,07	0,39	36,5

Source: FAOSTAT

As the world wheat supply remained at a high level during the period analysed, the international prices remained uncompetitive for the domestic producers, except in 2021, when Romania obtained USD 1.54 million from wheat exports, and in 2022, when it obtained USD 2.08 million. From a value point of view, both wheat exports and imports vary significantly, the CV being 32.7% for export value and 35.5% for import value, and the CV for trade balance being 36.5%, which means that the values are relatively statistically heterogeneous. Table 8. Regarding the exchange rate for trade transactions, it can be seen that exporting at a favourable exchange rate makes products more competitive in foreign markets, but increases the cost of imports.

Table 9: Sunflower export/import (million tonnes)

	2015	2016	2017	2018	2019	2020	2021	2022	Average	Stdev	CV %
Export	1,10	1,18	1,33	1,70	2,05	1,48	1,45	1,45	1,47	0,30	20,4
Import	0,19	0,20	0,28	0,31	0,33	0,24	0,23	0,65	0,30	0,15	49,3
Balance +	0,91	0,99	1,06	1,39	1,72	1,24	1,21	0,80	1,17	0,30	25,4

Source: FAOSTAT

Romania is recognised on the international market as a net exporter of sunflower seeds, occupying the first place in sunflower seed exports. During the period analysed, the exported quantities maintain the same upward trend as the domestic production, reaching 2.05 million tons in 2019, due to the favourable weather conditions. The quantities exported vary relatively homogeneously around the average (1.47 million tonnes), with a coefficient of variability of 20.4%. **Table 9.**

Table 10: Sunflower exports/imports (billion USD)

	2015	2016	2017	2018	2019	2020	2021	2022	Average	Stdev	CV %
Export	0,50	0,54	0,59	0,76	0,84	0,69	0,99	1,17	0,76	0,23	30,3
Import	0,14	0,15	0,18	0,23	0,22	0,24	0,27	0,54	0,25	0,13	51,1
Balance +	0,36	0,39	0,41	0,53	0,62	0,45	0,72	0,63	0,51	0,13	25,5

Source: FAOSTAT

Compared to the quantities of sunflowers exported, the value indicators show greater variability. This is due to price variability. The coefficient of variability for export value is 30.3%, the value data are relatively statistically homogeneous, for import value 51.1%, the variability of export value data differs significantly from the average.

Table 11: Sugar beet export/import (thousand tons)

	2017	2018	2019	2020	2021	2022	2023	Average	Stdev	CV %
Export	67	59	46	53	32	45	121	60	29	48,3
Import	369	383	473	346	440	511	514	434	69	15,9
Balance -	-302	-324	-427	-293	-408	-466	-392	-373	67	-18,0

Source: Own calculations based on data from the Ministry of Agriculture and Rural Development, Agriculture, Field Crops

Foreign trade in sugar is characterised by a negative trade balance, as Romania is a net importer of raw and white sugar (Zahiu, L., et al., 2010). Romania still imports most of its sugar needs. In 2022 and 2023, more than 500 thousand tonnes will be imported. The imported quantities are statistically relatively homogeneous, the CV is 15.9% and the standard deviation (69 thousand tonnes) from the average (434 thousand tonnes) is relatively small. In 2023, Romania exported 121 thousand tonnes, contributing to the reduction of the trade balance to 392 thousand tonnes compared to 2022, when the balance was 466 thousand tonnes. Table 11.

Table 12 Sugar beet exports/imports (million euro)

	2017	2018	2019	2020	2021	2022	2023	Average	Stdev	CV %
Export	32	26	18	23	15	28	101	35	30	86,2
Import	169	146	169	140	186	292	360	209	84	40,0
Balance -	-138	-120	-151	-118	-171	-264	-259	-174	62	-35,7

Source: Own calculations based on data from the Ministry of Agriculture and Rural Development, Agriculture, Field Crops

In terms of value, both imports and exports differ significantly from the averages, with a coefficient of variability of 86.2% and a standard deviation of 30 million euro from the average. The value of imports has a variability of 40%, with a deviation of EUR 84 million from the average, contributing to an increase in the trade balance of 35.7%. The increase in the trade balance in favour of imports is reported in 2022 (€264 million) and 2023 (€259 million), compared with 2020 (€118 million) and compared with 2018 (€120 million). The increase in producer prices in the last years, 2022 and 2023, compared to 2017-2021, contributes to this increase. Table 12.

Policies and subsidies to support cereal, sunflower and sugar beet producers

In general, wheat, sunflower and sugar beet are supported by the main forms of support: Basic Income Support for Sustainability (BISS), Complementary Redistributive Income Support for Sustainability (CRISS), Transitional National Aid 1 (ANT 1) - arable crops payment, and Complementary Income Support for Young Farmers (CYS). Environmental and

climate related eco-schemes are payments to farmers to partially compensate for additional costs and income losses. As application for the eco-schemes is voluntary, producers of wheat, sunflowers and sugar beet can apply for intervention PD-04 (agri-environmental measures) and small farms and traditional households can apply for intervention PD-5 (environmentally friendly farming practices). In addition, sugar beet benefits from ANT-6 and coupled income support (intervention PD-16). **(APIA, 2024).** The amount of coupled aid is an indicative planning amount of 900 euro/ha for a planned area of 20,000 hectares in 2023. Sugar beet is an important crop both economically and socially, as well as in terms of environmental benefits: the well-developed foliage apparatus provides very good ground cover and thus contributes to soil carbon storage. **(PNS, 2023-2027).**

Agricultural market trends and outlook

The study *Agricultural and food markets: Trends and prospects* highlights the main projections for consumption, production, trade and prices for 25 agricultural commodities for the period 2022-2031. According to the study, agricultural demand is expected to slow down over the next decade. International trade will remain essential for food security in food-importing countries and for rural livelihoods in food-importing countries. Changes to this outlook will be caused by weather variability, plant and animal diseases, changing input prices, macroeconomic developments and other uncertainties, etc. (OECD-FAO, 2024).

The European Commission's report *"Short-term outlook of agricultural markets: gradual but fragile return to stability"* states that agricultural markets are showing signs of stabilising: food inflation has fallen, the fertiliser market is stabilising, trade flows have returned to normal, domestic production is showing signs of recovery, and so on. EU cereal production in 2024/2025 is estimated at 260.9 million tonnes, about 7% below the 5-year average and the lowest production in the last decade; oilseed production is estimated at 29.7 million tonnes (-8% y/y) due to a reduction in rapeseed area and unfavourable weather conditions for sunflowers; EU sugar production in 2024/2025 is estimated to increase by up to 1 million tonnes compared to 2023 (European Commission, 2024).

CONCLUSIONS

The trends and prospects of the agricultural markets for wheat, sunflower and sugar beet have generally followed the main indicators that contribute to the supply and demand of these products. The average share of cultivated area in Romania's arable land is 25.9% for wheat, 13.1% for sunflower and 0.3% for sugar beet. The trends for wheat and sunflower areas would be to maintain these percentages rather than to reduce or increase them. Sugar beet is one of the crops for which financial support is available to increase its area to 20 000 ha. The total production of the three crops is determined on the one hand by the area cultivated and on the other hand by the production yield. The increase in yield per hectare is determined by the technology used, the availability of irrigation water, etc. From this perspective, investment is needed to acquire precision technologies for better management and resource efficiency.

Wheat and sunflower provide sufficient raw material for domestic needs. Sugar beet is imported at an average rate of 86% (373 thousand tonnes). The National Strategic Plan 2023-2027 foresees support measures to avoid the risk of sugar beet abandonment and restructuring of processing units.

In terms of wheat and sunflower exports and imports, Romania is among the top 10 countries in the world, the trade balances are in favour of wheat and sunflower exports in both quantity and value, and in terms of international market prices, Romania is 16th for wheat prices (average USD 197/t) and 11th for sunflower prices (average USD 396/t).

For sugar beet, the trade balance is negative in both quantity and value. With an average of 60 000 tonnes exported and 7.2 times as many imported (434 000 tonnes), the trade balance in value terms is on average -174 million euro.

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COMPARATIVE ANALYSIS OF TECHNICAL AND ECONOMIC INDICATORS FOR WHEAT AND MAIZE CROPS IN THE EUROPEAN UNION AND ROMANIA IN THE PERIOD 2015-2023

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Abstract: *The purpose of this paper is to perform a comparative analysis of the technical and economic indicators for wheat and corn crops in Romania and the European Union, in the period 2015-2023. The paper focuses on the evolution of cultivated areas, productions and prices, with the objective of identifying the differences between agricultural results in Romania and in other European Union member states. The working method used in this paper was the comparative method, the method of quantitative and qualitative analysis of data and used in the literature. Following this analysis, the conclusions obtained will provide an overview of the competitiveness and efficiency of these crops analyzed in the national and European agricultural context.*
Keywords: *agricultural sector, indicators, outlook, market*
JEL classification: J43; Q13

INTRODUCTION

Wheat is one of the most important food crops, providing nearly one-fifth of the world's calorie intake (Mitchell, et al, 2015). Wheat is a key global commodity in terms of area and marketable value and as a staple food in household diets. Cereals are currently the most important contributor to the global human food supply. About 21% of the world's food depends on annual wheat crops, which often have relatively low stocks. (Enghiad, et al. 2017).

Corn is a cereal used in human nutrition, animal feed and as a raw material in various industries. (Soare, et al, 2016). Corn is the most demanded cereal in the world and is among the fastest growing in annual volume. Currently, the annual production and demand of corn exceeds 1 billion tons. (Martinez, et al, 2019).

MATERIAL AND METHODS

The data based on which the calculations in the paper were elaborated are data provided by the European Commission (eurostat.eu), in order to achieve the main objective of this work, the technical and economic indicators for wheat and corn crops in Romania and the European Union in the period 2015-2023 were analyzed. The research method used is the analysis method, the statistical method, the graphical method, and the tabular method.

RESULTS AND DISCUSSIONS

As a result of the analysis, from the data used, the cultivated areas, the total productions and the price for the wheat and corn crop in Romania and in the context of the European Union were evaluated, the cultivated areas were analyzed in order to highlight the recent developments and their distribution compared to other European Union member states.

The average and total productions were evaluated according to the climatic conditions, the agricultural practices and the technologies used, highlighting the variations in the yields obtained. Regarding prices, the analysis included their trends and fluctuations on the domestic and European markets, their impact on farmers' incomes and the importance of price stabilization to balance the market.

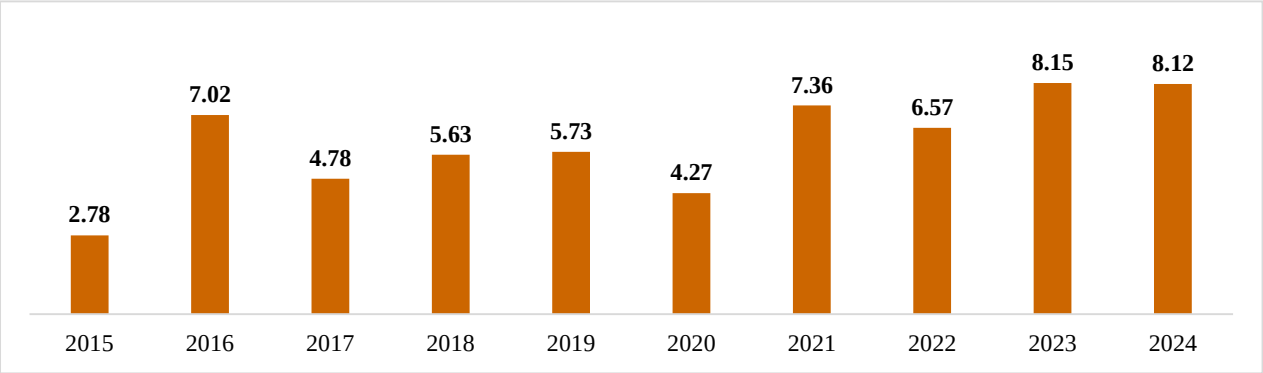
Table no. 1. Ranking of EU countries according to the area cultivated with wheat in 2024 (thousand hectares)

Country	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2024/ 2015 (%)
Italy	1328.9	1383.7	1304.9	1278.4	1224.0	1210.4	1228.5	1238.0	1269.3	1134.7	-14.6
Spain	347.9	448.2	417.6	374.6	266.6	250.9	259.1	278.7	268.5	272.3	-21.7
France	318.8	403.0	370.0	353.9	245.5	252.3	294.2	253.0	235.7	230.3	-27.8
Greece	333.4	388.2	296.3	296.5	253.9	262.7	313.9	317.7	161.7	170.1	-49.0
Slovakia	21.5	40.7	42.6	48.0	43.6	34.0	49.0	62.9	65.6	47.0	118.9
Hungary	19.3	29.8	33.6	44.3	36.9	27.0	29.5	36.7	37.5	33.5	74.2
Austria	19.1	23.3	22.9	21.9	16.7	16.5	19.5	23.3	23.4	26.3	37.9
Romania	2.8	7.0	4.8	5.6	5.7	4.3	7.4	6.6	8.2	8.1	192.1
Cyprus	12.0	7.6	7.1	7.8	6.4	7.6	7.4	7.3	6.5	6.9	-42.4
Portugal	2.7	4.7	4.1	4.2	4.2	3.6	4.3	5.5	4.1	4.9	80.9

Source: Eurostat.eu, own calculations

In 2024, at the level of the European Union, Italy is at the top of the areas cultivated with wheat with an area of 1.13 million hectares, followed by Spain with 272.32 thousand hectares and France with 230.3 thousand hectares. Although these countries have significant areas at the level of 2024, they have registered decreases compared to the areas presented in 2015. Romania ranks 8th in 2024 with a cultivated area of 8.12 thousand hectares of wheat.

Figure no.1. Area cultivated with wheat in Romania (thousand hectares)



Source: Eurostat.eu, own calculations

Regarding the area cultivated with wheat in Romania, in 2015, the area cultivated with wheat was 2.78 thousand hectares, and in 2024 it increased to 8.12 thousand hectares, showing an increase of over 198%.

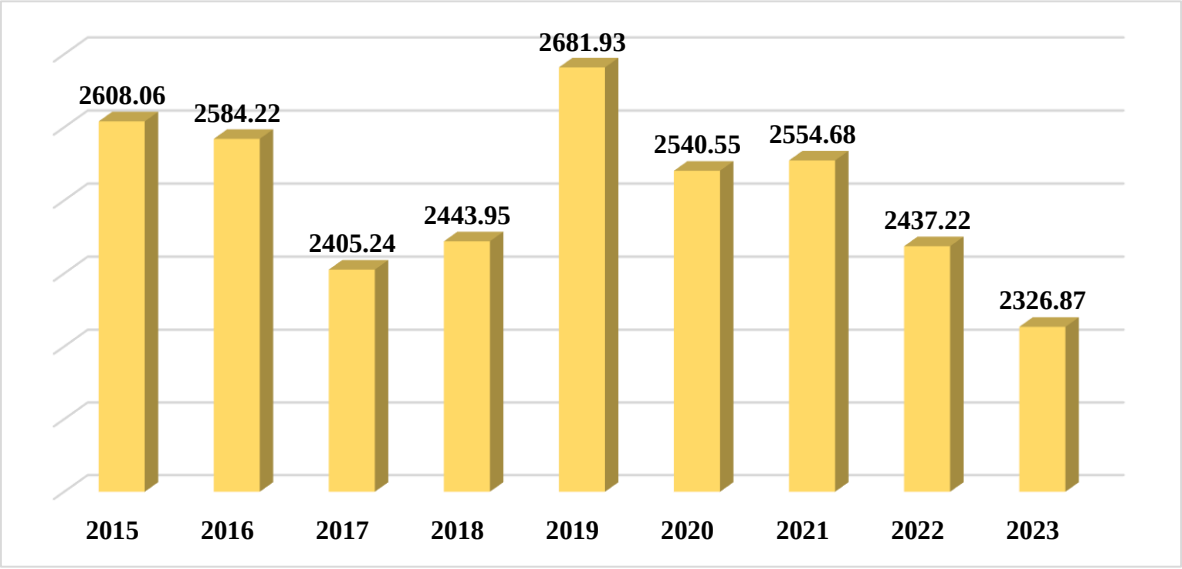
Table no.2. Ranking of EU countries according to the area cultivated with maize in 2024 (thousand hectares)

Country	2015	2016	2017	2018	2019	2020	2021	2022	2023	2023/2015 (%)
Romania	2608.1	2584.2	2405.2	2444.0	2681.9	2540.6	2554.7	2437.2	2326.9	-10.8
France	1637.1	1442.8	1435.7	1426.3	1506.1	1730.0	1549.5	1456.1	1299.1	-20.6
Poland	670.3	593.5	562.1	645.4	665.0	946.0	998.5	1196.0	1255.6	87.3
Serbia	1010.2	1010.0	1002.3	901.8	962.1	996.5	1020.3	952.2	923.0	-8.6
Hungary	1146.1	1011.6	988.8	939.1	1027.6	981.0	1054.6	816.6	767.9	-33.0
Bulgaria	498.6	406.9	398.2	444.6	560.9	581.5	573.0	520.5	533.0	6.9
Italy	656.0	660.7	645.7	591.2	628.8	602.9	588.6	563.7	498.5	-24.0
Germany	455.5	416.3	432.0	410.9	416.0	419.3	430.7	456.7	466.4	2.4
Croatia	264.0	252.1	247.1	235.4	255.9	288.4	288.0	268.1	266.0	0.8
Spain	398.3	359.3	333.6	322.4	356.8	343.8	358.3	314.3	249.2	-37.4

Source: Eurostat.eu, own calculations

In the top of the countries with the largest area cultivated with corn at the level of the European Union, there is Romania with 2.3 million hectares in 2023, followed by France with 1.3 million hectares and Poland with 1.25 million hectares.

Figure no. 2. Area cultivated with corn in Romania (thousand hectares)



Source: Eurostat.eu, own calculations

At the level of Romania, in 2015, the area cultivated with corn was 2608.06 thousand hectares, reaching in 2023 the area of 2326.87 thousand hectares, representing a decrease of over 13%.

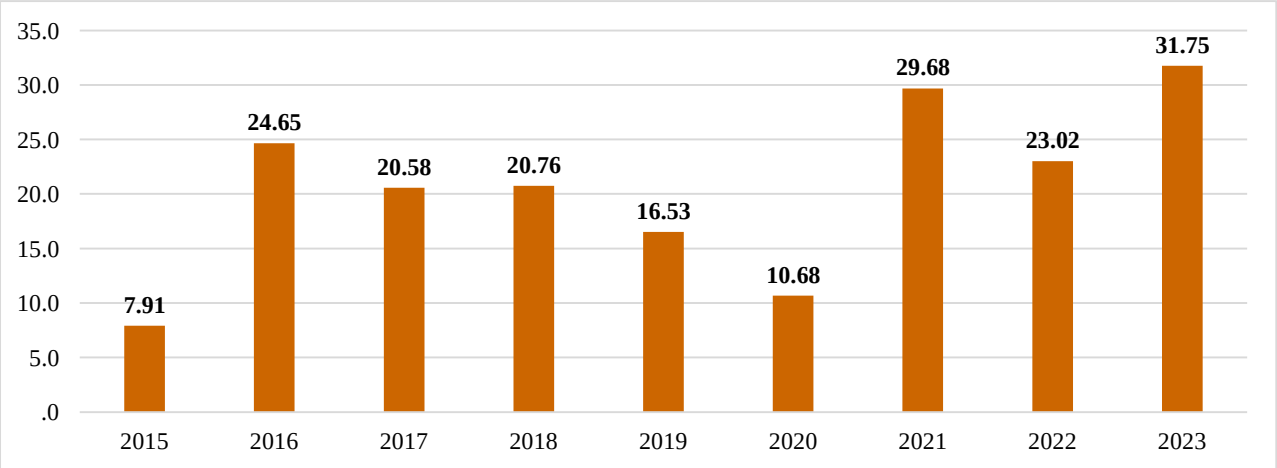
Table no. 3. Ranking of EU countries according to total wheat production (thousand tonnes)

Country	2015	2016	2017	2018	2019	2020	2021	2022	2023	2023/ 2015 (%)
Italy	4509.8	5242.5	4373.9	4303.1	3996.4	4033.9	4220.5	3831.2	3829.1	-15.1
France	1784.4	1676.0	2094.1	1774.6	1548.0	1310.4	1574.6	1330.4	1266.5	-29
Greece	820.4	1172.8	721.1	774.3	683.9	793.7	881.0	940.5	534.6	-34.8
Spain	968.0	1107.1	1111.0	1342.1	736.8	824.1	806.2	695.3	451.9	-53
Slovakia	113.3	239.7	182.9	225.8	187.8	173.5	287.4	312.7	403.1	255.8
Germany	87.3	134.6	170.4	138.1	154.7	183.0	206.9	218.4	238.0	172.6
Hungary	93.9	149.9	159.1	209.1	162.5	120.7	162.3	136.2	195.2	107.9
Austria	88.0	123.3	91.1	90.9	80.2	78.9	88.3	119.8	139.2	58.2
Bulgaria	33.2	55.6	46.6	61.0	39.5	30.3	50.3	58.1	79.7	140.2
Romania	7.9	24.7	20.6	20.8	16.5	10.7	29.7	23.0	31.8	301.4
Cyprus	36.2	6.8	14.3	12.4	18.5	20.4	16.3	20.2	15.5	-57.1
Portugal	6.1	13.2	9.7	11.6	12.2	10.6	12.3	13.1	7.9	28.6
Croatia	10.1	2.5	3.3	1.9	1.8	3.3	3.6	4.3	1.2	-88
Luxembourg	-	-	-	-	-	0.5	1.4	1.3	0.7	-

Source: Eurostat.eu, own calculations

At the level of 2023, Italy occupies the first position in terms of total wheat production with a value of 3.8 million tons, followed by France with 1.3 million tons and Greece with 534.6 thousand tons. Romania ranks 10th in terms of total wheat production in 2024 with a production of 31.8 thousand tons.

Figure no. 3. Total wheat production in Romania (thousand tons)



Source: Eurostat.eu, own calculations

As for the total wheat production in Romania, we can note that in 2015, Romania produced a quantity of 7.91 thousand tons of wheat, and in 2023 the total production increased to 31.75 thousand tons, which represents an increase of over 300%.

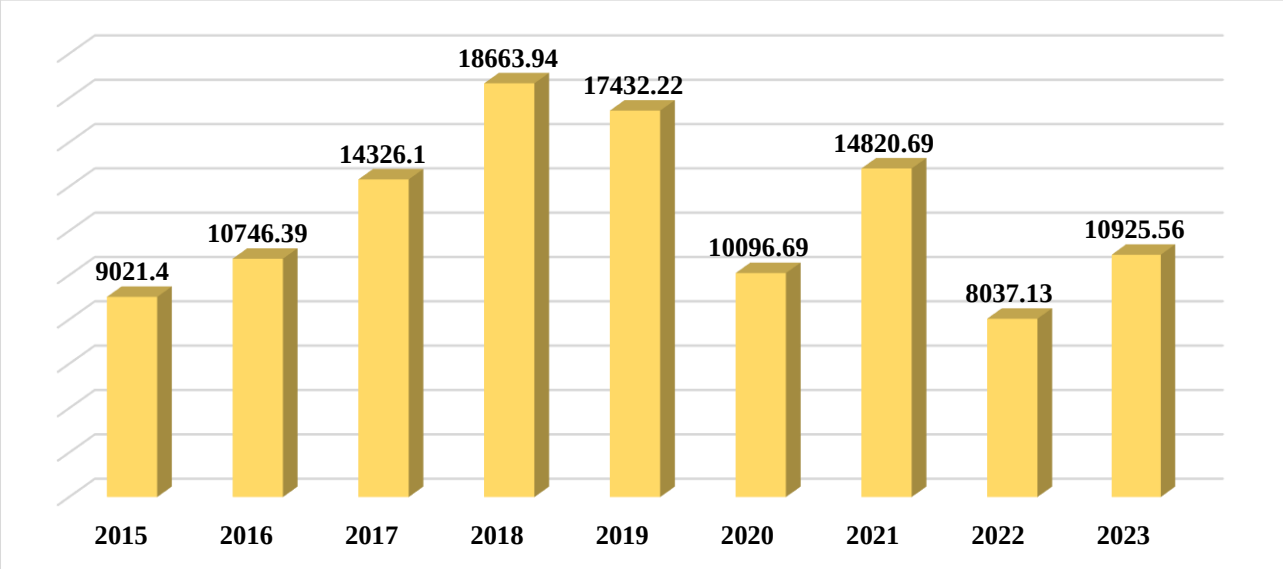
Table no. 4. Ranking of EU countries according to total maize production (thousand tonnes)

Country	2015	2016	2017	2018	2019	2020	2021	2022	2023	2023 /2015 (%)
France	13556.6	11702.1	14365.9	12580.4	12845.0	13726.4	15358.3	10877.2	12622.0	-6.9
România	9021.4	10746.4	14326.1	18663.9	17432.2	10096.7	14820.7	8037.1	10925.6	21.1
Poland	3097.5	4262.1	3946.8	3792.1	3664.6	6694.4	7321.9	8344.9	8981.9	190.0
Hugary	6594.2	8679.2	6700.0	7930.6	8229.7	8365.4	6424.6	2765.6	6236.1	-5.4
Italy	6612.4	6861.8	6068.2	6199.2	6279.1	6793.1	6080.0	4697.2	5348.7	-19.1
Germany	3973.0	4017.8	4547.6	3344.3	3664.8	4020.0	4462.4	3837.4	4498.9	13.2
Spain	4564.4	4069.5	3775.7	3842.5	4184.5	4214.1	4597.7	3590.3	2908.2	-36.3
Bulgaria	2709.5	2277.9	2610.2	3522.5	4059.8	3014.1	3427.3	2554.4	2445.3	-9.8
Austria	1637.9	2179.6	2076.0	2130.3	2298.9	2411.9	2434.9	2114.0	2105.1	28.5
Croația	1709.2	2154.5	1559.6	2147.3	2298.3	2430.6	2242.1	1641.9	1974.0	15.5

Source: Eurostat.eu, own calculations

From the analyzed table, it emerges that France ranks first in terms of total corn production obtained in 2023 with 12.6 million tons, followed by Romania with 10.9 million tons and Poland with about 9 million tons.

Figure no. 4. Total corn production in Romania (thousand tons)



Source: Eurostat.eu, own calculations

Graph no. 4, presents data on the total corn production in Romania. In 2015, the total corn production recorded in Romania was over 9 million tons, reaching a total production of 10.9 million tons in 2023, showing an increase of 21%.

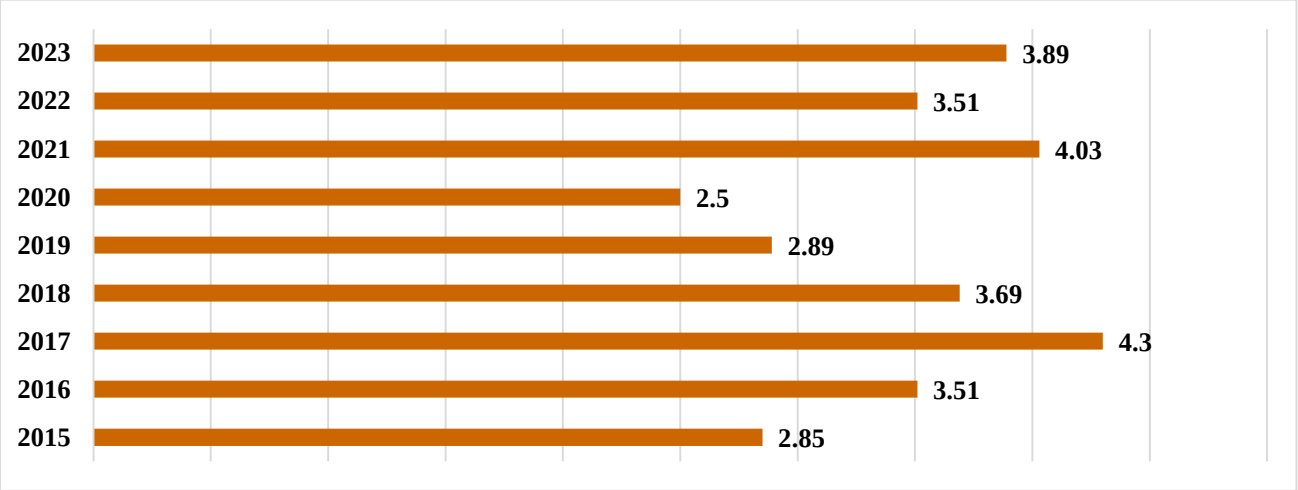
Table no. 5. Ranking of EU countries according to average wheat production (tonnes/hectare)

Country	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024/ 2015 (%)
Slovakia	5.16	4.37	4.30	4.82	4.29	5.12	5.87	4.97	6.14	19.0
Austria	4.61	5.30	3.98	4.15	4.80	4.78	4.54	5.15	5.95	29.1
Germany	4.65	5.33	5.75	4.58	4.92	5.38	5.51	5.35	5.75	23.7
Czech Republic	-	-	-	-	-	-	-	-	5.54	-
France	5.60	4.16	5.66	4.98	6.21	5.20	5.35	5.24	5.37	-4.1
Hungary	4.88	5.03	4.74	4.72	4.40	4.47	5.50	3.71	5.20	6.6
Bulgaria	3.41	4.13	4.30	4.09	4.23	3.91	5.57	4.81	4.97	45.7
Croatia	6.58	5.00	5.26	5.15	5.06	4.28	5.12	5.12	4.05	-38.4
Luxembourg	-	-	-	-	-	4.13	4.76	5.06	4.04	-
Romania	2.85	3.51	4.30	3.69	2.89	2.50	4.03	3.51	3.89	36.5
Greece	2.46	3.02	2.43	2.61	2.69	3.02	2.81	2.96	3.31	34.6
Italy	3.39	3.79	3.48	3.37	3.27	3.33	3.44	3.09	3.02	-10.9
Cyprus	3.02	0.89	2.01	1.60	2.89	2.68	2.19	2.76	2.39	-20.9
Portugal	2.25	2.81	2.34	2.79	2.89	2.94	2.83	2.39	1.92	-14.7
Spain	2.78	2.47	2.66	3.58	2.76	3.28	3.11	2.50	1.68	-39.6

Source: Eurostat.eu, own calculations

From the analyzed table, it follows that Slovakia is in the top of the E.U. countries in 2023 with an average wheat production of 6.14 tons/hectare, followed by Austria with an average production of 5.95 tons/hectare and Germany with 5.75 tons/hectare. Romania ranks 10th in terms of wheat yield in 2023 with 3.89 tons/hectare.

Figure no. 5. Average wheat production in Romania (tons/hectare)



Source: Eurostat.eu, own calculations

In the figure above, at the level of Romania, for the wheat crop, the yield in 2015 was 2.85 t/ha, reaching a yield of 3.89 t/ha in 2023, which represents an increase of over 36%.

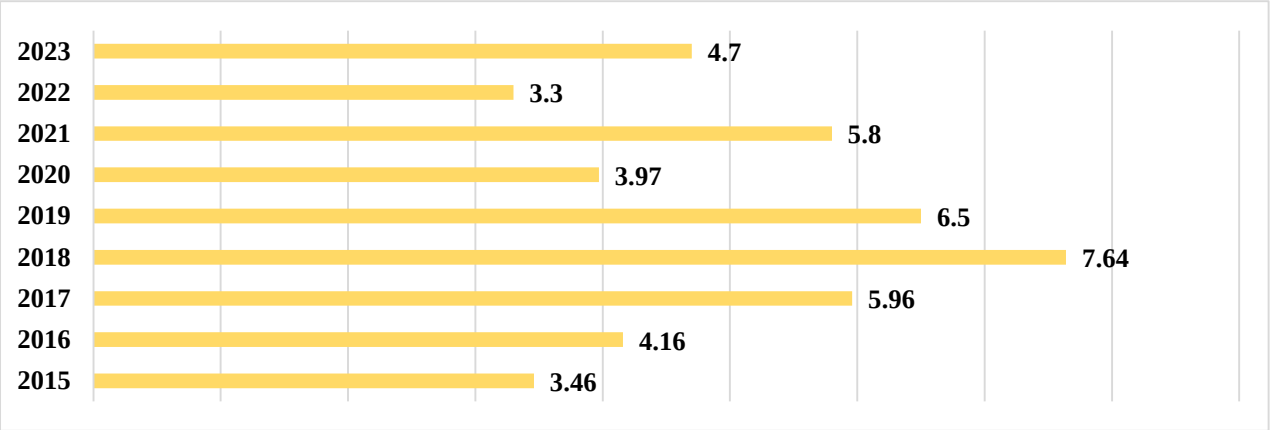
Table no. 6. Ranking of EU countries according to average maize production (tonnes/hectare)

Country	2015	2016	2017	2018	2019	2020	2021	2022	2023	2023 /2015 (%)
Spain	11.46	11.33	11.32	11.92	11.73	12.26	12.83	11.42	11.67	1.83
Italy	10.08	10.38	9.88	10.13	10.05	11.27	10.33	8.33	10.73	6.45
Portugal	8.45	8.02	8.61	8.56	9.80	9.35	10.10	9.62	10.67	26.27
Netherlands	8.30	6.46	10.16	6.49	7.80	8.54	9.96	8.79	10.14	22.17
Austria	8.68	11.16	9.91	10.15	10.42	11.35	11.16	9.82	9.93	14.40
Belgium	9.40	7.47	10.28	7.00	8.83	8.11	9.33	7.96	9.82	4.47
France	8.28	8.11	9.97	8.79	8.48	7.94	9.91	7.45	9.73	17.51
Germany	8.88	9.65	10.53	8.14	8.81	9.59	10.36	8.40	9.65	8.67
Greece	10.59	10.84	9.86	10.63	10.68	10.09	11.24	10.58	9.50	-10.29
Slovenia	8.97	9.51	7.11	9.45	9.27	10.79	9.39	6.68	8.79	-2.01
Switzerland	7.69	10.31	10.82	9.89	11.03	11.13	7.95	10.01	8.63	12.22
Lithuania	4.81	6.94	5.74	6.54	7.67	7.01	5.86	5.31	8.24	71.31
Hungary	5.75	8.58	6.78	8.44	8.01	8.53	6.09	3.39	8.12	41.22
Czech Republic	5.54	9.79	6.84	5.98	8.29	9.46	9.65	7.95	7.88	42.24
Slovakia	5.47	7.76	5.61	8.41	7.39	8.29	7.77	4.31	7.57	38.39
Croatia	6.50	8.50	6.30	9.13	9.01	8.43	7.79	6.13	7.42	14.15
Sweden	5.76	8.03	7.33	4.18	6.96	6.77	8.56	6.92	7.36	27.78
Serbia	5.40	7.30	4.01	7.72	7.63	7.90	5.91	4.50	7.18	32.96
Poland	4.62	7.15	7.02	5.88	5.52	7.08	7.33	6.98	7.15	54.76
Luxembourg	5.36	5.45	7.00	5.07	4.62	5.49	6.41	5.14	5.58	4.10
Denmark	6.13	7.59	7.54	5.63	7.56	6.25	7.07	7.23	5.44	-11.26
Romania	3.46	4.16	5.96	7.64	6.50	3.97	5.80	3.30	4.70	35.84

Source: Eurostat.eu, own calculations

As for the average corn production at the level of the European Union, Romania is at the bottom of the ranking with an average production of 4.7 t/ha, the first places being occupied by Spain (11.67 t/ha), Italy (10.73 t/ha) and Portugal (10.67 t/ha).

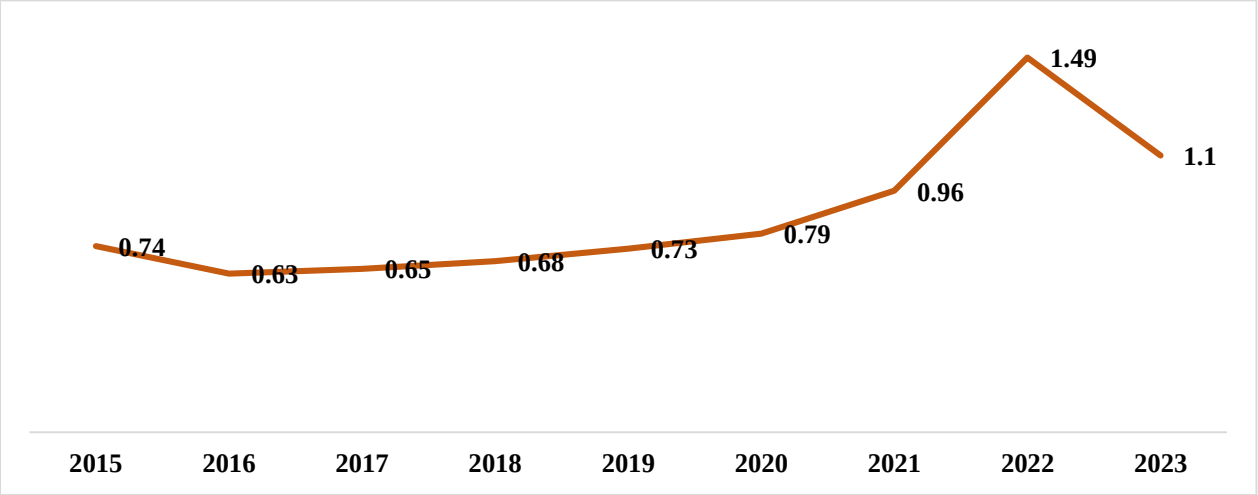
Figure no. 6. Average corn production in Romania (tons/hectare)



Source: Eurostat.eu, own calculations

At the average corn production in Romania, we can say that in 2015, Romania had a yield of 3.46 t/ha of the corn crop, reaching a yield of 4.7 t/ha in 2023, which shows an increase of over 35%.

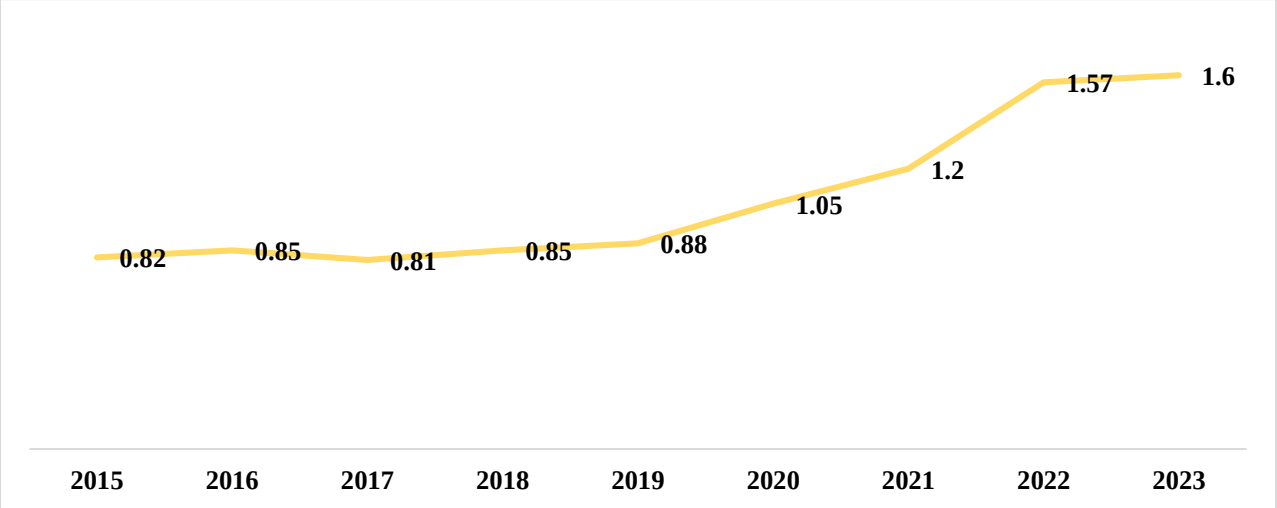
Figure no. 7. Average annual price of the wheat (lei/kg)



Source: Eurostat.eu, own calculations

Regarding the price analysis for wheat and corn crops, in Romania, wheat recorded a price of 0.74 lei/kg, reaching 1.1 lei/kg in 2023, thus showing an increase of 48%.

Figure no. 8. Average annual price of the maize crop (lei/kg)



Source: Eurostat.eu, own calculations

As for the average annual price for the corn crop, it is noted that in 2015, the average price of a kilogram of corn was 0.82 lei/kg, reaching 1.6 lei/kg in 2023, which represents an increase of over 95%.

CONCLUSIONS

Comparative analysis of the main technical and economic indicators for maize and wheat crops highlights a number of key aspects. First, economic factors such as production volume, market prices, and production expenses have a significant impact on the performance of these crops.

Agriculture remains an essential field in Romania's economy, involving an important part of the population and playing a major role in the country's socio-economic development. With generous natural resources and a long tradition in agriculture, Romania has considerable potential in the agricultural sector, thus contributing to food security, both nationally and globally.

Corn and wheat play a special role in Romanian agriculture, providing not only essential food for the population, but also contributing to farmers' incomes and rural development. These crops occupy a significant part of the agricultural land in the country, being cultivated in various regions and having an important influence on national agricultural production.

By evaluating yields and areas allocated to maize and wheat crops, significant variations and trends are observed, determined by factors such as climatic conditions, agricultural practices and the technologies used. The analysis of this data is crucial for an effective management and planning of agricultural production, especially in the context of the need to optimize production and ensure food security.

From the price analysis for corn and wheat it provides a deeper understanding of market dynamics and the factors influencing their fluctuations. Prices are influenced by factors such as the supply-demand ratio, changes in agricultural policies and international economic developments.

In conclusion, this paper provides a solid basis for decision-making on farms, contributing to the creation of a more efficient, competitive and sustainable agricultural sector.

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THE IMPACT OF CLIMATE CHANGES ON THE VEGETABLE SECTOR

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Summary: *Vegetable crops are strongly affected by extreme weather phenomena (for example drought and floods), which disrupt the technological production process and favor the spread of diseases and pests, thus creating an unstable agricultural environment. In addition, these climate changes directly affect farmers who are forced to change the way they plan their crops, adopt sustainable agricultural practices and implement the links of advanced technologies. At the same time, it is essential that together with the application of sustainable agricultural practices in vegetable farms, there are also support policies that come to the aid of farmers to guarantee the success of these changes. The article aims to analyze the impact of climate change on the vegetable sector and provide a vision of how it can survive in a constantly changing climate.*

Key words: *vegetable sector, climate change, market, support policies*

JEL classification: Q13,Q15,Q54

INTRODUCTION

The subject of climate change is very often addressed in scientific papers, which highlighting its significant impact on agricultural crops and the major challenges it brings to farmers. These phenomena not only directly influence production by destroying plants, but also increase the proliferation of diseases and pests, creating an unstable agricultural environment.

In recent decades, climate change has clearly made its effects felt in Romania and in the world, through extreme weather phenomena such as drought, floods, heat waves and sudden temperature fluctuations(www.presidency.ro). These changes have considerably affected the sector, and vegetable crops, due to their biological characteristics and ecological needs, are among the most vulnerable (Kondinya A. et all, 2014). These changes disrupt both the technological processes of production and the natural ecosystems in which vegetables are grown, which directly affects farmers, agricultural production and the agri-food economy (Rurac M. et all, 2021; Manzoor M. A. et al., 2024).

One of the most common phenomena is drought, which affects plants by reducing water availability, causing water stress. This leads to decreased productivity and, in severe cases, to the compromise of crops.

On the other hand, flooding can damage the roots, leading to plant asphyxiation and massive losses. The soil soaked with water also favors the development of pathogenic fungi, which can destroy crops in a short time.

From the perspective of the risk associated with hail, which can cause severe damage, the most exposed are the areas where the land is used for vegetable crops and fruit or vineyard plantations (Mihăilă D., 2006).

These phenomena have a devastating impact on farmers, affecting not only crop yields, but also products, as well as the income they can obtain.

MATERIALS AND METHODS

The research method used is quantitative analysis, which involves the collection and analysis of meteorological data (precipitation, temperatures) and agricultural production, in order to establish possible correlations between climatic variations and vegetable production. This type of research helps to identify trends and assess the impact of environmental factors on crops. The data collected are obtained from official sources (INS) for the period 2014-2023.

The statistical indicators used in the analysis and interpretation of the data (Țimiraș Laura Cătălina, 2016) were:

1. *The average* – represents the average annual value of each indicator in the period 2014-2023. Media provides a reference point for interpreting variations.
2. *The coefficient of variation* (C%) given by the formula: C%= σ/ x *100;

where: x = the average value of the analyzed indicator in the analyzed period;

σ = standard deviation of the analyzed data string $\partial = \sqrt{\frac{\sum(\bar{x}-xi)\wedge 2}{n-1}}$.

The coefficient of variation measures the significance of the degree of variation in relation to the mean.

Interpretation: *small variation* (< 10%) - relatively stable data; *medium variation* (10.1 % - 20 %) - moderate variability; *high variance* (> 20.1%)- high variability, which may indicate instability in the trends of the analyzed indicator.

