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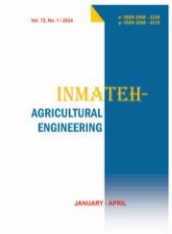

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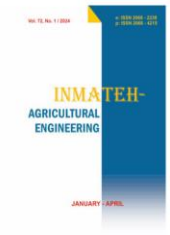

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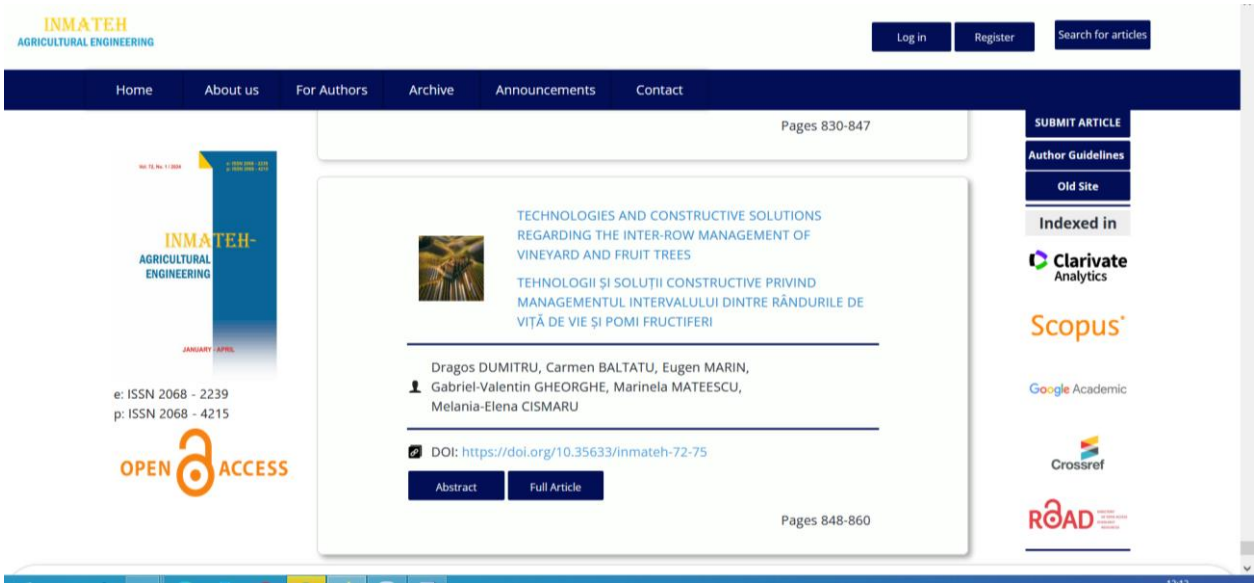
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ANALYSIS AND MANAGEMENT OF ORGANIC AGRICULTURE DEVELOPMENT IN EASTERN EUROPEAN COUNTRIES
/
ANALIZA I ZARZĄDZANIE ROZWOJEM ORGANICZNEGO ROLNICTWA W KRAJACH EUROPY WSCHODNIEJ

Nadiia SHMYGOL[1)], Władysława ŁUCZKA[2)], Nataliia GAVKALOVA[3)], Zhanna HARBAR [4)], Viktor KOVAL [5)] and Lucian-Ionel CIOCA[6,7,*)]

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ABSTRACT

The study analyses trends in domestic markets and international trade in organic products in some Eastern European countries based on a multifactorial comparative analysis in the regional context and estimates of yield losses about traditional agricultural land processing technologies. Prospects for the development of organic farming by region and in general are determined based on unused reserves of agricultural land suitable for this. The study assessed the organic production development in different regions of Poland and Ukraine: the annual growth rate of transitional and organic lands should be at least +13.3% to meet the strategic goal of reaching 3% of the total agricultural land by 2030.

STRESZCZENIE

W badaniu są analizowane trendy handlu na wewnętrznych i międzynarodowych rynkach produktami organicznymi w niektórych krajach Europy Wschodniej na podstawie wieloczynnikowej analizy porównawczej w kontekście regionalnym oraz oceny strat plonów związanych z tradycyjnymi technologiami uprawy rolniczych gruntów. Perspektywy rozwoju rolnictwa organicznego w poszczególnych regionach i ogólnie określane są na podstawie nieużytkowanych zasobów gruntów rolniczych nadających się do tego celu. Badanie ocenia rozwój produkcji organicznej w różnych regionach Polski i Ukrainy: roczny wskaźnik wzrostu obszarów przejściowych i organicznych powierzchni rolnych powinien wynosić co najmniej +13,3%, aby osiągnąć strategiczny cel osiągnięcia 3% ogólnej powierzchni gruntów rolniczych do 2030 roku.

INTRODUCTION

The global agricultural landscape is undergoing a paradigm shift towards sustainability and eco-friendly practices. Increasing food security is one of the key strategic goals of national development in many countries, including the European Union. This contributes to the gradual transformation of the population's consciousness towards the consumption of safe and environmentally friendly food products. This, in turn, has led to an increase in the demand for organic products grown by agricultural enterprises without the use of mineral fertilizers and pesticides. However, the mass introduction of organic farming is associated with certain technological difficulties and limitations, which determine the relevance of this study. Ukraine and Poland, as significant contributors to European agriculture, find themselves at a critical juncture. The urgency arises from environmental concerns, changing consumer preferences favoring sustainable food, and the need for resilient agricultural systems in the face of climate change. The study's relevance is further underscored by the potential environmental impact of conventional farming practices, the growing demand for organic products among consumers, and the delicate balance required for economic viability in organic farming. Examining how Ukraine and Poland navigate these challenges is crucial not only for their agricultural sectors but also for setting global precedents in sustainable agriculture policy.

The purpose of the study is to analyze the prospects of organic farming development in cases of Eastern European countries: Ukraine and Poland.

This study addresses the pressing issues these nations face and explores recent initiatives fostering organic agriculture. In the Literature Review Section, the results of synthesizing contemporary scientific research of organic agriculture current state and future prospects in Ukraine and Poland are presented.

In the Methodology Section, the study presents a methodology for analyzing the prospects of organic farming development in Ukraine and Poland. This approach is designed to address common challenges faced by both countries in sustainable organic production. The study delves into an analysis of trends in domestic markets and international trade of organic products within the contexts of Ukraine and Poland. In the Conclusion, the analysis of the current state and future prospects of organic agriculture in Ukraine and Poland leads to several key recommendations for regulatory policy.

Literary review

The problem of studying the prospects of organic farming has become widespread in various scientific circles (*Galat, 2021; Wojciechowska-Solis et al., 2022)*. Thus, according to the results of research, the development of organic production in Ukraine is connected, first of all, with the growth of demand for its products in the countries of the EU and North America (*Senyshyn et al., 2023; Stupnytskyi et al., 2023*). However, currently, the domestic market is not capable of performing a stimulating function, as it is only in its stage of formation (*Galat, 2021)*. To accelerate this process, the authors emphasize the need to improve the legal framework, the importance of information exchange between organic market operators, the promotion of a healthy lifestyle among the population, and further liberalization of international trade.