3. *Average annual growth rate(r)* shows us what is the annual growth of the analyzed phenomenon *:* $r = \sqrt[n-1]{\prod\left(\frac{p\,n}{p\,n-1}\right) - 1}$*,* where*:* ∏pn/pn-1 = indicators of chained growth
4. Adjusting the trend by trend equation, parabola type, of the form: Y= ax2+bx+c

With the help of the FORECAST statistical function in EXCEL, forecasts of the temperature and the amount of average annual precipitation for the next 5 years were made, based on statistical data. It provides estimates of how weather conditions will change.

RESULTS AND DISSCUSION

In Romania, agriculture depends to a large extent on climatic conditions, and these changes negatively influence both production and food security of the population.

As the temperature rises, extreme weather events, such as prolonged droughts, floods and early frosts, become more frequent altogether. Vegetables, especially those grown in the field, are crops that are very sensitive to environmental conditions (Mehdi B. B.et all, 2018), and such phenomena greatly affect its production and quality. For Romanian farmers, temperature variations directly influence planting and harvesting periods, amplifying the risks associated with pest and disease attacks. These changes affect the stability of supply and increase uncertainties in the vegetable market (Mattos Leonora M. et all, 2014).

The average annual temperature in Romania has increased significantly in recent decades, and seasonal variations have major consequences on agricultural production, including horticulture. In the analyzed period 2014-2023, the average annual temperature registered an increase of 1ºC in this interval, from 10.4 ºC in 2014 to 11.56 ºC in 2023. The year

2021 presented unusual weather conditions, recording a significant drop in temperature, up to 9.9 ^{oC} (Table 1).

The vegetable sector is strongly influenced by the rainfall regime, given that vegetables require a constant supply of water for optimal growth and development. In dry periods, farmers are forced to use the irrigation system more frequently, which leads to an increase in production costs. Fluctuations in the rainfall regime also have a major impact on production, which can have significant negative effects on the vegetable market. As a rule, in dry years the production is lower, which leads to an increase in imports and prices of domestic products (www.cotidianul.ro).

In recent years, Romania has recorded significant variations in the rainfall regime, a phenomenon aggravated by climate change. The IPCC (Intergovernmental Panel on Climate Change) analyses have identified an increase in the amount of precipitation in the autumn season in most regions, but also a decrease in the winter-summer periods, especially in the East and South-West regions of the country(www.mmediu.ro).

From the statistical data of the last 10 years, there is a significant variation in the average annual amount of precipitation, with a maximum of 806.4 mm in 2014, and a minimum of 553.2 mm in 2022, the latter being a year with difficult climatic conditions for agriculture(www.agerpres.ro).

In 2023, the amount of precipitation increased slightly to 629.76 mm, but remains about 21.9% lower than the level of 2014. The data reflect a trend of decreasing rainfall, which puts additional pressure on agriculture and requires adaptation of agricultural practices to counteract water scarcity (Table 1).

Table 1. Dynamics of temperature and average annual precipitation in Romania in the period 2014-2023

Indicators	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Average	C%	Annual rhythm
Average annual air temperature (^{oC})	10,4	10,8	10,3	10,2	10,7	11,2	11	9,9	10,6	11,56	10,67	4,66%	1,18%
Average annual amount of precipitation (mm)	806,4	622,9	766,1	670,4	684,9	601	636,7	699,6	553,2	629,76	667,10	11,42%	-2,71%

Source: INS data processing – TEMPO ONLINE – matrix code - TOX1332, TOZ1334 - Target 3 - Environment accessed on 29.10.2024.

The climate changes observed during the last decade in Romania (Table 1), are characterized by an increase in temperature with an average annual rate of 1.18% and a decrease in precipitation by -2.71%, indicating a significant impact on the country's agriculture, environment and economy. The constant decrease in rainfall represents an important challenge for the vegetable sector, especially for those grown in the field. This puts increasing pressure on farmers, leading them to invest in modern technologies for monitoring and optimizing irrigation.

As climatic factors play an important role in the success of agricultural crops, it is necessary for farmers to use weather data to be able to adapt their production strategies. Using statistical data from 2014-2023, it was possible to create forecasts, using the Forecast function

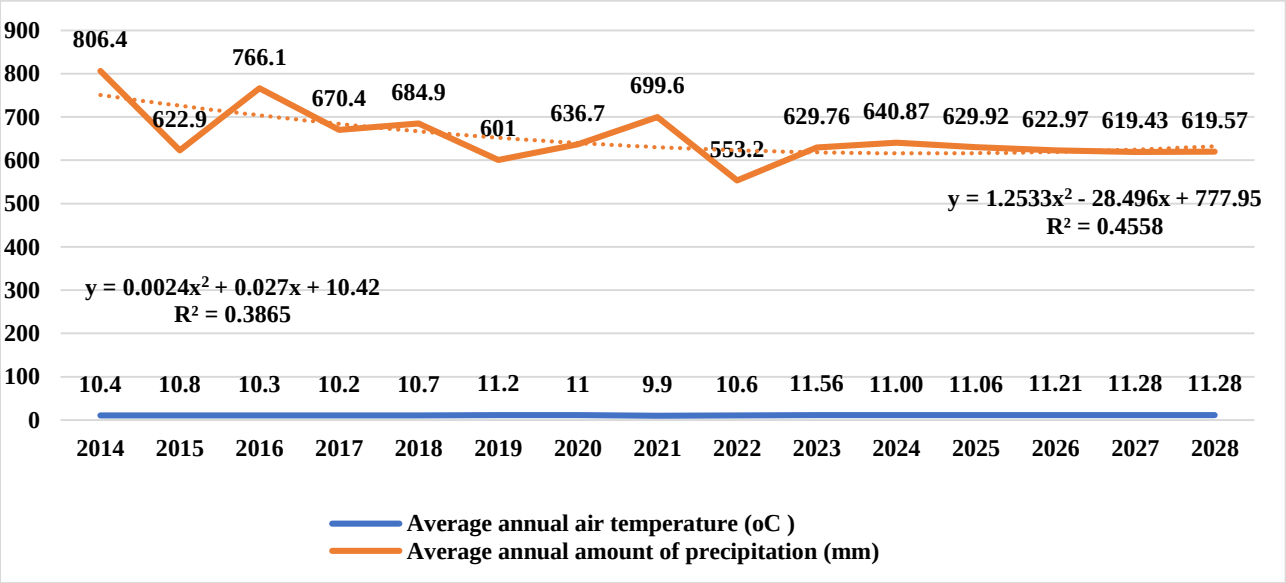
in Excel, for the temperatures and amount of precipitation in the next 5 years, which can be used for efficient planning of agricultural activities. Knowing the temperature and precipitation forecasts can be useful to farmers to be able to choose the best periods for sowing, planting, carrying out works or treatments during the vegetation period.

Looking at the forecasts for the period 2024-2028 regarding the average annual air temperature and the average annual amount of precipitation, we can see that (Figure 1):

1. The temperature in 2024 (11 $^{oC)}$ is slightly lower than the maximum value recorded in 2023 (11.56 oC), but higher than the average for the period (10.67 oC). In the period 2025-2028, the temperature values remain almost constant, with very small fluctuations (11.06-11.28 oC).

2. For the period 2024-2028, the forecasts indicate a decreasing trend in the amount of precipitation, with estimated values between 622 mm and 640 mm. These values are lower compared to those recorded in 2014 (806.4 mm) and 2016 (766.1 mm), but higher than those recorded in 2019 (601 mm) and 2022 (553.2 mm).

Figure 1. Forecasts for the average annual temperature (°C) and the average annual amount of precipitation (mm) in Romania for the period 2024-2028



Source: INS data processing - TEMPO ONLINE - MATRIX CODE - TOX1332, TOZ1334 - Target 3 - Environment, accessed on 29.10.2024.

Rising temperatures and reduced precipitation have a number of implications for horticulture, such as:

- The increase in temperatures directly affects the process of photosynthesis, with repercussions on the quantity and quality of production (4. Bisbis, M. B.et all, 2018; Mattos Leonora M. et al., 2014). Studies in the field show that high temperatures can cause changes in the sugar content of vegetables, the composition of fatty acids and vitamins, affecting their nutritional benefits. At high temperatures, vegetables lose their firmness, which influences the quality of production and also the resistance to transport and storage (Moretti C.L. et al., 2010).

- In addition to the effects on production, high temperatures directly influence the period of establishment of crops. Farmers can cultivate earlier in case of high temperatures, leading to an early harvest (Mattos Leonora M. et all, 2014).
- Indirectly, the increased temperatures have a negative effect on water resources, the expansion of diseases and pests as well as weeds (Mattos Leonora M. et all, 2014). Rising temperatures have a significant impact on plants, as warm air can intensify evapotranspiration, increasing plants' demand for water (Moretti C.L. et al., 2010). Vegetables such as: peppers, cucumbers, pumpkins, tomatoes, eggplant, etc., bear less fruit in conditions of heat stress, resulting in a decrease in production and a deterioration in its quality (Bisbis, M. B.et all, 2018). Experiments in different parts of the world have confirmed that increased temperatures lead to decreased yields and increased production costs, which complicates the situation of farmers, requiring additional adaptation measures (Moretti C.L. et al., 2010).
- A special impact on vegetable crops is the rainfall, which in insufficient or excess quantities influences the growth and development of plants (Enache L., 2009).
- Vegetable crops, such as tomatoes, cucumbers, cabbage, which depend on constant moisture in the soil, do not develop properly in conditions of water scarcity. In such conditions, farmers are forced to supplement the water needs through irrigation, which implies additional costs that will be reflected in the prices of vegetable recovery. On the other hand, excess rainfall has as negative an impact on vegetable crops as water scarcity (Schmidt, N. et all, 2024). Excess accumulated water causes suffocation and rotting of the roots, which leads to the death of plants. Also, excess water favors the appearance of diseases, leading to a decrease and deterioration of production. Long periods of rainfall can completely compromise the crop, affecting farmers' incomes.

CONCLUSIONS

The vegetable sector in Romania is strongly influenced by climate change, which has a negative impact on food production and security.

Rising temperatures and the increasing frequency of extreme weather events affect both the quantity and quality of production, especially in field vegetable crops.

To meet climate challenges, it is essential for farmers to adapt their crop establishment and treatment periods, diversify crops and adopt modern technologies such as efficient irrigation and soil monitoring to reduce climate risks.

Farmers must also adopt sustainable practices, such as crop rotation, the use of organic fertilizers and the implementation of soil conservation farming techniques.

It is necessary to take into account the specific climatic conditions of each area (from humid to Mediterranean influences) when choosing crops.

Agriculture is one of the sectors most affected by climate change, and in order to face these challenges, it is important that authorities, farmers and the private sector work together to overcome current vulnerabilities, transforming this sector into a modern and sustainable one.

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BEEKEEPING SECTOR OF THE REPUBLIC OF MOLDOVA – SUSTAINABLE DEVELOPMENT CHALLENGES

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Abstract: *Beekeeping plays not only an important role in supporting biodiversity, but also has a significant contribution to the development of economic activities in rural areas and increase of the well-being of population. In recent years, honey production in Moldova has been increasing, with small fluctuations, but it is still strongly dependent on climate conditions, that can significantly affect the volumes of production. At the same time, the amount of production can also be affected by the limited capabilities of beekeepers in managing the business, the production process itself, lack of association, etc. The paper aims to present an overview of the beekeeping sector of the Republic of Moldova, by carrying out a general analysis on the evolution of the number of bee families, production, export capacities and degree of competitiveness at the international level. It concludes that although, in recent years, progress has been observed in increased volumes of production and the process of association of beekeepers, etc., still additional efforts are needed for its sustainable development like specialized courses, trainings, demonstrations in the field, access to more efficient infrastructure, assistance in disease diagnosis, with an emphasis on development and integration of sustainable honey production in the complete value chain.*
Keywords: *agriculture, beekeeping, Republic of Moldova, sustainability*
JEL classification: Q01, Q18

INTRODUCTION

Beekeeping represents one of the most important sectors of agriculture, due to not only its contribution to the agricultural output, insurance the population with honey, but also by playing a significant role in supporting biodiversity. Pollination of agricultural crops by bees can help increase yields of fruit trees, vegetables, canola, sunflower significantly (Rollin & Garibaldi, 2019). The sector's continuous development depends on several factors of both endogenous and exogenous nature. The production of honey, as well as other products of beekeeping origin, is strongly linked to traditional values from a certain community, investments in new processing tools, research and development activities in the field (Vapa-Tankosic et al, 2020), etc. At the same time, it is also affected by weather conditions, which can significantly affect the amount of production, as well as its quality (Garabedian, 2021). Moreover, the sustainable development of the beekeeping sector can be affected by the limited capabilities of beekeepers in managing the business, poor processing machinery and skills, the production process itself, use of excessive chemical substances in multiannual plantations during the blossom period, hive loss, pests and diseases (González Pacheco, Barragán Ocaña, 2023), etc.

In the Republic of Moldova, at the moment, the tendency to increase honey production by applying modern inputs specific to the beekeeping sector is observed. The improvement of the product is achieved by encouraging honey producers to use modern hives, as well as by providing training on how to care for bees in the cold period in particular. Organic beekeeping, which is quite new for the Republic of Moldova, represents a future direction for the sustainable development of the sector, but it faces from the beginning several important challenges, among

which can be mentioned: insufficient knowledge in carrying out an organic beekeeping business and complicated process related to certification of organic honey (Pocol et al, 2021).

Nevertheless, in recent years, progress has been observed in the process of association of beekeepers, which has many advantages such as: permanent contacts with other beekeepers, including more experienced ones, the possibility to participate in courses, trainings, demonstrations in the field, access to more efficient processing and other types of infrastructure, assistance in disease diagnosis, possibility for development of organic production, etc., but additional efforts are still needed in this direction, with an emphasis on development and integration in the complete value chain.

The honey value chain consists of the following components: inputs, production, logistics elements for processing, processing, sale/distribution and consumption. Along the honey value chain, the producer is the main figure who can be involved in all stages and processes, once his position is improved and he has all the necessary levers and tools. In the Republic of Moldova, as a rule, small honey producers sell their products on the local market, and with the increase in quantities, the difficulty in their distribution appears, as a result of the larger production volumes. As a result, the position of producers in the value chain is characterized by a reduced ability to negotiate the price and define the quality of the product obtained.

Taking into account that the development of the beekeeping sector in the Republic of Moldova has not been approached form the perspective of sustainability, the paper aims to present an overview of the beekeeping sector of the Republic of Moldova, by carrying out a general analysis on the evolution of the number of bee families, production, export capacities and degree of competitiveness at the international level, with an emphasis on the sustainable development challenges.

MATERIALS AND METHODS

The methodological basis for research is made of scientific methods of investigation, the methods of analysis, comparison, other qualitative and quantitative methods.

The assessment of competitiveness at the international level with respect to other countries was performed with the use of Revealed Comparative Advantage (RCA) coefficient.

SWOT analysis has been performed in order to identify strengths, weaknesses, opportunities and threats for the beekeeping sector from the Republic of Moldova.

The statistical data used during the analysis of the sector was retrieved from the National Bureau of Statistics of the Republic of Moldova (data on number of bee families), FAO Stat (honey production), UNComtrade (data on natural export and import volumes, export prices) and WITS (monetary values for export and import).

RESULTS AND DISSCUSION

In the Republic of Moldova, in the recent years, there is noted an increase in the number of bee families as a result of the interest of farmers in this specific sector, as well as the public support intended for its sustainable development. According to the Ministry of Agriculture and Food Industry, the number of authorized beekeepers in 2024 reached 9421

persons, of which about 3319 have a legal form of activity. Therefore, during the period 2005 - 2024, the number of bee families increased from 87 thousand to 207.1 thousand. When analysing the sector according to the type of ownership, most of the bee families belong to rural households, with a share of 98.5% in 2024, meaning that agricultural enterprises hold only about 1.5%.

In territorial profile, during 2007 – 2024, the number of bee families increased in all regions of the country. Therefore, the largest number of bee families is located in the Central region of the country, with an almost twofold increase in the number of bee families from 37.3 thousand to 72.8 thousand, followed by the Northern region – with the same trend of increase from 31.9 thousand to 67, 2 thousand, and the South area – from 27.0 thousand to 51.7 thousand.

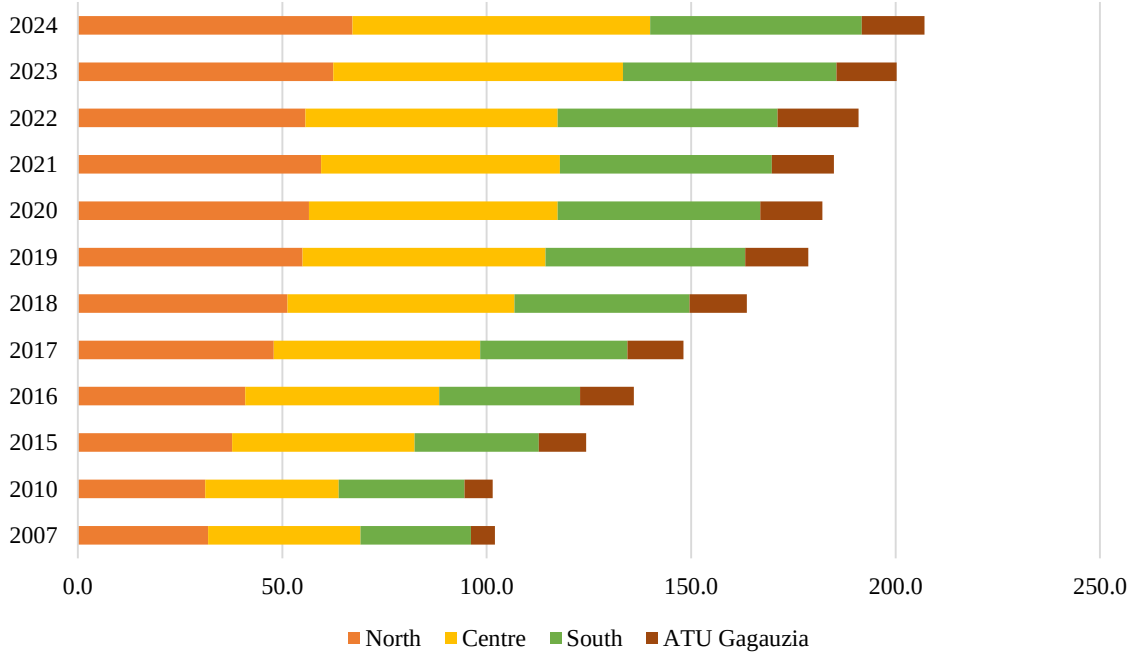

Figure 1. Dynamics of the number of bee families in territorial profile, thousands of pieces

Source: developed by author based on (National Bureau of Statistics, 2024)

As a result of the increasing number of bee families, the honey production in the Republic of Moldova has experienced an important increase from 2655 tons produced in 2011 to 5500 tons in 2023. The increase in production is related to a series of factors, among which can be mentioned increased capacities and knowledge of beekeepers in diversification of production, increase of productivity and better business management, a better coordination among agricultural producers from the vegetable sector with beekeepers, diminish of the risks related to poisoning of bees with phytosanitary products, etc.

Besides honey, honey by-products like beeswax, pollen, honeycombs, etc. can also represent an important direction for the sustainable development of the sector and they can bring an additional value to the bee-related production. Statistical data is not available for assessing quantities or monetary values of these types of products.

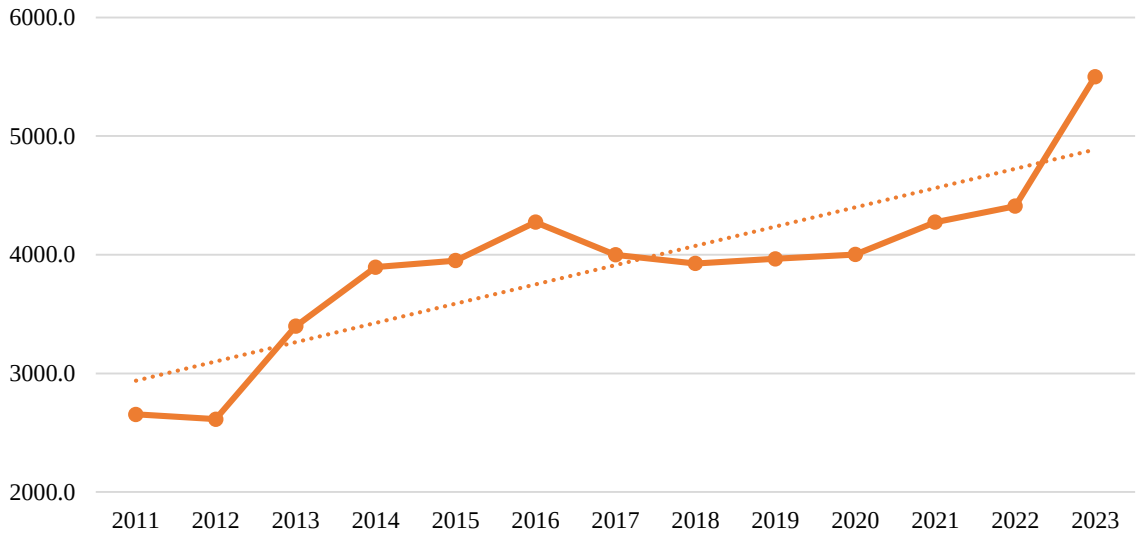

Figure 2. Honey production, 2011 – 2023, tons

Source: developed by author based on (FAO, 2024)

The external trade with bee honey has a positive trade balance during 2015 – 2023. The export values have fluctuated over the time, with some periods of ascent (particularly years of 2017 and 2021), as well as periods marked with a decline in export values (2016, 2020 and 2023). In 2023 the export of natural honey decreased by approximately 2 times compared to the previous year, from 12845.1 thousand USD in to 6014.1 thousand USD. Not every Moldovan beekeeper has the physical capacities for exporting natural honey. Taking into account that 98,5% of bee families are registered in rural households, there is a need for a better coordination of actions among beekeepers for creating associations capable of providing necessary amounts of products for export as a result of common processing of honey.

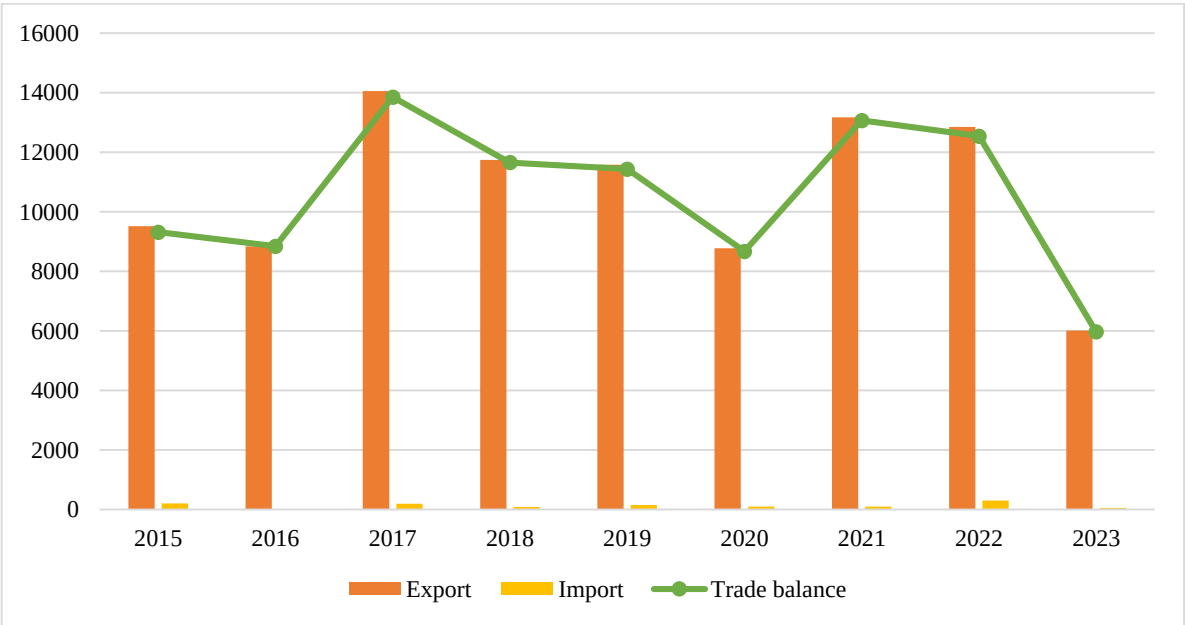

Figure 3. Foreign trade with natural honey, 2015 – 2023, thous. USD

Source: developed by author based on (World Bank, 2024)

The geography of domestic honey exports is quite vast, with 51 distinguished economic partners registered during 2015-2023. The main importers of natural honey from the Republic of Moldova are represented by EU countries. On average for the period 2020 – 2023, Italy held 25% of the value of honey exports, followed by Romania with 16.3%, Slovakia - 10.9%, Serbia - 8.8%, France – 7.2%, Czech Republic – 6.5%, Poland – 5.7%, Germany – 4.5%, etc.

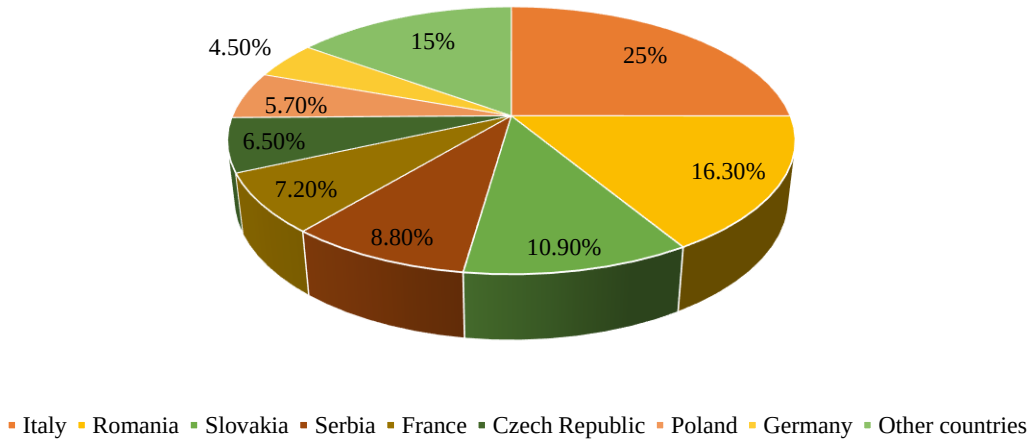

Figure 4. Export of natural honey by countries, average values for 2020 – 2023, %
Source: developed by author based on (World Bank, 2024)

The quantities of honey exported between 2015 and 2023 fluctuated, from 2.8 thousand tons to 1.7 thousand tons, with a maximum export value of 5 thousand tons in 2017 and a minimum of 1.7 thousand tons in 2023. Honey imports during the same period were insignificant. In 2023, only 14 tons of honey were imported.

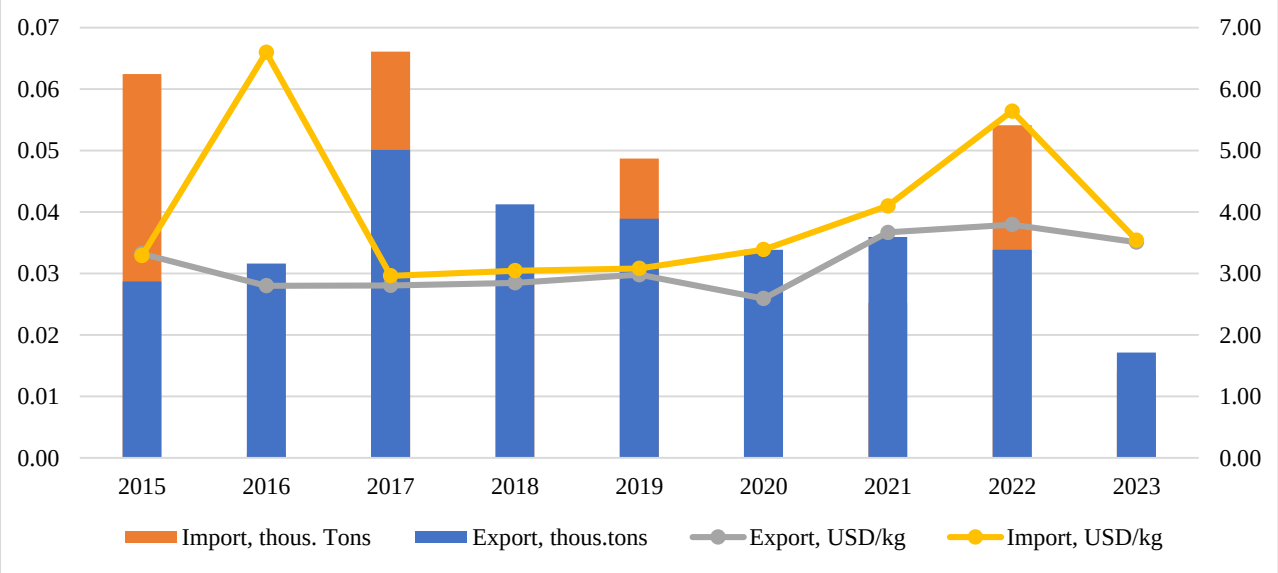

Figure 5. Foreign trade with natural honey, 2015 – 2023, natural values and prices
Source: developed by author based on (UN Comtrade, 2024)

The price for one kg of exported natural honey varied from 3.7 USD in 2022 to 2.6 USD/kg in 2020. The price for 1 kg of natural honey in 2023 reached 3.5 USD/kg.

For assessing the Moldovan natural honey competitiveness on international markets, the RCA indicator was calculated and all the obtained values are considerable higher than 1, thus pointing on the existing of a competitive advantage in this area. The values fluctuate between 42,5 in 2017 to 15,9 in 2023. Although experiencing a sharp decrease in the last two years, the values are still net positive and point on the existing competitiveness of the product at the international level.

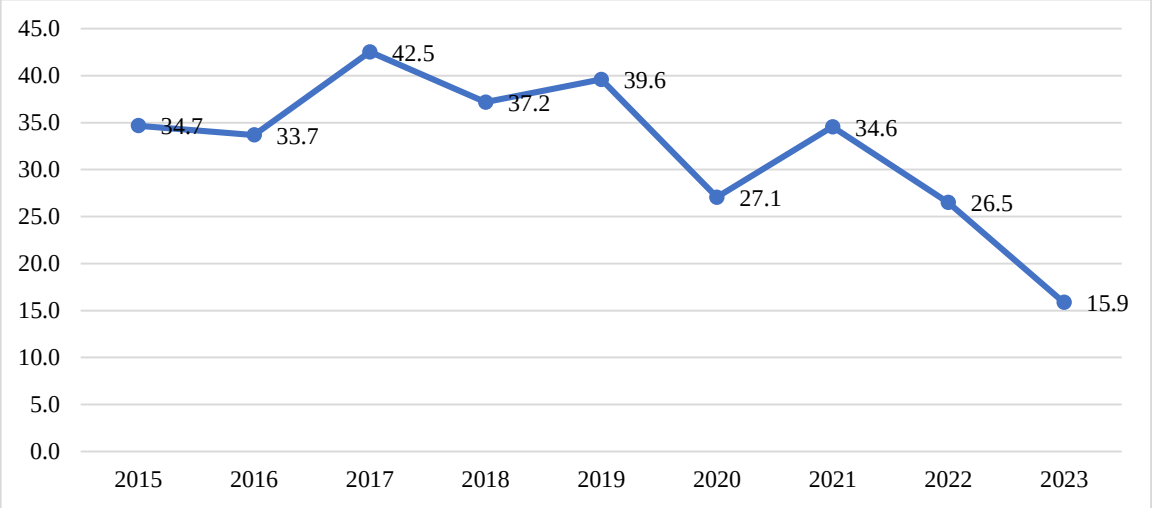

Figure 6. RCA values for natural honey with respect to world countries, 2015 – 2023

Source: developed by author based on (World Bank, 2024)

The increasing success of the beekeeping sector is also due to the public support intended for it, that relies on several directions:

- Reimbursement of investments:

a. Reimbursement of investments in livestock farms, in this case, for at least 30 queen bees/swarms of queen bees. The amount of subsidy accounts for 50% of the investment costs for queen bees no more than 12 months old, but no more than 150.0 thous. MDL per beneficiary and 50% of the investment costs for swarms of bees with queens no more than 12 months old, but no more than 300.0 thousand lei per beneficiary.

b. Reimbursement of investments for construction or modernization of bee honey storage units; construction or modernization of units for primary/finished processing, packaging, refrigeration, freezing or storage of bee honey; modernizing the processes of performing test analyses for honey and bee products. The size of the subsidy accounts for 50% of the value of the eligible project, but no more than 5.0 mil. MDL per beneficiary (Guvernul Republicii Moldova, 2023a).

- Subsidies in advance:

a. modernization of livestock farms with beekeeping specialization, with at least 30 queen bees/swarms of bees;

b. procurement of queen bees and/or swarms of bees with queens not more than 12 months old. For both directions, the total cost of the investment project should not exceed 2.0 mil. MDL for bee families or the purchase of bee queens, and the applicant's financial

contribution should account for at least 30% of the total cost of the investment project (Guvernul Republicii Moldova, 2023b).

During 2023, more that 100 mil. MDL have been allocated for the beekeeping sector as public support. Half of the applications for subsidies in advance were intended for business in beekeeping.

In order to summarize the overview of the beekeeping sector, the SWOT analysis has been developed pointing on the most vulnerable points of the sector, as well as on its advantages.

Table 1. SWOT analysis for the beekeeping sector of the Republic of Moldova

Strengths	**Weaknesses**
- Favourable geographical location and large variety of biodiversity (flora, crops); - Increasing number of bee families and production; - High competitiveness values for natural honey at the international level; - Existing public support for the sector in the form of subsidies; - Proximity to EU market; - Sector stimulating gender equality and involvement of youth; - Association process already initiated and existence of success stories.	- In terms of ownership, concentration of the sector in rural households; - Low diversification of honey and by-products; - Still insufficient association process; - Low capacities in terms of processing, packaging, etc. - Difficulty in homogenization of quality of natural honey; - Weak and fragmented value chain; - Weak market power; - Lack of investment and operative capital; - High certification costs.
Opportunities	**Threats**
- High demand for honey worldwide and at the EU level; - Development of organic honey production; - Development of honey by-products; - Increasing exports of natural honey and by-products once improving the quality of production; - Technology transfer and innovations in the sector for increased productivity; - Enhancing the association process.	- Increasing impact of climate changes on the beekeeping sector; - High use of pesticides and lack of coordination between honey producers and crop sector producers; - Increasing prices for inputs; - Instability in market prices; - Invasion of markets with fake honey products.

Source: developed by author

Therefore, the existing strengths like favourable geographical location, increasing number of bee families and production, high competitiveness values for natural honey at the international level, existing public support for the sector in the form of subsidies may be overweighted by the still important weaknesses like concentration of the beekeeping sector in rural households, low diversification of honey and by-products, insufficient association process, weak and fragmented value chain, as well as weak market power.

Nevertheless, there are a series of opportunities that must be taken into account when discussing about the sustainability of the beekeeping sector, mainly related to high demand for honey worldwide and at the EU level, development of organic honey production and honey by-products, technology transfer and innovations in the sector for increased productivity and enhancement of the association process.

CONCLUSIONS

Beekeeping sector is an increasing sector both, in terms of number of bee families, and honey production, as well. The export potential for natural honey is quite significant, with significant RCA values that demonstrate the high competitiveness of Moldovan honey with respect to the other countries of the world.

In order to develop the capacities of beekeepers, it is necessary to increase the degree of awareness among beekeepers regarding the professional practice of the activity. At the same time, the development of consulting services, strengthening of the capacities of educational institutions, including the promotion of professional - dual education in the field of beekeeping will ensure increased opportunities for quality education and professional training, which will lead to progress regarding production volumes and their quality, easier integration into the value chain, increased export capabilities, etc.

Improving the position of beekeepers in the value chain through targeted investments in the sector, public support and special training programs will contribute to increasing their financial capacities, the development of storage and processing spaces, will create preconditions for the development of beekeeping by-products and the development of related industries, handicrafts, as well as the development of beekeeping clusters based on regional associations. Promoting beekeeping products as high-quality food products, as well as involving beekeepers in direct sales is another way to ensure the sustainability of beekeeping businesses.

At the same time, encouraging the consumption of honey and bee products such as pollen, propolis, beeswax, etc. may contribute significantly to the well-being of citizens with an additional positive impact on the healthcare system.

ACKNOWLEDGEMENT

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ECONOMIC EFFICIENCY IN MILK PRODUCTION

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Abstract: *The paper analyzes comparatively the level of economic efficiency in the production of cow, sheep and goat milk, for the year 2023. The methodology used is economic analysis, based on the calculation of technical-economic indicators and economic efficiency indicators. The results indicate that, for cow's milk, depending on the level of production and other factors, profitability can have negative or positive values, varying between minus 5.4 and 7.5%. In sheep's milk, without capitalizing secondary production (mainly lambs) and without subsidies, farmers would suffer financial losses. Goat's milk seems to have the least economic vulnerability, as the activity ends with an estimated average profit of 8.1%. The activity of milk production remains of strategic economic importance, but located in a challenging context of destabilizing factors, which leave their mark year after year and which discourage farmers from continuing their activity.*

Key words: *milk, economic efficiency, cows, sheep, goats*
JEL Classification: Q11, Q12, Q13

INTRODUCTION

Agriculture in the European context must become a competitive sector of activity (Chiran A., Gîndu Elena, Banu A., 2002), with compliance with the rules regarding environmental protection, as well as with the implementation of support measures for the rural area, for the plant and animal production sectors. The application of the Common Agricultural Policy implies the integrated development of the rural economy and the protection of the environment, under the conditions of the new challenges related to the environment and climate.

Various researches have highlighted the discrepancies between the potential of agriculture and its contribution to sustainable development and reducing the degree of poverty. Our country has structural characteristics similar to those of other member states, but presents a significant gap between the category of large farms and that of small farms, with subsistence and semi-subsistence agriculture still prevailing. Under these conditions, profitability indicators are low, even negative, for many of the activities, including animal husbandry (Constantin M., 2007). In small farms, new technologies penetrate with difficulty, receptivity is still low.

Determining and assessing the economic efficiency in milk production requires the development and use of a system of indicators, which will quantify and express as correctly as possible both the efforts made to obtain production and the effects obtained as a result of these efforts.

The conducted research aimed to elaborate and analyze the economic efficiency of the milk of the three species (cow, sheep and goat) comparatively, on two levels of production, based on the different technical-economic indicators, for the year 2023.

MATERIAL AND METHODS

In determining the production costs, it starts from the size and structure of the direct allocations of material and human resources necessary for the good performance of the production processes (Toma Elena, 2008).

To achieve economic efficiency (a reasonable and encouraging profit) it would be necessary to ensure an adequate fodder base, a performing genetic material, and a management with great responsibility.

Feeding is the biggest challenge nowadays, not only here, but worldwide. The calculation of technical-economic indicators was carried out based on the relationships known in specialized economic literature, the examples presented being considered medium level, the milk productions considered being 3,500 liters and 6,000 liters per cow, 60 liters per sheep and 270 liters per goat.

RESULTS AND DISCUSSIONS

Cow's milk

Following Figure 1, the largest share in total expenses, in both variants (3,500 l/head and 6,000 l/head), is held by variable expenses, approximately 76-80%.

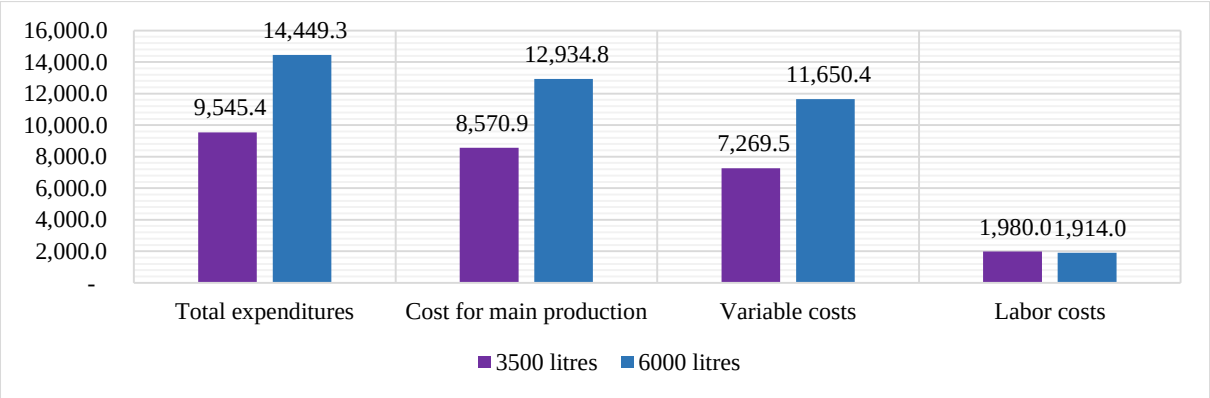
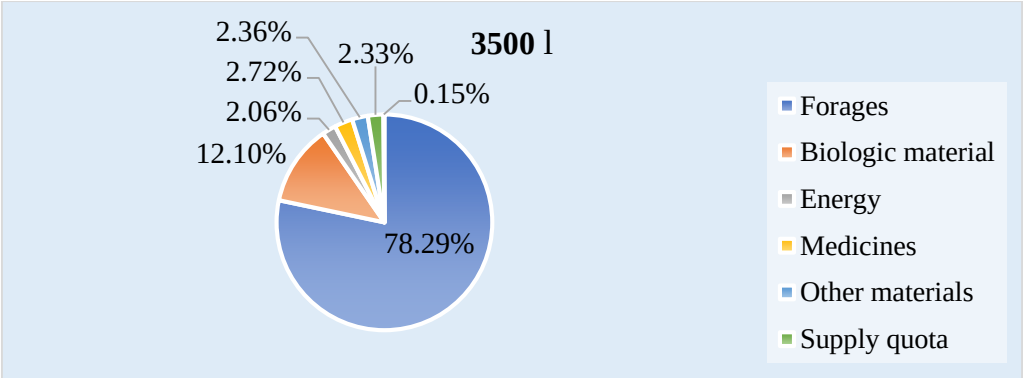


Figure 1 – Different categories of expenditures for cow's milk, on levels of production
Source: Own calculations

Within variable expenses, forages expenses represent 78.3 – 79.2% (Figure 2).



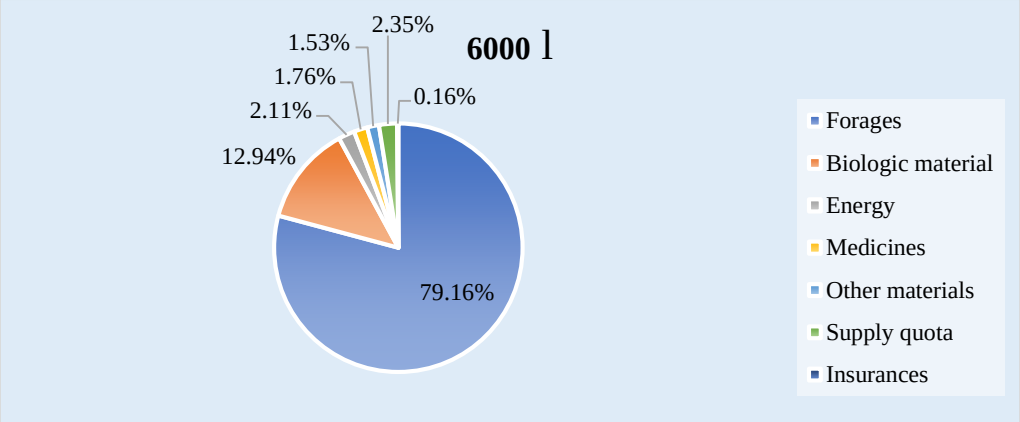


Figure 2 – The structure of variable expenses for cow's milk

Source: Own calculations

Another element in the structure of variable expenses is the value of the biological material, which participates with 12.1-12.9%, and labor costs represent 13-20% of the value of total expenses.

Regarding the production level, it can be easily seen that with a production of 6,000 l/head, the total expenses are higher, compared to a production of 3,500 l/head, but lower by approximately 40% per liter, concluding that high yields require lower effort allocations per liter of milk. Economic calculations highlight the cost of the product and the profit or loss that a farmer can make in running a production cycle.

After recovering from the total expenses, the expenses for the value of the secondary production (the value of the calf + the manure and the value of the reform), the production cost resulted, a cost that differs from one production to another, from one maintenance system to another. Thus, at a production of 3,500 l/head, the cost of one liter of milk was 2.45 lei, and for 6,000 l/head, the cost was 2.16 lei/l (Figure 3).

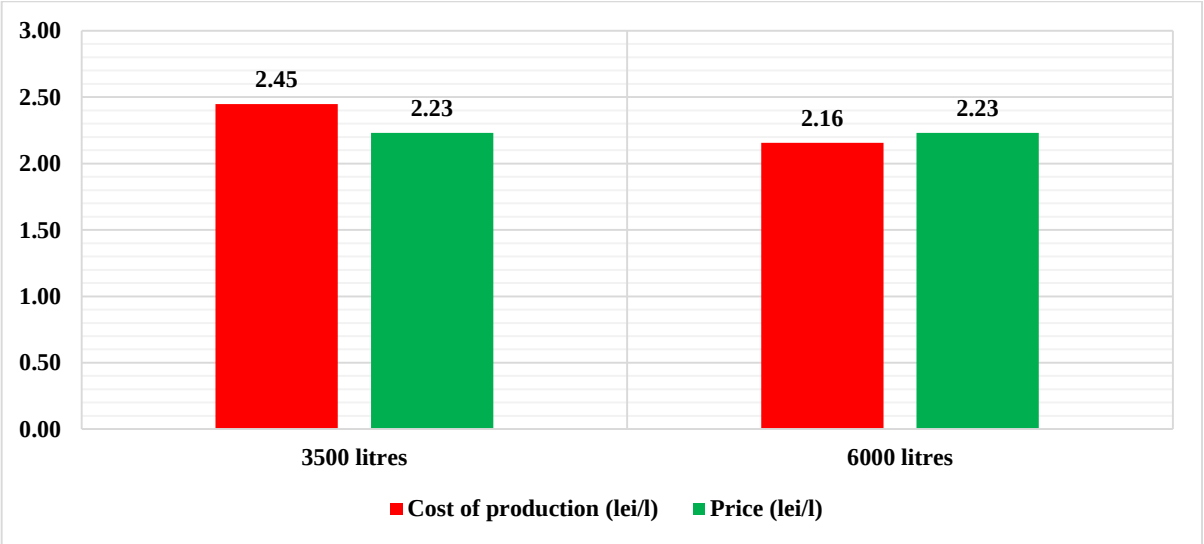


Figure 3 – Cost and price for cow's milk

Source: Own calculations

According to the data from NIS, related to the purchase price at the farm gate, in 2023, it did not exceed 2.30 lei/l, but a price that would allow farmers to continue their business, to be able to support and develop successfully would be 3 lei/l.

It is obvious that, with a production of only 3,500 l/head and a price of 2.23 lei/l, the rate of taxable profit was -8.9%, and with the production of 6,000 l/head, the rate recorded a value slightly positive, of 3.4% (Figure 4).

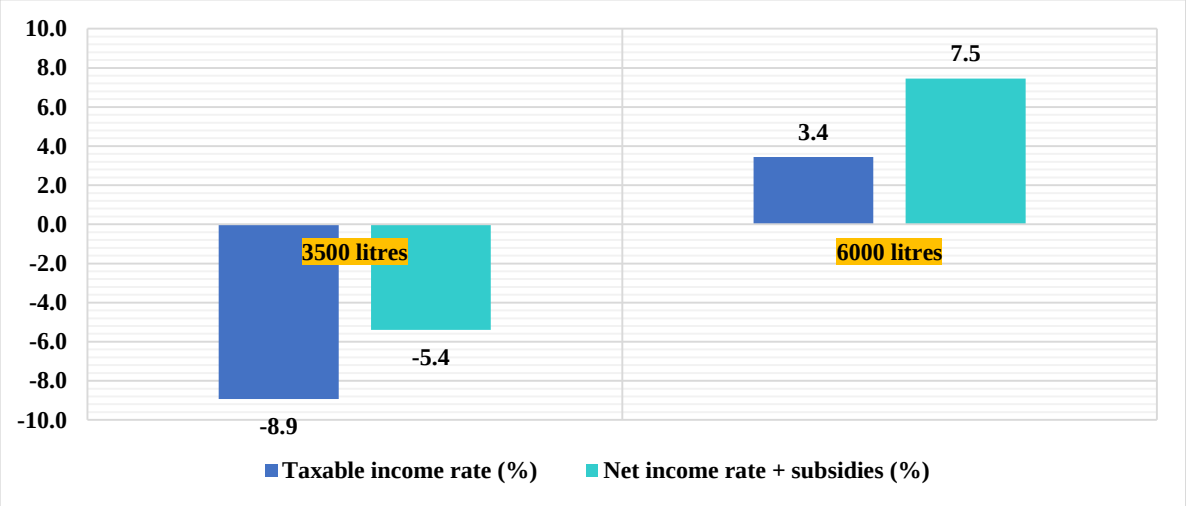


Figure 4 – The income rates for cow's milk

Source: Own calculations

There is a profitability threshold, which also depends on the number of cows milked, not only on production. The bigger the farms, the more profitable they are.

Sheep's milk

Sheep's milk represents an important source of income for breeders, milk that is processed in specialized units or in the farm, especially for obtaining cheeses, through which a very good yield and added value are achieved (Dinescu S., 2003). The results listed in Figure 5 represent the main technical-economic indicators for sheep milk with an average production of 60 l/head/year. Of the total expenses, variable expenses represent over 80%, the rest belonging to fixed expenses.

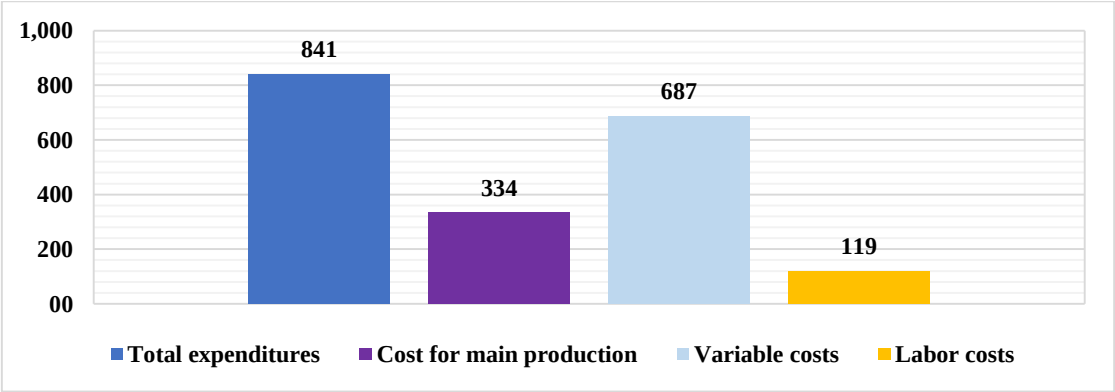


Figure 5 – Different categories of expenditures for sheep's milk

Source: Own calculations

Within variable expenses, the largest share is of feed, 83%, followed by biological material 9.7%, and the rest is held by other expenses (medicines, energy, other material expenses etc.) (Figure 6).

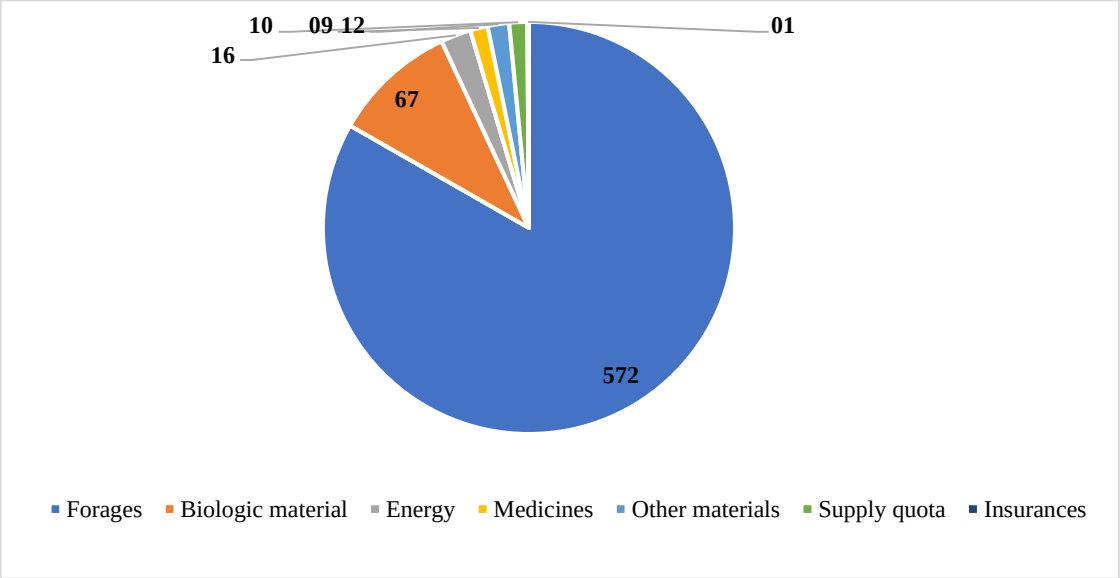


Figure 6 – The structure of variable expenses for sheep's milk

Source: Own calculations

Labor costs represent over 75% of fixed costs and over 14% of total costs. If 14.02 lei are spent for one liter of milk, 8.45 lei/l can be recovered after the sale of the secondary production. The value of secondary production, which is brought by the value of lambs, and the reformations, does not always compensate total expenses, so that many breeders record losses. In our case, with a production of 60 l/head, the cost per l of milk was 5.57 lei/l, and the sale price at the farm gate 5.50 lei/l. So, under these conditions, the rate of taxable income recorded a negative value of -1.3 lei/l, to which, adding the subsidy per head of sheep, a rate of net income plus subsidy of 5.4% was obtained (Figure 7).

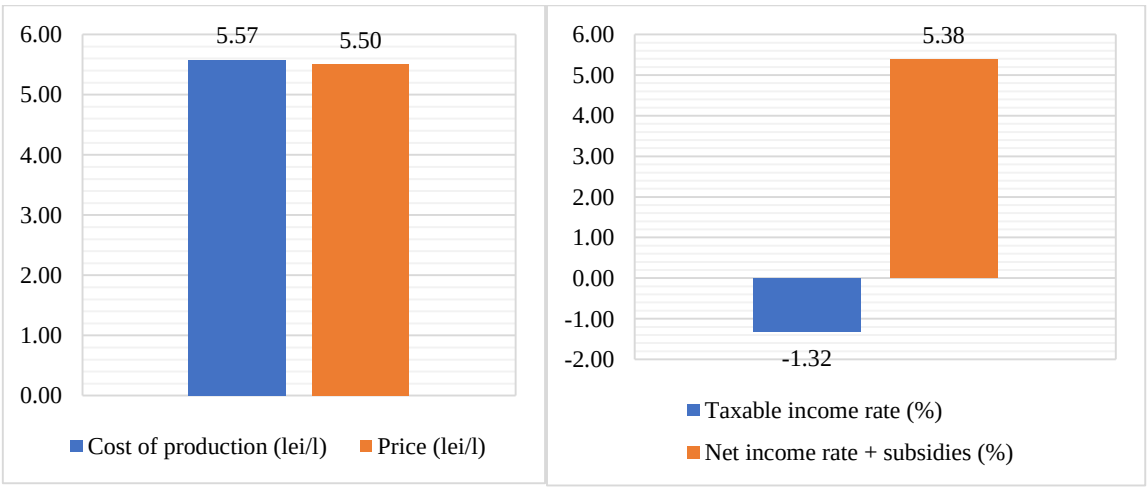


Figure 7 – Cost, price and income rates for sheep's milk

Source: Own calculations

Goat's milk

Although it cannot talk about significant differences between the three types of milk (cow, sheep, goat), they do exist. First, goat's milk is known for its slightly higher protein content compared to cow's and sheep's milk and is more easily digestible. The efficiency and productivity of goat milk is influenced by the competition of other agricultural products, as well as the decrease in fodder production due to drought. All this affects the cost of production.

Thus, in Figure 8, it can be seen that 5.82 lei are spent to obtain a liter of milk, from which the value of the secondary production (the lambs plus the reform) is gained, and it can talk about the actual cost of 4.21 lei. Within it, 81% are held by variable expenses, and the difference of 29% belongs to fixed expenses. Feed expenses have the largest share of over 85% of the value of variable expenses, followed by 7.2% of biological material expenses.

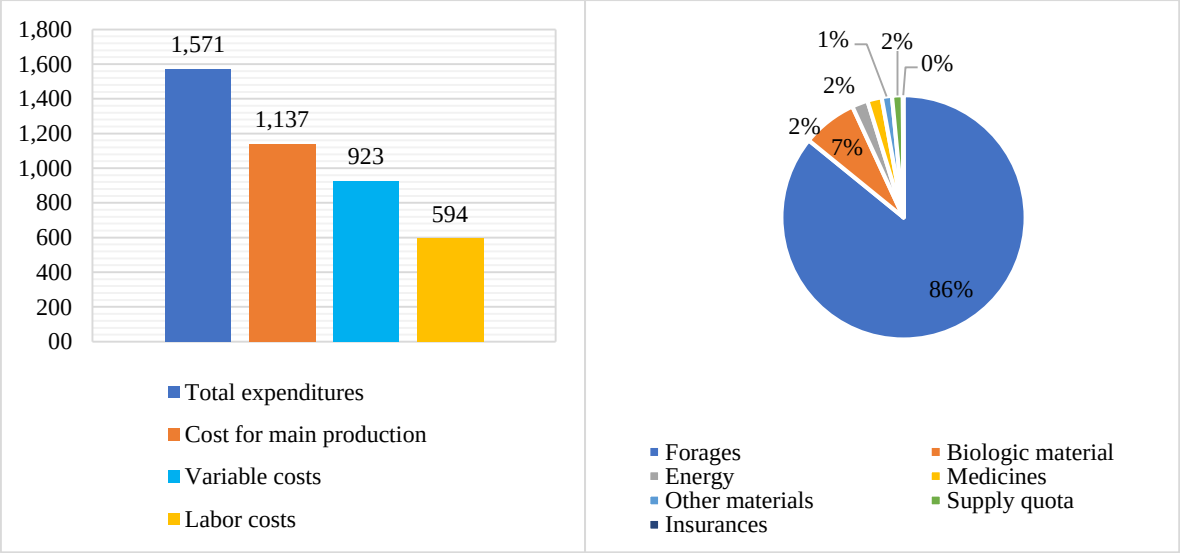


Figure 8 – Different categories of expenditures for goat's milk

Source: Own calculations

The price of a liter of goat's milk was 4.5 lei, in 2023 (according to NIS data), from which, subtracting the expenses for the main product, a taxable income of 0.29 lei/l, and 0.34 lei results /l value of net income plus subsidy (Figure 9).

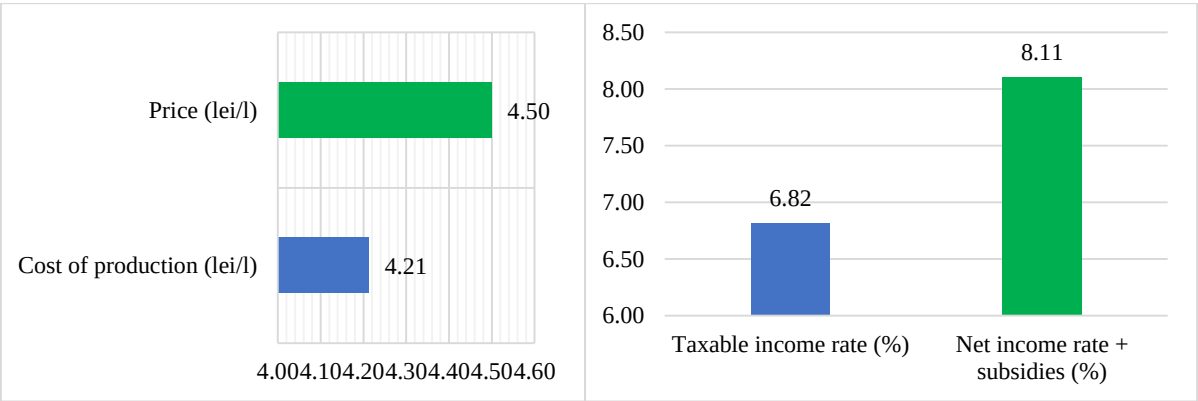


Figure 9 – Cost, price and income rates for goat's milk

Source: Own calculations

CONCLUSIONS

Analysis of the dairy farming sector is subject to high volatility in input prices which repeatedly affects the farm income. In recent years, this volatility refers mainly to the expenditure on feed, biological material, energy, and fuel. Feed expenses represent the largest share in the cost of milk, so that their share of total expenses is 60-64% for cow's milk, over 67% for sheep's milk and over 50% for goat's milk.

The price of a liter of milk in most cases does not cover the cost of production on the farms. The high prices of recent years, and especially climate change, directly affect livestock farmers. By following the structure of total milk production expenses, the basic problem of milk production is the low level of production per head of animal. If increased productions are obtained, then production costs per liter of milk also decrease.

Profitability is a basic component of economic efficiency and expresses the ability of economic units to obtain profit. Profit refers only to the amount of products sold outside the farm. Production profitability is expressed, as a rule, with the help of two indicators: profit and profit rate. To make the production activity more efficient in the farms of cows, sheep and goats raised for milk, the following should be considered:

- permanent correlation of purchase prices with real production costs;
- the use of rations and recipes balanced in terms of energy, protein, and minerals, adapted also to the conditions of climate change, in the feeding of dairy animals;
- the use of farm management and marketing strategies, for a more efficient correlation of production with market requirements;
- character improvement regarding the aptitude for mechanical milking in sheep and goats.

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RESEARCH ON THE DEVELOPMENT OF THE MEAT PROCESSING INDUSTRY AS A COMPONENT OF UKRAINE'S FOOD SECURITY

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Abstract: *The meat processing industry is strategically important for ensuring Ukraine's food security, as its products are essential in every person's diet, contributing to proper health. Therefore, it is important to examine its current state both through statistical data and by gathering and analyzing primary marketing information. The collected and analyzed secondary marketing information indicates a decline in beef and veal production in Ukraine, which are considered the most beneficial meats for human health. At the same time, research shows that the import of sausages to Ukraine increased significantly during 2021-2022, with a slight decrease in 2023. This suggests an insufficient level of demand satisfaction for sausage products from domestic producers, which negatively impacts food security in Ukraine. Given the low per capita meat consumption and the importance of this product in supporting the normal functioning of Ukrainians, meat processing enterprises should actively promote increased meat and meat product consumption among the Ukrainian population, offering new products in the market that align with consumer preferences. Moreover, domestic meat processing enterprises should pay considerable attention to the quality parameters of their offered products, increase the use of beef and veal, which are considered healthier, and employ eco-friendly packaging, as many consumers prefer to purchase packaged meat and sausage products.*

Keywords*: food security, meat processing industry, eco-friendly packaging, sausage production and import, product quality.*

JEL classification: D13 E37 F17

INTRODUCTION

The meat processing industry is strategically important for ensuring Ukraine's food security, as its products are essential in every person's diet, supporting overall health. Ukraine has traditionally been a major producer of meat products. In today's environment, this is particularly important, as a stable supply of meat and high-protein products helps sustain the health and vitality of the nation, especially during crises. The meat processing industry provides employment for a significant number of workers, particularly in rural areas where meat processing plants are often the main source of jobs. Additionally, investment in meat processing stimulates the growth of related sectors, such as agriculture, transportation, and logistics, creating an economic multiplier effect.

Domestic meat production and processing help reduce dependency on meat imports, especially given volatile global market prices. This increases economic resilience, lowers foreign exchange expenses, and provides protection from external economic risks. In the context of crises, such as war or global economic upheaval, a country's ability to ensure food security through internal resources becomes critically important. By utilizing domestic raw materials, the meat processing industry can operate relatively independently of external factors, particularly the supply of food products from other countries.

Achieving these goals requires enhanced support for the meat processing industry, including creating favorable conditions for investment, modernizing production, fostering innovation, and ensuring high product quality standards.

MATERIALS AND METHODS

This study involved the use of information from the State Statistics Service of Ukraine, including data on industrial production by types, retail turnover of retail enterprises by product groups, dynamics of per capita food consumption in Ukraine, and foreign trade of specific goods by countries from 2010 to 2021. In the process of writing this work, primary marketing information was collected and analyzed using the survey method.

RESULTS AND DISSCUSION

The meat processing industry holds an important place in Ukraine's economy and food industry. This is confirmed by data on the structure of food production in Ukraine for 2011-2021 (Table 1).

Table 1

Product structure of retail turnover of enterprises in Ukraine

Periods	All Goods		Food Products		Meat		Meat Products	
	Million UAH	%	Million UAH	%	Million UAH	%	Million UAH	%
2011	350059	100	124905	35.7	7153	2.0	8720	2.5
2012	405114	100	150100	37.1	9165	2.3	9754	2.4
2013	433081	100	164891	38.1	10555	2.4	11409	2.6
2014[1]	438343	100	170174	38.8	10217	2.3	10473	2.4
2015[1]	487558	100	200236	41.1	11745	2.4	12099	2.5
2016[1]	555975	100	227902	41.0	12255	2.2	12864	2.3
2017[1]	586330.1	100	233204.1	39.8	12535.7	2.1	13881.5	2.4
2018[1]	668369.6	100	289695.9	43.3	16513.5	2.5	17359.2	2.6
2019[1]	793479.2	100	336587.9	42.4	15627.3	2	23734.9	3
2020[1]	868283.3	100	384091.6	44.2	17457.4	2	26739.1	3.1
2021[1]	1044516.5	100	449762.3	43.1	19442.8	1.9	30588.3	2.9

Excluding the temporarily occupied territory of the Autonomous Republic of Crimea, the city of Sevastopol, and parts of the zone of the anti-terrorist operation.
According to the official website of the State Statistics Service.

The analysis of Table 1 indicates that during the years 2011-2021, the production volumes of meat and meat products in Ukraine increased in monetary terms; however, the share of these products decreased in 2021.

The Ukrainian market for meat and sausage products is characterized by the following features:

- The market has nearly reached saturation, with intense competition determining the assortment, quality, and regulating pricing policies.

- A certain surplus of sausage products in stores of large retail chains forces producers to release high-quality branded products, seek new niches, and create innovative products.
- There is a dependence of the market on raw materials and fluctuations in raw material prices.
- A characteristic feature is the short shelf life of certain types of finished products (Hurzhiy, N. H., 2014).

In modern conditions, the meat product market is consolidating (Rybachok, N., & Maksym, A.). Large Ukrainian producers are creating vertically integrated structures that encompass the entire cycle of meat product production and sales—from livestock farming to retail sales. To achieve competitive advantages in the meat product market, producers are modernizing their facilities and improving production technology.

Crisis phenomena in animal husbandry have also impacted the operations of meat processing enterprises (Hurzhiy, N. H., 2014), in particular, the utilization of production capacities is only 15-40%.

Among meat products in Ukraine, sausages account for 70%. Over the past 15 years, the market capacity for sausage products has doubled, reaching over 7 billion UAH. Consumers in Ukraine spend an average of 6.7% of their food budget on sausage products. The production volumes of sausage products from 2012 to 2020 are presented in Table 2.

Table 2

Production Volumes of Sausage Products, Thousand Tons

Periods	Sausage Products				
	Cooked sausages, sausages, and salsiccia	**Semi-smoked**	**Cooked-smoked, semi-dry, raw-dried, raw-smoked**	**Smoked-baked**	**Liver products and similar products and food products based on them**
2012	188	54.9	23.5	8.7	6.2
2013	190	52.1	25.6	7	7
2014[1]	171	47.3	24.9	5.5	6.9
2015[1]	151	42.7	21.6	3.6	7.2
2016[1]	155	40.4	23.9	3.2	6.2
2017[1]	169	42	23.9	2.9	6
2018[1]	167.5	41.1	24.1	3.4	5.6
2019[1]	158.8	40.3	24.3	3.3	5.1
2020[1]	156.5	42	24.5	3.2	5.2

Excluding the temporarily occupied territory of the Autonomous Republic of Crimea, the city of Sevastopol, and parts of the zone of the anti-terrorist operation.
According to the official website of the State Statistics Service.

The most popular types of sausages among Ukrainian consumers are boiled and semi-smoked sausages. In 2020, they accounted for 66.3% and 17.8% of the total production volume, respectively.

Analyzing the dynamics of the production of major types of meat and meat processing products from 2003 to 2020, it is evident that in 2020, the production of fresh or chilled beef

and veal decreased by 77.69%, frozen beef and veal by 88.05%, and frozen pork by 25.93%. However, the production of fresh or chilled pork increased by 180.54%, and the production of fresh or chilled chicken and chicks rose by 339.69%. This indicates that Ukrainians have significantly reduced their consumption of the most nutritious meats—beef and veal—in recent years.

For the sausage group, significant fluctuations in production volumes were not observed from 2003 to 2020, which cannot be said about the export and import indicators of sausage products, as shown in Figure 1. During 2021-2022, the import of sausage products into Ukraine significantly increased, slightly decreasing in 2023. This indicates an insufficient level of satisfaction for the demand for sausage products from domestic producers, which negatively impacts food security in Ukraine.

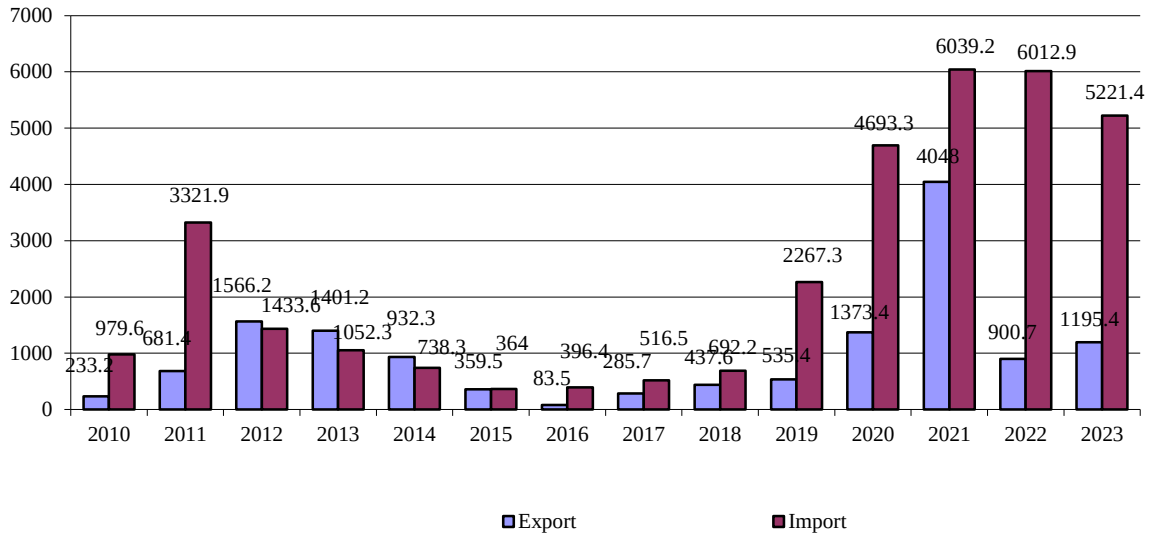

Fig 1. Dynamics of Export and Import Indicators for Sausage Products in Ukraine, tons**

According to the official website of the State Statistics Service.

In 2023, Ukraine sourced sausage products exclusively from European countries, with the largest quantities coming from Poland. Other major importers of sausage into Ukraine include Italy, Spain, and France. (According to the official website of the State Statistics Service).

The main trends in the modern meat processing industry worldwide are the offer of environmentally safe products characterized by minimal content of food additives (Bal-Prylypko, L. V. (2013)). Such products do not negatively impact public health and, therefore, need to be actively promoted in Ukraine from the perspective of sustainable development. Currently, only a small number of meat processing enterprises in Ukraine offer such products.

A notable feature of the modern market for meat products in Ukraine is the significant level of product adulteration, which can occur in the following ways (Kotsiumbas, I. Ya., Kotsiumbas, H. I., Shchebentovska, O. M., & Peleshak, M. I., 2011): the addition of soy protein components, violation of manufacturing recipes, use of mechanically deboned meat, addition of foreign substances, artificial meat flavorings, wheat flour or semolina proteins, and substitution of high-quality raw materials with low-cost additives that are often not disclosed.

Such products can harm people's health; therefore, from the perspective of sustainable development, the government should be more proactive in identifying and preventing their sale in the market.

Recently, many producers have emerged in the "craft" sausage segment. These are small family businesses that produce meat products using traditional folk recipes, focusing on high-quality raw materials and natural ingredients. As a result, the products of such manufacturers are gaining attention and trust from consumers. However, these producers need to promote their products more actively in the market.

Ukraine ranks 85th in the world for meat consumption per capita. In 2007, the average resident of Ukraine consumed 45 kg of meat per year, including 11.4 kg of beef, 15.3 kg of pork, and 17.4 kg of poultry, as well as smaller amounts of lamb and other types of meat. The average resident of Poland consumes 51.2 kg of pork, a German citizen consumes 55.6 kg, a Serbian resident consumes 64.8 kg, and an Austrian consumes 66 kg (Datsko, O. B. (2013)). In 2021, meat and meat product consumption per capita per year was 53 kg, which is 27 kg below the rational norm of 80 kg. Today, nearly one in four families living in Ukraine has been forced into vegetarianism. On the other end, 12-13% of the population consumes over 100 kg of meat products per year, reaching levels comparable to leading countries in this regard.

The dynamics of food consumption per capita in Ukraine is presented in Table 4.

Table 4

Meat and Meat Product Consumption per Capita

Periods	Average per Month per Person	Average per Year per Person
2010	5.1	52
2011	5.1	51.2
2012	5.0	54.4
2013	5.1	56.1
2014[1]	4.9	54.1
2015[1]	4.6	50.9
2016[1]	4.7	51.4
2017[1]	4.7	51.7
2018[1]	4.9	52.8
2019[1]	5.1	53.6
2020[1]	5.2	53.8
2021[1]	5.1	53.0

Excluding the part of the area designated for the anti-terrorist operation.
According to the official website of the State Statistics Service.

Given the low level of meat consumption per person and the importance of this product for ensuring the proper vitality of Ukrainians, meat processing enterprises should actively promote increased consumption of meat and meat products among the Ukrainian population, as well as offer new products on the market.

Today, it is difficult to surprise consumers with a wide assortment of sausage products. Over recent years, most producers have tried to expand the range as much as possible, believing this would enhance sales. The product line has also been expanded with items made using recipes developed by individual producers (with an emphasis on smoked products). As a result,

the assortment of sausage products has significantly grown, yet for most producers, sales volumes have not increased.

To determine consumer preferences regarding ready-to-eat sausage products, a consumer survey was conducted. A random sampling method was used for the market research, and 265 individuals of different ages from Lviv and the Lviv region were surveyed via Google Forms. Specifically, the respondents included 92 people aged 36-50 (34.7%), 82 people aged 21-35 (30.9%), 16.6% under 20 years old, 16 people over 65 years old (6%), and 31 people aged 51-65 (11.7%). The majority of respondents were women, as they are primarily responsible for purchasing decisions. Among those surveyed, 179 were women (67.5%) and 86 were men (32.5%).

Table 5 presents the main findings of the study.

Table 5

Study Results on Consumer Preferences for Ready-to-Eat Sausage Products

Factors Influencing Consumer Choice of Meat and Sausage Products	The most important factor influencing consumers' choice of meat and sausage products is personal experience, chosen by 74% of respondents. Other significant factors include product composition (46.8%) and price (43.4%). The least important factor is brand recognition, with only 21.5% considering it a priority.
Respondents' Attitude Towards Packaged Meat and Sausage Products	The majority of respondents (172 people) purchase packaged products, while 93 people do not.
Consumer Preferences Regarding Packaged Meat and Sausage Product Weights	The following percentages of respondents predominantly purchase packaged meat and sausage products in quantities of 201-500 grams: • Sausages and frankfurters: 46% • Boiled sausages: 40.8% • Semi-smoked sausages: 35.8% • Dry-cured sausages: 32.6% • Boiled-smoked meat products: 27.26% • Dry-cured meat products: 22.3% The following products are mainly purchased in quantities of up to 200 grams: • Pâtés: 27.5% • Rolls: 20.4% • Liver sausages and head cheese: 13.6%
Advantages of Packaged Products as Indicated by Respondents	Respondents highlighted the following advantages of packaged products: Convenience in purchase and consumption: 26.04% Protection from external environmental influences: 20.38% Clearly defined shelf life: 13.58% Exact product weight: 9.43%
Disadvantages of Packaged Products as Indicated by Respondents	The main disadvantages of packaged products, as noted by respondents, are: Questionable product quality: 21.13% Higher price: 16.6% Weight that does not meet consumer needs: 14.34%

	However, 13.58% of respondents believe that packaged products have no disadvantages.
Main Places for Purchasing Meat and Sausage Products	Respondents primarily prefer to buy meat and sausage products in branded stores (66.8%) and supermarkets (65.7%). Significantly fewer respondents purchase these products in neighborhood stores (42.6%). Additionally, 29.4% of respondents buy them at markets, and only 2.6% purchase from food kiosks.
Motives Guiding Respondents in Choosing Meat and Sausage Product Purchase Locations	The most important motives for respondents in selecting places to purchase meat and sausage products are confidence in product quality (67.2%), convenience of purchase (49.1%), and a wide selection (31.7%). A lower price is attractive to only 21.1% of respondents.
Frequency of Respondents' Meat and Sausage Product Purchases	Meat and sausage products are purchased daily by 2.3% of respondents, every 3-4 days by 27.2%, once a week by 51.7%, once a month by 8.4%, only for celebrations by 6.5%, and 3.8% of respondents chose other options.
Influence of Information Sources on Meat and Sausage Product Market Innovations	Respondents most often receive information about new products in the meat and sausage market near the store counter (58.9%) and from relatives and acquaintances (38.9%). The least utilized source for this purpose is manufacturers' websites (8.75%).

CONCLUSIONS

Considering the importance of meat and meat products for ensuring the normal livelihood of Ukrainians, meat processing enterprises should actively promote the increase of meat and meat product consumption among the population of Ukraine. They should offer innovative products in the market and adapt their offerings to consumer demands. This effort should align with the goal of ensuring food security in Ukraine. At the same time, domestic meat processing enterprises should pay significant attention to the quality parameters of the products they offer and increase the use of raw materials such as beef and veal, which are considered more beneficial for health.

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STUDY REGARDING THE ROMANIAN CONSUMERS BEHAVIOR ON THE FOREST FRUIT MARKET

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Abstract: *Encouraging the consumption of fresh food products, with a reduced degree of processing and processing, represents one of the sustainable global targets found both at the level of the 2030 Agenda for Sustainable Development and within the European directives and strategy, components of the European Ecological Pact. Fruits are also mentioned in the European Strategy from farm to fork, recommended to be consumed, both for the health of the population, the benefits brought to the environment and for the encouragement of domestic production and the support of local producers. The consumption of berries is encouraged by specialists due to the high intake of minerals and antioxidants and the low calorie content. however, although in the last period of time there has been progress in terms of the consumption of profiled products at the national level, Romania is below the European average for the consumption of forest fruits. The current work aims to identify the main consumption barriers at the level of consumers, beyond those related to the seasonality or perishability of profile products, basic characteristics of agricultural production. Also, based on the results obtained, a series of recommendations regarding the opportunities to increase the consumption of forest fruits were mentioned, useful for local producers, economic agents and also for decision-makers.*
Keywords: *SGD, From Farm to Fork, marketing, consume behaviour, forest fruits*
JEL classification: M31, C12

INTRODUCTION

Analyzing from a global perspective, regarding the level of fruit and vegetable consumption, it can be stated that it still remains below the values recommended by health experts, although progress has been made, with a noticeable trend among the population towards healthier foods and changing eating habits. Supporting this statement are the reference statistical data published by the Food and Agriculture Organization (FAO), which show a steady increase in global fruit consumption between 2010 and 2022. Thus, in 2022, the global demand in the fruit market reached a quantitative threshold of 261,503 thousand tons, a value 40% higher than the one recorded in 2010. Despite the growing trend of introducing fruits into the population's diet, few Europeans reach the daily weight recommended by nutrition guidelines and experts, as the World Health Organization recommends a minimum daily intake of 400 grams of fruits and vegetables (WHO, 2023).

Fruit and vegetable consumption is encouraged not only for reasons related to the population's health, but also from the perspective of sustainable development. Thus, starting with the global agreement of the United Nations translated into the Sustainable Development Goals included in the 2030 Agenda, followed by the European Commission's Green Deal and its implementation through directives at the national level within EU member states, the importance of facilitating the transition from current production and consumption models to sustainable models is emphasized. These sustainable models aim to ensure a balance between the beneficial impact on public health, minimizing environmental impact, and ensuring the well-being of local farmers.

Wild berries are included into the category of non-wood forest products (abbreviated in English as 'NWFP'). According to the FAO report published in 2001, in general, non-wood forest products are more commonly exploited in rural areas, particularly by individuals with modest financial means or by small enterprises as a subsistence solution. New approaches to this concept highlight a series of benefits brought by the utilization of non-wood forest products, including in terms of bioeconomy, as they are considered 'one of the central elements of sustainable development and sustainable forest management' (Wolfslehner B., et al., 2019).

In Romania, some of the most well-known non-wood forest products include edible mushrooms, medicinal plants, and wild berries. Wild berries represent the reference category for this research, being studied from the perspective of consumer behavior regarding the main types of products, both at the national and European levels.

MATERIALS AND METHODS

In order to achieve the goal of this paper, which is to determine the main barriers and opportunities regarding consumer behavior in the wild berry market, both at the European and national levels, a series of specific methods were applied, not limited to: comparative analysis between the current national context and the European one, quantitative analysis of previous studies on the specific topic, formulation of logical reasoning and research hypotheses, and others. Among the main materials used are statistical data published in official statistical databases (Eurostat, FAO, INS), specialized studies and scientific articles published at the national and international levels, official reports from decision-makers, policies, strategies, and documents specific to the current European legislative framework.

RESULTS AND DISSCUSION

From the perspective of the agricultural supply of wild berries recorded at the European level, according to the recent update of data published in statistical databases (Eurostat, 2023), as shown in Figure 1, the wild berry market identifies larger areas for currants (60 thousand hectares) and higher production for raspberry crops (200 thousand tons). Thus, higher yields are identified for raspberry crops (6.26 tons/ha) and blueberries (6.32 tons/ha).

Analyzing from a chronological perspective, over the last ten years, a growing trend in the areas cultivated with wild berries at the European level can be observed, across all analyzed categories, according to the statistical data provided by the same source. However, the same cannot be said about the level of production yields, which has shown a decreasing trend over the analyzed period, resulting in lower production yields. A possible explanation for the inverse relationship between the areas and the yields could be the negative impact of intensified conventional agricultural activity and climate change on soil quality, leading to a decrease in performance in the analyzed crops. From the perspective of wild berry production levels in EU member states, according to statistical data, Poland ranks first in both cultivated areas and the resulting production, a hierarchy identified across all analyzed crops. Other EU member states that produce wild berries are also identified, but with a considerable difference compared to the top position, namely Spain, Portugal, and Germany. Regarding organic wild

berry production, we also observe, according to Eurostat data, a higher production level in Poland (46,000 tons), Spain (8,136 tons), and Romania (4,877 tons).

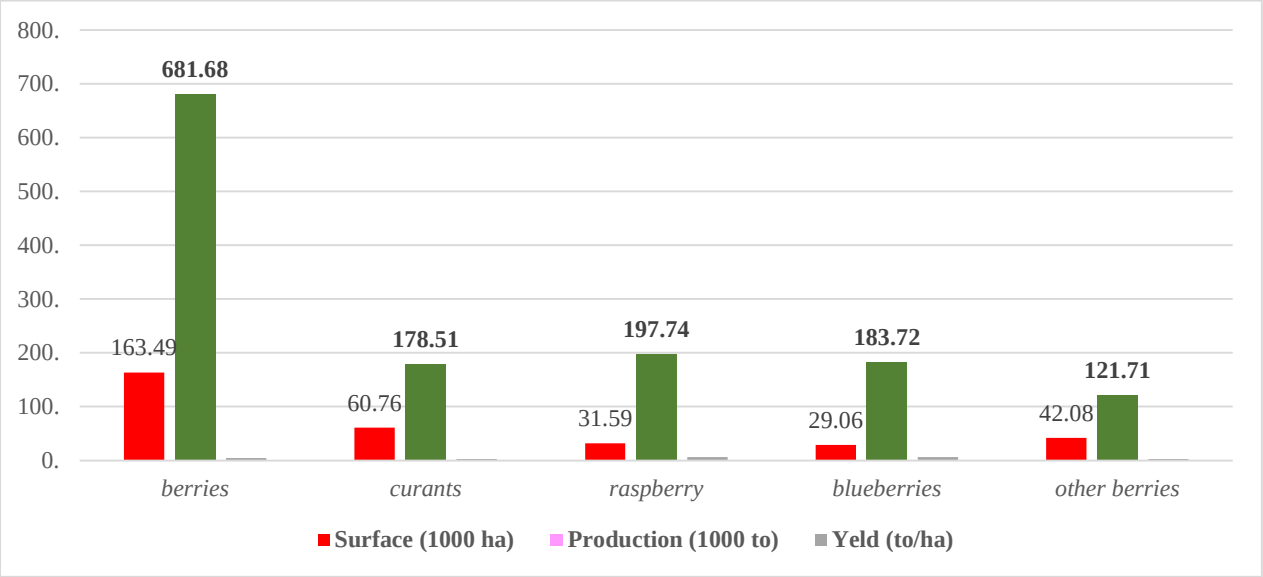

Figure 1. Total level of surface, production and production yeld, main berries crops, 2023

Source: Eurostat data, own prelucration, Time series Crop production in EU standard humidity, 2015-2023

Regarding fruit consumption, including wild berries, in EU member states, higher values are identified in Italy, France, Spain, Germany, Poland, the Netherlands, and Romania (Figure 2).

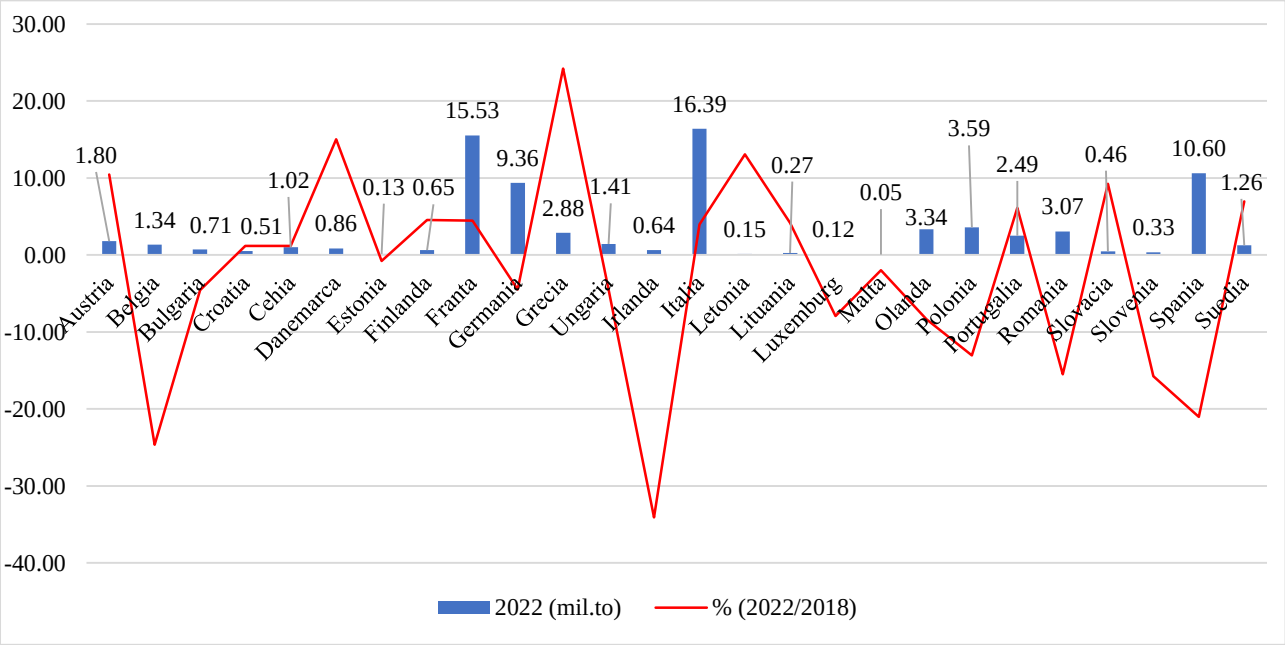

Figure 2. Fruits demand in European member states (mil. tonnes), 2018-2022

Source: FAOstat data, own prelucration, Time series Domestic supply quantity, 2018-2022

In this ranking, Romania is in 7th place out of the 26 countries analyzed, regarding the demand for fruits and specific products. When comparing to the values of the indicator

recorded in 2018, Romania is among the countries where fruit consumption has decreased, such as Spain, Estonia, Poland, and others.

The average annual per capita fruit consumption is higher in European countries such as the Netherlands (173 kg/capita/year), Greece (167 kg/capita/year), Luxembourg (156 kg/capita/year), Austria (148 kg/capita/year), Portugal (138 kg/capita/year), Italy (133 kg/capita/year), and Denmark (131 kg/capita/year). In Romania, in 2022, the average annual per capita fruit consumption reached 101 kg/capita/year, aligning with the European average for the analyzed period (Figure 3).