Evaluating the prospects of organic farming for producers, *Garazha (2021)* and *Ohorodnyk (2023)* pay attention to the additional competitive advantages they receive, which are the following: significant savings due to the rejection of mineral fertilizers and agrochemicals, as well as high prices for final products, which allow them to compensate for a decrease in productivity and increase profits. Despite this, the concept of organic production as a strategic direction for the development of the agricultural industry in Ukraine has been established among Ukrainian scientists in recent years. The main prerequisites for this are: the rapidly growing market for ecological food products, in combination with limited reserves of increasing organic land in the EU; and the high quality and fertility of Ukrainian chernozem (soil) (*Ohorodnyk, 2023*).

It should be highlighted that scientists have encouraged the growth of organic agriculture if the study of this topic is considered in Poland, specifically, where the active development of organic farming began earlier. For example, *Golik and Żmija (2017)* studied ecological agriculture and the foundations of sustainable development in villages and territorial communities. *Iagaru et al. (2016)* study the process of developing strategic options for the development and diversification of the rural economy based on the principles of environmental protection.

Jasiński et al. (2014) emphasize that organic agriculture is one of the powerful clusters of regional development, as it accumulates significant amounts of labor resources and a highly educated agrarian elite open to innovation. In their study, the authors started with the concept of "zakorzeniony" of the market, which implies a high concentration of certain endogenous resources in a certain area. In the case of organic production, such a market is based on the close cooperation of organic farming operators, processing enterprises, and local government institutions. *Łuczka (2016)* draws attention to the lack of such communication at an appropriate level. In her opinion, the inconsistency of supplies of organic raw materials from producers negatively affects the rhythm and stability of the work of processing enterprises. As a result, there is a shortage of ecological products in the domestic market, even in conditions of high demand. The considered studies of Polish scientists are a theoretical generalization of existing trends, where, along with the obvious advantages and potential of ecological production, there is an understanding that the economic justification of such activity is currently an unresolved issue. In this context, to ensure the balance between the pillars of sustainable development, *Iagău et al (2023)* highlight the implications of strategic thinking, in the development and promotion of the circular economy, including the concept of sustainability, in the agri-food sector.

Marszałek (2018) and *Groszyk (2022)* consider the prospects of this field of activity in the existing European Union strategy. Special attention is paid to the non-alternativeness of this strategy, since only it can ensure the permanent preservation of the balance between ecological, economic, and social systems.

Marszałek (2018) separately notes that the level of social responsibility of society has reached the level where agriculture must ensure not only economic viability but also environmental acceptability. Both studies are characterized by a generalizing theoretical character and practically do not use the economic-mathematical apparatus, which is a significant shortcoming.

Recent studies attest to the role of economic education in the sustainability of agricultural businesses, emphasizing that brand image and loyalty is relevant and directly proportional to it (*Nuanphromsakul et al., 2022*). There are studies that offer optimal solutions for the environment and agriculture in the sense of using sludge from sewage treatment plants (after applying optimal solutions to prevent contamination with metals) for restoring acidic soils (with pH < 6) and reintegrating them into agriculture, respectively in organic agriculture (*Iticescu et al., 2021*).

Continuing the development of this concept, *Zielińska (2015)* considered the indirect benefits of organic production. Based on the results of the research, the author concludes that it is inappropriate to assess the effectiveness of agriculture-based only on economic indicators of activity and offers his own approach to managing the natural value of territories. The theoretical significance of this approach, in our opinion, is beyond doubt. However, its practical application is significantly limited by the lack of any methodology for the quantitative assessment of target indicators.

The results of the generalization of modern scientific experience regarding the state and prospects for the organic agriculture development in Ukraine and Poland are shown in Table 1.

Table 1

Analysis of modern scientific experience of organic farming development.

Research goals	Results and disadvantages	Quantitative assessment methods	Sources
Study of the processes of formation of the internal organic products market in Ukraine	The system of factors restraining of the organic production in Ukraine has been improved: the domestic development market does not perform a stimulating function; insufficient attention of researchers to certain segments of organic production; imperfection of the regulatory framework. The proposed model of the transformation of traditional agriculture underestimates the role of modern world experience regarding the significant increase in costs over income, especially in the transition stage	Summary and grouping, comparison, absolute, relative and average values, index, graph-analytical	*Galat, L. (2021); Wojciechowska-Solis et al. (2022); Senyshyn et al. (2023)*
Approval of the concept of organic production as a strategic direction for the development of the agricultural industry of Ukraine	An economic justification of the need for state financial support of organic producers was carried out. The budget system of Ukraine does not have the financial resources to implement the specified recommendations, following the example of the EU countries	Cost calculation in the analysis of economic activity, rating method of interstate comparisons	*Garazha (2021)*
Implementation of ecological agriculture for sustainable development basis of villages and territorial communities in Poland	The concept of "zakorzeniony" of the market, as a cluster of regional development based on the concentration of certain endogenous resources, received further development. The study requires further development of the mechanisms for realizing competitive advantages in this sector of the economy	Assessment of the dynamics of time series, relative indicators of the structure, interstate comparative analysis, methods of expert assessment, SWOT analysis	*Jasiński et al. (2014); Golikand Żmija, (2017)*
Study of factors promoting organic farming in Poland	Stimulating measures were further developed: provision of communications between producers of agricultural raw materials, processing enterprises and sales channels; the need for state financial support. Economic substantiation of organic activity was not conducted	Combinational grouping	*Luczka (2016)*
A study of the prospects of organic farming in Poland in the context of the EU development strategy	Received further development of the basis of the strategic development of rural areas: the constant preservation of the balance between the economic and ecological systems. The theoretical analysis is not supported by a quantitative assessment methodology	-	*Marszałek (2018);* *Groszyk (2022)*

Research goals	Results and disadvantages	Quantitative assessment methods	Sources
Increasing the economic efficiency of organic production in Poland	An approach to managing the natural value of territories is proposed. Its practical value is leveled by the lack of a methodology and a system of indicators	-	*Zielińska (2015)*

Comparative Table 1 showed the presence of a complex of unsolved scientific tasks, which confirm the relevance and timeliness of this study.

MATERIALS AND METHODS

The analysis of scientific studies both in Ukraine and in Poland showed that the practical measures proposed by the authors are most often based on the generalization of existing developments and the analysis of data from open sources. Moreover, the given recommendations are, in most cases, based on our own expert experience, which is not confirmed by any practical calculations. Taking into account these shortcomings, the actual study proposed a methodology for analyzing the prospects of regional development of organic agriculture, in which the main attention was paid to the use of economic and statistical methods of data processing.