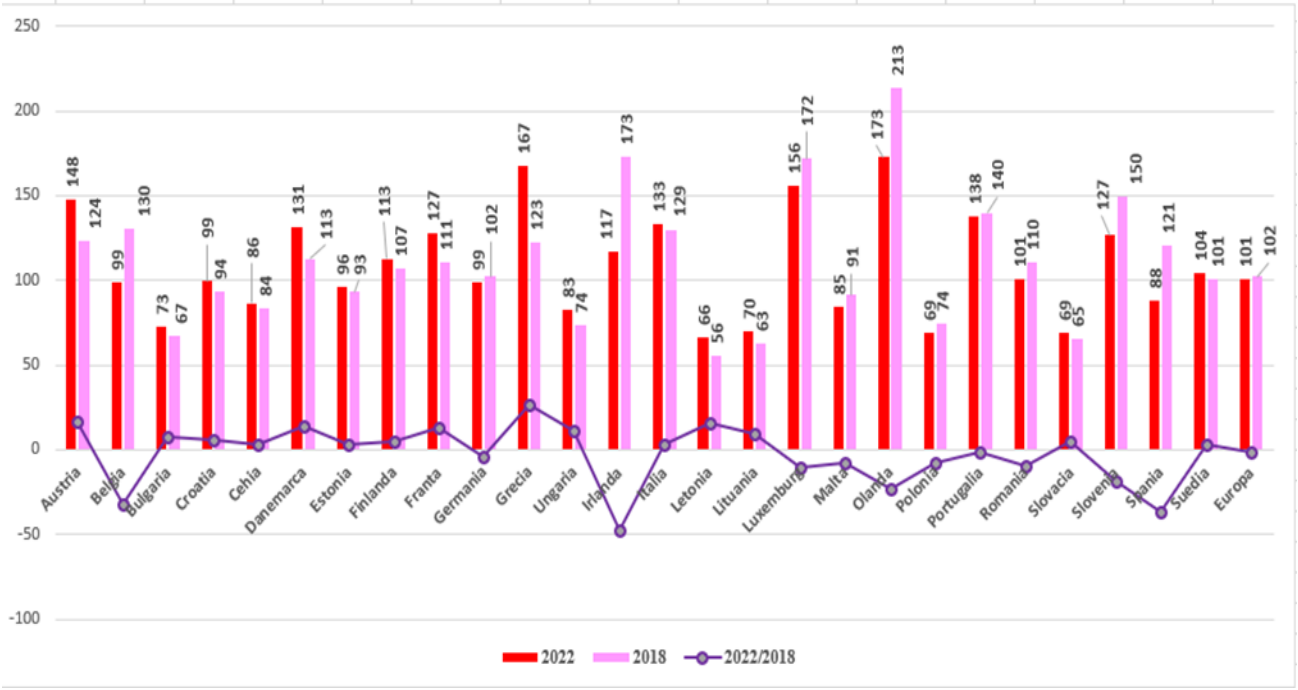

Figure 3. Average annual per capita consumption (kg/capita/year) on the fruit market, in EU member states, 2018-2022.

Source: FAOstat data, own prelucration, Time series Domestic supply quantity, 2018-2022

Regarding consumption frequency, European statistical data reflect an unfavorable current context in terms of consumption trends, with 33% of Europeans not consuming fruit daily.

Thus, a higher percentage of people who include 5 servings of fruits and vegetables in their daily diet is observed in countries such as Ireland (33%), the Netherlands (30%), Denmark (23%), and France (20%). In Romania, according to statistical data, only 2.4% of the population consumed more than 5 servings of fruits and vegetables daily in 2019. As for countries where the consumption of 1 to 4 servings of fruits and vegetables daily is more common, these include Belgium (68%), Spain and Italy (66%), Slovenia (63%), and Croatia (62%). In Romania, 24% of the population consumed between 1 and 4 servings of fruits and vegetables daily in 2019. Finally, among the European countries where most people do not consume fruits and vegetables daily, regardless of the quantity, Romania (74%), Latvia (54%), the Czech Republic, and Luxembourg (48%) stand out.

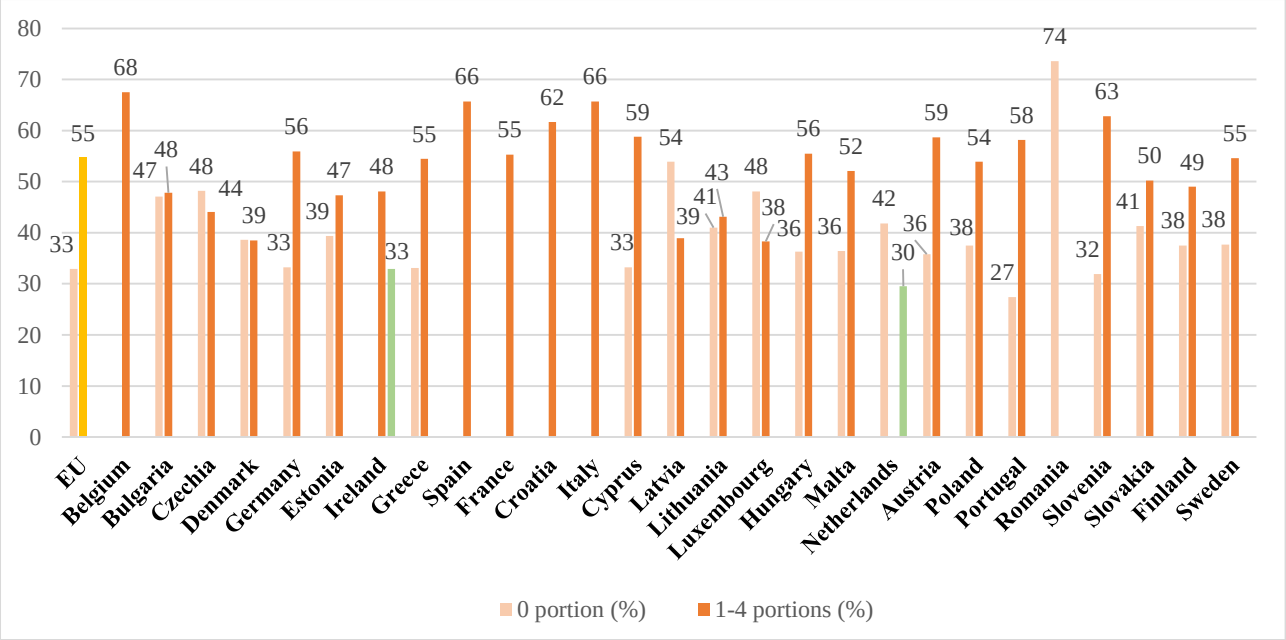

Figure 4. Consumption frequency on the fruit and vegetable market, depending on the number of servings (% of the country's population), at the European level, 2019.

Source: Eurostat, 2019

Regarding Romania, according to the latest statistical update from 2019, over 73% of the population in Romania does not consume fruit daily, while only 24% consume 1 to 4 servings of fruit daily. A minority percentage of 2.4% of the native population consumes 5 servings of fruits and vegetables. The values recorded at the European level are also low compared to the recommendations of specialists regarding the optimal intake of fruits and vegetables (Eurostat, 2019). Figure 4 presents the statistical data published at the European level regarding the frequency of fruit and vegetable consumption.

According to the statistical data published by the National Institute of Statistics, at the national level, an increase in average monthly consumption per person is observed during the period from 2008 to 2023, with the maximum value reached in 2023 of 4.424 kg per capita, representing a 33.6% increase compared to the reference year 2008 (Figure 5).

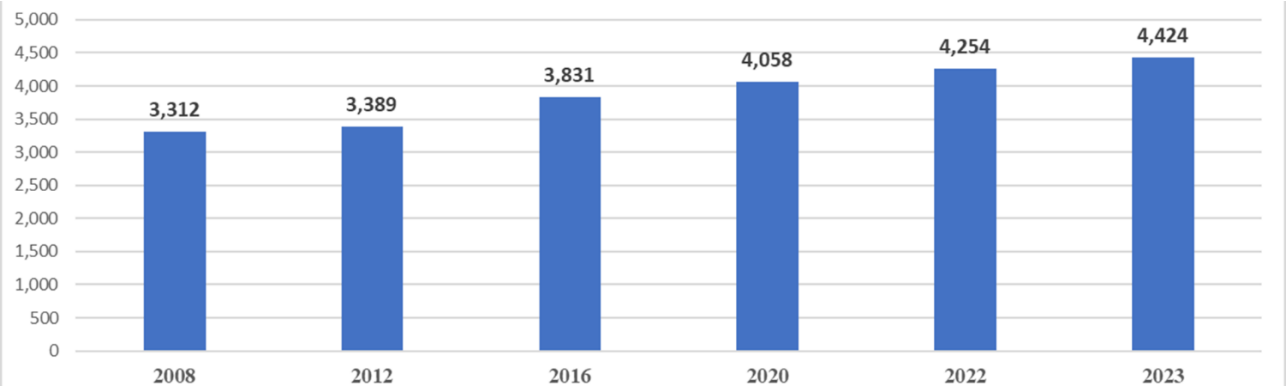

Figure 5. Average monthly consumption per capita (kg/person/month) on the fruit market, nationwide, 2018-2023

Source: NIS data, own processing

Progress in consumer behavior on agri-food markets and their dietary lifestyle can be observed. The introduction of foods with a low degree of processing and preparation, particularly fruits and vegetables, into the daily diet is one of the priorities of the European strategy "From Farm to Fork" (EC, 2019), aiming to achieve global goals related to improving public health and conserving environmental resources. However, the level of fruit consumption recorded nationwide fails to meet the recommended intake by the World Health Organization (WHO, 2023), which is at least 400 grams per day of fresh fruits and vegetables. Referring to statistical data (INS, 2023) on vegetable consumption, the average daily intake is 420 grams of fruits and vegetables, which represents the amount consumed by a person, but these data include vegetables and fruits consumed in processed form (e.g., canned), whereas experts' recommendations refer to the daily intake of fresh, unprocessed fruits and vegetables.

Regarding the preferences of Romanian consumers on the fruit market, the influence of production characteristics can be observed in the hierarchy of different types of fruits. Seasonality, perishability, and availability influence the level of consumption recorded for various categories of fruits, according to statistical data. Apples and pears are at the top of the ranking of consumed fruits (35% of total fruit consumption), as they are available year-round, affordable in terms of prices and presence in specialized stores, and have a lower perishability compared to other fruit categories. Additionally, apple production represents a significant share of the total fruit production recorded at the national level. The next categories consumed by Romanians, according to statistical data, are bananas (21%) and citrus fruits (16%), which are not as affordable in terms of prices, imported products, but available year-round, regardless of the season. Plums, cherries, and berries are categories that are less commonly found in consumer choices, accounting for 3.5% (plums), 2.12%, and 2% (berries) of total fruit consumption (Figure 6).

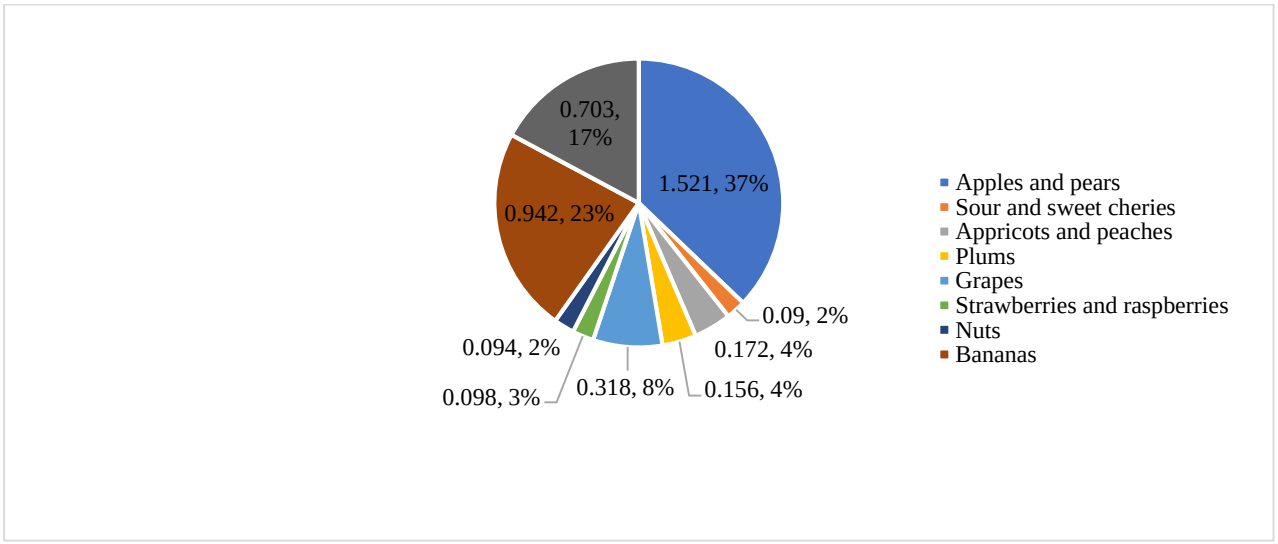

Figure 6. Average monthly consumption per capita (kg/person/month) on the fruit market, at main categories, 2023

Source: NIS data, own processing

Regarding the consumption of forest fruits (strawberries and raspberries) recorded at the national level, as presented in Figure 7, it remains low compared to the other categories

identified in the previous figure, although it is characterized by an oscillating trend, predominantly increasing.

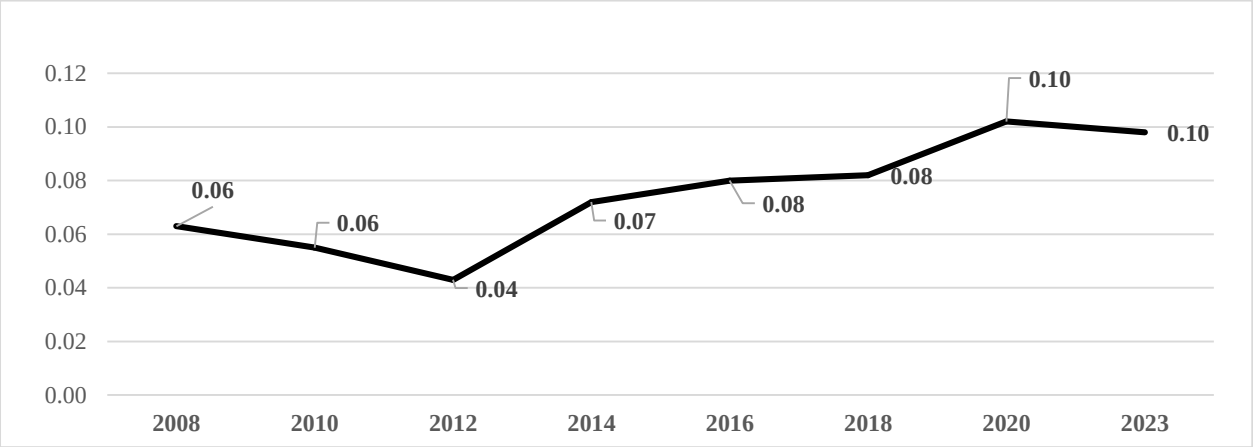

Figure 7. Average monthly consumption per capita (kg/person/month) of the main categories of berries, 2008-2023 (kg)

Source: NIS data, own processing

According to the statistical data published at the European level (FAO, 2024), the annual demand for the main categories of forest fruits in 2022 reached higher values for strawberries (30,683 tons), blueberries (2,054 tons), raspberries (1,176 tons), and lower values for black currants (255 tons). In most cases, the trend regarding the annual consumption of forest fruits was increasing, taking the year 2012 as a reference. However, decreases were recorded for categories such as other forest fruits and currants within the reference period.

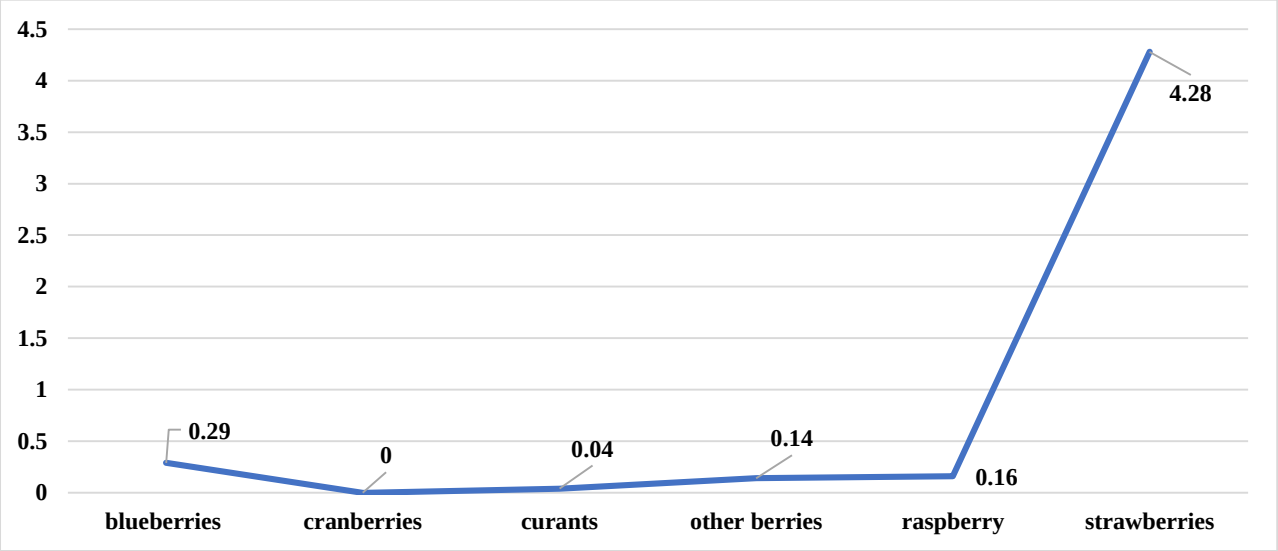

Figure 8. Daily intake of blueberries in member states, 2022 (grams/person/day)

Source: Data processing by FAO, Supply Utilization Accounts, Food Supply Quantity time series

Thus, it can be observed, following the analysis of statistical data, the dynamics of consumption behavior within the European population, including Romanian consumers, starting from 2008 to the present. The period of 2020-2021 represented a turning point in changing consumption trends, with the COVID-19 pandemic having a significant impact on

redirecting consumers towards healthier, fresh foods with a low degree of processing and preparation *(Marin, A., Pop, R., 2024).*

This research has generated relevant results for identifying the current context regarding the consumption of forest fruits for the main categories analyzed, both at the European and national levels, and precedes a quantitative study conducted among Romanian consumers on the forest fruit market.

CONCLUSIONS

This paper presents an interpretation of the statistical data published in reference databases, both at the European and national levels, regarding consumption behavior in the domestic fruit and forest fruit markets. The relevance of the research topic arises from the importance given to fruits and vegetables and the inclusion of key categories in the daily diet of Europeans, from the perspective of global sustainable development goals (SDG 3: Good Health and Well-being; SDG 12: Responsible Consumption and Production), as well as through regional strategies transposed at the national level (Green Deal – From Farm to Fork).

Forest fruits represent a distinct category within the group they belong to, primarily due to their specific characteristics, such as a higher degree of perishability and seasonality. Domestic production is available for a short period on the market, and maintaining it under optimal conditions requires rigorous monitoring of specific parameters. On the other hand, although nationally consumers maintain a degree of loyalty to domestic production (or not) but available year-round (apples, citrus fruits), statistical analysis shows a trend of increasing preferences for forest fruits, especially for raspberries, blueberries, and strawberries.

The results obtained in this research are part of a larger investigation and precede research conducted among consumers in Romania on the forest fruit market through the application of a structured questionnaire to a sample of 126 respondents. The goal of the research is to identify consumer preferences and requirements regarding the qualities and properties of forest fruits, as well as derived products, focusing on achieving specific objectives such as: determining the socio-demographic profile of the respondents participating in the present research; determining consumer perception regarding the consumption of fruits and vegetables; determining the extent to which consumers understand the importance of forest fruits, the differences between domestic fruits and forest fruits in terms of their properties, the main types of forest fruits identified, awareness of the benefits of consuming fruits and vegetables; determining frequent consumption habits on the forest fruit market; identifying the determining factors in the consumer's purchasing decision: product characteristics and reasons for purchase; determining consumption trends in reference markets – fresh and processed.

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MARKETING THROUGH ALTERNATIVE METHODS OF AGRI-FOOD PRODUCTS. BIBLIOMETRIC ANALYSIS

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Abstract: *In the context of changing consumption trends of the population, diversifying the ways of marketing agro-food products becomes a priority for the needs, preferences and satisfaction of consumers. The present study aims to identify some of the alternative methods, found in the specialized literature, through which agro-food products can be directly utilized by producers. In order to create a database of relevant scientific resources, the information platform was accessed - the WoS database, from where, after querying the keywords "marketing" and "agri-food products", they selected the scientific works that address these two subjects.*
Keywords: *agro-food product, producer, marketing, commercialization, alternative methods.*
JEL classification: Q13

INTRODUCTION

According to Pătărlăgeanu et al. 2019, the importance of agri-food marketing is given by the nature of human physiological needs towards agri-food products, and the fact that both the agricultural and food sectors contribute significantly to economic development/growth. The agricultural sector and that of the food industry are two sectors connected both horizontally and vertically with all other branches of the economy, being directly involved in the national, regional, international and world economic environment.

The market for agri-food products has grown substantially globally. At the same time, social concern in food-related issues, such as: food safety, food quality, traceability and sustainability, is ever greater. These concerns highlighted the need for the development of new models and tools for the management of agri-food supply chains, taking into account the attributes that differentiate them from other industrial supply chains, as well as the uncertainties present in the sector (Esteso et al. 2017).

The markets of agro-food products are among the main relevant pawns for the valorization of these products. The relationship between producers, intermediaries and consumers is relevant for assessing the implementation of a feasible future strategy on sustainable rural development, including the conservation of genetic resources for food and agriculture (Sava & Antofie, 2019).

In the modern market economy, agro-food chains have been imposed and strengthened due to the evolution registered by the demand and supply of food in the last decades, the dynamics determined by the fragmentation of the market, on the one hand, and the specific processes of consumption and emancipation of consumers, on the other part (Boboc et al. 2017).

With the outbreak of the health crisis caused by the Covid-19 pandemic, a series of dysfunctions was generated in the global agri-food system, especially in farms, in the supply chains of inputs and agri-food products, and at the level of demand for agri-food products. In Romania, in the current context, agriculture is characterized by a significant share of family

farms, mostly subsistence and semi-subsistence. A study carried out in order to ensure the conditions for the valorization of agricultural products that used as a research tool a questionnaire that was applied in the agri-food markets in 2 municipalities, respectively Călărași and Oltenita, as well as in 9 localities in Călărași county, with a population that exceeds 5,000 inhabitants, where weekly markets and fairs are organized where local agri-food products are valued, identified the problems faced by producers. Among the main challenges are: the change in consumption patterns, the blockages in the peasant markets and the development of online delivery services, the syncopation in the agro-industrial sector, the closure of HoReCa companies, but also of schools, canteens, etc. All these challenges had the effect, first of all, of reducing the incomes of producers of agri-food products due to the drastic reduction of agricultural production (Crețu et al. 2022).

Studies show that the consumption trends of the population are constantly changing. Consumers are increasingly informed and pay more attention to the origin and quality of the products they purchase. Recent decades have seen a significant increase in interest in agri-food products certified under quality schemes, which are often perceived to be of superior quality and with unique sensory properties. Quality systems are a way to recognize the quality of agri-food products to enable consumers to make informed choices. In addition to product quality, producers must maintain a food safety standard by following clear rules that are verified by the competent institutions of the Romanian Government (Șomîcu & Vladu, 2023).

A paper presenting the results of a market research on the behavior of consumers of agro-food products and their desire to adopt a more sustainable diet, carried out in one of the developing regions of the European Union: the North-East Region of Romania, more precisely in Iași county, it indicates that personal benefits (eg taste, perceived health benefits and freshness) are the main motivations that lead to the adoption of sustainable consumption, while environmental aspects have not reached such great significance among consumers. Research findings have shown that consumers are generally not well informed about the environmental implications of their diet. At the same time, consumers' ecological attitudes are not aligned with their actual purchasing practices: although most people report being concerned about environmental protection, the main motivations for agri-food purchases do not necessarily involve environmental concerns such as transport, reusable/recyclable packaging or the desire to protect the environment. The research showed that women are more willing to change their food consumption behavior to contribute to a sustainable environment. At the same time, older people are more determined to purchase agro-food products produced in a sustainable manner (Robu et al. 2021).

MATERIALS AND METHODS

To carry out the study, a systematic review of the existing publications in the Web of Science (WoS) database was carried out regarding the commercialization of agri-food products by alternative methods. The purpose of this review was to provide an overview of the evolution and research directions in this field.

Bibliometric analysis is a quantitative research method, which centralizes scientific studies according to several criteria (subject, title, keywords, authors, years, countries, etc.). The research started from creating the database by setting up the "Subject" field in the WoS

database, which searches scientific articles by keywords, title, abstract and author. For the search, the words "marketing" and "agri food products" were selected in the subject field. The results displayed after querying the two selected words, which had the topic as a search filter, displayed a sample of 1,030 publications in the WoS database, and by means of the VOSviewer software, the publication data was represented graphically, through maps and then interpreted.

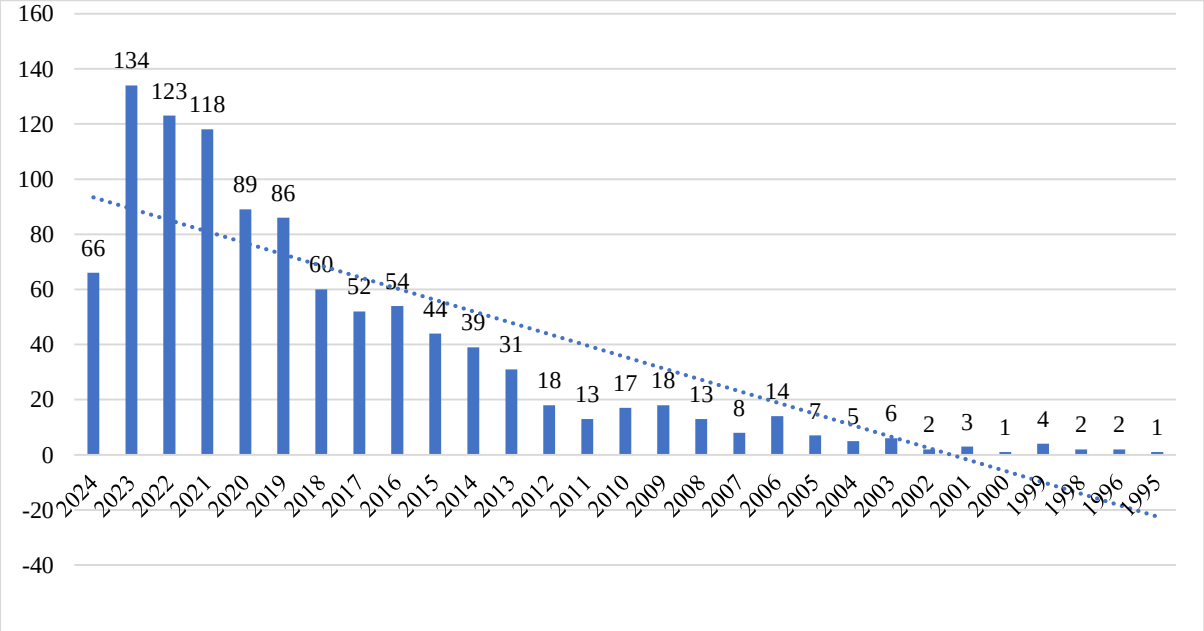
RESULTS AND DISSCUSION

Following the query of the keywords "marketing" and "agri-food products", 1,030 publications were identified that were found in the WoS database, most of the publications belonging to categories such as: Agricultural Economy Policy, Economy, Science Technology Food and Environmental Sciences. Most publications are classified as scientific articles, proceeding papers and review articles.

Regarding the main publication titles in which the studied articles are found, Sustainability, Scientific Papers Series Management Economic engineering in Agriculture and Rural Development, British Food Journal, Agriculture Basel and Foods, record the most publications.

Regarding research areas, most publications fall into domains such as: agriculture, business economics, food science technology, and environmental science.

Graph 1 - Dynamics of WoS publications with the words "marketing" & "agri food products" as their subject in the period 1995-2024



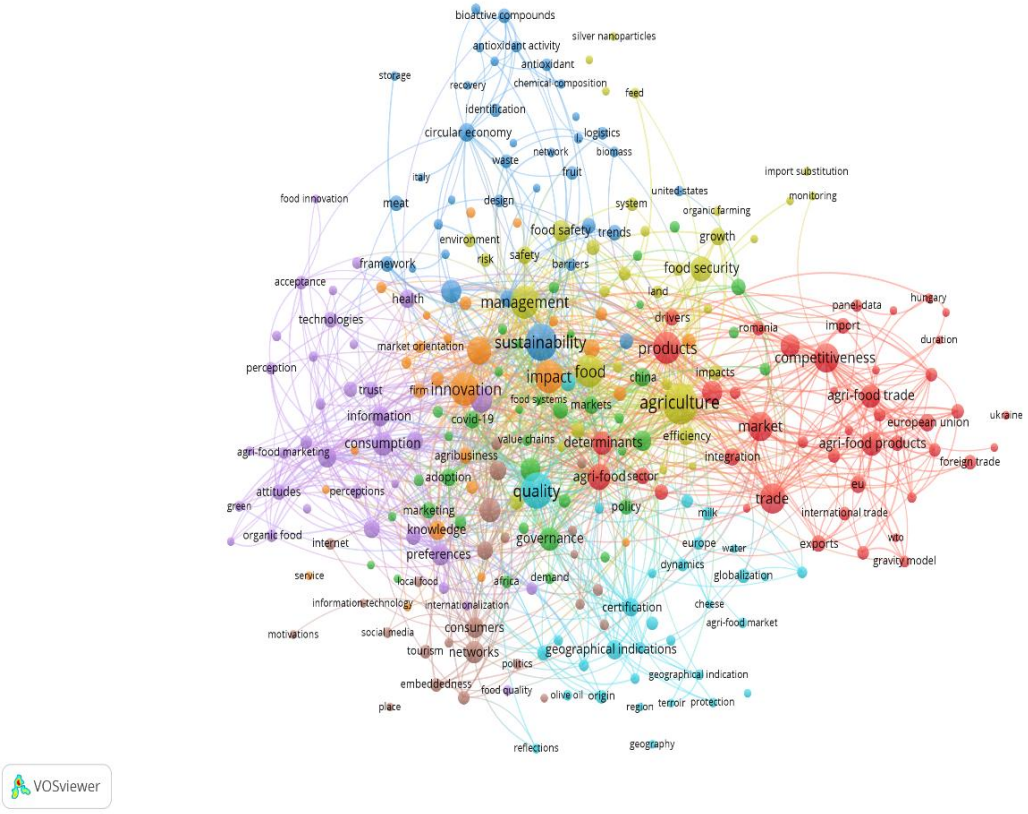
Source: data processing from WoS, accessed on 09.09.2024.

In the graph above, we can see an increasing trend, with small variations, of the publications indexed in WoS during the period 1995-2024 on the analyzed subjects. The maximum number of scientific papers was reached in the year 2023 when 134 articles were produced, and the minimum number in the year 1995 (1 article), respectively the year 2000 (1 article). It was found that starting from 2013 (31 articles) the number of articles published in

WoS began to increase significantly, this increase can be attributed to the impact of agricultural policy measures within the Community Agricultural Policy at the level of agri-food markets in the EU countries (graph 1).

The first paper indexed in WoS that addresses the researched topic appeared in 1995 in the Canadian Journal of Agricultural Economics-Revue Canadienne D Economie Rurale, and presents the perspectives of the food system moving away from mass markets driven by the production of standardized goods to many niche markets smaller, diverse and customized, driven by consumer preferences for specific food characteristics.

Fig. 1 - Correlation of the subjects "marketing" & "agri food products" with other terms



Source: data processing from WoS using VOSviewer software

The first cluster (red) named "agri-food" is made up of 44 terms: products, market, competitiveness, agri-food trade, agri-food sector, agrifood products, integration, export, import, international trade, liberalization, etc.

The second cluster (green) named "marketing" is made up of 38 terms: farmers, e-commerce, value chains, standards, policy, governance, smallholders, etc.

The third (blue) closed cluster called "sustainability" is made up of 36 terms: supply chain, industry, circular economy, energy, design, digital agriculture, framework, etc.

The fourth cluster (yellow) called "agricultural management" is made up of 36 terms: food security, food safety, management, food, agriculture, efficiency, impacts, growth, productivity, etc.

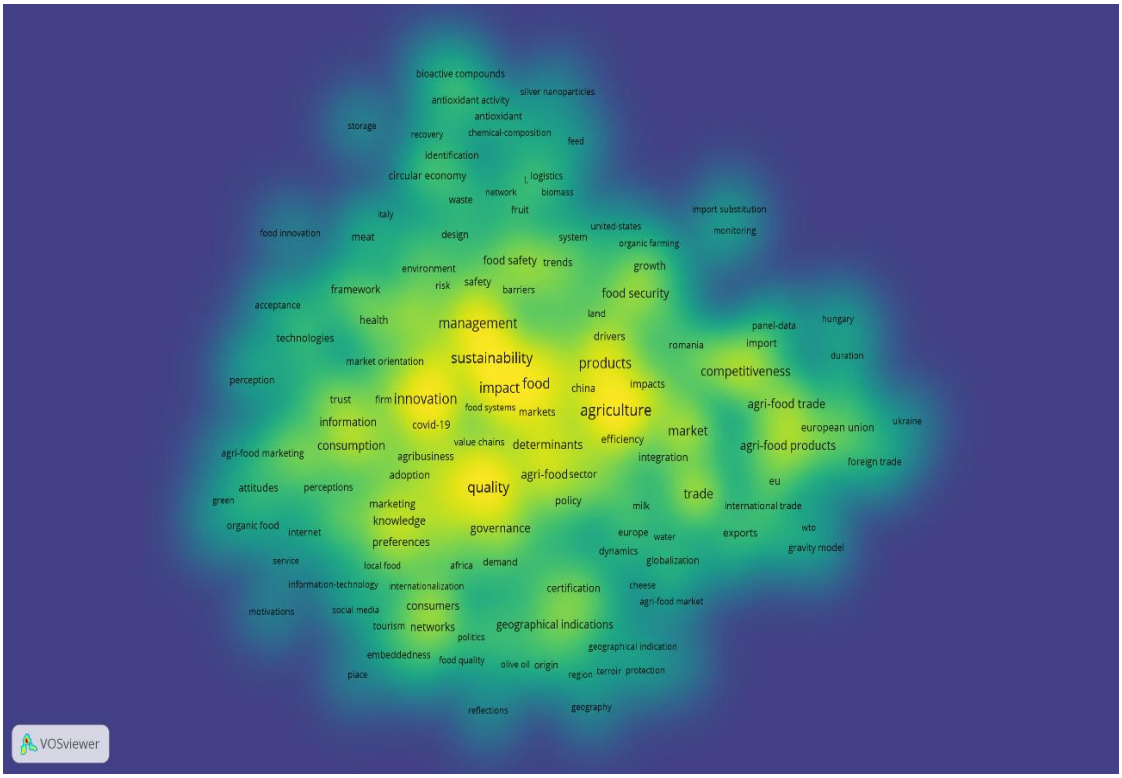
The fifth cluster (purple) called "consumption" is made up of 35 terms: preferences, attitudes, organic food, behavior, information, strategy, satisfaction, perception, health, etc.

The sixth cluster (light blue) called "rural development" is made up of 32 terms: certification, quality, globalization, protection, region, agri-food market, price, etc.

The seventh cluster (orange) called "innovation" is made up of 27 terms: performance, impact, food industry, technology, product development, sustainable development, etc.

The eighth cluster (brown) called "systems" is made up of 25 terms: supply chains, consumers, networks, alternative food networks, tourism, social media, internet, etc. (Fig. 1).

Fig. 2 - Graphic representation of the density of keywords the words "marketing" & "agri food products"



Source: data processing from WoS using VOSviewer software

The figure above represents the density map that is generated by the VOSviewer program and indicates the terms/keywords that are most frequently used in the bibliographic analysis or in the research carried out on a certain topic. Based on the frequency of keywords, the density map indicates the areas of interest/research topics that are more important/relevant in that area. Therefore, for the subject analyzed in the present study, keywords such as: sustainability, agriculture, innovation, quality, impact, food, management, products, governance, agribusiness, food security, food safety are identified (Fig. 2).

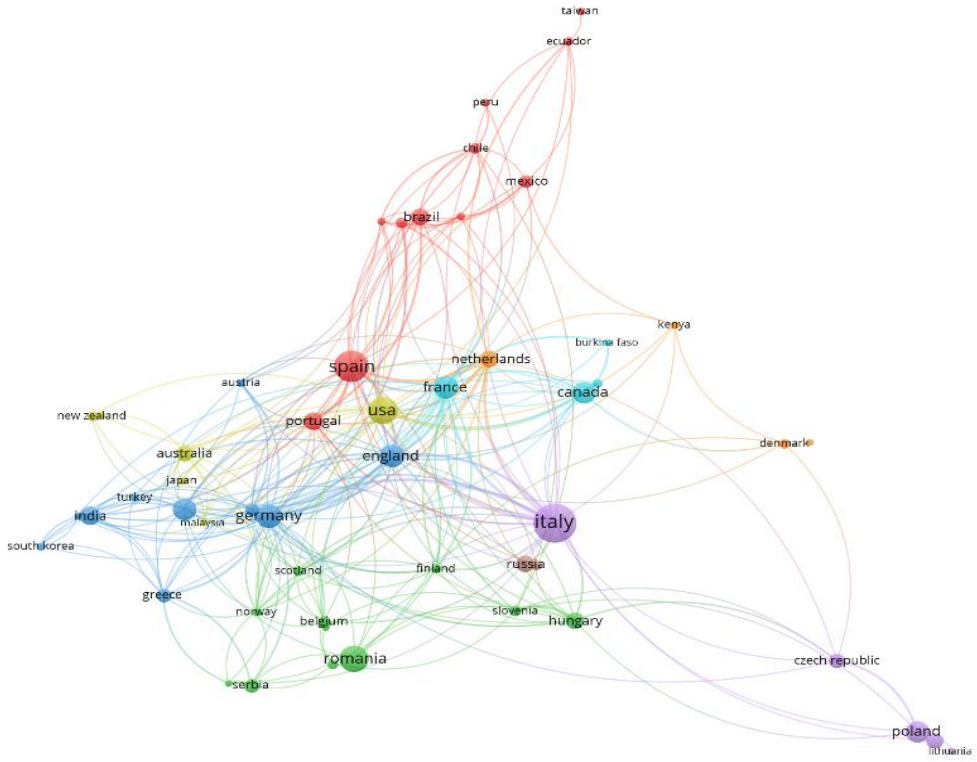
Table 1 – Top 10 countries with the largest number of publications indexed in WoS according to the keywords "marketing" & "agri food products"

Nr. crt.	Country	Number of registered publications	% of 1.030
1.	Italy	158	15,27
2.	Spain	102	9,86
3.	USA	76	7,34
4.	Romania	71	6,86
5.	Germana	56	5,41
6.	Anglia	52	5,02
7.	Franța	52	5,02
8.	Polonia	50	4,83
9.	Canada	49	4,73
10.	China	49	4,73

Source: data processing from WoS, accessed on 09.09.2024

The most publications were registered in Italy (158 publications), representing a share of 15.27% of the total publications indexed in WoS. Romania registered a number of 71 publications, holding a weight of approx. 7%, thus ranking fourth in the list with the largest number of publications in WoS, the interest of Romanian researchers in the subject being addressed being high.

Fig. 3 - Graphic representation of the co-author countries



Source: data processing from WoS using VOSviewer software

In the figure above, a map has been represented that shows the correlation between the topic addressed and the countries that address the topic addressed in this research to the greatest extent. The map was generated with the aim of identifying the frequency of partnerships between countries, and is made up of nodes representing the countries from which the researches taken into account in the analysis originate. At the same time, the colors of the clusters used on the map allow the identification of research directions, and the distance between nodes suggests the level of cooperation between countries. Through this map, the countries that give importance to the research topic were identified, these being: Italy, Spain, USA, Romania, Germany, England, France, Canada, Poland and China. Also, the research directions are diverse (8 research directions). It was observed that Romania presents research directions similar to those of countries such as: Hungary, Serbia, Slovakia, Belgium, Finland, Croatia and Turkey (Fig. 3).

CONCLUSIONS

The topic of commercialization of agri-food products through alternative methods is a very current one among researchers from all over the world, this is also highlighted in the large number of publications developed on this subject.

The present research provides an overview of the research conducted to date, which presents promising directions for future approaches to the topic. The analysis was based on 1,040 publications that were selected in the bibliometric analysis to present the connections between the topic studied and the interest given to it depending on the country. The analysis fulfilled its objective, by identifying a significant number of publications, from which several perspectives can be extracted regarding the commercialization of agri-food products, through alternative methods.

The results of the analysis revealed a substantial increase in the number of publications in the period 2012-2024, most of them being published in the Multidisciplinary Digital Publishing Institute (MDPI) and Elsevier, these two being some of the most important journals that contribute to the literature on agri-food marketing.

Regarding the global impact of the works, it was found that in the top 10 with the largest number of publications in this field, Romania occupying the 4th place in the ranking with a weight of 6.86% of the articles (71 publications).

By grouping the keywords resulting from the database query, 3 main topics from the specialized literature were noted: Agriculture and Sustainability which were interconnected by different terms such as: innovation, quality, policies, marketing, etc.

In conclusion, the subject of the marketing of agri-food products through alternative methods needs special attention, especially in terms of the adoption of policies that support local producers in the marketing process so that they can increase their income from the valorization of agri-food products from their own households.

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COMPREHENSIVE ASSESSMENT OF THE AGRICULTURAL SECTOR IN THE SOUTH-WEST OLTENIA DEVELOPMENT REGION AND ITS IMPACT ON ECONOMIC GROWTH

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Abstract: *In the era of globalization, the importance of the integrated analysis of the agricultural sector is justified, because it allows a more efficient adaptation of this sector to the conditions and requirements of the global market, while ensuring economic and food sustainability. Thus, this analysis allows the understanding of how each component contributes to the overall economic development and allows the identification of those strategic interventions that can maximize the potential of agriculture to stimulate economic growth, improve food security and ensure long-term ecological sustainability. The choice of the South West Oltenia Region for the case study is motivated by its economic relevance, demographic challenges and regional disparities. The case study used different statistical methods of data processing published in national and regional statistics with the aim of determining the importance of each of the component counties in obtaining agricultural performance, but also to determine their economic diversity. The statistical data were collected, processed and analyzed, so that, based on the resulting conclusions, they can be used to formulate relevant proposals that lead to the economic growth of this region. What we found was that although the total value of agricultural production has increased considerably at the regional level, the disparities between counties and sectors underline the need for well-oriented regional agricultural policies to ensure sustainable and equitable development*

Key words: *agricultural sector, South West Oltenia Region, economic development*

JEL Clasificassion: Q0

INTRODUCTION

Amid globalization, a comprehensive examination of the agricultural sector gains significance, as agriculture no longer operates independently but is intricately connected to global markets, international trade policies, and global supply chains. (Tudor V. et al, 2022). Globalization has intensified competition among agricultural producers worldwide, making it crucial to develop a deeper understanding of the sector's dynamics to remain competitive and ensure long-term sustainability. Consequently, an integrated analysis of the agricultural sector is vital, particularly for grasping its complex role in contributing to the economic development of a country or region (Oppenkowski, M. V., 2019). This type of analysis involves all agricultural sub-sectors, from plant production to animal production and agricultural services, precisely to assess how each component contributes to economic growth, employment and food stability (Chiritescu, V. et al., 2014). By using an integrated approach, it becomes possible to gain a thorough understanding of how different elements of the agricultural sector connect and affect each other, which is essential for shaping effective policies. (Bran, M. et al, 2012). The European trend is to reduce the areas cultivated with corn and replace it with rape or sunflower, more profitable crops (Tudor, V. et al, 2017).

The importance of the subject is given by the role of each of these sectors. Thus, plant production, which includes cereal crops, vegetables, fruits and other cultivated plants, is

fundamental for ensuring food security and generating income in many economies, as it not only provides essential food products, but also supports other sectors such as the food industry and biofuel production. The different factors facing the modern world, such as climate change, access to water resources and modern agricultural technologies, significantly influence the yield and sustainability of vegetable production, which is why the analysis is more current (Constantin, E. et al, 2008; Chedea, V. S. et al, 2021). On the other hand, animal production also plays an important role in the agricultural economy, contributing to food diversification and exports. Animal products such as meat, milk and eggs are essential to the population's diet and contribute significantly to agricultural GDP (Marcuta L. et al, 2013). In addition, the livestock sector is closely linked to crop production through the need for feed, thus creating a synergy that can increase overall agricultural efficiency and productivity. In turn, agricultural services, which include activities such as irrigation, agricultural consultancy, processing and distribution of agricultural products, have an essential role in supporting production and increasing the added value of agricultural products, because they contribute to the modernization of the agricultural sector, facilitating the transition towards more sustainable and productive agricultural practices.

The integration of the analysis of these three subsectors allows an integrated understanding of agriculture as an economic engine, given that agriculture not only provides food, but also creates jobs, stimulates exports and contributes to rural development (Marcuta L. et al, 2013). Thus, a developed agricultural sector can serve as the basis for sustainable economic growth, reduce poverty and improve the quality of life in rural communities, this being particularly important for developing economies where agriculture remains a key pillar of the economy.

MATERIALS AND METHODS

The research methodology assumed the collection, analysis and interpretation of information provided by national and county databases and assumed, on the one hand, the analysis of the total value of plant and animal production, as well as that of related services, as the main indicators that measure the value of these productions, providing a clear perspective on the growth or decline of the agricultural sector.

Growth indices or growth rates were also determined, which is an essential tool in the analysis of data series, being used to measure the variation of economic indicators over a certain period (Constantin, S. et al, 2014). This index provides a clear perspective on growth or decline trends and is important for understanding the evolutionary dynamics of the analyzed variables, allowing the identification of moments of acceleration, stagnation or decline and serving as an essential tool in the strategic planning and decision-making process (Sibirskaya, E. V. et al., 2019). This approach enabled us to perform a comparative analysis across various time periods and sectors of activity, facilitating the identification of trends and the assessment of the effectiveness of the implemented economic and political measures. The index is calculated based on the following established formula:

$I^{y}_{t/t'} = \frac{yt}{yt'} \times 100,$

where t' can be:

t' = 1 base period (first interval, first moment of the series)

t' = t - 1 previous period

Another calculated indicator was the average annual growth rate that shows the contribution of each county to the total value of agricultural services in the region each year, and which is determined as follows:

CAGR = $\left(\frac{Vfinal}{V\ initial}\right)^{1/n}$ -1, where

V_{final} is the final value (2022)

$V_{initial}$ is the initial value (2018),

n is the number of years

We also used the Economic Diversity Index, with the aim of analyzing the diversification of agricultural production in the South-West Oltenia region and which is calculated as follows:

ID = $\frac{1}{2}\sum_{i=1}^{n} /pi - \frac{1}{n}/$, where

p_i represents the proportion of each component in total output

n is the number of components

By using these indicators, the process of data comparison and interpretation was simplified, which allowed us to formulate some conclusions that would contribute to supporting the decision-making process in essential areas such as economic policy, regional development and strategic planning.

RESULTS AND DISCUSSIONS

The analysis of the integrated evolution of the agricultural sector was carried out for the South West Oltenia development region. The reason for choosing this region was that it has a diversified economic structure, which includes essential sectors such as agriculture, extractive industry and energy production, sectors with a significant impact on the local and national economy, which gave us the opportunity to understand economic developments global and national.

Also, the Southwest Oltenia Region is one that faces major demographic challenges, such as depopulation and population aging, that is, phenomena that have direct consequences on the labor market, infrastructure and public services in the region. Studying this region allows a detailed exploration of how population dynamics influence economic and social development, thus providing valuable lessons for other similar regions in Romania and Eastern Europe. South-West Oltenia stands out as a region of interest due to its regional disparities, particularly the stark contrast between rural and urban areas, which highlights significant differences in economic development and resource access—key factors for both regional and national policies. In this region, agricultural production increased from 10,656 million lei in 2018 to 13,576 million lei in 2022, marking a 27.4% growth. This growth reflects the strengthening of the agricultural sector, driven by investments in technology, expansion of cultivated areas, and improvements in agricultural management. Strengthening the agricultural

sector in South-West Oltenia could lead to substantial economic gains, enhancing regional competitiveness and help stabilize the rural population. However, to ensure lasting benefits, it is crucial to prioritize natural resource management and adopt sustainable practices, safeguarding the environment while balancing economic growth with ecological preservation.

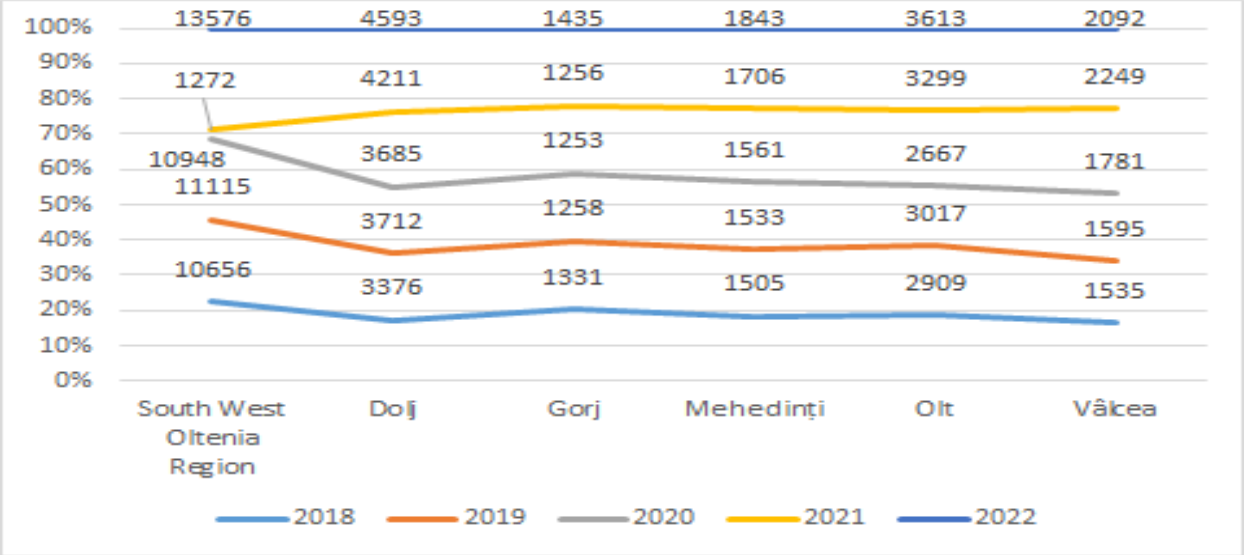

Figure 1. Evolution of agricultural production value in the South-West Oltenia region (2018-2022) (million lei)

Source: INSSE, Own calculations/processing

The analysis of the data provided by the national and county statistical databases highlighted the fact that the County with the greatest contribution to the agricultural production of the region is Dolj, with an increase of 36.04% between 2018 and 2022, reaching this year's level a value of 4,593 million lei. This development indicates a strong development of agriculture in Dolj, supported by well-developed agricultural infrastructure. By contrast, Gorj county registered a reduced growth, of only 7.81%, from 1,331 million lei in 2018 to 1,435 million lei in 2022, which was due to both structural and economic limitations specific to agriculture, i.e. greater dependence compared to climatic factors, but also to a less developed agricultural infrastructure.

Mehedinți County had an increase of 22.45%, reaching a value of 1,843 million lei in 2022, which demonstrates the improvement of agricultural performance, which is the result of the expansion of cultivated areas, but also of the adoption of more efficient agricultural practices.

Agricultural production in Olt County saw a 24.2% increase, reaching 3,613 million lei in 2022. Despite this notable growth, production fluctuations in 2020 were influenced by unfavorable weather conditions and other external factors that impacted overall output. In Vâlcea County, agricultural production increased by 36.28%, rising from 1,535 million lei in 2018 to 2,092 million lei in 2022. This represents the highest percentage growth in the region, attributed to both the diversification of production and the optimization of agricultural land use. Thus, the growth in the value of agricultural production in the South-West Oltenia region indicates a strengthening of the agricultural sector; however, it is important to highlight the

existing disparities between counties. While Dolj and Vâlcea counties demonstrate higher performance, Gorj county stands out as one that requires targeted interventions to promote balanced agricultural development across the region. This emphasizes the need for agricultural development strategies tailored to the unique characteristics of each county to fully harness the region's agricultural potential.

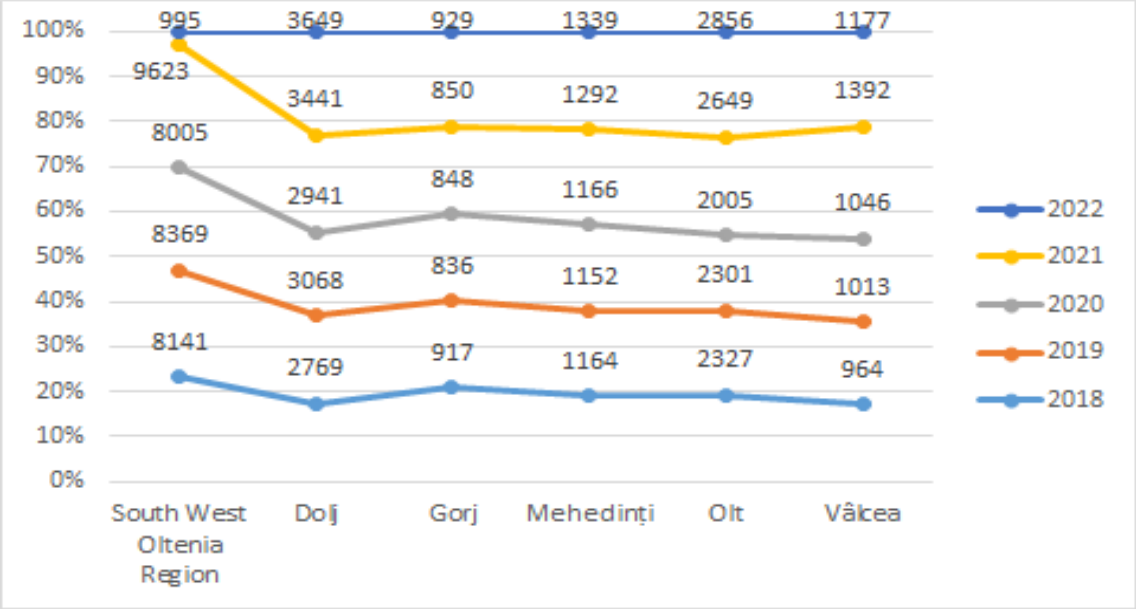

Figure 2. Trends in the value of vegetable agricultural production in the South-West Oltenia region (2018-2022)- (millions of lei)

Source: Source: INSSE, Own calculations/processing

An analysis of the data on the value of agricultural vegetable production in the South-West Oltenia region reveals a significant decline, dropping from 8,141 million lei in 2018 to just 995 million lei in 2022, representing a sharp decrease of 87.77%. Among the counties within this region, Dolj County experienced consistent growth, reaching 3,649 million lei in 2022, a 31.78% increase compared to 2018. Gorj County saw a minimal rise of only 1.3%, with production values remaining almost stagnant, while Mehedinți County registered a moderate increase of 15.03%. Notable increases were observed in Olt and Vâlcea Counties, with growth rates of 22.73% and 22.09%, respectively. Therefore, although the South-West Oltenia region had a sharp decrease in the value of vegetable production, some counties managed to improve their value, which indicated a significant variation in agricultural performance at the local level. This disparity between counties was influenced by several factors, including local climatic conditions, the agricultural policies implemented, and access to resources. Given these conditions, the compound annual growth rate (CAGR) was -40.87%.

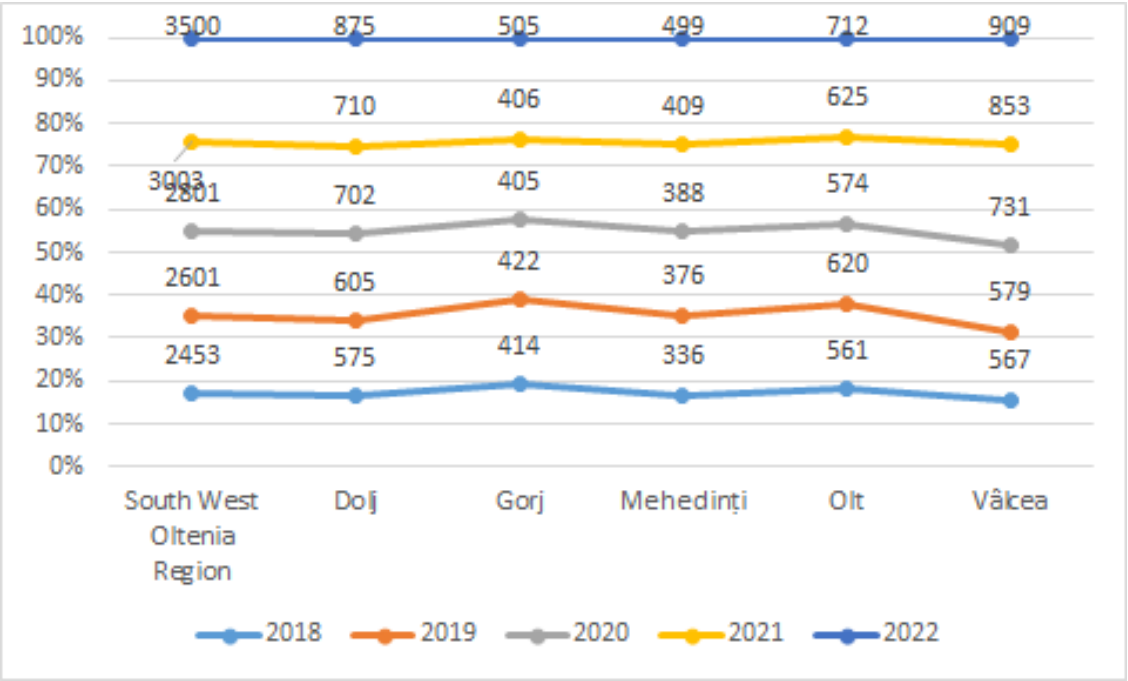

Figure 3. Trends in the value of agricultural animal production in the South-West Oltenia region (2018-2022) - (millions of lei)

Source: Source: INSSE, Own calculations/processing

The correct data on livestock production in the South-West Oltenia region for the period 2018-2022 shows an increase of 42.68%, from 2,453 million lei in 2018 to 3,500 million lei in 2022, which was due to increases in each of the component counties. Thus, Dolj county registered one of the largest increases, this being 52.17%, and due to an increase in the production value from 575 million lei in 2018 to 875 million lei in 2022. Gorj county had an increase of 21 .98%, and Mehedinți county registered an increase of 48.51% because of the increase in production value from 336 million lei in 2018 to 499 million lei in 2022. In Olt County the increase was 26.91%, while at the level of Vâlcea county, the highest percentage increase was noted, this being 60.31%.

The factors that contributed to these increases were: the modernization of farms and the adoption of advanced technologies in animal husbandry that significantly contributed to improving productivity favorable agricultural policies, including subsidies and government support, which encouraged the development of the livestock sector relatively favorable climatic conditions and improved access to markets sales stimulated production growth. In some counties, such as Vâlcea and Dolj, local initiatives and investments in agricultural infrastructure have had a major impact, leading to more pronounced growth in these areas. All these factors combined have played a significant role in fostering the sustainable development and growth of livestock production in the region, resulting in a Compound Annual Growth Rate (CAGR) of 9.29%.

Data on the value of agricultural services in the South-West Oltenia region, provided by the National Institute of Statistics and the Ministry of Agriculture and Rural Development, indicate growth both at the regional level and in most of the counties within the region. If at the global level there was an increase of 102.56% in 2022 compared to 2018, due to the value

of agricultural services of 1,262 million lei in 2022, we note that it was due to increases of 115.24% due to Dolj county, of 108.37% owed to Olt County, 63.88% owed to Valcea county and 24.48% owed to Mehedinti county. In Gorj county, there were no significant changes in the value of agricultural services. However, this overall growth at the regional level suggests a substantial expansion of the agricultural sector.

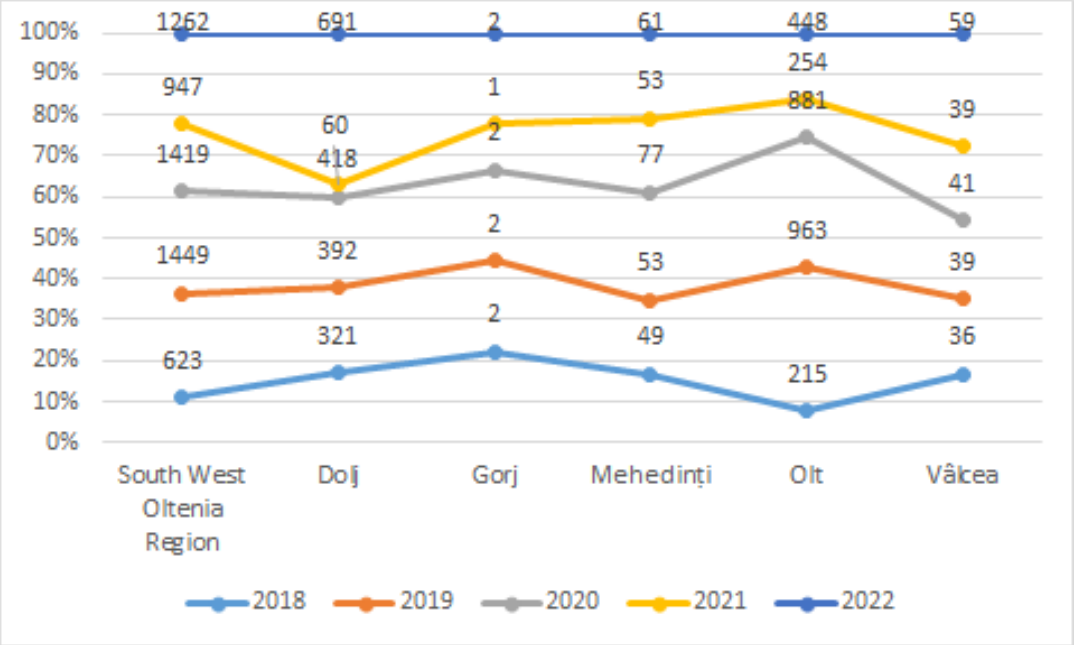

Figure 4. Evolution of the value of agricultural services in the South-West Oltenia region (2018-2022) - (Million Lei)

Source: Source: INSSE, Own calculations/processing

The Compound Annual Growth Rate (CAGR) of the value of agricultural services in the South-West Oltenia region between 2018 and 2022 is approximately 19.30%. This indicates that the sector is expanding, likely driven by investments, technological advancements, and an increased demand for agricultural services within the region. A high CAGR value, like that of agricultural services, makes the sector much more attractive to investors, as it can determine a return on investment in this sector. However, the growth rate must be supported by appropriate agricultural policies, continuous investment and infrastructure improvements to ensure long-term development. In the context of disparities between counties, rapid growth in some areas will accentuate regional differences, thus requiring a more equitable distribution of resources and opportunities.

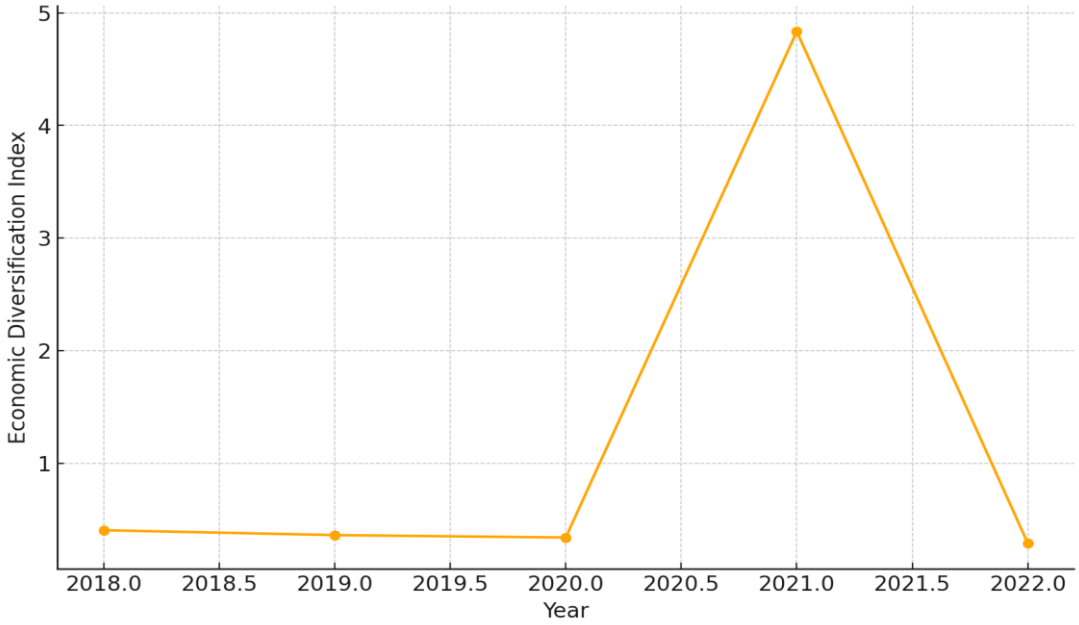

Figure 5. Economic diversification index in the South-West Oltenia Region

Source: Own calculations/processing

The Economic Diversification Index is an essential tool for understanding economic dynamics, assessing risks and developing sustainable economic strategies. The values calculated for the analyzed region vary, indicating fluctuations in its economic diversification. In 2021, the index reached a significant peak of 4.8353, signaling a major disruption in the structure of agricultural production. This was primarily due to a decrease in total production value, driven by an agricultural year characterized by unfavorable weather conditions. In the remaining years analyzed, the index remained at lower values, reflecting a much more balanced diversification. Thus, although the region had a relatively diversified agricultural structure in most years, the year 2021 was a special one, with a significant deviation. By calculating this index, imbalances in the structure of economic production can be identified and public policy and investment decisions can be guided.

Based on this data we were able to determine the Slope Coefficient, which indicates that over the years the Economic Diversification Index tends to increase slightly with an average of about 0.4242 units per year. The coefficient of determination (R^2), with a value of 0.1116, indicates that only about 11.16% of the variation in the economic diversification index is explained by the variation over the years. This suggests that other factors are also influencing the index. Therefore, in the long term, the linear regression indicates a slight upward trend in the diversification index, which demonstrates the further increase in the diversification of the agricultural economy in the Southwest Oltenia region.

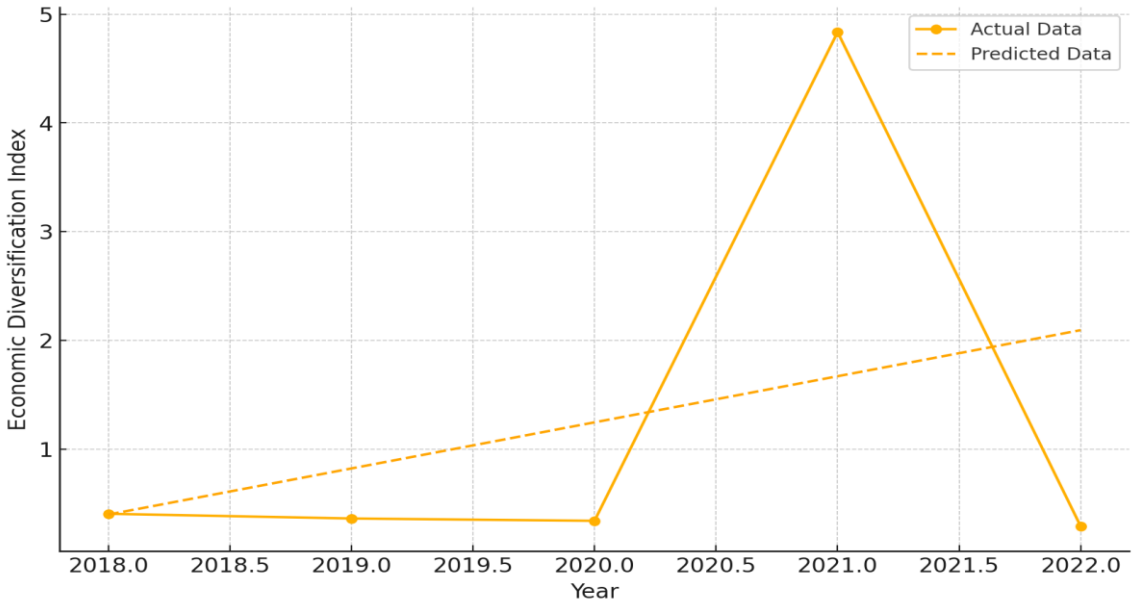

Figure. 6. Actual vs Predicted Economic Diversification Index

Source: Own calculations/processing

CONCLUSIONS

A comprehensive analysis of the agricultural sector within the framework of globalization is vital for shaping policies that facilitate its modernization and integration into the global economy. Additionally, food security emerges as a global concern, influenced by factors such as climate change, economic crises, and geopolitical conflicts, all of which can disrupt supply chains and directly affect food availability and accessibility. By thoroughly analyzing the agricultural sector, policymakers can craft resilience strategies to protect food security in the face of global challenges. The assessment of agricultural production in the Southwest Oltenia Region from 2018 to 2022 reveals substantial growth, though this increase has been unevenly spread across different sectors and counties in the region. While the vegetable sector stood out through important increases, exceeding the national average and consolidating as the main pillar of the regional agricultural economy, the evolution of the livestock sector and agricultural services was more diversified. Counties such as Dolj and Vâlcea recorded outstanding performances, but Gorj and Mehedinți counties faced significant challenges. Although the total value of agricultural production has increased considerably at the regional level, disparities between counties and sectors underline the need for well-oriented regional agricultural policies to ensure sustainable and equitable development in all fields and areas, reducing vulnerabilities and maximizing the agricultural potential of the region.

In an agricultural economy, such as the case of South-West Oltenia, diversification between plant, animal production and agricultural services can reduce the risks associated with climatic factors, market price variations or other unforeseen events.

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LOCAL GASTRONOMICAL POINTS – ELEMENTS OF THE NATIONAL STRATEGY FOR THE DEVELOPMENT OF ROMANIAN ECOTOURISM

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Summary: *The National Strategy for the development of ecotourism 2023-2027 has as its objective the development of the offer of ecotourism products made by local communities within ecotourism destinations/with ecotourism potential, supporting, among other things, the development of local gastronomic points (PGL) that can be found within the premises of family holdings in the environment rural, animal and agricultural farms, stables, fishing shelters, beehives, wineries, trout farms, hunting funds, where one or more activities related to primary production are carried out. According to Law no. 412/2023 for the establishment and operation of local gastronomic points, the Ministry of Agriculture and Rural Development will propose measures to grant support in order to establish or support the activity of local gastronomic points, within the limits of the budget provisions. The purpose of the paper is to analyze the distribution of local gastronomic points by counties and development regions, in order to identify areas with potential for development in this regard. The analysis is based on the data available in the databases of the Sanitary Veterinary and Food Safety Directorates in each county of Romania from 2023-2024.*
Key words: *local gastronomic points, National Strategy for the development of ecotourism*
JEL clasificassion: Q 01,Q26,Q57

INTRODUCTION

According to the National Ecotourism Development Strategy, Romanian rural communities can develop, by establishing Local Gastronomic Points (PGL), where you can consume dishes from local products, prepared in private kitchens within the premises of the houses in the villages, obtained according to traditional, authentic methods (Action plan of the National Eco-tourism Development Strategy 2023-2029).

By Law no.412/2023 local gastronomic points are defined as units of "utilization of local primary production, located in a rural locality, where food products are prepared and served, according to recipes specific to the area, directly to the final consumer, for a maximum number of 15 people at sime time". Thus, PGL represents a concept that responds to the growing demand in our country for family-type public food establishments, which offer those who want products and food preparations specific to the geographical areas of Romania.

The Local Gastronomic Point represents an efficient way of capitalizing on products from the peasant household, in family-type public catering units, taking into account the specifics of each tourist area/region with known gastronomic traditions. Unlike restaurants or guesthouses, local gastronomic points offer tourists the opportunity to benefit from traditional, local dishes, produced and served directly by members of a family, in their own household, respecting legal hygiene requirements, without affecting people's health (National Agency of the Mountain Zone – Establishment of local gastronomic points).

Culinary products must be prepared from raw materials preferably from primary production obtained in the own household/farm, as well as from local producers or from

authorized sanitary-veterinary registered units. (Order of the President of ANSVSA no. 111/2008 and subsequent amendments and additions).

The products are prepared according to traditional methods and are intended for fresh consumption, on the same day, as soon as possible after cooking. Canned products can also be used - jams, jams, canned vegetables, canned animal preparations (Guide to good hygiene and culinary production practices).

Ignorance of the legislation as well as the steps that must be taken to establish a PGL represents a serious obstacle for rural entrepreneurs. That is why a more intensive promotion is necessary, both through the creation of a guide for those interested, a counseling program at the level of destinations, for the development of small businesses in the ecotourism sphere, as well as the creation of scientific articles and in specialized publications.

Multiple financial sources are needed for the conservation and preservation of biodiversity. This can be achieved in part through the contribution of ecotourism businesses. Economic operators, including PGL, who operate in the locality or in the respective area, can voluntarily contribute to support the financial mechanism, the funds collected through this type of mechanism can be used for nature conservation actions at the level of the rural area. Informing tourists about nature conservation projects, existing at the time in the rural area visited, can determine their participation in various direct or indirect contributory activities. Thus, tourists can contribute with sponsorships/donations to the purchase of objects made by locals or by volunteering in greening actions, monitoring some species or publishing informative articles and materials, creating exhibitions with photographic images (Action Plan of National strategy for the development of eco-tourism 2023-2029).

MATERIAL AND METHOD

The first research method used in the paper is the bibliographic analysis and aimed at extracting the existing official data in the scope of the paper's research. The data was collected by accessing the MADR and ANSVA databases. The second method used was statistical-mathematical analysis, this one studying phenomena and processes from a quantitative point of view, in order to describe them and discover the laws that govern their manifestation, by calculating statistical parameters.

RESULTS AND DISCUSSION

Studying the available literature, I found the first information about local gastronomic points, in Romania, in 2010, when the Ivan Patzaichin - Mila 23 Association was born. This aims to support local development in the Danube Delta, but also in other natural regions in Romania, promoting and protecting their cultural and natural profile, as well as Romanian traditions (Gihd of good hygiene and culinary production practices - Ivan Patzaichin Association - Mila 23).

In 2018, Vama Buzăului was certified as a tourist resort of local interest, the main problem identified by the mayor of the town being that the tourists who came to admire the natural beauty of the area had no place to eat. This is how the idea of establishing Local

Gastronomic Points in Buzăului Customs appeared (General information - Intorsura Buzău City Hall).

The local gastronomic points aim to highlight the local gastronomic specifics, the valorization of local products, the creation of public gastronomic events (meals for tourists, brunches, tastings, tourist packages), the development of local networks.

Gradually the activity expanded, so that in November 2023, there were 303 PGLs in Romania, of which 201 - representing 66.33% of the total, in the mountain area. These come to complement, in a harmonious way, the tourist offer already existing in the mountain area (Law no. 412/2023).

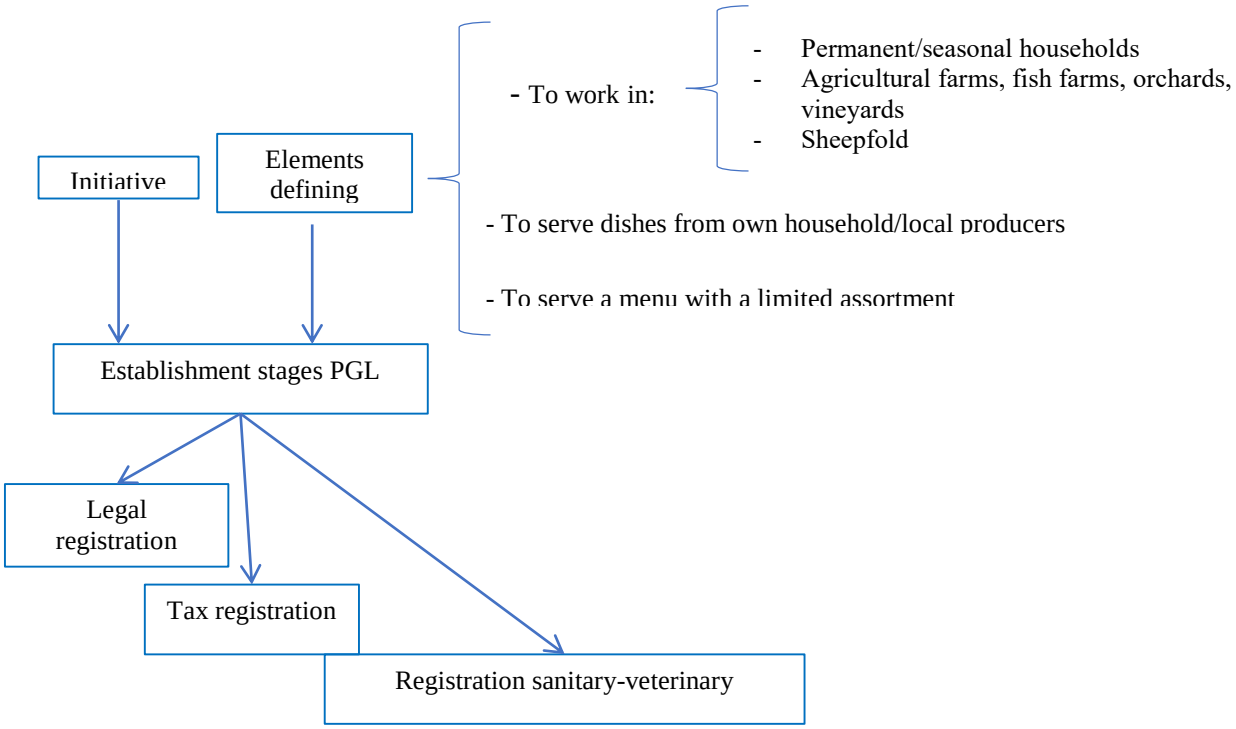

Figure no. 1 – The stages of the establishment of Local Gastronomic Points
Source: Law no. 412/2023

According to the law for the establishment and operation of Local Gastronomic Points, the legal form can be Authorized Natural Person (PFA), Individual Enterprise (ÎI), Family Business (ÎF) according to GEO no. 44/2008 or Limited Liability Company (SRL) according to Law no. .31/1990, CAEN codes being in all the cases 5610 – Restaurants (Figure no. 1).

The documents required for the registration of a PGL are the following (Table no. 1):

Table no. 1 - Documents required for registration

REGISTRATION		
LEGALLY	**TAX**	**SANITARY-VETERINARY**
- The application for legal registration is submitted to the county ONRC together with:	- The application for fiscal registration is submitted to ANAF => Fiscal Registration Certificate	- The application for the sanitary-veterinary registration is submitted to the DSVSA together with the following documents:

REGISTRATION		
LEGALLY	**TAX**	**SANITARY-VETERINARY**
- Request to check the availability and/or reserve the name of the company	- Registration at the National Fiscal Administration Agency: - SRL will keep double-entry bookkeeping - PFA, ÎI, IF will keep a single-entry bookkeeping by completing only the Register of Receipts and Payments, the Inventory Register, the Register of Fiscal Records and the Single Declaration on Income Tax and Social Contributions	- Sketch of the location of the PGL activity - Copy of the registration certificate from the ORC - Copy of product sales card or manufacturer's certificate - Copy of the manufacturer's Identity Card - Proof of tax payment
- Declaration on personal responsibility regarding compliance with sanitary-veterinary legislation, labor protection, environmental protection.	- All units will use electronic marking machines for issuing tax receipts.	- DSVSA schedules a visit to the headquarters of the PGL activity.
- Declaration on personal responsibility regarding the fulfillment of the legal conditions for carrying out the activity.	- At the request of customers, all units will issue the tax invoice.	- After the visit, if the conditions are met, the PGL obtains the Sanitary-Veterinary Certificate, if not, it notifies the responsible person of the deficiencies and the deadline for their remediation.
- The document certifying the right of ownership/use of the space.		
- The constitution agreement concluded with the family members.		
- Copy of the Identity Card, specimen signature and special power of attorney to appoint the representative.		
- The certificate from ANZM regarding the professional training course in the field.		

Source: Law no. 412/2023

For the establishment of a PGL, those wishing can access Sub-measure 6.2 "Support for the establishment of non-agricultural activities in rural areas", and for modernization and/or development they can access Sub-measure 6.4 "Investments in the creation and development of non-agricultural activities".

The first sub-measure has, among other objectives, the creation of new non-agricultural activities in the countryside, in particular, for small farmers or their family members. As it follows from this objective, the beneficiaries can be farmers or members of an agricultural household in rural areas, who diversify their activity by establishing a non-agricultural activity for the first time. The value of the support can be a maximum of 50,000 euros per project, money that will be granted in 2 installments: 70% after signing the Financing Agreement and 30% will be granted if the Business Plan has been correctly implemented, before the completion of 3 years from the date of signing the contract, with the mention that the last payment will be made no later than December 31, 2025.

A second mention that must be made is that the payment of the first installment is conditional on the presentation of the final document, from the environment agenty. An essential condition is that the implementation of the Business Plan begins no later than 6 months from the date of the decision to grant support.

According to the instructions in the guide, applicants who propose such investments must also submit the documentation to ANSVSA in order to obtain the operating authorization in time. The applicant must be an agricultural producer or the owner/associate/majority shareholder must hold at least 50% of the shares. If the applicant is an agricultural producer, he must hold a Producer's Certificate, issued according to Law no. 145/2014 for the establishment of measures to regulate the market of products from the agricultural sector, at least 12 consecutive months before submitting the Financing Application.

The agricultural activity must be carried out at least 12 consecutive months before the submission of the Financing Application and must be maintained throughout the duration of the activity financed by the project. The maximum duration of execution of the Financing Contracts cannot exceed the payment deadline of 31.12.2025, provided for by Regulation (EU) no. 2220/2020 (Applicant Guide Sub-measure 6.2).

The second sub-measure aims to support those who develop non-agricultural activities in rural areas, with the aim of stimulating the business environment in that area, developing existing non-agricultural activities, creating new jobs, increasing the incomes of the rural population and reducing disparities between rural and urban. The value of the non-reimbursable support is a maximum of 90% of the total cost of the investment and will not exceed 200,000 euros over 3 fiscal years (Applicant Guide Sub-measure 6.4).

We accessed and processed the data available at the countys ANSVSA and concluded that the emergence of Law no. 412/20023 did not produce significant changes in terms of the number of PGL. In November 2023, before the law came into force, there were 295 PGLs registered at country level, and in February 2024, this number had increased to 303, with 8 more (Table no. 2).

Table no. 2 – The impact of the emergence of Law no. 412/2023 on the number of PGL, by development region

	PGL no		**Differences**	
	November 2023 before the advent of the law	February 2024 after the appearance of the law	+	-
The Region North West	29	47	18	

	PGL no		Differences	
Center Region	140	124		-16
The Region North East	20	24	4	
The Region South East	53	53		
The Region South-Muntenia	16	15		-1
The Region South-West Oltenia	12	13	1	
The Region West	25	27	2	
TOTAL	295	303	25	-17

Source: author's interpretation of data from the countys ANSVSA, February 2024

From the analysis of the distribution of PGL by development region, most were begining in the Center Region (124) followed by the South-East Region (53) and the North-West Region (47) (Figure no. 2).

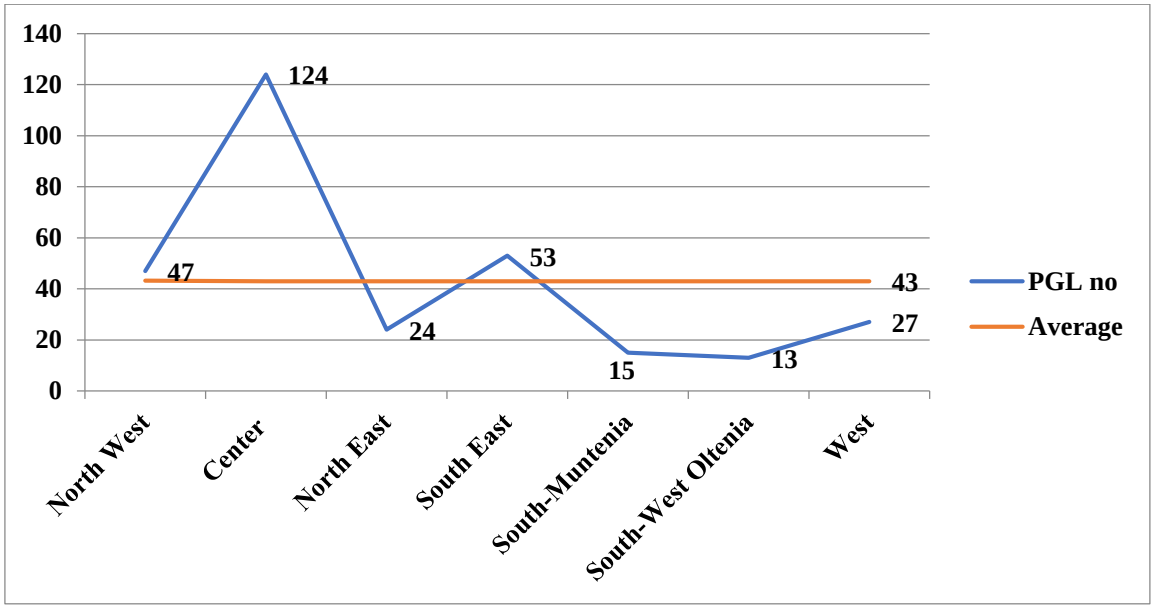

Figure no. 2 – Distribution of the PGL number by development regions

Source: author's interpretation of data from the countys ANSVSA, February 2024

With the help of an interactive map (Figure no.3), we analyzed the distribution of local gastronomic points by county. Thus, we note that in the counties of Iași, Bacău, Ialomița, Ilfov, Călărași, Teleorman and Dolj there is no PGLs registered, although there are tourist attractions.

On the territory of Iași County, outside the county capital, which is very beautiful, you can visit the Cuza Palace from Ruginoasa, the Sturza Castle from Miclăușeni, the Sturza Palace from Cozmești, the Cucuteni Archaeological Site, the Ciric Forest, etc.

In Bacău County, you can visit Salina Drumul Sării, the Red Castle from Hemeiuș, the George Bacovia Memorial House, the Știrbei Palace from Dărmănești, and for those who love nature outings, Poiana Uzului Lake or the Nemira Nature Reserve.

In Ialomița, in addition to the Piscul Crăsani Archaeological Site and the ruins of the Geto-Dacian fortress Helis, you can also visit the Ionel Prelea Memorial House (musician), the Marghiloman Mansion or the Amara lake.

In Teleorman you can visit the Constantin Noica and Marin Preda Memorial Houses, the Coșoteni Vedea Monastery, but also numerous natural attractions such as the Loess Cliff from Lunca, the Ostrovul Mare Nature Reserve, Suhaia Lake, the Troianul Forest Nature Reserve.

For nature lovers in the counties of Călărași and Dolj, located along the Danube, there are numerous attractions: Valea Roșie lake, Balta Ialomiței (Călărași) Ornithological Reserve Ciupercenii noi, Peony Reserve from Plenița, Prejbea-Făcăi Lake Complex (Dolj). Also in these counties we can visit the Vicina Byzantine Fortress, the Negoiești Monastery or the Jegolia Stables in Calarasi and the Amza Pellea Memorial House or the Sadova Monastery in Dolj.

Even in Ilfov, there are insufficiently promoted tourist attractions such as Brâncovenesc Palace, Știrbei Palace, Cernica Monastery or Ciorogârla Monastery with 3 altars.

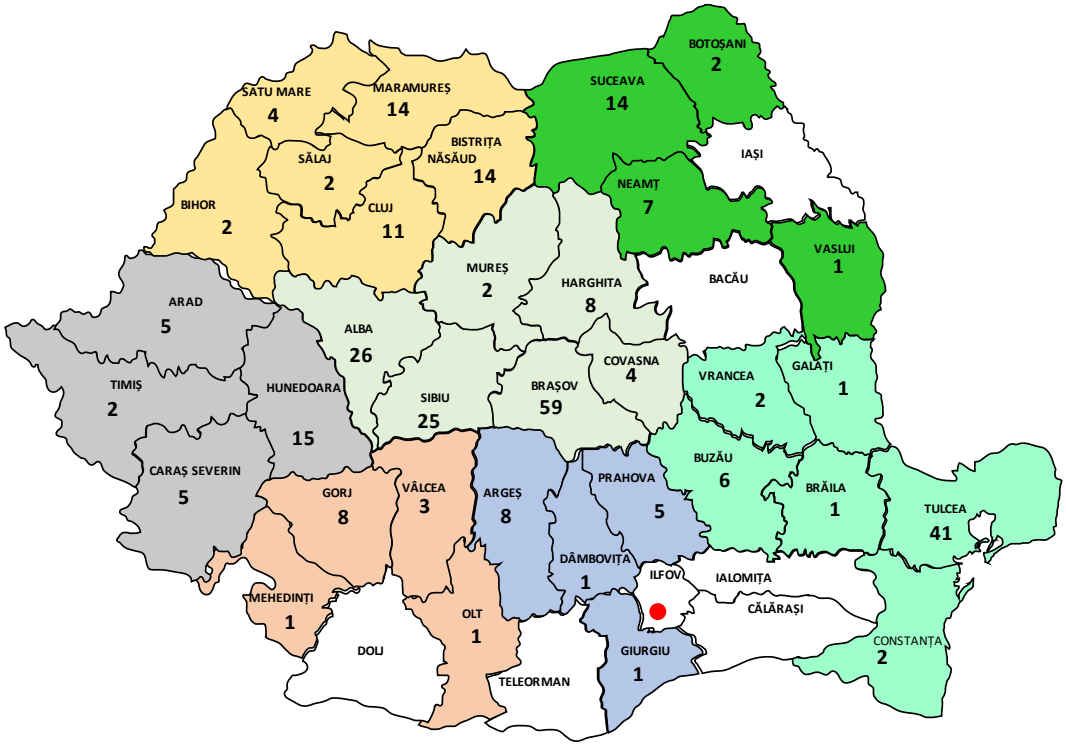

Figure no. 3 – Distribution of the PGL number by county

Source: author's interpretation of data from the countys ANSVSA, February 2024

As will be seen in the SWOT analysis, the number of tourists who dine in a local gastronomic point depends directly proportionally on the tourism promotion of the area.