The methodology involved several stages, each with specific tools and techniques:

1 Economic and statistical analyses of organic production trends – utilizes statistical analysis methods for dynamic series and average values.
2 Assessment of the role of state support – deterministic factor analysis and the absolute differences method.
3 Analysis of organic land disposal after state support – economic risk assessment methods.
4 Assessment of the impact of organic production on crop development – relies on statistical methods to evaluate the effectiveness of crop production.
5 Formulation of conclusions and recommendations – draws from expert generalization methods based on ordinal measurement scales.

Each stage is explained in detail with a focus on environmental payments as a key incentive in organic production. These payments are tied to fulfilling specific environmental obligations, and this article highlights the impact of various factors, such as land status, agricultural use, and adjustment factors, on the base rate of organic payments per hectare. This methodology aims to quantify the effects of these factors on organic farming development, whether intensive or extensive, providing valuable insights into the sustainability of organic agriculture in both countries.

This comprehensive analysis draws on statistical and economic methodologies to quantitatively assess the prospects for regional organic farming development in both countries. The evaluation of regional organic farming prospects considers untapped opportunities to expand organic agriculture by utilizing available agricultural land.

The economic and statistical analysis of trends in organic production is based on the methods of analysis of dynamic series and average values: the dynamics of time series were measured using average growth rates; bringing value indicators to the prices of the base period using discounting methods; and the study of a certain phenomenon in a certain period using relative indicators of intensity and structure. At the end of this stage, an idea of the current state of organic production development in the country and the nature of existing trends is obtained.

The practice of producing ecological food products in the EU shows a high dependence of this activity on the amount and duration of state support. Therefore, to assess its role in the development of organic agriculture in different regions, it is suggested to use deterministic factor analysis, namely, the method of absolute differences. Factor analysis makes it possible to obtain a quantitative assessment of the directions for the use of state funds: the expansion of the area of organic land, the growth of the share of small and medium-sized enterprises, changes in agricultural specialization, etc.

The regional analysis of the disposal of organic land after the end of the term of environmental obligations is carried out using economic risk assessment methods, in particular, the risk of uncertainty based on the coefficients of variation of target indicators and the risk of disposal based on the relative indicators of the distribution of the studied phenomenon in a certain environment. Not all natural and climatic conditions

allow effective agricultural activity under the conditions of ensuring its economic payback. Therefore, the purpose of the appropriate stage of the methodology is to determine those regions where state stimulation of agricultural producers of ecological products is more appropriate from this point of view.

Assessment of the impact of organic production on the development of agriculture as a whole is proposed to be carried out with the help of statistical methods of analyzing the effectiveness of activities in crop production. A relative comparison of the productivity of certain crops in relation to traditional farming methods allows us to determine the amount of cumulative losses to the gross harvest from the introduction of new technologies. In this case, it is advisable to replace traditional farming methods where the relative loss of productivity is the smallest.

According to the results of the preliminary multifactorial analysis and using expert generalization methods based on ordinal measurement scales, the regions are ranked. On its basis, conclusions and recommendations are formed regarding the prioritization of territories for the development of organic farming.

The practical implementation of this methodology requires appropriate statistical support. To date, the State Statistics Service of Ukraine does not carry out appropriate accounting, with reporting being publicly available. The sources of information are the Ministry of Agrarian Policy and Food of Ukraine, as well as the Federation of the Organic Movement in Ukraine. However, their data are general and do not allow them to fully implement the proposed methodology. As for Poland, regular reports on the state of organic crop production by voivodeship, according to certain indicators, are published here.

Comparing the experience of implementing organic farming in Ukraine and Poland, common problems for both countries can be observed. Although, according to its duration, ecological production of food products in Poland has existed much longer, the areas of the relevant lands are comparable to each other today. Also, despite the low share of organic land, compared to the average level for EU countries, the development of ecological production in Ukraine and Poland is not sustainable. Therefore, there is a need to develop an appropriate methodology for further research on its prospects (Fig. 1).

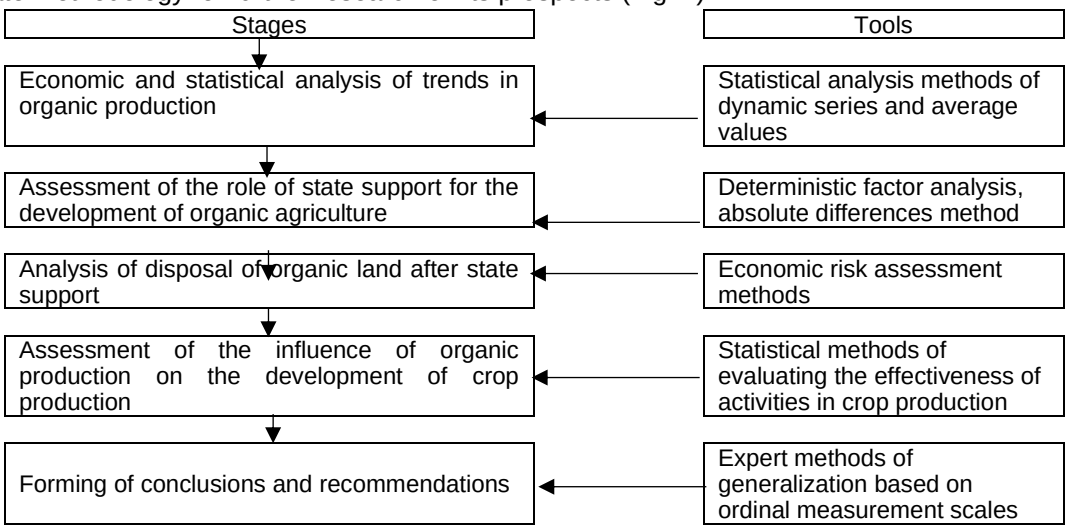

Fig. 1 - Methodology for the analysis of prospects for the development of organic farming.

Let's consider each of the stages of this methodology in detail. To stimulate organic production, appropriate environmental payments have existed in Poland for a long time. To receive them, farms must fulfill certain environmental obligations. Until May 2021, the term of these obligations was 5 years, and after that, 3 years. During this period, the operator of organic production has the right to receive a state subsidy. Such a system of incentives is used as part of the implementation of the Program for the Development of Rural Regions, with the participation of the European Agricultural Fund.

The number of relevant subsidies has a direct correlation with the development of organic production in the country. However, the factors of this development may indicate its different nature: intensive or extensive. That is why their systematization and quantitative assessment of the impact are important scientific tasks.

The basic rate of organic payment, calculated per 1 ha of area, depends on the following:

1 transitional or organic status of agricultural lands;
2 agricultural use of organic land, which includes: cultivation of agricultural, vegetable and herb crops, berries, basic and extensive horticulture, fodder crops and pastures;

3 areas of transitional or organic lands for which a regression scale is introduced. Farms with an area of up to 50 hectares receive up to 100% of environmental payments from the base rate; 75% – with a residual area of up to 100 hectares; 60% – more than 100 hectares;

4 individual adjustment factors of the base rate, which depend on the specificity and intensity of activity. For example, in animal husbandry - from the number of livestock per unit area, in horticulture - from the minimum density of fruit trees, etc.