Table no. 3 – SWOT analysis regarding the establishment of a local gastronomic point

ADVANTAGES	DISADVANTAGES
• An already existing building can be set up for serving the meal, without the need for a separate, new building. • Little documentation for setting up. • Does not require additional labor, outside the family. • It allows direct capitalization of household products. • Reduced costs of preparation, storage and transportation of raw materials and preparations.	• Insufficient knowledge of the tourist potential in order to establish the location. • Insufficient knowledge of the sanitary-veterinary food preservation legislation.
OPORTUNITĂȚI	**RISCURI**
• The rich/varied tourist potential of the rural area. • Accessing European funds.	• Many and often contradictory legislative changes. • The number of tourists who dine in a PGL depends directly proportionally on the tourism promotion of the area.

Source: author's interpretation

CONCLUSIONS

The National Strategy for the development of eco-tourism provides for the development of rural communities and through the establishment/modernization/expansion of local gastronomic points. Starting from the importance of the rural area in Romania, non-agricultural development solutions seem to be taking shape.

Starting with 2010, the PGL concept began to develop first in the Danube Delta and the neighboring areas, then in the Intorsura Buzău area. Currently, in Romania, there are 303 PGL unevenly distributed throughout the country. Thus, 41% of local gastronomic points are found in the Central Region, 17.5% in the South East and 15.5% in the North West. Analyzing by county, there is a big discrepancy between the first two ranked: Brașov with 59 PGL (representing 19.5% of the total in the country) and Tulcea with 41 PGL (representing 13.5% of the total in the country) and those located on places 3 (Alba with 26 PGL, representing 8.60% of those in the country as a whole) and 4 (Sibiu with 25 PGL, representing 8.25% of those in the country as a whole).

The rich and varied tourist potential is insufficiently known and promoted, as well as the possibilities of financing the activity from non-reimbursable funds, leaving an open door for the development of rural non-agricultural activities. The essential condition is that all those involved in the proper development of rural activity - local authorities and agricultural producers - show their interest in promoting eco-tourism in the respective area, the benefits being well-known.

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THE AGRARIAN STRUCTURE AND EVOLUTION OF SMALL FARMS IN ROMANIA AFTER THE ACCESSION TO THE EUROPEAN UNION

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Abstract: *At the moment, the European Union is facing a process that has been going on for decades (for 70 years now), of the disappearance of small farms, under the conditions of financial support mainly oriented towards large farms through the Common Agricultural Policy. The 2024-2027 CAP recognises the important role of small farms in local agri-food production, maintaining agro-biodiversity, as well as promoting the preservation of cultural heritage and comes with a series of measures aimed at small farms. Romania is facing a challenge regarding the future of small farms. Recent history reveals a decline by about 25% of farms in our country, mainly small farms, since 2007 to the present day. The evolution of Romania's agrarian structure highlights the perpetuation of excessive polarisation between a few large farms and millions of small and very small farms. At the moment, farmers are facing new challenges generated by the new NSP, in which even if small farmers are offered new opportunities for modernisation and development, in order to benefit from them, they must meet a series of environmental conditions that come in the package, which can generate a series of difficulties for them.*
Key words: *agrarian structure, small farms, sustainable rural development*
JEL Classification: Q01, Q18

INTRODUCTION

In the post-accession period, in Romania, the number of farms has decreased by about 25%, mainly in the segment of small farms, but the farm structure in numerical terms has remained unchanged. Only in terms of utilised agricultural area a consolidation of farms in the segment of medium and large-sized farms has taken place, to the detriment of small and very small farms.

Thus, the evolution of agrarian structure in Romania in the post-accession period reveals the perpetuation of excessive polarisation between a few large-sized farms and millions of small and very small farms, while no consolidation has been noticed in the case of medium-sized farms. An obvious link can be seen between the presence of large farms and a higher level of rural poverty. This can be explained by the fact that the rural population gave up the farming activity for an immediate gain (by selling the agricultural land), but this population was not attracted in the large farm business (where no numerous labour force is needed, as these farms are mainly based on mechanisation) or in other local non-agricultural activities (poor diversification of non-agricultural activities).

MATERIALS AND METHODS

The paper aimed to highlight the evolution of Romania's agrarian structure in the post-accession period. The main data sources were the National Institute of Statistics (tempo online, General Agricultural Censuses GAC, Farm Structure Surveys) and Eurostat databases. The data on the evolution of analysed indicators (utilised agricultural area, number of farms, average

farm size, share of farms by size classes, gender structure, structure of farms by level of training) were systematised, processed and synthetically presented in Excel tables and analysed in quantitative and qualitative terms in the paper. The statistical data were analysed through the lens of national and international literature.

RESULTS AND DISCUSSIONS

Even though there is a large number of small and very small farms, these have a significant importance as they ensure the survival of the Romanian countryside. The density of rural population and the rural viability/sustainability implicitly depend on the viability of small farms (Borychowski, M. et al., 2020). Small farms also present a number of advantages that should not be neglected, and Romania should capitalise on this potential. Among these advantages, we next present the most important ones:

- small farms remain a cornerstone of agricultural activities in Romania and in the European Union, providing healthy food to consumers, jobs in the countryside, public, social and environmental goods (Mortan, M.; 2008; Darnhofer, I.; 2016);
- importance of family farming in alleviating hunger and poverty and for the improvement of food security and living standards in rural areas, while protecting the environment and biodiversity;
- small farms have a high resilience level, so that small producers can survive under difficult and risky conditions (Heidhues, F.; Brüntrup, M.; 2003);
- an important role of small farms in their contribution to the creation and protection of cultural and natural heritage.

Small-scale agriculture in Romania has a long history, yet its evolution has not been easy for a harmonious and sustainable development. At the moment, most people living in poverty in Romania are found in rural areas and rely on agriculture for their existence, having no other alternatives. Otiman (2012) argues that there is a strong correlation between farm size – more exactly the presence of large farms in certain areas – and the severe rural poverty phenomenon. A fact confirmed by the situation of Romania's Est and Sud development regions, which have the best agricultural land and where the most and largest farms are found, but which are also the poorest regions of the country; while smallest farms are present in the northern and central regions of Romania, which are known as the richest rural areas of Romania (Mihaleche, 2022).

Small farms are currently exposed to major, unpredictable economic, political social and ecological changes. To protect the long-term existence of small farms, farmer families have to find market-based, innovative, sophisticated and sustainable strategies (Suess-Reyes, J.; Fuetsch, E., 2016).

In the European Union, small farms used to be disadvantaged for a long time compared to large (industrial) farms; but with the raising awareness of the important role of small family farms in promoting sustainable farming, in the sustainable development of rural areas, there is a paradigm shift according to which the role of these small-scale agricultural entities is not limited only to food production, but they also contribute to the provision of social and environmental public goods (Guarin, A. et al., 2020; Lowder, S.K. et al., 2016; Rivera, M. et al., 2020). This is also the reason why the economic viability of farms cannot be measured

only according to the economic principles (revenue, income or value added and production costs, as well as by the indices of efficiency, profitability, liquidity, stability, productivity and investments) (Latruffe, L., 2010), but social aspects should be also considered (targeting empowerment, equity and inclusion) as well as environmental aspects (natural resources, pollution and biodiversity) that the agricultural holding as a whole provides.

In the period 2007-2020, Romania recorded the largest diminution of the number of farms in Europe (their number decreased by 26.56%, to reach 2,887,070 agricultural holdings); yet even under these conditions, our country remains the country with the largest number of agricultural holdings in the EU, with 31.84% of the total number of EU farms. The number of farms in Romania is more than twice as high than that of Poland, which is the country that ranks second in the EU (1.3 million farms in Poland, i.e. 14.4 % of total EU farms).

The farms under 5 hectares in the EU account for 62.41% of the total number of farms. There are 2,562,070 farms under 5 hectares in Romania, accounting for 88.74% of the total number of farms in Romania, 45.27% of the number of farms under 5 ha in the EU and 28.26% of the total number of EU farms.

In the investigated period, Romania's agricultural area decreased by 7.20%, to reach 12,762.83 million hectares. In the year 2020, the agrarian structure of our country had a dual structure, with many very small farms (the farms under 5 ha representing 88.74%) that operate a small area (22.85% of the agricultural area), and large farms (farms over 100 ha that represent 0.55%) that utilise a very large agricultural area (47.83%).

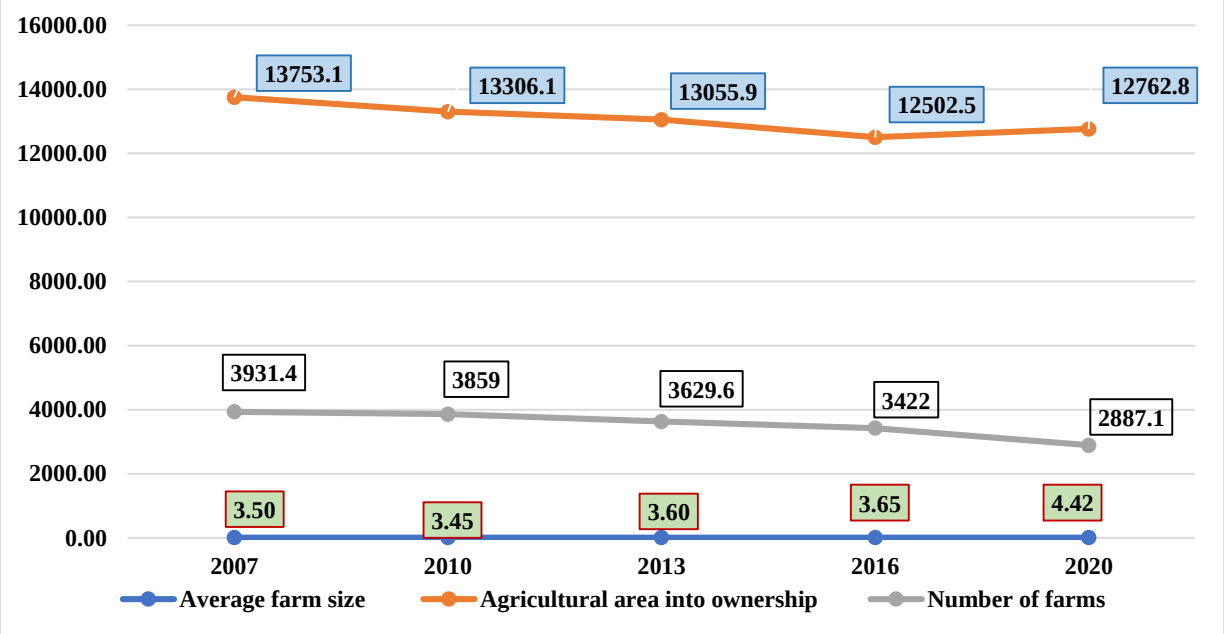

Figure 1. Evolution of farms in Romania in the period 2007-2020

Source: author's processing of Eurostat data

The number of large-sized farms (over 100 ha) increased from 9.70 thousand in 2007 to 16.01 thousand in 2020 (+65%), but in terms of agricultural area these farms increased more slowly, from 5,172.4 million ha in 2007 to 6,104.85 million ha in 2020, which resulted in a diminution of the agricultural area into ownership of a large (from 533.24 ha/farm in 2007 to 381.31 ha/farm in 2020).

In the analysed period, even though there was a spectacular evolution of the number of farms under 5 hectares, with a significant diminution of 889,130 farms (-25.76%), in percentage terms this category remains at about the same level in the investigated period, at about 88% (see Annex). In other words, no changes in structural terms were noticed.

In the period 2007-2020, farm structure by size classes remained broadly unchanged. The farms over 20 de hectare experience sustained growth, which did not influence farm structure in any way. Certain changes are worth noting at the level of farms under 2 ha, the number of which decreased by 17.82%, yet the area of this category increased from 63.22% in 2007 to 70.75% in 2020.

In the investigated period, the number of farms under 20 ha decreased (by 1,042.01 thousand farms, i.e. by 27.27%), while their area also decreased (by 3,003.7 million ha, i.e. by 38.65%); at the same time, the farms in the higher size classes increased both in number and in area.

Structurally, in terms of agricultural area into ownership, a consolidation of farms from higher size categories (medium and large-sized farms) can be noticed, to the detriment of small and very small-sized farms. As it could be noticed, the farms that disappeared in the analysed period were mainly from the category of small, subsistence holdings.

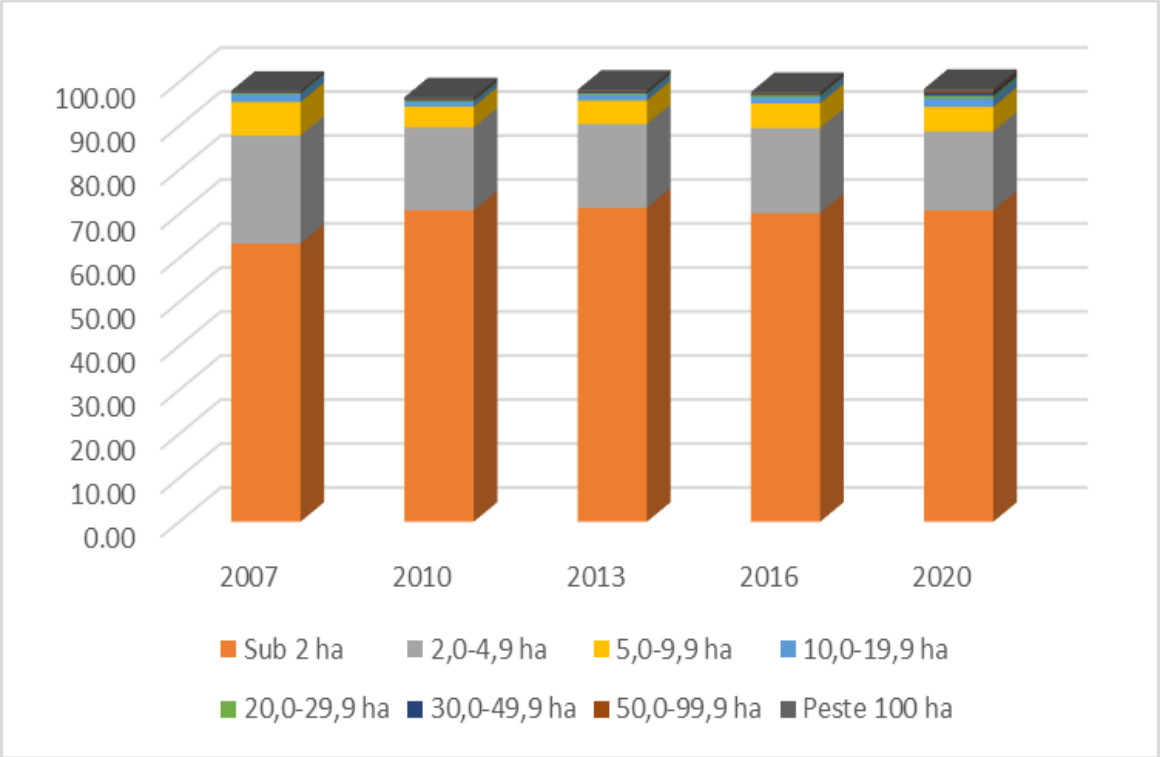

Figure 2. Evolution of farm structure in Romania, by size classes, in the period 2007-2020

Source: author's processing of Eurostat data

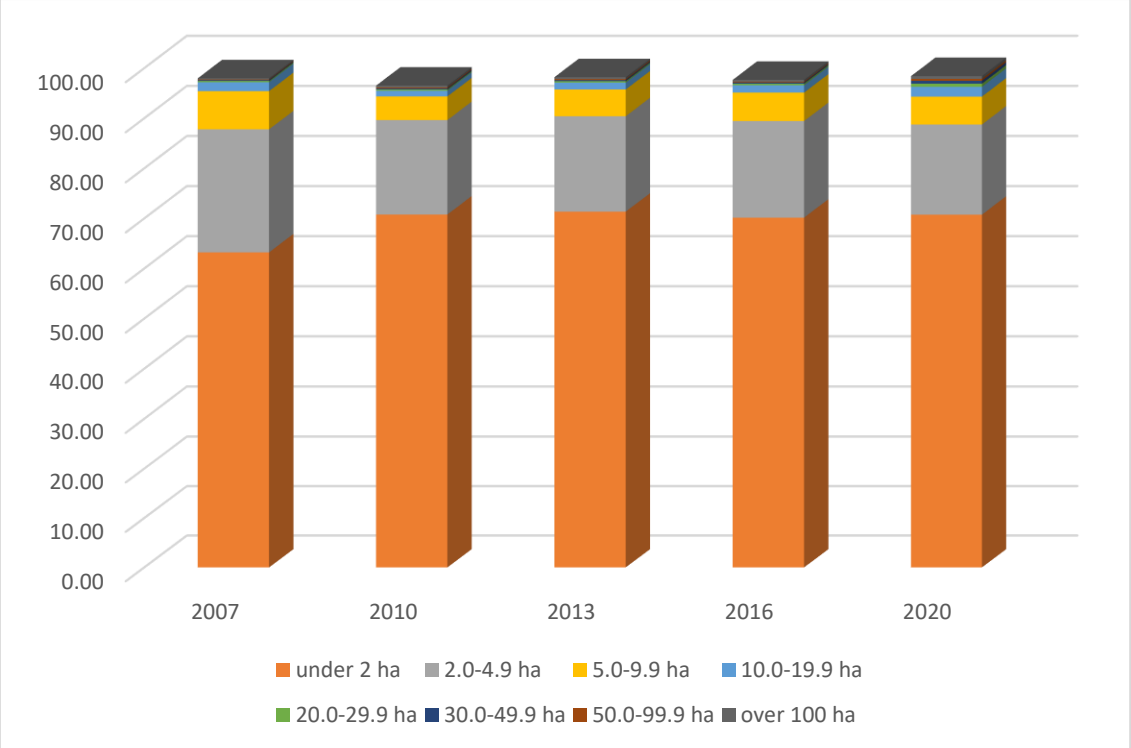

Figure 3. Evolution of the structure of utilised agricultural area by Romanian farms, by size classes, in the period 2007-2020

Source: author's processing of Eurostat data

The average farm size increased in the analysed period, from 3.5 ha in the year 2007 to 4.42 ha in 2020; very large differences in terms of size were maintained between farms without legal personality (with 2.73 ha/farm on the average) and those with legal personality with 194.78 ha/farm on the average.

The average size of agricultural holdings with legal personality decreased from 270.45 ha/farm in 2007 to 194.78 ha/farm in 2020. In number, these farms doubled their share in the total number of farms in Romania, from 0.45% in 2007 to 0.88% in 2020. There was an increase in the number and utilised agricultural area of these farms with legal personality, from 17,699 holdings in 2007 to 25,394 holdings in 2020, and from 4.79 million ha in 2007 to 4.95 million ha in 2020 respectively. Thus, the few farms with legal personality increased in number, yet not significantly, and they operate a utilised agricultural area of 38.75%, on the rise from 34.80% in 2007, which reveals a steady consolidation of these farms.

Table 1. Average utilised agricultural area per farm (ha) by legal status

	2007	2010	2013	2016	2020
Agricultural holdings without legal personality	2.29	1.95	2.02	2.04	2.73
Agricultural holdings with legal personality	270.45	190.78	207.49	213.64	194.78
Total	3.50	3.45	3.6	3.65	4.42

Source: FSS 2007, 2013, 2016, Agricultural Census 2010 and 2020

At the same time, the agricultural holdings without legal personality significantly decreased both in number and as utilised agricultural area, from 3.91 million farms in 2007 to 2.86 million farms in 2020, and from 8.97 million ha in 2007 to 7.82 million ha in 2020 respectively. The average size of this segment of farms slightly increased in the analysed period, from 2.29 ha/farm in 2007 to 2.73 ha/farm in 2020; the disappearance of 1 million farms (26.88%), from the category of small and very small farms is worth noting.

The European officials anticipate a possible food crisis in the coming period, but not because of lack of food, but because food will become unaffordable for many people due to higher prices. This highlights once again the importance of small farmers, who need to be advised to diversify their production and get oriented towards the short food supply chains. The importance of this production comes from ensuring the subsistence of small farmer families, as well as the access to the market of higher quality food products (with high value added). European authorities consider that small farms can play an important role in reducing rural poverty risk, by providing additional incomes and food.

The analysis of Romania's agrarian structure, in the post-accession period, reveals the strengthening of excessive polarisation between a few large-sized farms and the millions of small and very small farms, which is the main characteristic of Romanian agriculture.

Against the background of the decrease in the number of farms in Romania, by 25.19%, in the period 2007-2020, the farms managed by women decreased less – by 13.84% (-172,810 persons) than those managed by men that decreased by 30.61% (-799,160 persons). In this context, the share of farms managed by women increased from 32.53% in 2007 to 37.26% in 2020.

By size classes, the share of female farm heads is higher for small farms and decreases as the farm size increases. Even though the share of farms managed by women is lower in the case of large farms, they also experienced the highest growth in the analysed period, which indicates that women are getting increasingly involved in the management of farming activities.

As regards agricultural training, the situation is quite critical in Romania: only 0.74% of farm heads have full agricultural training, 4.76% have basic training and 94.50% have practical experience only. In the analysed period, this situation slightly improved, but not so much as to significantly increase the quality of farmers' professional training.

The small family farm or in other words the semi-subsistence farm, or the agricultural household farm is recognised, both in the literature and by decision-makers, as the main actor in supporting the vitality of rural area, in supporting the rural economy, and therefore it is treated prioritarily.

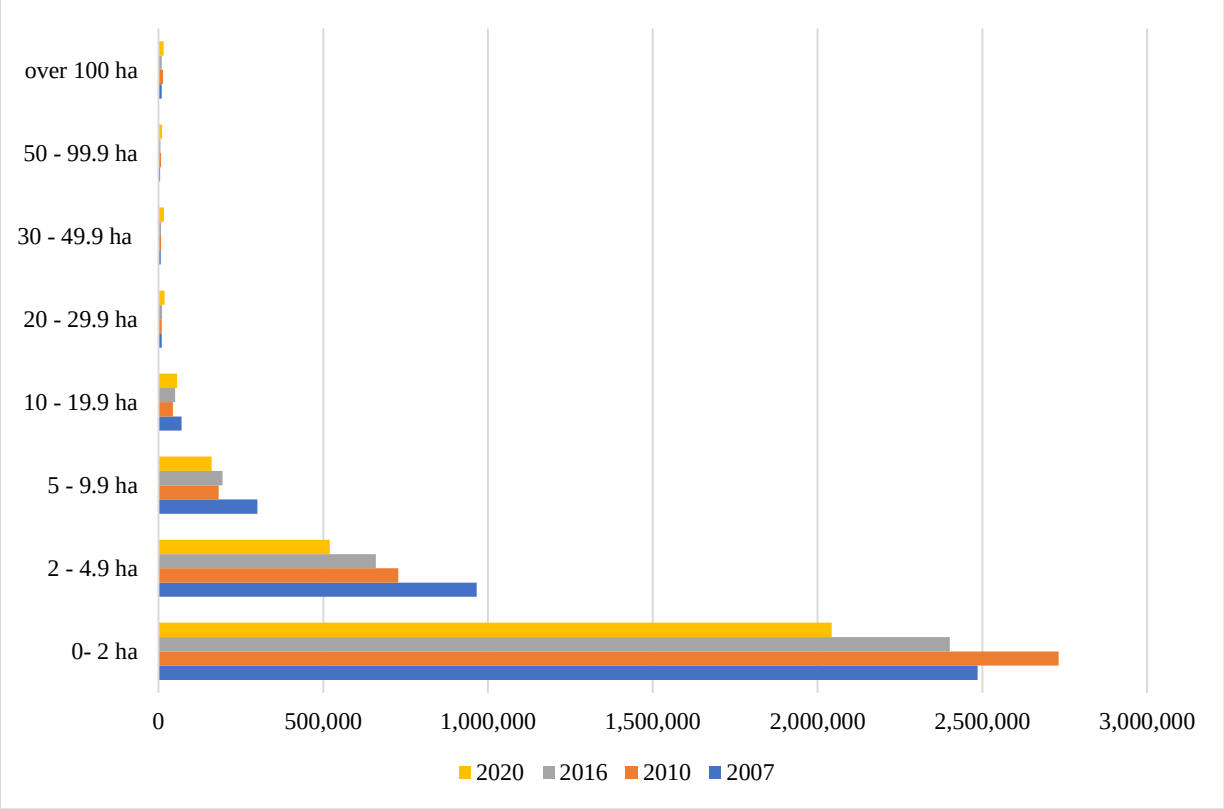

Figure 4. Evolution of Romanian farms by size classes in the period 2007-2020

Source: Eurostat

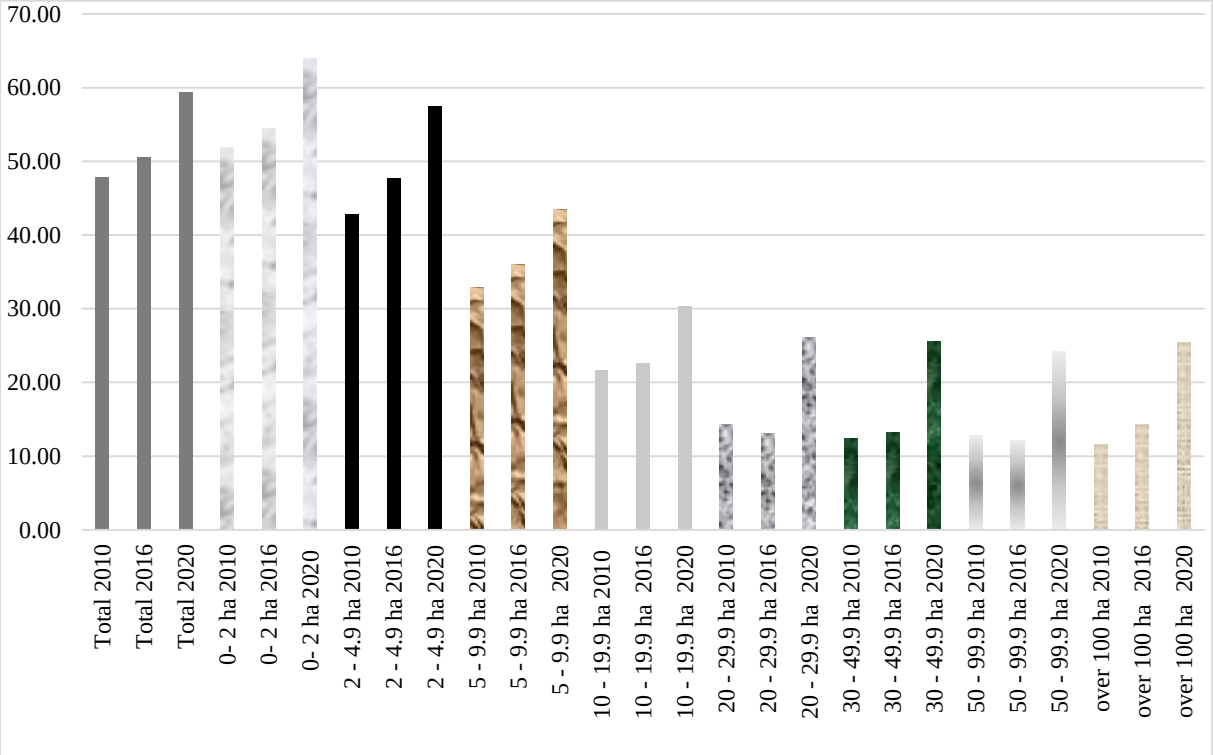

Figure 5. Farms managed by women in Romania, by size classes

Source: Eurostat

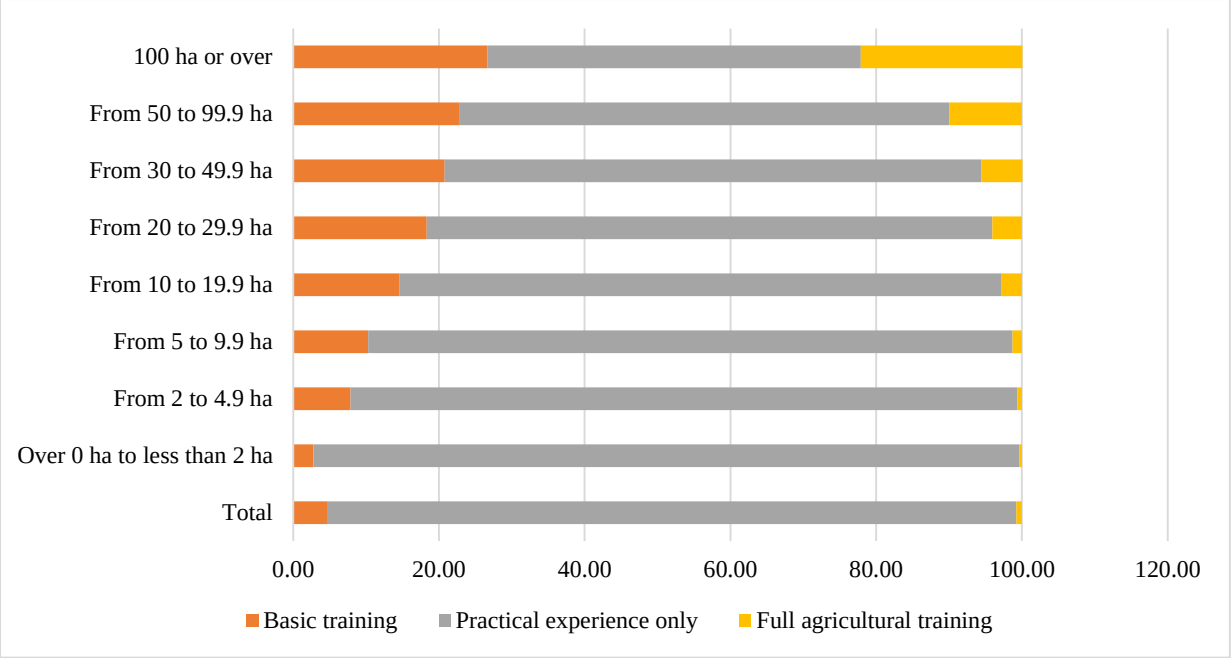

Figure 6. Share of farm heads by level of training, by farm size classes, in the year 2020
Source: Population Census, 2010, 2020

After the accession to the European Union, Romania has constantly supported semi-subsistence/small farms through a series of measures from the National Rural Development Programme 2007-2013/National Rural Development Programme 2014-2020 and from the current National Strategic Plan 2023-2027. These measures were mainly aimed at orienting semi-subsistence farms/small farms towards the market, yet this support has not been sufficient to contribute to the consolidation of farms. A national strategic vision is needed to reverse this situation, with a national budget complemented by European funding (EIR, 2022).

CONCLUSIONS

The future of small farms in Romania is uncertain, and the recent history (the period 2007-2020) shows a decrease by about 25% of farms in our country, mainly of small farms. The evolution of agrarian structure in Romania shows the perpetuation of excessive polarisation between a few large farms and millions of small and very small farms. And where large farms are found, it can be noticed that rural poverty is higher than in the areas where large farms are absent (in the hilly areas). This can be explained by the fact that the population gave up the farming activity for an immediate gain (by the sale of agricultural land); however, this population could not be attracted to the activity of large farms either (that do not need numerous labour force, as they rely on mechanisation and technological advancement) or in other local non-agricultural activities (low diversification of economic activities).

At the moment, farmers are facing a new challenge generated by the new NSP in which even though small farmers are offered new opportunities for modernisation-development, they cannot benefit from them because of the environmental conditionalities that come with the package, and it cannot be estimated whether these opportunities will have the expected result.

Romania must be aware that in the absence of an integrated strategy for the sustainable development of rural areas on the long term, it will lose important resources from the country's wealth (human capital, natural capital, cultural capital, etc.).

Small farm must be protected as a national asset, the more this segment is revigorated, the higher the chances that the Romanian rural area will fulfil its purpose (supplying food for the population, social role, environmental and landscape protection, preservation of cultural heritage), this entity can be a multiplying factor of rural development.

In the most realistic way, Romania must capitalise on the multiple benefits generated by the existence of small farms, but the problem is whether the vital resources of these entities have not been exhausted and whether they can withstand the test of time to be able to face the new opportunities, the new challenges of current policies.

Rural does not mean only agriculture, it is true, but it is also equally true that the diversification of activities in the rural area is very low as the distance from the development poles, from towns increases, and there is contact with the deep countryside, which seems to concentrate a multitude of factors unfavourable to development (isolation, accelerated aging of the population, depopulation, lack of education, lack of social services, etc.), and occupational alternatives are almost non-existent.

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DYNAMICS OF CHARACTERISTICS of THE AGROECOLOGY LIVING LABs ORGANICS, REPRESENTATIVES FOR" SOUTH-MUNTENIA" REGION OF ROMANIA (2021 – 2023)

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Abstract: *The characteristics of the Agroecology Living Labs Organics (ALL Organics) are related with Agroecology principles (Biodiversity, Ecology processes, Synergy, Sustainability and System thinking), Living Lab approache (Mission, Co-innovation & sharing knowledge, Learning & feedback, Capacity buiding) and Organic farming practices: Research, one health, Stakeholder engagement, Integrate pest management, Organic certificate inputs and Net profit/year). The dynamics of this set of characteristics it was studied in 2021 - 2023 period, at 4 types of organic business models from South – Muntenia region: Agroecological Center of Research, Innovation and Technological Transfer Fundulea, S.C. Eco - Fruct SRL Ștefan cel Mare, Beleza Store SRL Vâlcelele and SC NOVALACT SRL Ștefănești/Ileana. The distinctive charateristics, something that make clear difference in a way easy notice, understand and measure, are specific to the ALL Organic studied*
- Biodiversity, Ecology processes, Synergy and Sustainability are permanent agroecology principles for all ALL-Organics studied, and System thinking is specific for Organic Research Center of NARDI Fundulea and SC NOVALCT SRL;
- Mission diversified and Capacity building are distinctive characteristics for the all ALL-Organics studied, but Co-innovation & Sharing knowledge and Learning & Feedback are special for ALL-Organic with research concerns – Agroecological Research Center Fundulea, SC Eco-Fruct Ștefan cel Mare and Beleza Store SRL.
- Soil health, integrate pest management (IPM) and Organic certificate inputs are permanent farming practices for the all ALL-Organics studied, Research is specific to ALL Organics with research concerns – Agroecological Research Center Fundulea, SC Eco-Fruct Ștefan cel Mare and Beleza Store SRL, and Stakeholder engagement is specific only to ALL Organics that have entered into commitments with the Agency for Payment and Intervention for Agriculture.

Keywords: *ALL Organic, distinctive characteristics, business models*
JEL Classification: O11, O12

INTRODUCTION

The etymological analysis of the" AGROECOLOGY LIVING LABs ORGANICS", suggests presence of 3 structural components: *Agroecology principles, Living Labs Approach*, *and Organic (ecological) farming practices.* Each of these components has specific definitions and, in case of business models studied, a minimum set of 15 common distinctive characteristics, more than chatGPT (9) suggest and much less than Google search engine provide for each components as follow:

1. The Agroecology principles *(Alexander Wezel et al 2020[9, 10.3])*

1.1 Biodiversity: living part of diversity, diversifying crops and animal species and varieties to create a resilient ecosystem;

1.2 Ecology (processes): ecological systems based on natural nutrient and water cycling processes, the cycling of local renewable energy resources, and recycling nutrients and biomass as little as possible;

1.3. Synergy: ecological interactions between different elements of the agroecosystem in both time and space.

1.4 Sustainability: increasing agricultural production by improving the productivity of soil, plants, animals, people, and the quality of natural resources – air, water, minerals, and sunlight;

1.5 Systems thinking[2]: how to make sense of the complexity of the farm by analyzing it in terms of holistic wholes and relationships, rather than dividing it into component structures;

2. Living Labs Approach or Concept *(Toncea Ion et al* 2022[5]):

2.1 Mission: important and specific activities of a business model or case, especially of an organic farm;

2.2 Co-innovation & knowledge sharing: involving stakeholders *(customers/consumers, researchers, decision-makers, etc.)* in the design and implementation of agricultural practices and in horizontal knowledge exchange, including local and scientific innovation, especially through farmer-to-farmer exchange.

2.3 Learning and feedback: continuous learning based on observations and measurements of the system's reaction to natural or/and organic inputs;

2.4 Capacity building: providing training and resources to improve and strengthen skills and knowledge and infrastructure development, especially on farms and rural communities;

3. Organic farming practices (Ion Toncea et.al 2011[4], GPT[10.1])

3.1 Participatory research: testing new ideas and practices in real-life environments;

3.2 One health[10.3, 10.5]: maintaining and/or improving the ability of soil to function as a living ecosystem that supports the health of plants, animals and people;

3.3 Stakeholder engagement: a process that organizations can follow to determine the best tactics for using available resources;

3.4 Integrated pest management (IPM): Using natural predators, biopesticides and crop diversity to control pests, diseases and weeds;

3.5 Certified organic inputs: organic and mineral fertilizers, pesticides, water – 100% organic and banning the use of synthetic fertilizers, pesticides and GMOs.

3.6 Efficiency: net profit/year (EURO)

Also, an Organic Agroecological Living Labs ("ALL Organic") is, at least hypothetically, any farm or other business models or case, certified organic (I. Toncea et al, 2023 - Volume-2023-final-1).pdf (iceadr.ro)[6].

MATERIALS AND METHODS

The studies were carried in 2021 and 2023 years, based on specific scientific articles and other informative publications (eg. ALL-Organic project Deliverable 4.3[7]), of information from the Romanian Ministry of Agriculture website regarding certified operators in organic farming provided by the certification bodies, and on the interviews with owners of selected

farms: Agroecology Center for Research, Innovation and Technological Transfer of the National Institute of Agricultural Research and Development Institute (NARDI) Fundulea, SC ECOFRUCT SRL, Ștefan cel Mare, SC NOVALCT SRL, Ștefănești/Ileana, and BELEZA STORE SRL, Vâlcelele, all from Călărași county, and located in a large plain and arid climate of South – Muntenia development region[10.2].

RESULTS AND DISCUSSION

The key learning and monitoring aspects of ALL Organics observed by ARAD over 3 years (2021 – 2023) in South–Muntenia pilot region are both in science, and, especially, in practice.

1. Benchmarking of ALL Organic identified across South-Muntenia region of Romania.

ALL Organic refers to organic certified agriculture working farms (OWFs), Organic Experimental Fields (OEFs) and Organic Long – Term Experiments (OLTEs) to the annual and permanent field crops, animal husbandry, as well as to business models in Agriculture, and Agriculture & food production. According to selected ALL Organics from South-Muntenia region benchmarking, the characteristics of these business models are showed in table 1.a and 1.b:

ALL Organic **"Agroecological Center for Research, Innovation and Technological Transfer of the National Institute of Agricultural Research and Development Institute (NARDI) Fundulea"** serve the South-Muntenia region and other Romanian development regions with scientific and practical ecological agriculture information, and has all characteristics of an ALL Organic, especially System thinking, Mission, Research, Learning & Feedback, One (mainly soil and crops) health etc., excepting Stakeholder engagement which is not a characteristic of it, and Profit Net negative. Also, the dynamic in time of the ALL Organic characteristics is not significant.

ALL Organic" SC **ECO-FRUCT SRL" Ștefan cel Mare/CL** is an exemple of Agriculture business model of succes as: Biodiversity, Synergy, Sustainability, System thinking, Mission, Learning&Feedback, Capacity building, Participatory research, Stakeholder engagement, IPM, Organic inputs, and Efficiency as Net Profit positive. Other characteristics of this ALL Organic, as part of Ecology processes, one (mainly soil and crops) health and Co-innovation and sharing knowledge, are still at incipient level. However, the dynamic in time of of the ALL Organic" SC ECO-FRUCT SRL" characteristics is accelerated.

ALL Organic **"SC SC NOVALACT SRL", Ștefănești/Ileana/CL** is an Agriculture & Food production business model, with most characteristics distinctive (13): all Agroecology principles - *Biodiversity, Ecology (processes), Synergy, Sustainability, and System thinking,* and most of all Living labs approache – *Mission, Learning & Feedback, and Capacity building*, and of Organic farming practices – *One (soil, crops, animals & human) health, Stakeholder engagement, Integrate pest managemt (IPM), Organic certified inputs and Efficiency as Net Profit/year*. The exceptions that confirm this rule are: Co-innovation & sharing knowledge, and Participatory research which are by chance or not exist. Also, the dynamic in time of the ALL Organic" SC NOVALACT SRL" characteristics is low, stability being important for future of the company.

ALL Organic **"BELEZA STORE SRL", Vâlcelele/CL** is an agriculture business model in cultivation and marketing of field fresh vegetables, with 14 compleet distinctive characteristics: *Biodiversity, Ecology (processes), Synergy, Sustainability, System thinking, Mission, Learning & Feedback, Capacity building, Participatory Research, One (mainly soil, crops & consumers) health, Stakeholder engagement, Integrate pest managemt (IPM), Organic certified inputs, and Efficiency as Net profit/year*, respective just *Knowledge exchang*e, and no *Co-innovation*. Also, the dynamic in time of most of these characteristics is significant and according with market dynamic and R. standards of Organic Certification[1] and Global g.a.p[10.4].

2. Characterisation of selected Agroecology Living Labs (ALL) Organics in South – Muntenia region of Romania suitable to be replicate as business models

The ALL Organics as business models, refers to their characteristics similarity with Canvas pillars[3].

Distinctive characteristics of ALL_Organic South – Muntenia region of Romania vs Canvas Pillars
(PS) Key partners and/or partnerships: Research and development Institutes and Experimental Stations, and Agricultural Universities and Farmer Associations at *(Participatory)* ***Research.***
(AC) Key Activities: ***System thinking, Learning and feedback***, ***Capacity building, and Integrate pest management (IPM)*** are specific to ALL Organic business models: **Agriculture production -** cultivation of Cereals *(Winter wheat, Winter spelta, Winter barley, Winter triticale, Maize, Millet)*, Legumes (Field peas, Lentils, Soybean), Oil crops (Sunflower, Lineseeds, Camelina, Rape), Clover and Alfalfa, Seeds production, Field vegetables, including potatoes and cherries; **Agriculture and Food production: (OWFs)** *of Alfalfa, Barley, Corn and Pasture cultivation & Goats breeding & Manufacture of dairy products and Cheeses;* **Technology:** OLTEs and EFs (seeds production & flower strips), and **Ecosystem services**: *Nutrient cycling, Nitrogen capture (cultivation of legumes); carbon sequestration; support of pollinator; basic food production; regulating water cycling*
R-C) Key resources: ***Biodiversity, Ecology processes, One health and Organic inputs,*** expressed by Good and live soils, land proper for agriculture, natural water resources, healthy and enough yields etc.
(PV) Value proposition (unique), which cannot be easily copied or taken into possession: ***Mission and Sustainability*** as: Organic land and crops, and Integrate farming systems.
(RC) Customer relationships: ***Stakeholder engagement*** is the main concern of the business models management teams, and un example of deep and lasting client relationships.
(CA) Channels: ***the Co-design & share knowledge*** as the key channels instruments for communication, dissemination, information etc.
(SC) Customer segments: the ***Co-design & share knowledge*** as a connecting instrument of the national and international traders, organic stores and direct consumers, like young mothers, and of the researchers involved in organic farming and agroecology.
($C) Costs structure: ***the Net profit/year,*** where the variable expenses are lower than the revenue and appears to correlate with the resilience score, except ALL Organics from research, where they were bigger.
((FV) Revenue streams: the Net profit/year, which depends, mostly, of the market competition, and customers "generosity".

CONCLUSIONS

1. ALL Organic, refers to a new procedure of veracity analysis of the Organic Working Farms (OWFs), and of the ecological research and innovation activities - organic long-term experiments (OLTEs) and organic experimental farms (EFs), to reach the organic standards.

2. Diversification of the business models is specific to interaction between environmental diversity, and human ingenuity, which in this paper is exemplified by– Agriculture production, Agriculture and Food production, Technology, and Ecosystem services.

3. The characteristics of the ”AGROECOLOGY LIVING LABs ORGANICS” are a mixture of Agroecology principles, Living Labs approaches, and Organic farming practices, and theirs characteristics representative: *Biodiversity, Ecology (processes), Synergy, Sustainability and System thinking,* respective *Mission, Co-innovation & sharing knowledge, Learning & feedback, Capacity building,* as well as *Research, One (mainly soil) health, Stakeholder engagement, Integrate pest management, Organic certificate inputs and Net profit/year*.