Aggregate state expenditures to support organic production are formed on the basis of:

$$VOP_i = AOL_i \times SOL_i \times \overline{OP_i}, \quad (1)$$

$$\overline{OP_i} = \sum_{j=1}^{m} (AB_{ij} \times OP_{ij}), \quad for\ all\ \ i=1...n, \quad (2)$$

where: VOP_i – the volume of regional organic payments (subsidies) paid by the state to farms in the i^{-th} voivodship (province), PLN; AOL_i – the area of organic land in the i^{-th} voivodeship (province), ha; SOL_i – share of organic lands of the i^{-th} voivodeship (province) covered by subsidies, %; $\overline{OP_i}$ – the average volume of organic payments per 1 ha in the i^{-th} voivodeship, PLN; AB_{ij} – the specific weight of the area of the j^{-th} type of organic farming for which the subsidy was paid in the i^{-th} voivodeship (province), %; OP_{ij} – the amount of organic payments per hectare in the i^{-th} voivodeship for the j^{-th} type of agriculture, PLN; n, m – respectively, the number of voivodeships (provinces) and types of organic farming. Then, the generalizing factor model will have the form:

$$VOP_i = AOL_i \times SOL_i \times \sum_{j=1}^{m} (AB_{ij} \times OP_{ij}), \quad for\ all \quad i=1...n, \quad (3)$$

RESULTS

Considering the temporarily occupied territories, Ukraine's total area is 60.3 million hectares. Of these, 41.4 million hectares (68.7%) are agricultural land (Verkhovna Rada of Ukraine, 2018), including:

– arable land that is systematically cultivated and used in crop production, the area of which in 2020 in Ukraine was 32.7 million hectares. Considering crop rotation, only 82% of arable land, or 27.7 million hectares, was used as sown area. Accordingly, 5 million hectares were fallow. Thus, the average level of ploughed land in Ukraine today is 54%. The highest level of this indicator is observed in Kirovohrad (71.9%), Zaporizhzhya (69.9%), and Mykolaiv (69.5%) regions; the lowest is in Transcarpathian (15.6%), Ivano-Frankivsk (28.8%), and Rivne (32.8%). In European countries, the average plowing of land is about 35%.

– perennial plantings or orchards and vineyards occupy 0.9 million hectares, or 2.2% of agricultural land; pastures and hayfields are used in animal husbandry for grazing agricultural livestock during the year and occupy an area of 5.3 million hectares and 2.3 million hectares, respectively; fallows are agricultural lands (of 0.2 million hectares), not cultivated for a long time and are a reserve for increasing arable land.

The principles of the organic production in Ukraine are identified by the relevant regulatory acts, which are based on the Law of Ukraine "On the basic principles and requirements for organic production, handling and labeling of organic products" (*Verkhovna Rada of Ukraine, 2018*). According to this, organic production refers to all stages of agricultural activity, including cultivation and harvesting, its processing, mixing and packaging, as well as labeling of finished products.

Each stage is regulated by the relevant rules, and the activity itself undergoes mandatory systematic certification. The dynamics of the number of operators and the corresponding areas of agricultural land in Ukraine during 2016-2020 are shown in Fig. 2 (*Federation of the Organic Movement in Ukraine, 2021*).

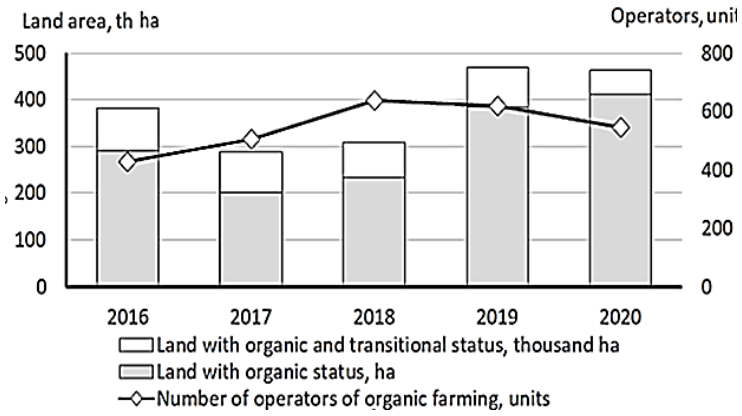

Fig. 2 - Organic farming operators and organic land area in Ukraine from 2016 to 2020

One of the main features of organic production around the world is the need for a transitional period for agricultural land to obtain organic status. On average, its duration is 3 years, and in exceptional cases it can be reduced to two.

During the transition period, organic production methods are used on the relevant lands in order to bring the indicators of soil pollution to a dangerous level, as well as its gradual saturation with organic substances and reproduction of natural fertility. In this regard, in the first years after the abandonment of mineral fertilizers, the yield of these soils drops significantly, and then gradually recovers.

As shown in Figure 1, since 2018, the number of organic farming operators in Ukraine has decreased from 635 to 544 units, or by -14.3%. At the same time, the growth of the areas of the corresponding lands slowed down in 2019, and by the beginning of 2021, it amounted to 462.2 thousand hectares, or only 1.1% of all farmland. It should also be observed that there is a negative tendency to reduce the land area in a transitional state, both in absolute and relative terms.

If, at the beginning of the study period, their areas accounted for up to 40% of land with organic status, then according to 2020, it will be only 12.6%. This means that in the coming years, the reserves for growing lands with organic status due to existing transitional lands will be minimal. According to different regions of Ukraine, the situation in 2020 is heterogeneous, as evidenced by the data in Table 2.

Table 2

The extent of organic and transitional lands in Ukraine in 2020

Regions	Area of land with organic status, thousand ha	Area of transitional lands, thousand ha	The proportion of organic and transitional land in the total area of agricultural land, %
Vinnytsia	4.3	0.4	0.2%
Volynsk	4.7	0.1	0.5%
Dnipropetrovsk	14.6	4.0	0.7%
Zhytomyr	28.1	1.2	1.9%
Zakarpattia	1.1	–	0.2%
Zaporizhzhia	17.1	27.5	2.0%
Ivano-Frankivsk	0.8	–	0.1%
Kyivska	8.6	0.2	0.5%
Kirovohradsk	13.4	0.1	0.7%
Lviv	11.8	0.7	1.0%
Mykolayivska	0.1	0.1	0.0%
Odesa	55.0	3.1	2.2%
Poltava	29.5	0.1	1.4%
Rivne	19.9	0.7	2.2%
Sumy	0.1	0.3	0.0%
Ternopilsk	62.0	0.1	6.0%
Kharkivska	3.3	0.6	0.2%
Khersonsk	70.6	11.1	4.2%
Khmelnytska	16.9	0.1	1.1%
Cherkassy	40.0	–	2.8%
Chernivtsi	0.2	–	0.0%
Chernihivska	8.5	1.2	0.5%
Together in Ukraine	410.7	51.5	1.1%

Based on the data in Table 2, the most common organic production is in the Kherson, Ternopil, Odessa and Cherkasy regions. In total, they account for more than 55% of all organic land in Ukraine. The worst situation took place in the Mykolaiv, Sumy and Chernivtsi regions, and there was no such activity on the territory of Donetsk and Luhansk.