4. Each ALL Organics studied in South-Muntenia region of Romania has specific characteristics, suitable to be use for organic business models analysis and generation, thus:

-” The Agroecological Center for Research, Innovation and Technological Transfer” of the National Institute of Agricultural Research and Development Institute (NARDI) Fundulea, which serve the South-Muntenia region and other Romanian development regions with scientific and practical ecological agriculture information, has most (14) of the ALL Organics characteristics, excepting Stakeholder engagement;

-” SC ECO-FRUCT SRL” Ștefan cel Mare/CL, is a succes Organic working farm (OWF), with most of (13) ALL Organics characteristics, and Ecology processes and Co-innovation and sharing knowledge in incipient phase.

-” SC SC NOVALACT SRL”, Ștefănești/Ileana/CL is an Agriculture & Food production farm, with most (13) ALL Organics characteristics. The exceptions that confirm this rule, are *Co-innovation & sharing knowledge*, and *Participatory Research* which are by chance or not exist.

-” BELEZA STORE SRL”, Vâlcelele/CL is a business model in organic cultivation and marketing of field fresh vegetables, with 14 full and one partly” Co-innovation and sharing knowledge” distinctive characteristics of ALL Organics.

5. The ALL Organics from this paper - *Organic working farms (OWF), Organic experimental farm (OEFs) and Organic Long-Term Experiments (OLTEs)* are or can be business models or case, because each of their characteristics is similar, at least, with one of nine pillars of the canvas business model - (PC) *Key partners*, (AC) *Key activities*, (R-C) *Key resources*, (PV) *Value propositions*, (CP) *Channels*, (RC) *Customer relationships*, (SC) *Customer segments*, ($C) *Costs structure* and (FV) *Revenues streams*.

6. For the moment, none of the business models (cases) in the South-Muntenia region is a perfect ALL Organic, as they lack one or more ALL Organic characteristics or, most of the time, these characteristics are incomplete.

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Annex 1.a

Dynamics of the distinctive characteristics of Organic Living Agroecological Laboratories (ALL), representative for the South-Muntenia Development Region (2021 – 2023)

		Agroecological Research, Innovation and Technology Transfer Center of NARDI Fundulea/CL		**SC ECO-FRUCT SRL, Ștefan cel Mare/CL**	
ALL Organics - Pillars and their Characteristics		**2021**	**2023**	**2021**	**2023**
Agroecological principles	***Biodiversity***	**Organically certified field crops:** 13,33 ha organic, divided into 32 plots, of which: **OLTEs 1:** W. wheat – 0,28 ha organic, W. barley – 0,28 ha organic, soy – 0,55 ha organic, maize – 0,28 ha organic; sunflower – 0,27 ha organic and alfalfa –1,50 ha organic, *in 8 years crop rotation*; **OLTEs 2:** with oldest and newest varieties, including CCPs and Dynamic populations: Legumes *(soy, lupine, peas and lentil)* – 0,32 ha organic; W. cereals *(wheat, barley, triticale)* – 0.32 ha; Spring crops *(wheat, barley, oats, flax for oil, camelina)* – 0,32 ha organic; annual clover – 0,32 ha organic, *in 4 years crop rotation*; **EFs Organic:** W. wheat – 2,0 ha organic seeds; milk thistle (*Silybum marianum*) - 0,80 ha organic seeds; soy – 2,20 ha organic, oats - 1.00 ha organic, maize - 1.00 ha organic, sunflower - 1,00 ha organic and Camelina - 0.83 ha organic, *in 4 years crop rotation)*:	**Organically certified field crops:** 13,36 ha organic, divided into 32 plots, of which: **OLTEs 1:** W. wheat – 0,28 ha organic, W. barley – 0,28 ha organic, soy – 0,55 ha organic, maize – 0,28 ha organic, sunflower – 0,27 ha organic and alfalfa –1,50 ha organic, *in 8 years crop rotation*; **OLTEs 2: O**ldest and newest varieties, including CCPs and Dynamic populations*:* Legumes *(soy, lupine, peas and lentil)* – 0,32 ha organic, W. cereals *(wheat, barley, triticale)* – 0.32 ha; S. crops *(wheat, barley, oats, flax for oil, camelina)* – 0,32 ha organic; annual clover – 0,32 ha organic, *in 4 years crop rotation*; **EFs Organic:** W. wheat – 2 ha organic seeds; oats – 0,92ha organic; soy – 1, 00 ha organic; Camelina - 1 1,00 ha organic seeds, and Sunflower – 0,80 ha organic, i*n 4 years crop rotation*. **Source:** Certificate of conformity of organic products no. RO-ECO-	**Organically certified field crops:** 989,98 ha organic and 3.88 ha in conversion, divided into 55 plots, of which: W. wheat – 258,06 ha organic; Soy – 44.03 ha organic; Lentil – 9,34 ha organic; Field pea – 39,22 ha organic; Soy – 44,03 ha organic; W. rape – 255,36 ha organic; Maize – 87,51 ha organic; Sunflower – 206,46 ha organic and 3,88 ha in conversion; Flax for oil– 60,98 ha organic and Alfalfa – 29,02 ha organic. **Source:** Certificate of conformity of organic products no. 2-07000-2021, issued by AUSTRIA GARANTIE.	**Organically certified field crops:** 944,76 ha organic and 115,99 ha in conversion, divided into 60 plots, of which: W. wheat – 227,58 ha organic and 24,42 ha in conversion; barley – 50,35 ha in organic; mixed cereals – 84,04 ha organic and 4.9,1 ha in conversion; soy – 112,70 ha organic and 30,75 ha in conversion; W. rape – 128,25 ha organic and 1,85 ha in conversion; maize – 130,57 ha organic and 7,79 ha in conversion; beet of root – 6,31 ha organic; sunflower – 114,59 ha organic and 43,18 ha in conversion; flax for oil – 65,37 ha organic and 3,1 in conversion and alfalfa – 25,0 ha organic. **Source:** Certificate of conformity of organic products no. RO-ECO-029.642-0000028.2023.005/, issued by BIO GARANTIE SRL.

		Source: *Certificate of conformity of organic products no. 1384/ 2021, issued by SC ECOINSPECT SRL*	008.642-0014264.2023.001, issued by SC ECOINSPECT SRL		
	Ecology (processes)	Harnessing natural cycling processes of nutrients and partly, control weeds, diseases and pest, and water management by long-term crop rotation and proper soil tillage.	Harnessing natural cycling processes of nutrients and partly, control weeds, diseases and pest, and water management by long-term crop rotation and proper soil tillage.	Harnessing natural cycling processes of nutrients and partly, control weeds, diseases and pest, and water management by long-term crop rotation (OLTEs), soil tillage and irrigation 200 ha, only.	Harnessing natural cycling processes of nutrients, control weeds, diseases and pest, and of water by long-term crop rotation, proper soil tillage and irrigation system on 1000 ha.
	Synergy	Ecological interactions, symbiosis, integration and complementarity among the elements of agroecosystems (crops, trees, soil, water etc.)	Ecological interactions, symbiosis, integration and complementarity among the elements of agroecosystems (crops, trees, soil, water etc.)	Ecological interactions, symbiosis, integration and complementarity among the elements of agroecosystems (crops, trees, soil, water etc.)	Ecological interactions, symbiosis, integration and complementarity among the elements of agroecosystems (crops, trees, soil, water etc.)
	Sustainability	Crops and crop varieties diversity create a resilient agroecosystem;	Crops and crop varieties diversity create a resilient agroecosystem;	Diversity of field crops and varieties, create a sustainable farming system.	Diversity of field crops and varieties create a sustainable farming system.
	Systems thinking	Every researcher and technician, when they talk and work on something, thinks holistically.	Every researcher and technician, when they talk and work on something, thinks holistically.	The management of SC ECO-FRUCT SRL is based on respecting organic standards.	SC ECO-FRUCT SRL use systemic thinking as a way to explore and develop effective actions in complex contexts, enabling changes in the agricultural system.
	Mission	Experiments for organic field crops production and Organic seeds production	Experiments for organic field crops production and Organic seeds production	Organic production	Organic Production & Storing
	Co-innovation and share knowledge	Organic seeds production	Organic seeds production	Innovation of cropping system due by the customer request regarding quality of yields.	Innovation accelerated of cropping system due by the customer request regarding quality of yields and cooperation with Organic Research centre of NARDI Fundulea

Living Lab approach	***Learning & Feedback***	The Learning & Feedback, as a key of research;	The Learning & Feedback, as a key of research;	SC ECO-FRUCT SRL experimented learning/feedback for improving activity based on farming system information in previous years.	SC ECO-FRUCT SRL is an example of learning from feedback for improving farm activity, based on information, positive or negative, about cropping systems in previous year.
	Capacity building	Daily on-the-job training program based on the news on organic agriculture and solving the current problems of the Organic Research Centre.	Daily on-the-job training program based on the news on organic agriculture and solving the current problems of the Organic Research Centre	On-the-job training and investments in the equipment and irrigation systems performant..	On-the-job training and investments in the equipment and irrigation systems performant.
Organic farming practices	***Research***	Permanent mission	Permanent mission	SC ECO-FRUCT SRL is part of different participatory research projects.	SC ECO-FRUCT SRL is part of different participatory research projects, such the ”ECOBREED”.
	One health	Soil – chernozem, stable in structure, fertility parameters and alive	Soil – chernozem, alive and stable in structure, and fertility parameters	Good soil as structure and fertility	Soil with earthworms, good structure and fertility
	Stakeholder engagement	The engagement of NARDI Fundulea with APIA for organic agriculture does not exist. The land and crops of Organic Centre of NARDI Fundulea was only, certificate as organic by a control body	The engagement of NARDI Fundulea with APIA for organic agriculture does not exist. The land and crops of Organic Centre of NARDI Fundulea was only, certificate as organic by a control body	The engagement of SC ECO-FRUCT SRL with Agency for Payments and Intervention for Agriculture (APIA) of Agriculture Ministry to practice organic agriculture on 5 years in exchange for a subsidy of 218 Euro/ha/year, is a major risk in context of most agriculture lands are rented.	The engagement of ECO-FRUCT SRL with Agency for Payments and Intervention for Agriculture (APIA) of Agriculture Ministry to practice organic agriculture on 5 years in exchange for a subsidy of 218 Euro/ha/year, is a major risk in context of most agriculture lands are rented.
	Integrate pests management (IPM)	Monitoring of weeds, pests and diseases and control of those by 4 and 8 years crop rotation, by allelopathy effects of crops and varieties, and by harrowing and treatments with performant bio-pesticides.	Monitoring of weeds, pests and diseases and control of those by: 4 and 8 years crop rotation, by allelopathy effects of crops and varieties, and by harrowing and treatments with performant bio-pesticides.	Organic crop rotation - high area of oilseeds crops (Winter rape (255,6 ha), Sunflower (206,46 ha) and Flax for oil (60,98 ha) than of cereals (Winter wheat - 258,06 ha and Maize - 87,51 ha), and	4 – 5 years and multi-functional organic crop rotation – cereals *(Winter wheat – 238,95 ha, Maize - 153,03 ha and Mixed cereals - 60,75 ha),* oilseeds crops *(Winter rape - 93,01 ha and*

				especially of legumes (Soy - 44,03 ha, Field pea - 39,22 ha and Lentils - 9,34 ha) as well as bio-pesticides specific to each crop.	*Sunflower – 231,09 ha)*, and legume *(Soy - 131,25 ha and Beet of root– 21,0 ha)* as well as bio-pesticides specific to each crop, and in optimal doses.
	Organic certificate inputs	Foliar fertilizers and bio-pesticides – 100% organic	Compost, foliar fertilizers, bio-pesticides – 100% organic	Foliar fertilizers, bio-pesticides and irrigation water– 100% organic	Compost, foliar fertilizers, bio-pesticides and irrigation water– 100% organic
	Efficiency (Net profit /year – EURO)	- 27362	- 23147 (estimated)	335.68	27199

Annex 1.b

Dynamics of the distinctive characteristics of Organic Living Agroecological Laboratories (ALL), representative for the South-Muntenia Development Region (2021 – 2023)

		SC NOVALACT SRL, Ștefănești/Ileana/CL		BELEZA STORE SRL, Vâlcelele/CL	
ALL Organics - Pillars and their Characteristics		**2021**	**2023**	**2021**	**2023**
Agroecological principles	***Biodiversity***	**a. Organically certified field crops:** 22,13 ha organic and 19,42 ha in conversion, unequally divided into 10 plots, of which: barley – 2,57 ha organic; maize – 7,28 ha organic; alfalfa – 12,28 ha organic and 4,42 ha in conversion and permanent pastures – 15,00 ha in conversion. **b. Organically certified animals** – 235 goats Murciano Granadina organic; **c. Processed animal products, certified organic:** Goat yogurt (175 g; Goat drinking yogurt (375 ml); Goat diet yogurt (370 ml); Goat Kefir (370 ml); Goat milk; Goat fresh chees (150 g): ***Source:*** *Certificate of conformity of organic products no. 494/28.06.2024, issued by BIO CERT TRADITIONAL SRL*.	**a. Organically certified field crops** – 29,30 ha organic and 2,0 ha in conversion, unequally divided into 6 plots, of which: maize – 2,30 ha organic and 2,00 ha in conversion; alfalfa – 11,70 ha organic and permanent pastures – 15,30 ha organic. **b. Organically certified animals** – 217 goats Murciano Granadina organic; **c. Processed animal products, certified organic:** Goat milk, organic; Diet goat milk, organic; Goat milk yoghurt organic; Goat milk Kefir organic; Goat cheese organic. ***Source:*** *Certificate of conformity of organic products no. 1038.2023.003/02.11.2023, issued by BIO CERT TRADITIONAL SRL*.	**Organically certified field crops** – 14,32 ha organic, unequally divided into 13 plots, of which: fresh vegetables – 3,77 ha organic *(sweet potato - 1.00 ha, Pepper - 1,38 ha, Eggplants - 1,39 ha),* potatoes – *1,00 ha organic*, annual clover – 0.70 ha organic, strawberry – *0.30 ha organic* and alfalfa – 8.55 ha organic. **Source:** Certificate of conformity of organic products no. 21/162175/RO/1262983/25.08.2021 , issued by ECOCERT SRL.	**Organically certified Field crops** – 14,32 ha organic, unequally divided into 14 plots, of which: fresh vegetables – 6,07 ha organic *(sweet potato - 1.00 ha, Pepper - 0,70 ha, pumpkins-3,37 ha, melon – 1,00 ha),* strawberry – *0.30 ha organic* and alfalfa –7.95 ha organic. **Source:** Certificate of conformity of organic products no. RO-ECO-007.642-0004625.2024.001/1&4.05.2024, issued by ECOCERT SRL R CE 848 & Global g.a.p certifications
	Ecology (processes)	Harnessing natural cycling processes of nutrients by alfalfa, permanent pasture and goats manure and of the weeds, diseases and pest control by crop rotation.	Harnessing natural cycling processes of nutrients by alfalfa, permanent pasture and goats manure and of the weeds, diseases and pest control by crop rotation.	Harnessing natural cycling processes of nutrients and partly, of control weeds, diseases and pests, and water by long-term crop rotation and suitable soil tillage and IPM, and irrigation	Harnessing natural cycling processes of nutrients and partly, of control weeds, diseases and pest, and water by multifunctional crop rotation, suitable soil tillage and IPM, and irrigation.
	Synergy	Ecological interactions, symbiosis, integration and complementarity among the elements of agroecosystems *(crops, animals, soil, etc.).*	Ecological interactions, symbiosis, integration and complementarity among the elements of agroecosystems (crops, animals, soil, water, etc.).	Ecological interactions, symbiosis, integration and complementarity among the elements of agroecosystems	Ecological interactions, symbiosis, integration and complementarity among the elements of agroecosystems

				(crops, strip flowers, soil, water etc.).	(crops, strip flowers, soil, water etc.).
	Sustainability	The raising goats, cultivating plant species for goat feeding, goat milk processing and goat dairy products valorization is an agriculture and food production sustainable system.	The raising goats, cultivating plant species for goat feeding, goat milk processing and goat dairy products valorization is an agriculture and food production sustainable system.	Diversity of field crops and varieties and economic difersification of activities created a sustainable farming system.	Diversity of field crops and varieties and economic difersification created a sustainable farming system.
	Systems thinking	SC NOVALACT SRL use systemic thinking as a way to explore and develop effective actions in integrate farm contexts, enabling changes in the agricultural system.	SC NOVALACT SRL use systemic thinking as a way to explore and develop effective actions in integrate farm contexts, enabling changes in the agricultural system.	Beleza Store SRL activity is based on respecting organic standards.	Beleza Store SRL use systems (holistic) thinking as a way to explore and develop effective actions in complex contexts, enabling changes in the agricultural system.
Living Lab approach	***Mission***	Organic of goat husbandry, of field crops for goats feeding, and of processing, and marketing goat milk.	Organic of goat husbandry, of field crops for goats feeding, and of processing, and marketing goat milk.	Production and marketing of organic fresh vegetables.	Production and marketing of organic fresh vegetables.
	Co-innovation and share knowledge	Investment in milk processing, stimulated by the good market and customers..	Investment in milk processing and irrigation, stimulated by the good market and customers.	Flowers strips	Flowers strips & Multifunctional crop rotation
	Learning & Feedback	SC NOVALACT SRL learn from feedback usually based on collecting information regarding goat's husbandry, and market, mainly of costumers, request.	SC NOVALACT SRL learn from feedback usually based on collecting information regarding goat's husbandry, and market, mainly of costumers, request.	Beleza Store SRL experimented learning/feedback for improving activity based on farming system information in previous years.	Beleza Store SRL use learning from feedback for improving farm activity, based on information, mainly observations in previous years.
	Capacity building	On-the-job training and investments in the performant milk processing equipment.	On-the-job training and investments in irrigation system and equipment.	On-the-job training and investments in equipment, seeds, and irrigation systems.	On-the-job training and investments in seeds, equipment, and irrigation system performant.
Organic farming practices	***Research***	It is not the case	It is not the case	Beleza Store SRL has own research activities like pests monitoring, and flower strips and those of a Master thesis.	Beleza Store SRL is part of different participatory research projects, such the "ALL-Organic" and those of a Ph. thesis.
	One health	Crops structure dominated of alfalfa and permanent pasture, fertilization with goats manure are the key factors of healthy soil.	Crops structure dominated of alfalfa and permanent pasture, fertilization with goats manure, and irrigation are the key factors of healthy soil.	Good soil as structure and fertility	Soil full of earthworms and other useful soil organisms, good structure and fertility.

	Stakeholder engagement	Novalact's engagement with Agency for Payments and Intervention for Agriculture (APIA) of Agriculture Ministry to practice organic agriculture is on 5 years in exchange for a subsidy of 218 Euro/ha/year for alfalafa, barley and maize organics, 170 Euro/ha/year for permanent pasture and 15,92 Euro per had of adult animal (goat).	Novalact's engagement with Agency for Payments and Intervention for Agriculture (APIA) of Agriculture Ministry to practice organic agriculture is on 5 years in exchange for a subsidy of 218 Euro/ha/year for alfalafa, barley and maize organics, 170 Euro/ha/year for permanent pasture and 15,92 Euro per had of adult animal (goat)	. The engagement of Beleza Store SRL with Agency for Payments and Intervention for Agriculture (APIA) of Agriculture Ministry to practice organic agriculture is on 5 years in exchange for a subsidy of 431 Euro/ha/year for field vegetables and 218 Euro/ha/year for strowberry and alfalfa. In context of most agriculture lands are rented, this engagenent is a major risk .	The engagement of Beleza Store SRL with Agency for Payments and Intervention for Agriculture (APIA) of Agriculture Ministry to practice organic agriculture is on 5 years in exchange for a subsidy of 431 Euro/ha/year for field vegetables and 218 Euro/ha/year for strowberry and alfalfa. In context of most agriculture lands are rented, this engagenent is a major risk .
	Integrate pests management (IPM))	Weeds, pests and diseases of crops are managed by crop rotation and through grazing of weeds by goats. Also, goats are, generally, resistant at specific pests and diseases, but the farm has a management plan, based on preventive measures.	Weeds, pests and diseases of crops are managed by crop rotation and through grazing of weeds by goats. Also, goats are, generally, resistant at specific pests and diseases, but the farm has a management plan, based on preventive measures	Monitoring of weeds, pests, diseases and control of those by 6 years crop rotation, and soil mulching, harrow of weeds, irrigation and bio-pesticides.	Monitoring of weeds, pests, diseases and control of those by multifunctional crop rotation and soil mulching, harrow of weeds, irrigation and bio-pesticides.
	Organic certificate inputs	Manure of goats, which is organic, odorless and beneficial for the soil.	Manure of goats, which is organic, odorless and beneficial for the soil.	Foliar fertilizers, bio-pesticides and irrigation water– 100% organic	Compost, foliar fertilizers, bio-pesticides and water– 100% organic
	Efficiency (Net profit /year – EURO)	48445	22969	40717	11721

THE IMPACT OF TEXTILE WASTE ON THE ENVIRONMENT

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Abstract: *The expansion of the textile industry and consumer trends have led to a rapid global increase in textile waste in the municipal solid waste (MSW) stream. Worldwide, 75% of textile waste is landfilled, while 25% is recycled or reused. Landfilling textile waste is a prevalent option that is considered unsustainable. This paper aims to present various technologies (anaerobic digestion, fermentation, composting, fiber regeneration and thermal recovery) of reuse and recycling for better waste management. Applying extended producer responsibility and a circular economy system involves a holistic consensus among major stakeholders.*
Keywords: *textile waste; reuse, recycling; durability*
JEL Classification: A10, D04, O13, Q01, Q53

INTRODUCTION

In the value chain of the textile industry, waste is produced especially from the fashion industry which is the most unsustainable of the industries. Textile waste can be pre-consumer (remnants of material,) and is recycled and requires less logistics process in collection and sorting.

American legislation has required manufacturers that exceed 10% waste from used textile materials to develop recycling and recovery programs. Another category of waste is post-consumer waste resulting from the last stage of the value chain, those that can no longer be worn/used.

Globally there are regulations on waste collection but there is no producer approach to the responsibility they should have.

At the European level in France there is legislation for these producers, with a good yield, and the main collection channels are the NGOs, the collection being carried out in stores (take back type program) or street containers. Following these collection actions there are advantages and disadvantages, the difference lies in the method that can affect the quality of the textiles.

Sorting by categories is performed according to the degree of degradation and is essential in this process, but more labor is required as it is a manual activity. Depending on the size of the organization, sorting can be done up to 300 items or categories (by color, size, type, etc.), or between clothes that can be worn or not and stored as waste.

Globally, only 20% is collected separately from the rest of the waste. This separation activity must be carried out in fractions made up of pure materials. According to information from the Association for Textile Reuse and Recycling (ARETEX), approximately 160,000 tons of textile waste are thrown away in Romania annually.

According to the data, about 6-10% are recyclable from the total waste generated, depending on the conditions imposed by the legislation and the market. This percentage would be possible to increase up to 25% if the selection, reuse and recycling industry is also developed with large amounts of sorting by quality and composition starting from the support of the manufacturer with extended responsibility in the textile industry.

Currently, the vast majority of the amount of textile waste is distributed to the landfill, respectively it takes the path of energy recovery.

MATERIAL AND METHOD

The study is based on primary research to identify textile waste reuse and recycling technologies with the help of specialized literature.

RESULTS AND DISCUSSION

Sustainable practices and recycling transform textile waste into valuable resources. In order to be able to recycle on a large scale it is essential to achieve a mixture of fibers as low as possible, being a difficult and expensive recycling process. Companies that carry out these actions often face obstacles in fiber-to-fiber recycling processes when reusing mixed textiles to design new clothing fabrics. Starting from 2011, the European Commission defined its medium and long-term objectives regarding the transformation of the European economy into a sustainable and competitive economy at the same time.

Within the policies adopted, the central pillar for sustainable development is the circular economy, which assumes a production and consumption model that involves extending the life cycle through the collection, reuse, repair, renovation and recycling of materials and products.

In support of accelerating the transition to a sustainable economy, the European Council adopted on May 22, 2018, the package of laws on waste: Directive (EU, 2018) 2018/851 of the European Parliament and of the Council of May 30, 2018 amending Directive 2008/98/ EC (EU, 2008) on waste, it sets new rules on waste management and new recycling targets. Member States will have to achieve a recycling rate for municipal waste of 55% by 2025 followed by sustained growth to reach 65% by 2035. In addition to the separate collection that already exists for paper, cardboard, bottles, metals and plastic, the member states will establish, by 1 January 2025, the separate collection of textile products and hazardous waste from households.

Textile waste can be classified into two categories:

- pre-consumption resulting from the technological manufacturing processes related to the subsectors of the textile industry, such as waste from spinning mills, weavers, from the manufacturing and finishing processes of textile products.

- post-consumer are textiles in the finished stage, in the form of clothing or other products collected from the population and institutions, with different degrees of wear.

Of the 2.1 billion tons of waste produced annually worldwide, 4%, or 92 million tons, is produced by the fashion industry, according to Boston Consulting Group analysis (Eder-Hansen et al., 2017). More than 35% of pre-consumer waste is produced in the primary processing phase of the raw material. Of this waste, 9% comes from fiber manufacturing and 91% comes from product manufacturing process operations such as weaving, knitting, textile manufacturing and spinning. This analysis also demonstrates that the processing and recycling of post-consumer textile waste has quantitative and technological limitations. In this case, only 25% of post-consumer waste ends up in incinerators and landfills.

At the present time, processing technologies have as a result five challenges that they face, namely:

- From a commercial point of view there is a lack of feasible recycling methods especially for lower quality textiles;

- The absence of integrated, progressive processes and the need to expertize the entire process to separate the fibers from the mixtures by types and compositional structures;

- The association of high costs in recovery processes;

- Predominance of lower quality materials on the final recycling market;

- Limited availability of regional and local recycling facilities as well as expensive logistics operations.

Also, recycling techniques must pass life cycle assessment to ensure ecological viability. The essential aspect of the supply chain assessment emphasizes both the recycling technique, the transport between the recycling plant and the waste storage areas and the energy consumption.

The methods used to recycle textile waste are classified as follows (Ellen MacArthur Foundation, 2017):

- Mechanics - the transformation of waste into new products (threads for fabrics, knitwear and non-woven materials by cutting, shredding and defibrating down to the fiber level, without affecting the basic chemical structures. It is recycling that covers the multitude of fibers, regardless of how they are: synthetic, animals or plants.

- Chemicals – decomposition of textiles to the level of monomers, oligomers or basic chemical elements. Through this recycling process, high-quality products can be obtained, because they are identical to the original constituents that were used to obtain the products subject to recycling (synthetic fibers, cellulosic fibers).

- Thermal – the process of transforming PET flakes into fibers by extruding the melt.

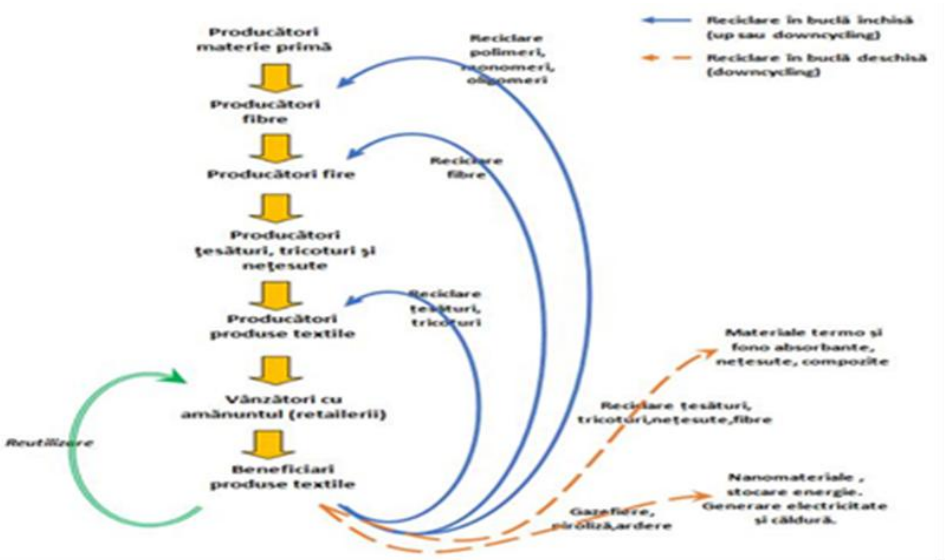

Figure 1. Textile waste recycling route (Sandin & Peters, 2018)

From the point of view of the textile waste recycling itinerary, recycling can be classified into upcycling or downcycling (Figure 1):

- Closed-loop recycling is the process of transforming textile waste into products identical to the original ones. (Ekström & Salomonson, 2014; Khan & Islam, 2015).

- Open-loop recycling or cascade recycling refers to the transformation of textile waste into products distinct from the original ones (Echeverria et al., 2019).

Reuse involves extending the life of textiles with or without modifications to other owners.

Technologies, currently, are diverse to facilitate the recycling and recovery of textile waste. Methods and techniques such as anaerobic digestion, fermentation and composting are part of textile waste biotechnology (Shrestha, B, 2020), (Ariunbaatar, J.,2014)

Anaerobic digestion is the most used technology for biodegradable treatment of organic waste in order to produce biogas. Cotton is a potential substrate for biological conversion and contains 50% cellulose (figure 1). Studies on anaerobic digestion using cotton as waste (cotton stalks, cotton husks, seeds and cotton oil) for biogas production show that they are rich in solid powder and cellulose content. (Isci, A.; 2007)

Waste from spinning mills is a basic source for anaerobic digestion (Chockalingam R.S,2009)

This pretreatment process before the anaerobic digestion of waste containing polyester (40%) and cotton (60%) or pure cotton at a temperature of 1500C results in a high methane productivity (361.1 mL CH4/g VS). Also, for methane, a comparable maximum production rate of 80% was obtained by digestion in reactors (one or two stages) using polyester/viscose or polyester/cotton fibers with 20g/L added cellulose. (Hasanzadeha, E., 2018)

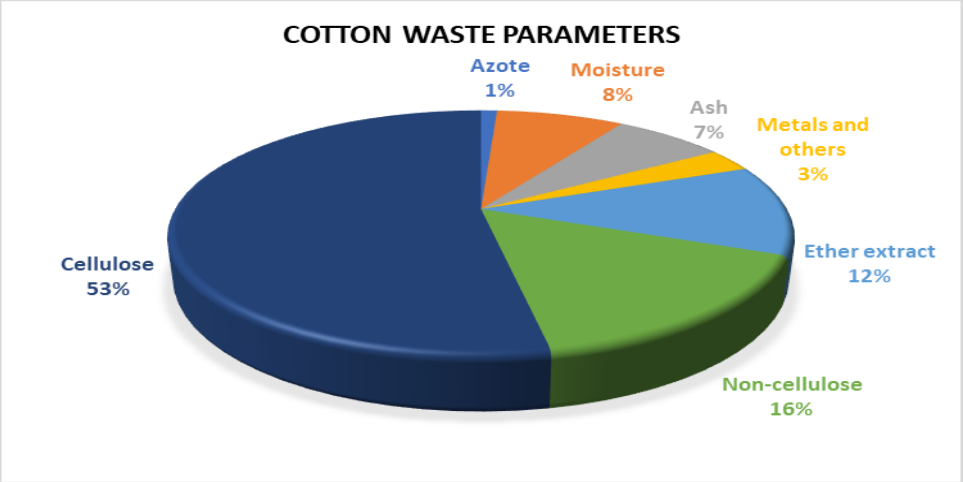

Figure 1 Cotton waste parameters (Chockalingam R.S,2009)

From the specialized literature studied, in table 1, it can be seen as a summary, the ideal, optimal operating conditions, using the anaerobic digestion process

Table 1. Ideal operating conditions using the batch anaerobic digestion process

Cotton waste stream	PRE treatment	Operating Temp. (°C)	Digestion Time (Days)	CH4 Yield (mL/g VS)	CH4 (%)
Cotton waste of which: cotton stalks (Isci, A.,2007)	-	35	23	65	60
- cotton seed husk	-	35	23	86	60
- cottonseed oil cake	-	35	23	78	60
Cotton waste from spinning mills (Chockalingam R.S.,2009)	-	30-32	50	-	77
Medical cotton waste (Zainab Z. Ismail,2016)	Na_2CO_3	55	90	37,6	60-70
Waste jeans (60% cotton) Cotton waste (100%)	0.5 M/ Na_2CO_3 at 150 °C for 120 min	37	40	328.9 (60% cotton); 361.08 (pure cotton)	-

Cotton waste stream	PRE treatment	Operating Temp. (°C)	Digestion Time (Days)	CH4 Yield (mL/g VS)	CH4 (%)
Cotton textile waste (100% cotton)	0.5 M Na_2CO_3 at 150°C	37	15	306,7	>50

- **Fermentation process of cotton textile waste**

The fermentation process of textile waste for ethanol production is carried out by:

- chemical dissolution (the process by which natural fibers can be recovered separately from synthetic ones and transformed into new raw materials);

- incineration (energy recovery process)

Synthetic fibers are being recycled less and less. Instead, natural fibers, especially cotton and wool, being produced from consumer sources, are more available on the market.

Studies investigating cotton waste began in 1979 in Texas Tech University, and looked at the use of textile waste to produce ethanol (Hamawand, I., 2016)

Technological processes result in waste classified into two categories:

- Recoverable waste: results from fiber mixtures resulting from knitting factories, spinning mills, weavers that can be exploited by making non-woven textiles, insulating materials, geotextiles (materials that can be permeable made of polypropylene, polyester or polyethylene used in special works of constructions in contact with the ground (approx. 60% of recovered sewage)

- Non-recoverable waste: textiles incinerated or thrown in landfills.

The process of pre-treating cotton and polyester textiles has had an essential impact in increasing ethanol production. After pre-treatment with /urea, the ethanol yield determined by the simultaneous fermentation and saccharification process was 70%. (Gholamzad, E., 2014)

Also, jeans waste (40% cotton and 60% polyester) was investigated for the production of ethanol through the enzymatic hydrolysis process that transforms cellulose into fermentable sugars (Raj, C.S., 2009)

Following the studies, it was observed that the effect of pre-treatment of non-mercerized and mercerized cotton textiles increased ethanol and glucose yields. In table 2, the optimal operating conditions for ethanol production based on the studied literature are summarized.

Table no. 2. Ideal operating conditions for ethanol production using cotton waste.

Technological flow of cotton waste	Pretreatment	Hydrolysis	Fermentation conditions	Glucose yield	Ethanol yield
Textile waste consisting of cotton and polyester (Gholamzad E.,2014)	NaOH/uree,	Cellulase and β-glucosidase enzyme, pH 4.8, 45°C, 72 h	36 °C, 72 h	91%	70%
Bleaching and mercerising cotton textiles (100% cellulose) (Nikoli, S,2017)	Pre-tratarea prin mercerizare*	Celluclast enzyme, 50 °C, 8 days	pH 5, 30°C, 100 rpm	0.94 g/g	0.9 g/L·h
Jeans waste (60% cotton) (Hasanzadeha, E.,2018)	1 M Na_2CO_3, 150°C,120 min	45 °C, 72 h, 120 rpm	36 °C,72 h	81,7% cotton 88% cotton pure	59,5% cotton 69,4% cotton pure

** the process of treating cotton threads or fabrics with a solution of sodium hydroxide to make them smoother, silkier, more compact and more durable*

- The process of composting textile waste

Composting textile waste (cotton) is a biodegradation process, under anaerobic conditions bringing a surplus of nutrients for the soil. At the same time, it is a biological-oxidative process that reduces the volume of organic waste by 50%. Currently, the disposal of textile waste has become a major problem, and the composting process is designed as an alternative method to direct disposal in the landfill. The biotechnological composting process using earthworms called vermi-composting consists of turning waste into compost containing a rich density of isolated bacteria. (Selvi, 2015)

From the bibliographic studies, it appears that cotton waste has been used for pig manure loading in different proportions of pig slurry and cotton waste (4:3, 3:4). (Santos, A., 2016)

The conclusions show that: the thermal properties of zootechnical agents were determinants in the temperature increase and the aeration process; the highest proportion of compost sludge resulted in high nutrient concentration.

As early as 1978, researchers Chang, S. T. and Hays, W. A. showed that the new technology of composting cotton can be used in the cultivation of mushrooms as a substrate with a yield of 65.1% compared to the traditional fermentation technology with a yield of 43.6%. In conclusion the use of cotton residues is more effective in matching the moisture content correctly.

Sustainable utilization of textiles through recycling and reuse

A topology of recovery and reintroduction of textiles into the economic circuit refers to extending the life of items by passing them on to other owners with or without repairs. (Fortuna and Diyamandoglu, 2017) This method can be done through exchange, loan, inheritance, market or thrift store, online, charitable donations. In the academic literature, the concept of reuse has been interpreted as a collaborative consumption, product-based service system, or access-based business system. In general, textile recycling produces materials of lower quality with the exception of combination with natural fibers or fiber-to-fiber sorting (pure materials). Therefore, in the textile industry, recycling and reuse are essential concepts, with a positive impact on the environment and the economy. While the act of recycling involves changing used materials into new ones, reuse focuses on the reuse of clothing and textiles without processing. . The distinction between the two concepts depends on several factors, including the condition of the material, economic viability and ecological impact.

- **Ecological impact**

The act of recycling textiles can reduce the amount of waste by helping to recover energy, but also landfills, minimizing pollution and saving natural resources. Through the transformation process into new products, the need for new raw materials can be reduced, which has a positive impact on the environment.

From the point of view of reusing textiles and clothing, the advantages are quick in terms of resource conservation. Donating used clothing items, in good condition, can extend their life but also have a minimal impact on the environment.

In perspective, the reuse of textiles and clothing presents many advantages over recycling because the cost of their collection, processing and transformation are significantly reduced.

CONCLUSIONS

The proliferation of textiles made from fiber blends – such as cotton and polyester or elastane – poses significant challenges when it comes to recycling post-consumer textile waste. This is due to

the labor-intensive process of separating different types of fibers and the different conditions required for chemical and mechanical recycling. Chemical recycling technologies can help overcome the complications associated with mechanical textile recycling, and there are several innovative startups working on solutions to create high value possible fiber mix recycling.

The EU Action Plan for the Circular Economy and the EU Strategy for Sustainable and Circular Textiles confirm a particular interest with ambitious objectives and measures until 2030.

Due to the increase in the global population, the textile industry is in continuous development, therefore the increase in the standard of living has determined a high consumption of textiles (fibers).

Although the application of the EPR (extended producer responsibility) policy in textile waste is still limited, it is considered essential in promoting a circular economy system. Extended Producer Responsibility (EPR) makes manufacturers responsible for the overall management of textile waste from collection to disposal at the end of the product's life cycle.

In addition to EPR, there is a holistic approach involving major stakeholders (industry, government, private agencies and consumers) who must work in unity to promote a dynamic circular system. Emerging textile economies should take the lead in moving from a linear to a circular economy.

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DAYCARE CENTERS TO PREVENT THE SEPARATION OF CHILDREN FROM THE FAMILY – A POSSIBLE SOLUTION FOR DISADVANTAGED COMMUNITIES

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Abstract: *Starting from the concept of harmonious development, children's needs, love and protection in a stable family environment, on the one hand, and, on the other hand, support services provided by the state, both for them and for their families, it becomes essential for the state to intervene actively to support children in difficulty. State services must be designed to support families and prevent children from being separated from them, ensuring that every child has the chance to grow up in safety and stability in their own family.*
Within the National Recovery and Resilience Plan, one of the specific objectives of Component 13 – Social Reforms is to ensure the legal framework necessary to carry out the activity of preventing the separation of the child from the family and supporting the family in terms of raising and caring for the child at risk of separation. In this context, a funding program was created to support local initiatives that lead to the creation of service networks in the interest and well-being of the child, namely Investment I1 - Creation of a network of day care centers for children at risk of being separated from their families.
This paper presents the situation of the day care centers created for children at risk of separation from their families, as an alternative to the radical solutions that some local communities, through the local authorities, choose to apply to children in this situation.
Key words: *child protection, vulnerable families, residence areas, development regions, European funding*
JEL Classification: I38, J13, O18, R23

INTRODUCTION

The year 1990 was the turning point for child protection in Romania, when Romania ratified the Convention on the Rights of the Child, as a first step in the development of the child protection system. However, the measures applied after 1990 were mainly crisis reactions (provisional solutions to the already chronic problems at that time) to media criticism and international political pressures[5]. Changes have taken place to improve the situation of children in the child protection institutions; but a real reform began in 1997, with the establishment of child protection system, namely the child protection departments, when the decentralisation of child protection activity was initiated.

The change of this system was extremely slow, following small steps in the creation of a new child protection system that would extract the children from the child protection institutions and place them with their families or in a setting as close as possible to the family model. This implied the following:

- improvement/ harmonisation of the necessary legal framework;
- national strategies for the development of the child protection system;
- creation and development of a national system for monitoring and evaluating the situation of vulnerable children/children in difficulty/ children at risk, to find out the most appropriate forms of child protection, which must consider the best interests of children, to meet their needs;

[4] Corina Dinculescu, scientific researcher, Institute of Agricultural Economics
[5] Cătălin Zamfir, 1997

- identification of a family-type environment for each child: biological family, extended family or family-based or family-like child care options.

A slow, but steady process of reforming the child protection system in Romania followed, with the main objective of closing child protection institutions; child protection within a specialised institution should be a solution accepted only in situations of strict necessity and only for a temporary period.

From a dysfunctional system, in major crisis, based on the institutionalisation of vulnerable children/ children in difficulty, which existed until 1990, Romania has gone through several stages of decentralisation of child protection activity. During this time, part of the child protection institutions have been modernised, while others have closed. The concept of alternative protection was introduced, represented by prevention and support services[6]: network of foster parents, recovery daycare centres and counselling and support centres for children and parents/centres for children with disabilities, family-type houses and apartments. These can replace the temporary or permanent incapacity of families to raise and take care of their children, and represent solutions adapted to the fundamental need of children to grow up in a family.

Since 2004, the special child protection has been represented by the set of measures dedicated to the care and development of children deprived of the protection of their parents (temporarily or permanently) or of children who cannot be left in their parents' care, in order to protect their interests.

Only in the third stage of reforms (announced in 2014, but effectively initiated in 2016), one of the major goals of this new wave of reforms was stated – the assumption that by the year 2020 there would be no children in foster homes, namely that all the large residential centres would be closed. A series of priorities were established regarding the transition to community-based services and preventive and immediate interventions, which would ensure the respect for the child's right to grow up in a family environment and would help children to reach their maximum potential. However, there are communities where children coming from disadvantaged families (with a precarious economic situation, for instance) are removed from their family environment, and are applied a special protection measure, as well as children whose parents went abroad to work, and are at risk of being separated from their families.

RESULTS AND DISCUSSIONS

Evaluations carried out at national level revealed that the activity of preventing children separation from their families has continued at a very modest pace, highlighting a practice at the level of some local authorities, mainly in less developed communities that lack services for children and families, of not assuming responsibility for carrying out the activity of preventing child separation from family[7]. These directly request that the child at risk is taken into the special protection system by the General Directorate of Social Assistance and Child Protection (DGASPC) at county level, without an assessment of the situation and without assuming a minimum responsibility in the attempt to find solutions at community level, for such cases. In the motivation for this practice, they most often invoke the poverty of the child family, a community with no or limited resources, so that the

[6] These types of services are under the general umbrella of prevention and support services, mentioned in the UN Convention on the Rights of the Child, by which member states must provide special assistance and a form of alternative protection to the family.

[7] According to the National Child Guarantee Action Plan, 2023

easy solution of local authorities is child separation from family, considering that a residential care service of DGASPC would offer all the conditions that the child is lacking in the family.

Yet these practices are detrimental to the child full development, and when children enter the special protection system they will be subject to additional challenges related not only to the lack of contact with parents, but also to adapting to new living conditions.

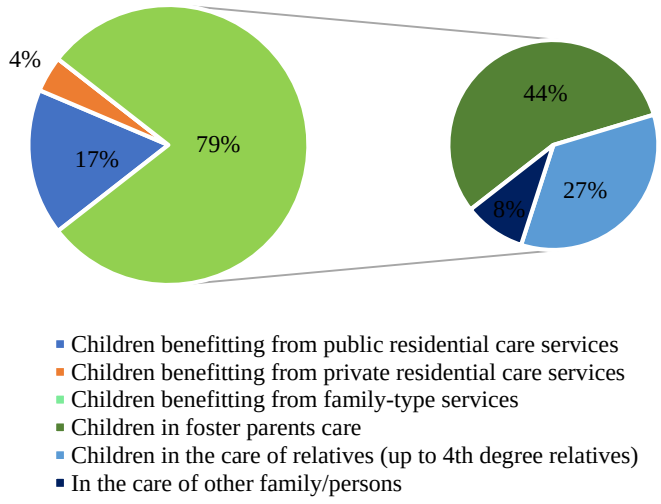
Statistical data[8] also highlight the need for a direct involvement of local communities, for children at risk of separation out of various reasons:

- about 60% of children in the special protection system come from the rural area – these being the most exposed to the social exclusion risk;
- about half of the number of children in Romania (48%) are living in rural areas;
- about 15% of communities are identified in marginalised, poor areas;
- for more than 90% of children found in special child protection system, the mother is known, which indicates a reduced effort of local authorities for identifying and applying solutions to maintain the child within the natural family.