Taking into account the temporary occupation of the Kherson and Zaporizhzhia regions, as of June 2022, Ukraine lost 126.2 thousand hectares of land with organic and transitional status, or 27.3% of their total area. The agricultural specialization of the Kherson region is vegetables, melons, oilseeds and cereals, as well as perennial plantings; the Zaporizhzhia region is grain and oilseeds, as well as vegetables and gardening.

In addition to this, 40% of Kharkiv communities are also occupied. Thus, the total loss of agricultural land in Ukraine is at least 22%.

According to the National Economic Development Strategy until 2030 (Cabinet of Ministers of Ukraine, 2021), percentage of organic and transitional lands in Ukraine should grow from 1.1% to 3.0% or more. Accordingly, the export of organic products should increase from $ 204 million in 2020 to $1 billion.

In 2020, the European Union countries collectively possessed an organic land area of 16.5 million hectares. Spain led with 2.4 million hectares, followed by France with 2.2 million hectares and Italy with 2 million hectares. The average proportion of organic land in relation to the total available agricultural areas was approximately 8.1%. The EU aspired to elevate this ratio to 25% by 2030, as outlined in the EU Biodiversity Strategy. Notably, Austria had already achieved a 26% share, while Estonia and Sweden reached 22% and 20%, respectively, underscoring significant progress towards the EU's biodiversity objectives (*Cabinet of Ministers of Ukraine, 2021*).

In 2021, the agricultural landscape of Europe witnessed notable changes in the realm of organic farming, with key countries in the region demonstrating diverse trends in the expansion of areas, market dynamics, and consumer behavior. France stands out as a leader in expanding organic areas, contributing nearly 2.8 million hectares in 2021, making a significant contribution to the 4.4% growth of organic areas in Europe. Germany, holding the largest market in Europe with 15.9 billion euros in retail sales, experienced moderate growth in 2021 after a substantial surge in 2020.

Austria distinguishes itself with the highest share of organic areas in the EU, encompassing 26.5% of agricultural land, highlighting its robust position in the domestic market. Sweden, with over 20% of agricultural land under organic management, demonstrates a strong organic farming sector with a substantial number of producers and processors. Estonia is making significant strides, approaching EU targets for 2030, with 23.0% of agricultural land dedicated to organic practices and the highest growth rate in organic markets in 2021 (+21%).

Liechtenstein leads the global list with 40.2% of agricultural land under organic management, pioneering dedication to organic practices. Italy contributed to the overall growth of Europe with 2.2 million hectares of organic areas and leads in the number of organic processors. Denmark claims global leadership with a 13.0% share of organic product sales, reflecting high per capita spending on organic produce. The Netherlands play a crucial role as a re-exporter, significantly influencing the import of organic products and demonstrating volume growth. Spain, with 2.6 million hectares of organic areas, adds diversity to the landscape of organic farming in Europe.

This scientific narrative unveils the intricate tapestry of organic farming in selected European countries, elucidating their contributions to the expansion of areas, market dynamics, and consumer preferences in 2021.

Taking into account the geographical characteristics of Poland, the overall extent of the region is 31.3 million hectares, with agricultural territory covering 18.7 million hectares, equivalent to 59.9%. As per the 2020 statistics, the expanse of transitional and organic lands within this framework comprised 509.3 thousand hectares, constituting 2.7% (*Agricultural and Food Quality Inspection, 2021*).

Thus, Ukraine is significantly inferior to the progress that has been achieved in the EU, but from a resource point of view it has significant potential to expand its activities.

Regarding organic and transitional resources, the extent in Poland has, on average, remained nearly constant in recent years, hovering around 500-510 thousand hectares. Compared with Ukraine, according to 2020 data, this area is only 1.1 times larger. Therefore, it can be talked about relative parity between countries on this indicator. The most dynamic development of this sector of the Polish economy took place during 2004-2013, when organic and transitional lands grew from 82.7 thousand hectares to 670.0 thousand hectares, or 8.1 times. After that, business activity began to decline, which lasted until 2017. Thus, it can be assumed that the economic system has come to a state of continuing equilibrium to this day.

In terms of the number of organic farming operators, a similar pattern of dynamics was observed. In 2004-2013, their number increased from 3760 to 27093 units. Among these, 26,598 establishments were involved in the direct manufacturing of organic agricultural goods, while 407 entities, constituting 1.8%, were dedicated to producing items for end consumers using organic raw materials.

In the following years, the number of operators began to decline rapidly. In 2020, their number was 20,274 units. Of these, 5.4% of enterprises have already been engaged in the production of products from organic raw materials.

The fundamental difference between Poland and Ukraine is a large number of small agricultural enterprises, with an average area of organic land of about 27.4 hectares. At the same time, in Ukraine, each such enterprise accounted for up to 850 hectares on average.

This situation in Ukraine has developed for certain objective reasons. Firstly, the lack of a working agricultural land market. Secondly, there is a high threshold for entering the industry due to the lack of state financial support, which is the main direction of spending of the budget of the European Union.

The proportion of Poland's transitional lands during 2016-2020 ranged from 25% to 33% of their overall quantity. This was anticipated to contribute to an annual increase of up to +10% in organic lands. Nonetheless, this expectation was not fulfilled due to the concurrent phenomenon of their gradual conversion into agricultural land (*Rozkrut, 2021*).

During 2016-2020, significant shifts that took place in the structure of organic acreage can be mentioned:

- the share of cereals increased by +10.3% to 29.2%;
- the share of forage plants decreased by -9.1% to 23.1%, and onions and pastures – by -8.7% to 16.9%;
- the share of fruit and berry crops increased by +2.6% to 9.2%, and legumes - by +5.1% to 7.4%; the latter, in turn, contribute to the accumulation of humus in the soil and the development of beneficial microorganisms, enrich it with nitrogen and are good precursors for crop rotation;
- the share of vegetables and potatoes decreased by -4.1% to 5.9%.

In total, these crops in 2020 occupied about 90% of the areas, of which 40% are hayfields and pastures for the needs of organic livestock, and only 15.1% are fruit and berry crops and vegetables directly intended for consumers. This structure is due to the complexity of growing cultivated plants using ecological technologies and low yields. For comparison, the share of hayfields and pastures in total agricultural land in Poland is only 21.7%, and in Ukraine – 20.8%.

In this case, it is advisable to evaluate the impact of each factor on the performance indicator using the method of chain differences. The specified model will be used to determine the nature of the changes that took place in Poland during 2019-2020. During this period, the total volume of organic payments for transitional lands decreased by -6.5%, or by -5104.7 thousand PLN; for lands with organic status increased by +2.7%, or by PLN +6999.1 thousand. Taking into account these data, a conclusion can be drawn about the redistribution of funds, which in the future will lead to a slowdown in the rate of expansion of the organic land area. Simultaneously, the growth of the total volume of financing indicates the gradual development of this sector of agriculture. However, the results of the factor analysis allow detailing and revealing the essence of the specified trends. For transitional lands there will be:

$$-\Delta VOP_{AOL} = \Delta AOL \times SOL_{2019} \times \sum(AB_{2019} \times OP_{2019}) = -6013{,}3 \text{ th. PLN} \quad (4)$$

The growth of the effective indicator due to the first factor $\Delta \mathrm{VOP}_{\mathrm{AOL}}$ will result in an actual expansion of the overall land extent of transitional lands, which is a call sign and vice versa. In our case, the reduction of expenses by -6013.3 thousand PLN was due to the reduction of the area of the relevant land by 8924.1 hectares, which indicates a slowdown in business activity.

$$-\Delta VOP_{SOL} = AOL_{2020} \times \Delta SOL \times \sum(AB_{2019} \times OP_{2019}) = +648{,}4 \text{ th. PLN} \quad (5)$$

The second factor determines the change in government expenditures due to the share of land covered by subsidies ΔVOP_{SOL}. In 2019-2020, it increased from 64.3% to 64.9%, which led to additional expenses in the amount of +648.4 thousand PLN. This growth is positive because it increases economic incentives for farms and has significant untapped reserves for further growth.

$$-\Delta VOP_{AB} = AOL_{2020} \times SOL_{2020} \times \sum(\Delta AB \times OP_{2019}) = -996{,}6 \text{ th. PLN} \quad (6)$$

The third factor indicates structural shifts in the agricultural specialization of farms ΔVOP_{AB}. A positive value of this indicator means redistribution of production in favor of those activities where the basic rate of organic payment per 1 ha is higher, and vice versa. Therefore, this factor does not directly characterize the general development trends in organic production, but reveals its inner essence.

$$-\Delta VOP_{OP} = AOL_{2020} \times SOL_{2020} \times \sum(AB_{2020} \times \Delta OP) = +1256{,}8 \text{ th. PLN} \quad (7)$$

The last factor reveals the change in the volume of organic payments due to adjustments in base rates. The average level of payments per hectare will decrease if large agricultural producers crowd out small businesses, which is undesirable. On the contrary, the mass development of small businesses, according to the accepted regression scale, will increase the average costs per 1 ha for each type of agricultural activity. In our case, this increased the total organic payments by +1256.8 thousand PLN. At the same time, a positive

value of ΔVOP_{OP} with a simultaneous negativeΔVOP_{AOL} means that the increase in the share of small businesses in transitional lands occurred due to the mass exit of large organic producers from the market.

As for the state subsidization of lands with organic status, the results of the factor analysis look like this: $\Delta VOP_{AOL} = +7129{,}6\ \text{th. PLN}$; $\Delta VOP_{SOL} = -10656{,}1\ \text{th. PLN}$; $\Delta VOP_{OP} = +5219{,}3\ \text{th. PLN}$. This means that the expansion of the area of organic land took place against the background of the growth of the share of small enterprises, which is positive. At the same time, in 2020, subsidies were paid for 78.9% of areas. This means that less than 21% of existing organic land was not covered by the 5-year environmental commitment program. Therefore, this business was characterized by high turnover: after the end of the period of state aid, the vast majority of agricultural enterprises left this market due to high costs and low crop productivity. Thus, today, organic production cannot exist without a subsidy policy. Within the second block of the methodology, an assessment of relevant costs was carried out for each voivodeship (province), followed by a ranking of regions by each factor.

It was mentioned above that the main reason for the lack of progress in the development of organic production in Poland is the high loss of land with organic status, due to the massive reduction of business after the end of the period of state support. From the point of view of public administration, it is important to assess the relevant risks, in terms of regions. For this, let's introduce conventional signs. Let's assume, that $AOL_{B,i}(t)$ is the area of lands of the $i^{\text{-th}}$ voivodeship (province), which were eliminated from the composition of organic during the $t^{\text{-th}}$ year. Then, the risk of uncertainty PH_i will depend on the variation of this indicator during the reporting period, lasting k years, and will be calculated according to the formulas:

$$\text{PH}_\text{i} = \left(\sqrt{\frac{\sum_{t=1}^{k} \left(AOL_{B,i}(t) - \overline{AOL_{B,i}}\right)^2}{k}} \Big/ \overline{AOL_i} \right) \times 100\% \ \rightarrow \ min, \tag{8}$$

$$\overline{AOL_i} = \frac{\sum_{t=1}^{k} AOL_i(t)}{k}, \quad \overline{AOL_{B,i}} = \frac{\sum_{t=1}^{k} AOL_{B,i}(t)}{k} \tag{9}$$

where:

$\overline{AOL_\text{i}}$ – average annual area of organic land in the $i^{\text{-th}}$ voivodship (province), for k years; $\overline{AOL_{\text{B,i}}}$ – the average annual land area of the $i^{\text{-th}}$ voivodeship (province), which was eliminated from the organic composition.

Evaluating the variation of the disposal of organic lands relative to their average area, the indicator of the risk of uncertainty should be minimized. If $\text{PH}_\text{i} \rightarrow 0$, this means that the disposal of organic land is permanent, and its dynamics are constant and predictable. On the other hand, minimizing uncertainty does not guarantee a slow rate of elimination of agricultural land from the composition of organic.

For this purpose, the risk of release PB_i is calculated as a relative indicator of the spread of the studied phenomenon in a certain environment:

$$\text{PB}_\text{i} = \frac{\overline{AOL_{\text{B,i}}}}{\overline{AOL_\text{i}}} \times 100\% \ \rightarrow \ min \tag{6}$$

The simultaneous fulfillment of both target conditions (3) and (5) will be characteristic of regions with minimum areas of disposal of organic land and sustainable trends. In the long term, this will lead to a decrease in the level of SOL_i, which in this case is positive. The results of the corresponding assessment by regional characteristic based on the data of 2015-2020 are shown in Fig. 3.