In the absence of the activity of preventing child separation from family and of the services intended to prevent child separation from family, in late 2021, in the special protection system, about one third of children who had a special protection measure had entered the system as a result of the precarious economic situation of the family, according to data mentioned in the *National Child Guarantee Action Plan.*

The distribution by type of special protection measure in which children from the special protection system[9] fall highlights that more than three quarters of these benefit from special protection measures in family-type services (out of which: almost half are in the care of foster parents, one quarter are in the care of relatives up to the 4th degree) and almost 20% benefit from public residential care services.

Children in the special protection system, by type of measure they benefit from



Source: ANPDCA, Statistical Bulletin, June 2024

The precarious economic situation of family is not the only reason that might determine the child separation from his family. Children with parents abroad are also exposed to such risk. Some of these children end up in the special protection system (in the care of foster parents or foster homes),

[8] ANPDCA and NIS statistical data
[9] Statistical data, June 30, 2024, ANPDCA

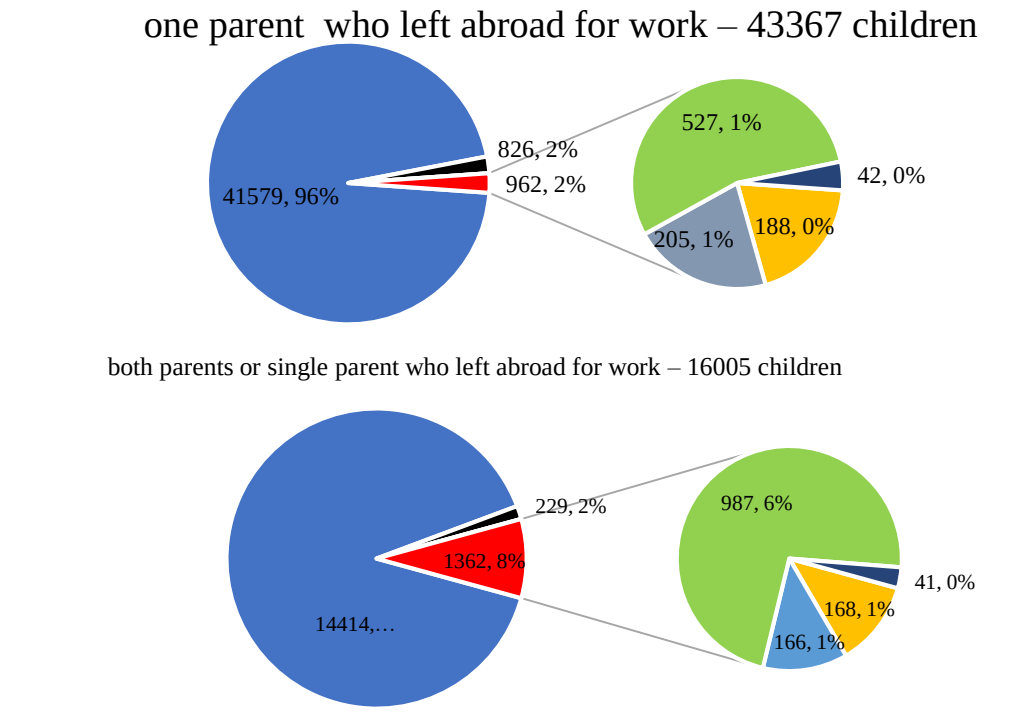
facing additional challenges related to the adaptation to new living environments and to the lack of constant contact with their parents.

According to the official data of the National Authority for the Protection of Children's Rights and Adoption (ANPDCA), in June 2024, 59 thousand children from 48 thousand families were in this situation, down from the same period of the previous year, when 71 thousand cases from 56 thousand families were registered. Although the 17% decrease indicates a continuous downward trend, which has been noticed in recent years, thousands of children continue to live in the special protection system, being deprived of what the family generally can offer.

The graph below highlights, comparatively, the situation of children left at home with both parents or the single parent who left abroad for work, on the one hand, and the situation of children left at home who come from families with one parent abroad for work, on the other hand.

The situation of children left at home who come from families with one parent left abroad for work is slightly more favourable than that of children with both parents or with the single parent who left abroad who remained in the care of relatives (up to fourth degree relatives).

Children left at home, who come from families with:



Source: ANPDCA, Statistical Bulletin, June 2024

This conclusion derives from the indicators – number and proportion of children with one parent who left abroad for work who are in the care of relatives (up to fourth degree relatives), with no protection measure, is higher than that of children with both parents or with the single parent gone

abroad for work, which reveals that these children are cared for in the family (the family of origin, by the second parent, or by the extended family, up to fourth degree relatives, which is a more favourable situation for children's development).

In the National Recovery and Resilience Plan, one of the specific objectives of Component 13 – Social Reforms, is to ensure the necessary legal framework for preventing child separation from family and supporting the family in raising and caring for the child at risk of separation. The establishment of daycare centres for children at risk of separation from family in the most vulnerable communities can contribute to achieving the goals of the EU strategic framework for equality and inclusion of vulnerable children; these community services have a fundamental role in the reform of the current child protection system, i.e. preventing re/institutionalisation and supporting the deinstitutionalisation process.

This creates the premises for fulfilling the commitments assumed by Romania in terms of completing the deinstitutionalisation process and of those derived from the ratification of the UN Convention on the Rights of the Child.

In this context, within the NRRP, under Component C13 – Social Reforms, a funding programme was created to support local initiatives that lead to the creation of service networks in the interest and for the well-being of child, namely Investment I1 – Creating a network of daycare centres for children at risk of being separated from family.

Investment I1 targets the creation of social services for preventing child separation from family, such as: care, education, recreation-socialisation, counselling, school and professional orientation, supervision and support activities in the learning process for children, as well as support, counselling, education, etc. activities for parents. These activities do not replace the efforts of the child's own family, but are complementary to them and to those provided by educational units.

2 calls have been launched for this investment, following which 168 projects for funding have been selected, with beneficiaries from municipalities, towns and communes, having as common objectives the creation of social services to prevent children separation from their families, through:

- building of daycare centres for children at risk of separation from their parents, recovery daycare centres for disabled, centres for counselling and support for parents and children and
- maintaining 14,483 children in their families, ensuring their access to services for the prevention of child separation from family offered by the daycare centres that will be created.

The selection of projects took into consideration the most vulnerable communities and was made taking into account the areas with (high, medium, low) priority, established on the basis of the results of the mapping[10] of services and infrastructure available for children at risk of being separated from their families, mainly in vulnerable communities. Daycare centre projects from high priority

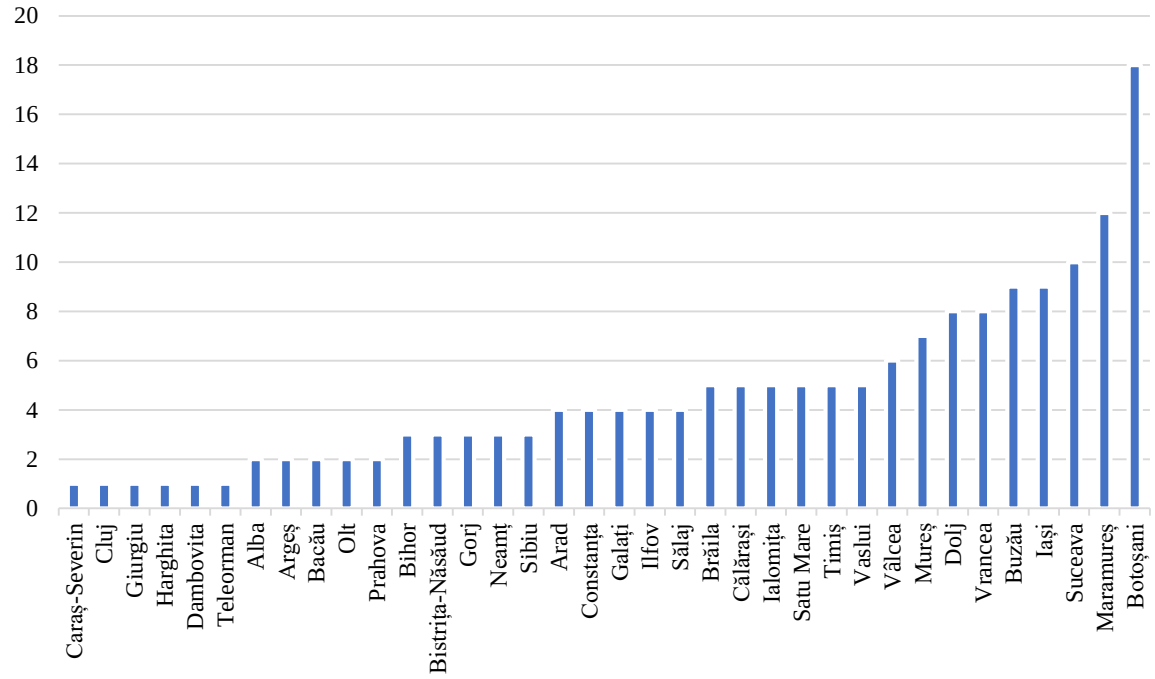
[10] The mapping was carried out by the World Bank under the Agreement of services and technical assistance concluded for the project „PROGRESS in ensuring the transition from institutional care to community care", code SIPOCA577/MySMIS 127380, implemented by the National Authority for the Protection of Child Rights and Adoption and co-financed from the European Social Fund through the Administrative Capacity Operational Programme.
The mapping aimed to identify the vulnerable communities with the greatest needs for the development of services to prevent child separation from family, which at the same time have the fewest services and infrastructure dedicated to the activity of preventing child separation from family.
The indicators used in the establishment of most disadvantaged communities were the following: number of children in the community; share of children in total population; community type (urban/ rural); rate of risk of poverty or social exclusion (AROPE); guaranteed minimum income (GMI); average unemployment rate; school dropout rate.

areas received a higher score. Daycare centre projects located in administrative territorial units with a significant Roma population (more than 5% of total population), according to the 2021 Population and Housing Census, also benefited from additional points.

Thus, the 168 daycare centres for children at risk of being separated from their families will be established in 36 counties, with the largest number of centres in Botoșani county (10.7% of total), followed by those in Maramureș (7.1%), Suceava (6%), Iași and Buzău (5.4%) counties.

At the opposite pole, we can find Caraș-Severin, Cluj, Dâmbovița, Giurgiu, Neamț and Teleorman counties, with only one daycare centre.

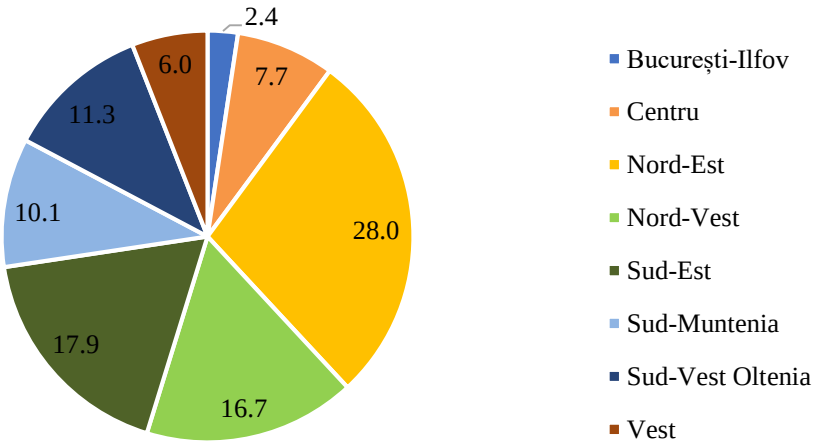
Number of daycare centres for children at risk of separation from family, by counties



Source: MFTES, Final-List-accepted-for-financing-NRRP-2022-C13-I1_CALL 1, Final-list-56-projects-selected-for-funding and Final-list- 15-eligible-projects_CALL 2 – Author's own calculations

The analysis **by development regions** reveals that most daycare centres will be established in the Nord-Est Region (more than one quarter of total), in the Sud-Est Region (18.2%) and in the Nord-Vest Region (17.0%). The fewest daycare centres will be created in the following regions: Vest (with 6.3% of total daycare centres), Centru (7.5%) and Sud-Muntenia (9.4%).

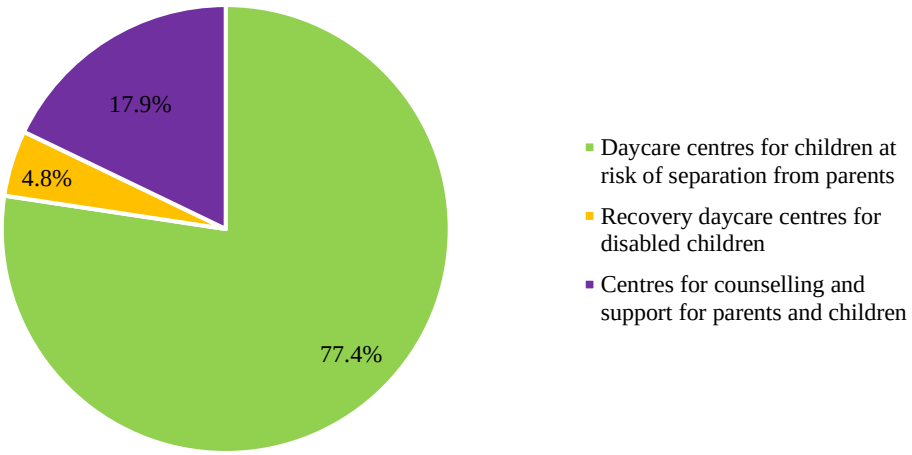
Structure of daycare centres for children at risk of separation from family,by development regions



Source: MFTES, Final-List-accepted-for-financing-NRRP-2022-C13-I1_CALL 1, Final-list-56-projects-selected-for-funding and Final-list- 15-eligible-projects_CALL 2 – Author's own calculations

The following categories of social services are financed: daycare centres for children at risk of separation from parents; recovery daycare centres for disabled children; centres for counselling and support for parents and children. The distribution of projects accepted for financing by these categories of social services highlights that three quarters of daycare centres will be created for children at risk of separation from parents.

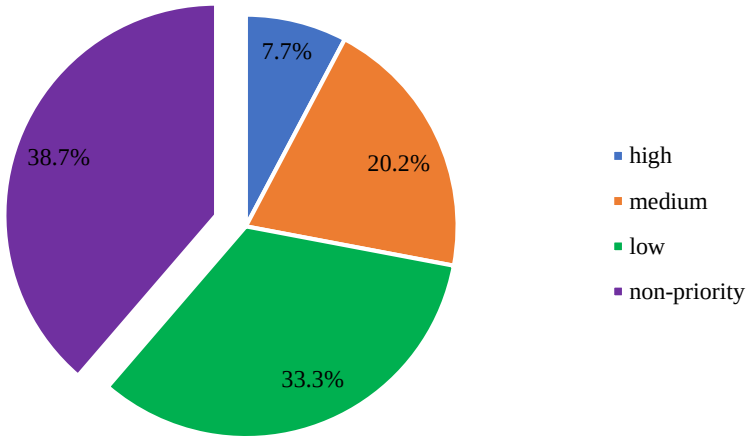
Structure of daycare centres, by category of social services



Source: MFTES, Final-List-accepted-for-financing-NRRP-2022-C13-I1_CALL 1, Final-list-56-projects-selected-for-funding and Final-list- 15-eligible-projects_CALL 2 – Author's own calculations

The selection of projects for funding, by priority areas (high, medium, low), reveals that of the total number of daycare centres, one third will be established in low priority areas, 20% in medium priority areas, less than 10% in high priority areas. But most daycare centres (38.7%) will be established in non-priority areas.

Structure of daycare centres, by priority areas



Source: MFTES, Final-List-accepted-for-financing-NRRP-2022-C13-I1_CALL 1, Final-list-56-projects-selected-for-funding and Final-list- 15-eligible-projects_CALL 2 – Author's own calculations

The low number of projects submitted and accepted for funding can be explained by:

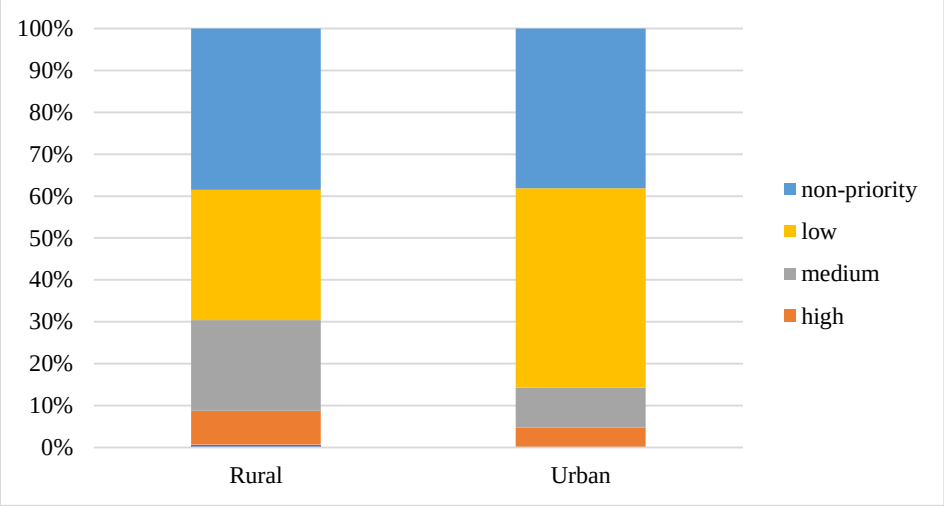
- lack of qualified human resources at the level of local councils (that could make an initial assessment of the cases of children at risk of separation from their families and identify immediate solutions at local community level);
- lack of own financial resources available to be allocated for the prevention activity, namely for the initiation of such a project – feasibility study for the future construction of the daycare centre, file submission, technical project, approvals, etc. and for the subsequent contribution necessary to support the daycare centre;
- non-involvement of local authorities in the creation of such daycare centres for children, which would benefit not only the persons concerned, but would also contribute to community development.

From the analysis of the distribution of daycare centres by residence and priority areas, it results that out of the 13 daycare centres (7.7%) that will be created in high priority areas, 12 centres will be located in rural areas; out of the 34 daycare centres (20.2%) that will be created in medium priority areas, most centres will be located in rural areas (32), and out of the 56 centres that will be established in low priority areas, more than 80% will be created in rural areas, which once again confirms that the rural population continues to be vulnerable.

At the same time, although most daycare centres will be created in the rural area (87.5%), rural areas being considered at higher poverty and social exclusion risk, there are also urban areas that are identified with high or medium priority (3 out of the 21 projects based in urban areas), in terms of the previously-mentioned mapping.

About half of the total number of daycare centres in the urban areas will be located in low priority areas, 9.5% in medium priority areas and only 4.8% in high priority areas.

Structure of daycare centres, by priority area and residence area



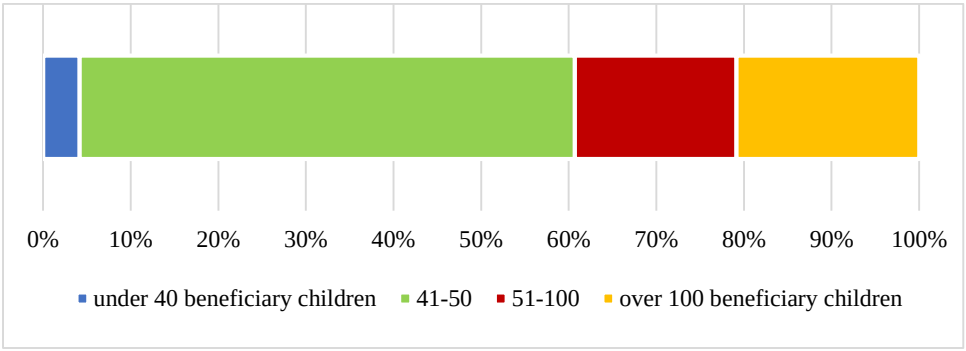
Source: MFTES, Final-List-accepted-for-financing-NRRP-2022-C13-I1_CALL 1, Final-list-56-projects-selected-for-funding and Final-list- 15-eligible-projects_CALL 2 – Author's own calculations

About one third of daycare centres in the rural areas will be located in low priority areas, 21.8% in medium priority areas and only 8.2% in high priority areas.

This situation indicates either a lack of interest of local authorities in creating benefits (namely daycare centres for children at risk of being separated from their parents) for community development, or a much too poor community, unable to ensure in advance the necessary resources for funding, up to the payment of transfer requests, in the case when the project is admitted for funding and to financially support the maintenance of the daycare centre, for 5 years after the completion of the investment[11].

As for the beneficiaries of the daycare centers to be created, more than half of them (56.5%) will aim to keep 41-50 children in their families by ensuring their access to services to prevent child separation from the family offered by the daycare centers, 20% of them will have between 51 and 100 children beneficiaries and another 20% of the daycare centers will have more than 100 children.

Distribution of daycare centres, by number of beneficiary children



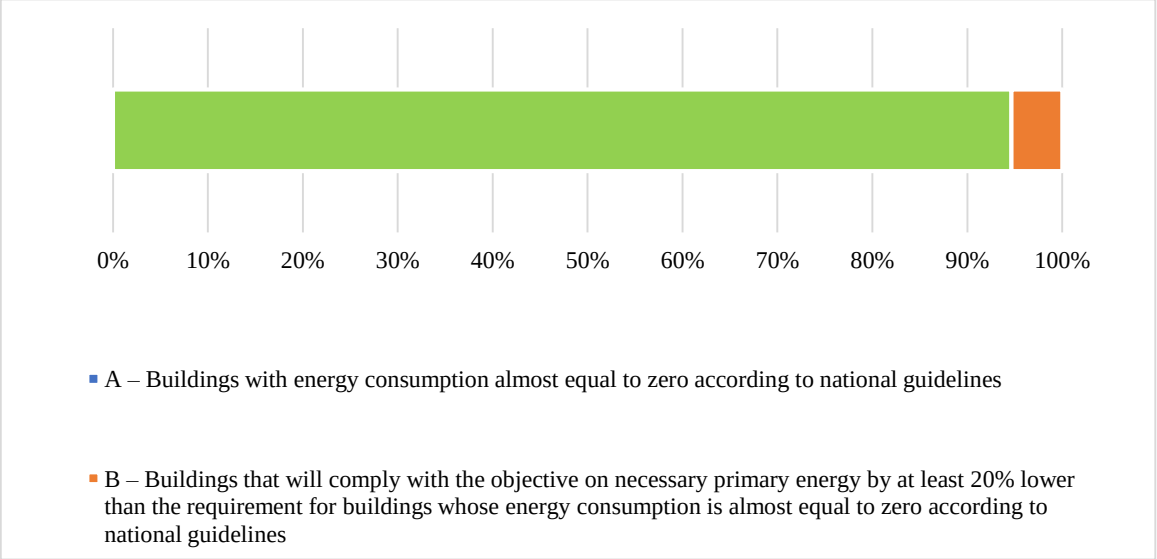
Source: MFTES, Final-List-accepted-for-financing-NRRP-2022-C13-I1_CALL 1, Final-list-56-projects-selected-for-funding and Final-list-15-eligible-projects_CALL 2 – Author's own calculations

Of the total 168 day care centers to be created, 159 will be in nearly zero-energy buildings according to national guidelines, and only 9 will be in buildings that will meet the target for primary

[11] Mandatory for projects funded through NRRP

energy demand at least 20% below the requirement for nearly zero-energy buildings according to national guidelines.

Daycare centres, by category of buildings that will accommodate them



Source: MFTES, Final-List-accepted-for-financing-NRRP-2022-C13-I1_CALL 1, Final-list-56-projects-selected-for-funding and Final-list- 15-eligible-projects_CALL 2 – Author's own calculations

CONCLUSIONS

Children must grow and develop in a suitable family environment, which provides for their material needs, as well as for their psychological needs. Therefore, in the case of children at risk of separation from family, out of various reasons, local authorities are the first to intervene, not to send children to an emergency centre (and later on to another protection measure, which would only meet children's material needs), but to find specific solutions, at local level. The first interventions should take into consideration the correct assessment of the situation, finding relatives from children's families, willing to care for them temporarily.

The creation of these daycare centres would be beneficial for any vulnerable community, reducing the burden on local authorities to support families at risk of poverty and social exclusion and their children.

At the same time, services to prevent children separation from their family and support services from local authorities must be developed, human resources from local councils must be specially trained for situations in which the child is at risk, to be able to make an accurate assessment of each special situation that will occur.

Therefore, it is absolutely necessary to correlate social policies in the field of child protection with support policies for child and family; this implies solving the problems that can cause child separation from family, namely those related to poverty, family abandonment, school dropout, juvenile delinquency, drug use, etc.

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THE FOUNDATION OF THE MODERNIZATION CONCEPT OF THE WINE SECTOR

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Abstract: *Agriculture, today, faces a series of challenges, both from climatic conditions and vice versa. To overcome these challenges and increase the efficiency of operations, maximize crop productivity and reduce the negative impact of agriculture on the environment, modernization of agriculture is necessary. The modernization of agriculture will open the formation of an effective digital economy, significant opportunities will be created for the creation and development of business, they will help increase investment flows, the accumulation of human and financial resources of the world.*
The aim of the work is the complex and deep study of the concept of modernization of the agricultural sector, the research of the development of modern technologies, by sharing the international experience that leads to the modernization of the wine sector. To achieve this goal, scientific research methods and tools were used, such as: the documentary method, which was based on the research and study of specialized materials; the synthesis method, applied to establish the connection between the researched aspects; the systemic analysis method; the graphical and tabular method of presenting data. As theoretical-scientific support, several works and scientific publications of renowned scholars, both from the country and abroad, served. The results of the research allowed the substantiation of the concept of modernization of the wine sector and the classification of the modernization process, developed and substantiated.
Keywords: agriculture; modernization, wine sector.
Classification JEL: Q1; Q10; O14

Note: The article was developed within Subprogram 030101 "Strengthening the resilience, competitiveness, and sustainability of the economy of the Republic of Moldova in the context of the process of accession to the European Union," institutional funding.

INTRODUCTION

Viticulture is a strategic pillar for the economy of the Republic of Moldova, contributing to the formation of the main indicators of the national economy, as well as to the development of regions by attracting investments and maintaining jobs. The sector has connections and collateral relationships with other sectors of the economy through the value chain, and the traditions and regional and international recognition of wines and grapes are undeniable arguments that highlight the major importance of this sector. Similarly, the added value of viticultural products is one of the benchmarks that attract investors to this important sector.

For the population in rural areas, viticulture represents a stable source of income, serving as a reason for their retention in rural environments, providing stimulation for their professional training, oriented towards initiating and developing businesses in the field of viticulture or other related branches. This sector contributes to the socio-economic profile of the country, being attractive from multiple perspectives.

The level of approach to the subject in the scientific literature

The theoretical and scientific support of the work was provided by important scientific works and publications of renowned researchers, both from the country and abroad. The research on the role and importance of the concept of modernization and development of the wine sector is based on

scholars such as Vasiliev A., Briuhanov A. Boincean B. R. Perciun, N. Amarfi-Railean, M. Oleiniuc, T. Bajura, V. Doga, O. Lebedeva, etc.

At the same time, legislative acts and policy documents in the field, reports of the Ministry of Agriculture and Food Industry, the National Office of Vine and Wine, as well as methodological studies, reports developed by the World Bank, the European Commission were studied.

RESEARCH METHODOLOGY

To substantiate the concept of modernization of the wine sector, the works of scholars from both the country and abroad served as the theoretical, methodological, scientific and informational support. The work is a continuation of previously developed research, and the novelty is the substantiation of the concept of modernization of the wine sector as a tool for attracting investments, resulting in the generation of added value, thus ensuring its development.

RESULTS AND DISCUSSION

Today, economic growth is impossible without the use of information and communication technologies, as they cover increasingly diverse spheres of economic activities and create new opportunities for socio-economic development. The notion of modernize (fr. moderniser) meaning improvement was used as early as 1585, and "modernity" means the quality of being modern. In the mid-20th century, the concept of modernity appeared, which means a process of transition, evolution of the social system towards contemporaneity (Iacob G, 1995).

Today, the concept of modernization of the agricultural sector is increasingly found in the works of domestic scholars. Thus, the authors Vasiliev A., Briuhanov A. (2016), Boincean B. (2012), approach the concept of modernization of agriculture through the application of ecological technologies, the creation of enterprises on the principles of the "green economy". The works of these authors highlight the importance of the accessibility of technologies and the modernization of the agricultural sector, in the context of regional development, the need for economic, financial and human resources for the implementation of innovations, as well as the efficiency of their implementation in practice. Also, this approach is found in the works of Russian researchers, such as Lebedeva O., Gafiatov I. (2015), who mention that: the implementation of modern technologies should not affect the environment and the quality of products for consumers. An important problem in the implementation of innovations and digital technologies is the efficiency of management at the level of the region and of entities in the agricultural sector.

In recent times, a variety of reforms and projects have been developed regarding the modernization of the agricultural sector in order to achieve efficiency, effectiveness, economy and quality. Technological developments in recent years have led all sectors to rapid changes. As in other sectors, agriculture has been affected by these technological developments that have entered a process of change and development. Many institutions, organizations and universities in different countries of the world are conducting various studies under the name of smart agriculture by using emerging technologies. As a result of researching these notions and terms, various concepts of agricultural modernization have been determined such as “Digital Agriculture”, “Precision Agriculture”, “Smart Agriculture” (Amarfii-Railean, N., Perciun, R., Shveda, N., 2020). International institutions such as the World Bank, FAO and the Consultative Group on International Agricultural have suggested that in order to provide food to the population, agricultural modernization is needed. Also, this idea of sustainable development through the establishment of the "green economy" is also found in the works of national researchers.

According to the author Inozemtseva V. L. (2008), modernization is impossible without political reforms, it must be "post-industrial", and its fate will be decided in the field of innovative technologies. Thus, one cannot talk about modernization if the development of science and education is not put in the foreground. The authors, Ghelbert A. (2016) and McKinsey (2017) mention that the digital agricultural revolution will have far-reaching consequences on the structure of agricultural labor around the world. However, the exact magnitude and direction of these consequences are not yet clear. Emerging evidence from other industries shows that the adoption of modern technologies in agriculture can increase the demand for higher-paid jobs that require secondary education and reduce the demand for jobs that perform routine tasks.

A study by McKinsey (2017) Center for Advanced Connectivity and Agriculture Practice mentions that agriculture has a high potential for automation compared to other sectors. John Sviokla, an American consultant, author known as a leader in innovation, said: "The Internet is one of the most complex things ever created. It requires human organization at another level. Thus, digital transformation will trigger a completely new revolution that will transform organizations and governments and lead to an extraordinary wealth of creation around the world".

Following the research conducted on the concept of modernization, it was concluded that the most significant approach to the concept of modernization is reflected in Figure 1, where modernization is seen as a process and as an outcome.

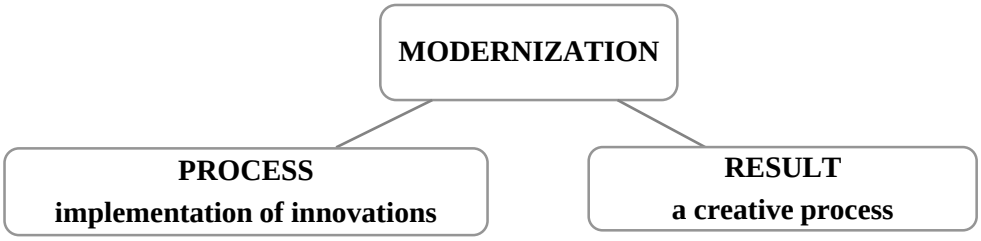

Figure 1. Approach to the concept of modernization
Source: Prepared by the author.

The debate over these approaches and the definition of which is more perfect has been suspended in connection with the development of an international standard for the concept and methodology of statistics and innovation as a well-defined tool. The formation of this international standard was largely facilitated by two works, known as the "Frascati Manual and the Oslo Manual". As stated in the Oslo Manual, "modernization is the introduction of a new or significantly improved product or process (good or service), a new marketing method or a new organizational method into business practice, workplace organization or external relations" (Руководства Осл, 2010).

The modernization of the wine sector through digitalization is based on four categories of digital tools, based on evidence of their impact:

- precision agriculture (including sensor technology);
- digital financial services;
- data-driven agriculture;
- ICT extension.

The modernization of the wine sector expands the use of these tools through different methods of engagement, including: technical assistance, capacity building for teams and by strengthening the knowledge base on best practices. At the same time, the concept of smart vineyards refers to new measurement tools, based on data collection using wireless sensors (possibly combined with satellite or drone imagery and powered by the potential of Artificial Intelligence). As an example,

wireless sensors, which are important for future smart vineyards, are used to collect various measurements within a given area, to help improve productivity and oeno-climate forecasting (Modern Technologies in Agriculture, 2020).

Following research conducted on the literature in this field, it was determined that research can be divided into three dimensions (Stratan A., 2019, Amarfii-Railean, N., Perciun, R., Shveda, N., 2020).

- ❖ The first dimension focuses on the application of modern technologies for the modernization and development of the wine sector. Specific business factors, support from authorities and ensuring rapid growth rates are noted.
- ❖ The second dimension explores the role and importance of digital technologies in the development and modernization of the wine sector, in terms of job automation and increased labor productivity, marketing opportunities for new markets and optimization of resource potential.
- ❖ The third dimension focuses on identifying the possibilities for the use and implementation of modern technologies in small farms.

The recovery of the situation in the wine sector is possible by implementing modern technologies in production management, and the modernization of the wine sector will improve working conditions for farmers, reduce the negative impact of wine on the environment and ensure a much higher profitability of entities in the sector. Thus, in the author's opinion, the objective of modernization is to provide support to farmers in managing their business, through various methods, but the final result being the maximization of profits with minimal impact on the environment.

In the wine sector, as some researchers mention, major changes are expected as a result of the implementation of modern technologies. Thus, with the help of technological applications and solid management, the wine sector will be one of the sectors with the greatest impact in the coming years (Rose, D., Lyon, J., Boon, A. et al. 2021). Karly Burch from the University of Otago, leader of the Project on the Adoption of Modern Technologies, mentions that the implementation of modern technologies in the wine sector will help to perform labor-intensive tasks, which include decision-making, namely, pruning vines. These technologies include a virtual reality (VR) training headset (e.g., training workers in grapevine pruning), an augmented reality (AR) headset to assist the work (e.g., making pruning decisions on behalf of field workers, supporting their work in the field), and fully automated robotic technologies that can perform these tasks on their own (Modern Technologies in Agriculture, 2021). These smart technologies are designed to support growers with tasks of interest (disease identification, yield estimation) that have been identified in co-design workshops with producers and industry partners.

International experts from the International Organization of Vine and Wine (OIVV) have determined the trends for the modernization of the wine sector (Figure 2), which consist of sensing (IT), artificial intelligence (AI), robotics, satellite imagery/geographic information systems (GIS), LiDAR (laser remote sensing), blockchain, E-Label (electronic label), E-certificate (electronic certificate), smart storage (Digital Trends Applied in the Vine and Wine Sector, 2022).

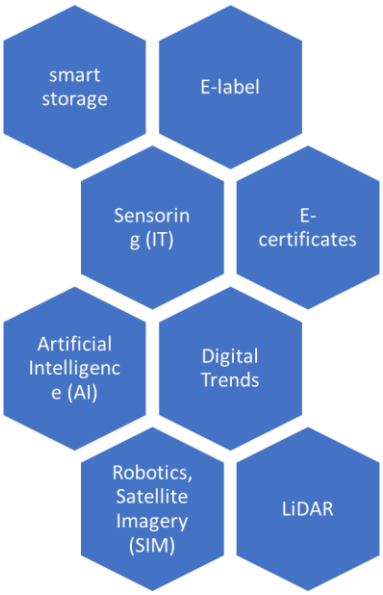

Figure 2. Trends in the modernization of the wine sector
Source: Prepared by the author, according to ONVV data

Also, researchers Bajura T., Doga V. Stratan A. et al. emphasize in their research the direct link between economic efficiency in agriculture and technical and scientific innovations, as well as the need to modernize and automate production processes and operations in the agricultural sector (Stratan, 2019).

By conducting a literature review, the author concluded that the process of wine sector modernization has been identified as one of the most important trends that will reshape society and the global economic system in the near and long term. Thus, in the author's opinion, the concept of wine sector modernization is a new concept and, at the same time, a key element of success. Wine sector modernization is the integration of modern technologies into all wine sub-branches, in order to add value, to change the way it operates and the way it provides value to its products, supply chain, processes, employees and customers.

The role of modernization in the modern economy has increased significantly. Modernization is a new way of meeting needs, providing an increase in the useful effect and, as a rule, based on the achievements of science and technology. Digital tools and data science lead to the most innovative development of society in our life and economy. Modern digital technologies are able to solve the assigned tasks, provide the most cost-effective production models, analyze and process large amounts of information, combine, various information resources on a single platform, which controls and reduces production risks and satisfies the information needs of a wide range of stakeholders. This is not a complete list of the possibilities of modern digital technologies that can be adapted to the needs of agricultural activities (Sinitsa, Y., Borodina, O. and others 2021).

Many countries have adopted a systemic approach to the development of digital agriculture, including the Republic of Moldova. Today, the Republic of Moldova is actively developing digital technologies and implementing information and communication technologies in the agricultural sector. Interest in the issues of introducing and assessing the effectiveness of innovative technologies in agriculture and the agro-industrial complex is associated with increasing trade and production results, with new opportunities for implementing accelerated import substitution models. At the same time, in our view, current trends in modernization are undergoing major changes, which can range from finding new business models, opportunities and making existing processes more efficient or more accessible, to pursuing opportunities to improve the state of an organization through current operations.

In other words, the modernization of the wine sector is not only about digitizing existing processes, but also about rethinking current operations in the light of new perspectives produced by modern technology. This will allow the modification and improvement of the wine sector, both at the operational and managerial levels, acting directly and indirectly for the benefit of winegrowers and the business environment in the sector (Iațișin T., 2019).

Agriculture is a link that creates conditions for the development of the most related sectors. Therefore, the modernization of the wine sector is important for increasing the efficiency of production and processed goods. Today's agriculture is continuously growing due to standardization through the use of modern technologies that include satellite imagery, GPS technology, robots and temperature, humidity sensors and others. All these advances help agriculture to be more efficient, safer and more environmentally friendly. In a context of increasing competition in global markets, achieving higher quality standards in the vineyard becomes extremely important. This has led to a radical renewal of viticulture and a review of agricultural techniques, with the aim of maximizing quality and sustainability by reducing and more efficiently using production inputs, such as energy, fertilizers and chemicals, and minimizing input costs, while ensuring environmental conservation.

Modernizing the wine sector through digitalization is becoming a goal, whether we are ready or not. The main effects of modernizing the wine sector through digitalization are efficiency, productivity, transparency, new business models/value propositions and sustainability (figure 3) (Amarfii-Railean, N., Perciun, R., Shveda, N.,2020).

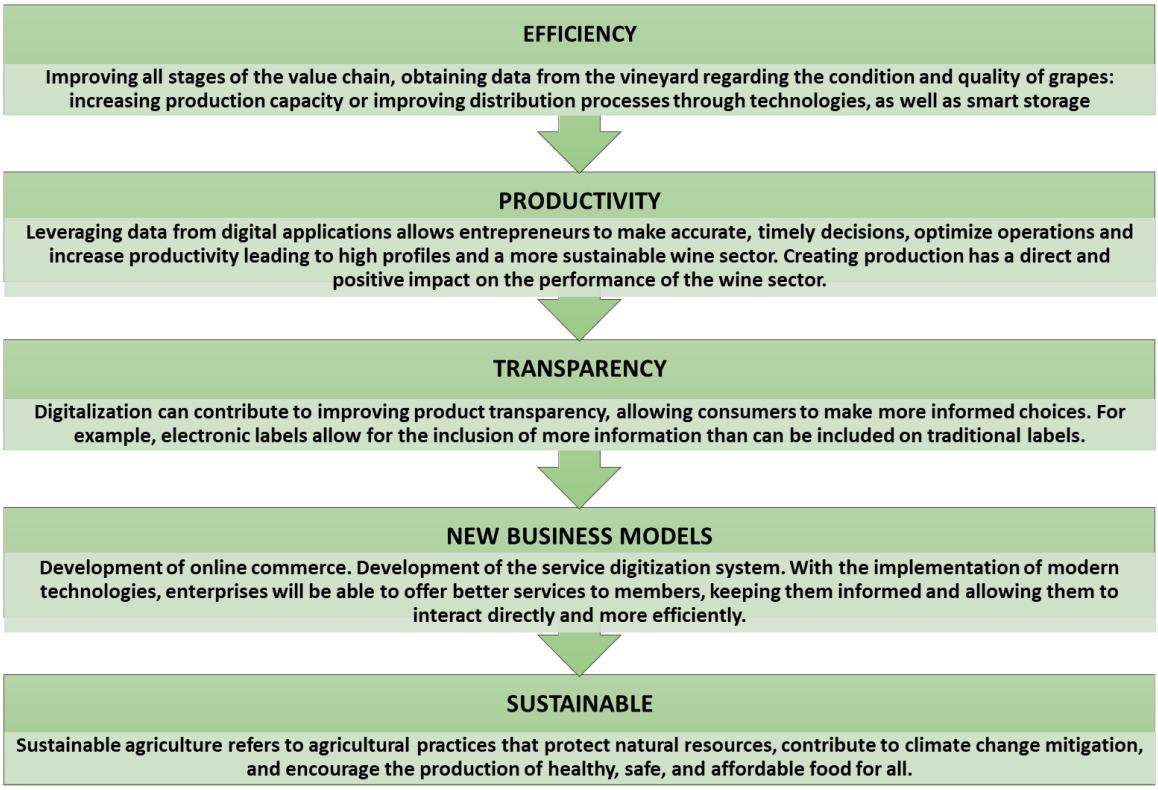

Figure 3. Effects of modernizing the wine sector through digitalization

Source: Prepared by the author (IAȚIȘIN, T., 2022;
Digital trends applied in the grapevine and wine sector, 2022)

Thus, the need to modernize the wine sector actually aims to increase the efficiency of the sector. It is known that only a small part of the pesticides applied reach the target plants, only a part of the applied nitrogen is used by the plants, only a part of the performance of agricultural machinery is used. Therefore, following the research carried out, we have come to the conclusion that for the

modernization of the wine sector, one of the main conditions is to establish goals and objectives, develop the means to achieve them and minimize the costs of implementation.

Analyzing the meaning of the concept of "modernization of the wine sector", it should be noted that it means renewal, access to a modern level of development comparable to that of advanced countries:

- ❖ development of agricultural production at a modern technological level on a scale that allows companies to occupy leading positions in domestic and world markets;
- ❖ modernization of production technologies, replacement of outdated equipment, machinery and technologies with modern, more productive ones;
- ❖ integration into the latest global innovation processes, in the world economy, the fastest use of all important innovations, including innovations in the field of organization and management;
- ❖ retraining and re-education of people, over time, which will lead to a change in living conditions;
- ❖ implementation of structural changes, the formation of an industrial structure that meets the criteria of a developed industrial country. This implies an increase in the share of products with high added value in GDP and exports, including moving away from the unilateral orientation of exports of raw materials.

Through a general synthesis of the literature in this field, the author highlights the following classification of the modernization of the wine sector (table 1).

Table 1. Classification of the wine sector modernization process

Modernization classification criteria	Classification description
Progressive	he process is approached as inevitable, necessary, because it ensures the growth and development of the sector, the material well-being of the regions and population involved, the promotion of wine culture;
Reversible	The process can have an inverse character, it is not viewed as a linear, continuous process.
Systemic	Process approached at the national, regional, organizational level
Complex	Aims at changes in all sub-branches: product; process; marketing; management.
Long-term	A process carried out quickly, slowly, growing, uniformly
Degree of intensity	Process that takes place in stages
Impact	Expected results at the economic, sectoral, social, environmental levels, etc.

Source: Prepared by the author.

From the perspective of the above, it follows that the modernization of the wine sector is a big step forward and necessary for increasing the efficiency of agricultural activities, for increasing production and controlling costs, maximizing profits and protecting the environment. Due to the evolution of technologies and IT solutions that have taken place in recent years, they are able to manage the complete flow, starting from tracking specific activities in the vineyard to obtaining and marketing wine. The development of the concept of modernization of the wine sector is influenced by some aspects of the political situation, as well as the challenges and problems registered in the sector, and the attractiveness of the wine sector and the investment opportunities are numerous.

The regulatory framework for the wine sector in the Republic of Moldova has been at the center of economic policy for several decades. Currently, the sustainable development objectives adopted by the Republic of Moldova involve the application of appropriate public policy and the creation of a favorable environment for sustainable and competitive development.

CONCLUSIONS

The experience and good practices of other countries support our belief that the modernization of the wine sector can only be achieved through investment strategies adapted to the modernization needs, this is the sure way to increase the economic performance of the local wine sector, to align with the European Union standards and to develop competitiveness overall.

The research allowed us to conclude that the implementation of modern technologies is new and relatively common for all related activities of the wine sector, and the integration and implementation of new practices requires a coordinated approach to reduce financial obstacles and increase knowledge and skills in the field.

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