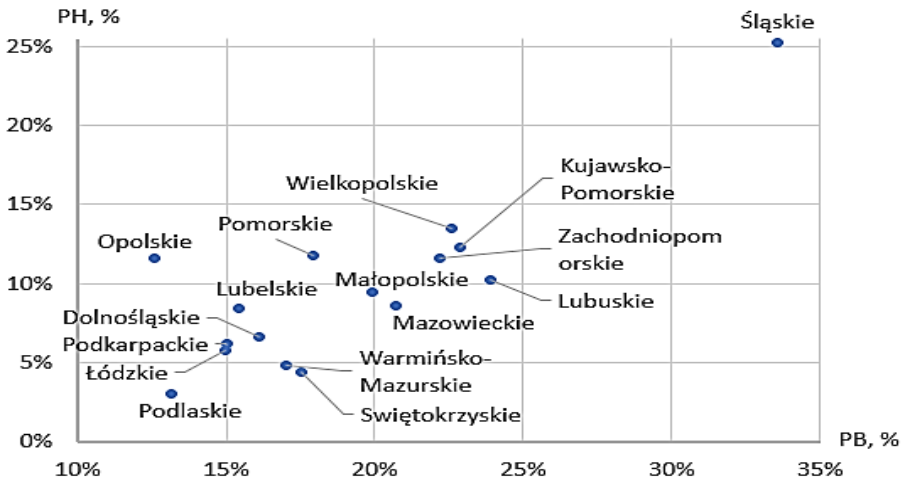

Fig. 3 - Risk indicators of organic production by voivodeship (province) in Poland according to data from 2015-2020

As shown in Fig. 3, according to both criteria, the lowest activity risk occurred in Podlaskie Voivodeship (Province) and the highest in Śląskie. Wielkopolskie, Kujawsko-Pomorskie, Zachodniopomorskie and Lubuskie were also in the high risk zone. Indicators (3) and (5) were also used to rank the regions. The next stage of the methodology provided for an assessment of the impact of organic production on the development of crop production. Several factors complicate such an analysis. Firstly, there is a lack of reliable and detailed information on the planted acreage and gross collection for certain types of crops, especially in organic production. Secondly, the assessment by groups of crops eliminates the factor of the structure of individual crops in the group. For example, the structure of cereals in organic and traditional agriculture may differ in composition. Summary statistical data (*Rozkrut, 2021*) made it possible to compare the yields of certain groups of crops for organic and traditional agriculture in Poland in 2020 (Fig. 4).

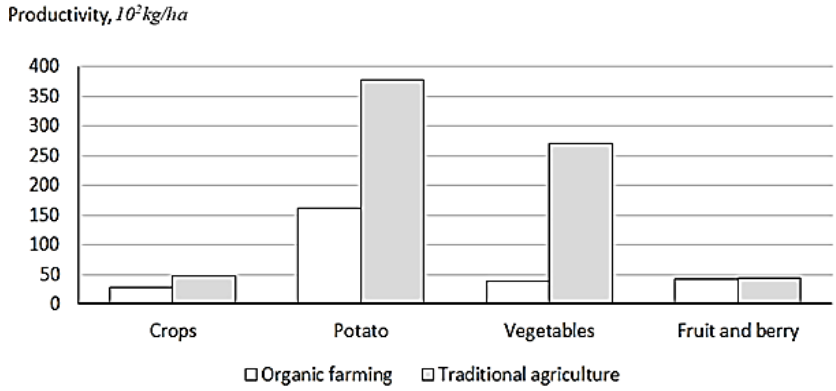

Fig. 4 - Comparison of crop yields for organic and traditional agriculture in Poland in 2020

Despite the indicated shortcomings, the comparative analysis allows us to form an idea of how the gross output of crop production will change as a whole, if part of the agricultural land will be converted to organic, or vice versa. At the same time, the structure of each group must remain stable.

As shown in Fig. 4, organic grain production in 2020 had a national average yield of 27.7x 10^2 kg/ha. This indicator's variation range by region was from 22.3 x 10^2 kg/ha in Lubelskie Voivodeship to 58.4 x 10^2 kg/ha in Małopolskie. At the same time, the average grain yield under traditional farming was 47.9 x 10^2 kg/ha, or 1.7 times higher. Thus, an increase in the organic land area will lead to a loss of 20.2 tons of grain from each hectare. In order to minimize these losses, in our opinion, it is advisable to encourage the development of organic grain production in those voivodships where the difference between its yield and traditional farming is the smallest. These voivodeships include Małopolskie, Swiętokrzyskie, Podkarpackie and Opolskie. On the contrary, the most significant total losses of the crop due to the spread of organic farming occurred in the Pomorskie, Zachodniopomorskie and Łódzkie voivodships.

Potato cultivation on organic lands had an average yield of 162.2 x 10^2 kg/ha, and for agriculture as a whole – 378.2 x 10^2 kg/ha or 2.33 times higher. Taking into account the criterion of minimizing losses of gross potato harvest, it is advisable to stimulate its organic production in the Małopolskie and Podkarpackie voivodeships. At the same time, it is advisable to engage in traditional farming in Opolskie, Zachodniopomorskie and Pomorskie voivodeships.

The situation with vegetables is not so clear, since this group of crops consists of a wide range of products. The largest share of total sown vegetable areas in 2020 was occupied by onions (15.9%), carrots (12.2%), cabbage (9.5%), beets (5.0%) and tomatoes (4.1%). As for organic production, the corresponding structure of acreage is unknown. Thus, only a significant difference in yield of 7.1 times between different farming technologies and the obvious complexity of organic production can be stated in this case.

The last group of crops is fruits. Traditional agriculture includes perennial plantings of orchards and fruit and berry. The latter in 2020 had the following structure of acreage: strawberries – 25.6%, raspberries – 13.6%, currants – 32.5%, gooseberries – 1.1% and others. In organic farming, there is statistical data only on the total cultivation of fruit and berry crops. As a result of comparing yields for different types of agriculture, a relative parity between them can be noted: 41.7 x 10^2 kg/ha in organic and 43.9 x 10^2 kg/ha in traditional production.

Summing up, it can be noted that the overall low level of yield is indeed a significant factor directly affecting the economic feasibility of organic production.

In Poland in 2020, with the help of organic crop production, the following were grown: 315.3 thousand tons of cereals, which is 0.9% of the gross harvest of cereals throughout the country; 22.6 thousand tons of potatoes, or 0.3% of the gross collection; 89,000 tons of vegetables, or 2.3%; 164.3 thousand tons of fruit and berry crops, or 29.7%. As it can be seen, the level of organic production of grains, potatoes and other vegetables was at a low level. Also, operators of organic production were engaged in the cultivation of fodder crops to meet the needs of animal husbandry, the livestock of which included: cattle for meat - 8341 heads, dairy cows - 12061 heads, other cattle - 10700, poultry - 696153, pigs - 3253, sheep - 15803 and goats - 3645 heads. At this stage of the methodology, the following relative indicators were calculated to assess the regional effectiveness of organic activities:

$$RY_{ij} = \frac{Y_{OPГ,ij}}{Y_{ij}} \quad \rightarrow \quad max, \tag{7}$$

where: RY_{ij} – the yield level of organic crops of the j-th species in the $i^{\text{-th}}$ voivodship, relative to traditional agriculture; $Y_{\text{ОРГ},ij}$ – yield of organic crops of the $i^{\text{-th}}$ species in the $i^{\text{-th}}$ voivodeship, 10^2 kg/ha; Y_{ij} – yield of crops of the $j^{\text{-th}}$ species in the $i^{\text{-th}}$ voivodeship in traditional agriculture, tons/ha.

The calculated indicators $РУ_{ij}$ show how many times the yield in organic production for certain crops is inferior to traditional agriculture. A smaller value of this indicator corresponds to greater losses of the gross harvest when switching from traditional to organic agriculture. Then, summarizing the relative level of productivity by region, it will be calculated according to the arithmetic weighted average formula.

$$RY_i = \sum_{j=1}^{p} \left(RY_{ij} \times \frac{AOL_{ij}}{AOL_i} \right) \quad \rightarrow \quad max \tag{8}$$

where: RY_i – summarizing the relative yield level of organic crops in the $i^{\text{-th}}$ voivodeship (province); AOL_{ij} – area of land under organic crops of the $j^{\text{-th}}$ type in the $i^{\text{-th}}$ voivodeship (province), ha.

In order to generalize the results of the deterministic factor analysis of regional organic payments and the risk of a decrease in business activity after the end of the period of state support for producers and productivity, it is necessary to solve the problem of multidimensional comparison. In the theory of decision-making, various matching methods for quantitative and ordinal scales of measurement are used for this purpose. In this case, a ranking assessment was conducted for each indicator, where a lower rank corresponds to a better value. The generalized ranking was performed using the method of average arithmetic ranks. As a result, each of the regions received the following assessment (Table 3).

Table 3

The results of the rating assessment of voivodships in according (Poland, 2015-2020)

Voivodeships	Overall Ranking
Podlaskie	1
Swiętokrzyskie	2
Dolnośląskie	3
Warmińsko-Mazurskie	4
Podkarpackie	5
Łódzkie	6.5
Małopolskie	6.5
Opolskie	8
Wielkopolskie	9
Mazowieckie	10
Lubuskie	11
Zachodniopomorskie	12
Pomorskie	13
Lubelskie	14
Kujawsko-Pomorskie	15
Śląskie	16

According to the general ranking, the best situation occurred in such voivodships as: Podlaskie, Swiętokrzyskie and Dolnośląskie. According to the analysis, the least favorable situation can be observed in the Śląsk, Kuyavian-Pomeranian and Lublin voivodeships.

Currently in Poland, the progress of organic production falls well below the average in the European Union. Achieving improvement, especially considering the notably low productivity, necessitates government backing and the establishment of supplementary financial motivators.

As for the prospects for the development of organic production in Ukraine, as mentioned above, by 2030, the planned share of organic and transitional land should reach at least 3% of the total area of agricultural land. Taking into account the current situation at the beginning of 2022, the total agricultural area in Ukraine amounted to 41,329 thousand hectares. Then, according to the adopted state development strategy, by the end of 2030, organic and transitional lands should occupy at least 1,233 thousand hectares. For this, the average annual growth of their areas, according to the results of calculations, should be equal to +9.4% and higher.

DISCUSSION

According to the results of the analysis, it can be noted that all the studies and works are the result of the generalization of the modern experience of organic production, in which the proposed proposals are formed based on the expert experience (*Kvasha et al., 2019; Popova et al., 2022*). At the same time, the scope of application of modern economic-mathematical tools is limited to the grapho-analytical method, as well as statistical indicators of dynamics and structure (*Nesenenko, 2022*). The total area of Ukraine, taking into account the temporarily occupied territories, is 60.3 million hectares. Of these, 41.4 million hectares, or 68.7% are agricultural land.

In our opinion, this is a significant drawback as it introduces subjectivity into the decision-making process. One of the reasons for this is the imperfections and the limited amount of available statistical data. In particular, the State Statistics Service of Ukraine, as of mid-2022, does not carry out separate accounting of organic farming in the country. This limits the available methodological apparatus for the analysis of economic activity, mathematical statistics, and modelling in the economy, which, in our opinion, is a significant drawback as it introduces subjectivity into the decision-making process (*Soloviova et al., 2022*).

Ukraine possesses competitive advantages over Poland, including abundant agricultural land and lower labor costs. However, organic agriculture in Ukraine has yet to gain widespread adoption owing to underdeveloped domestic markets and limited profitability. The following recommendations are proposed to foster growth (*Iermakova et al., 2022*):

- Promote awareness of eco-friendly and safe food products in the population.
- Simplifying market entry for producers, especially small and medium-sized farms, subsidizes part of their expenses during the transition period.
- Support small agricultural enterprises as they transition to organic crop production by subsidizing costs and helping them meet ecological standards while selling products at conventional prices.
- In Poland, the analysis revealed that a uniform policy of fixed tariffs, irrespective of regional specifics, hampers the balanced development of organic production. It is evident that the duration of state support significantly influences the life cycle of organic farming in most farms. To address this, a region-based differentiation approach is recommended.
- Group regions based on their performance, with the most successful regions receiving continued state support at the current levels.
- Distribute State aid within the second and third groups to regions with average positions, extending the duration of State support for organic production.
- Provide transitional support to regions facing the most challenging conditions for organic activities, helping maintain organic production in larger agricultural enterprises.

These recommendations aim to optimize organic agriculture development by tailoring strategies to each country's unique circumstances and needs.

CONCLUSIONS

The analysis of the state current status and future outlook of organic farming in Ukraine and Poland, based on the proposed methodology, allows us to offer the following recommendations regarding regulatory policy in this direction.

The competitive advantages of Ukraine over Poland are, firstly, the quantitative and qualitative composition of agricultural land and a lower level of costs, in particular, for labor. As a result, the organic agriculture development in Ukraine took place without direct state intervention in the form of centralized subsidization of producers. Despite this, organic production in Ukraine has not yet become widespread due to the underdevelopment of the domestic market. In addition, low profitability slows the pace of development. Therefore, when formulating recommendations, it is important to consider Poland’s experiences. First, it is

necessary to pay attention to the popularization of ecological and safe food products among the population. Also, it is necessary to simplify the entry threshold to this market as much as possible for producers, particularly, small and medium-sized farms. For this purpose, it is advisable to cover part of the expenses for such enterprises during the transition period at the expense of state subsidies. In the opposite case, small agricultural enterprises do not have the opportunity to engage in organic crop production beyond the break-even point, when the production process must meet ecological standards, while the products are sold at conventional prices.

As for Poland, the analysis of the effectiveness of public spending, the risks of disposal of organic land and the yield of crops proved that the centralized policy of uniform tariffs, without taking into account the specifics of specific regions, does not ensure the uniform development of organic production. As it was shown above, for the vast majority of farms, the life cycle duration of such activities directly depends on the term of state support.

That is why it is necessary to differentiate between the regions. The first group includes the most successful regions according to these criteria, for which state support should remain at the current level. Within the second and third groups, state aid must be distributed in favor of regions that have average positions. Such assistance should include an increase in the duration of state support for organic production. These regions represent the largest untapped reserves of future growth. At the same time, regions with the most difficult conditions for conducting such activities should receive state aid during the transition period. This will allow for the preservation of organic production by large agricultural enterprises.

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