

Development of Organic Production in Ukraine: Potential, Current Threats and Consequences for Global Food Security

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Abstract

The article aims to analyze the potential of organic production in Ukraine in war conditions and determine its consequences for world food security. Methodological approaches based on cluster and rating analysis of regions based on their potential in the field of organic production are proposed and provide an appropriate evaluation algorithm, mathematical tools, and strategic alternatives for all variants of data obtained in the calculation process. With the help of the given methodological approaches, the development of strategies for organic production for the primary clustering of regions, namely in Kyiv, Odesa, and Cherkasy oblasts, is proved. The system of forming a regional model of organically oriented multidisciplinary agriculture is appropriate for these regions. This will create the preconditions for organic food production, organic livestock, and related sectors of environmentally oriented economic activities. The development of an innovative component for implementing SMART-specialization projects is possible. It is substantiated that the most affected regions (Kharkiv, Luhansk, Donetsk, Kherson, Mykolaiv, Zaporizhia) from hostilities and occupation are potential for organic production and have significant areas for agricultural production. It is projected that the other war in Ukraine will reduce the production of farm products, including organic, which will lead to food security in most countries.

Keywords

Organic production, world food security, agricultural products, potential, war.

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Introduction

The situation in Ukraine can lead to a global crisis in the world, due to the deterioration of agricultural lands and other lands, the destruction of agricultural and critical infrastructure. Ukraine has the largest area in Europe (603.6 thous. sq. km), a significant share of agricultural land (about 70% of the country's total area), favourable geographical location and labour resources for farming.

Russia's war against Ukraine led to the loss of a significant part of Ukrainian agricultural products due to the production and conduct of intense hostilities. Russia's ongoing war against Ukraine could lead to a global food crisis

in the world. That is why the strategy of organic product development should be reflected in the process of socio-economic development of Ukraine's regions during the war, in particular in a separate territory, as an alternative direction of competitiveness, improving the quality of life of a rural population, development of depressed areas and one of the alternative ways of economic growth.

Most scientists influence the diversification of agricultural production, cultivation of various species, and population growth on food security (Oppong, et al., 2014; Blizkovsky, et al., 2020). However, the study of the impact of hostilities on global food security in current conditions has not

received sufficient attention. Ukrainian scientists note that Ukraine has significant domestic potential for agricultural production, allowing it to strengthen global food security (Popadynets et al., 2021).

Despite the low productivity and high costs for the production of organic products in the region for display in the production of pesticides, GMOs, and other substances of non-biological origin, the development of the organic output brings significant economic long-term benefits to the country. According to UNEP, such benefits include:

- Direct economic benefits for farmers, traders, and producers from the products themselves (e.g., higher prices and reduced costs);
- Economic benefits for society - employment (throughout the value chain);
- Economic benefits for society - increased exports (e.g., organic products and/or reduced imports, such as energy and agrochemicals);
- Direct economic benefits for producers from the sale of public goods and services (e.g., biodiversity conservation and landscape care or capture-oriented carbon pricing mechanisms);
- Long-term benefits from increasing natural capital, especially from soil improvement;
- Costs for society (for example, water purification and medical care);
- increase capital (for example, cooperation between consumers, pride in doing something valuable, increasing trust in the value chain, as well as deeper understanding between consumers and owners) (UN Environment Program, 2018).

This is Senyshyn (2017) believes that "if the development of organic food production and organic farming in the coming years does not become a strategic task of Ukraine, the import and its own shadow production of genetically processed food can destroy the gene pool of the Ukrainian people. Therefore, we strive to emphasize the need to intensify the production of organic products in Ukraine, taking into account the experience of production of these products in European countries". Thus, the stage in substantiating strategic directions for the development of organic food products is the harmonization of national and international legislation. We propose to divide the strategic principles of the development of organic food

products into macro-, meso- and micro-levels.

Thus, as noted by Kulish (2019), "Organic production in Ukraine is an up-and-coming area that can increase the competitiveness of agricultural products, significantly improve the country's image on the world stage, and promote market infrastructure and sustainable development of the country as a whole. However, the identified problems require the development of effective measures of state support to increase production and sales of organic products, which requires further research in this area ". Thus, only with the help of well-established cooperation between the state and business is it possible to sustainably increase the production of organic products, ensuring its competitiveness in the world. An effective mechanism of state support will ensure sustainable organic food production.

Ushakova-Kirpach (2020) believes that "In the context of increasing trends in human population, exacerbation of the global food problem and growing global demand for food, the interest of academia and economic elites in the efficient production of environmentally friendly agricultural products is growing. Given the geopolitical and climatic conditions, Ukraine has a huge potential in the market of organic products, which is developing rapidly in the world and especially in the European Community. This requires the creation of a clear regulatory state mechanism for the development of organic production and harmonization of Ukrainian legislation with European standards". The current state mechanism for regulating the production of organic products must meet the requirements of the international community. That is why the legislation of Ukraine on organic production should harmonize with the international one.

In addition, Granovska (2017) also determines that "The development of organic sector enterprises requires continuous improvement of their management and production activities to ensure competitiveness. Competitive development and the formation of sustainable competitive advantages help maximize management's positive economic effect, the disclosure of aggregate production potential, and economic growth of agricultural formations. The process of providing competitive advantage has several stages of development. Competitive advantages of the first level are formed due to the excess of basic resources, the second - due to the intensification of investment policy

and increased investment, and the third level is determined by innovation; such competitive advantages are considered the highest". The competitive development of organic production is impossible without an active investment policy and the search for essential resources that will ensure the implementation of innovations.

Tkachuk (2015) emphasizes that "Given the world experience, it can be argued that without the organization of the organic market it is impossible to spread organic farming, so it is necessary to support and stimulate its development, promote information about the benefits of organic products, create appropriate information and consultation structures. It protects the rights of consumers of organic products, research, educational centers, etc. All this will increase the number of organic enterprises and increase employment. In addition, the intensification of organic production will improve the biological activity of the soil, restore the balance of nutrients and, as a result, increase crop yields and increase producers' income". A compulsory component for developing organic production is the activation of all participants in the process. This will provide incentives from different sides to organize the production of organic products.

Food and Agriculture Organization of the United Nations (FAO) (2006) "Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences in order to lead a healthy and active life." This definition gives greater emphasis to the multidimensional nature of food security and includes: "the availability of food, access to food, biological utilization of food, and stability".

Given the significant potential for developing organic production and expanding the market for organic products in Ukraine, specific mechanisms have been launched to stimulate this area of agriculture. In particular, according to the Ministry of Agrarian Policy and Food, in 2021, the government has allocated UAH 50 million for state support of producers of organic agricultural products, which will be directed as follows:

- 1) Budget subsidy per unit of cultivated land (1 hectare) - for UAH 5,000, but not more than UAH 100,000. Per one operator (total amount UAH 30 million);
- 2) Budget subsidy for the maintenance of cattle, identified and registered by the law

as of August 1 of this year - in the amount of 5 thousand UAH. Per 1 head of livestock (total amount UAH 15 million);

- 3) Partial reimbursement of the cost of certification of organic products - in the amount of 30% (excluding value-added tax), but not more than 20 thousand UAH per business entity (total amount of 5 million UAH) (Ministry Agricultural Policy and Food, 2021).

The purpose of the article is to assessing the potential of regions in the field of organic production.

Materials and methods

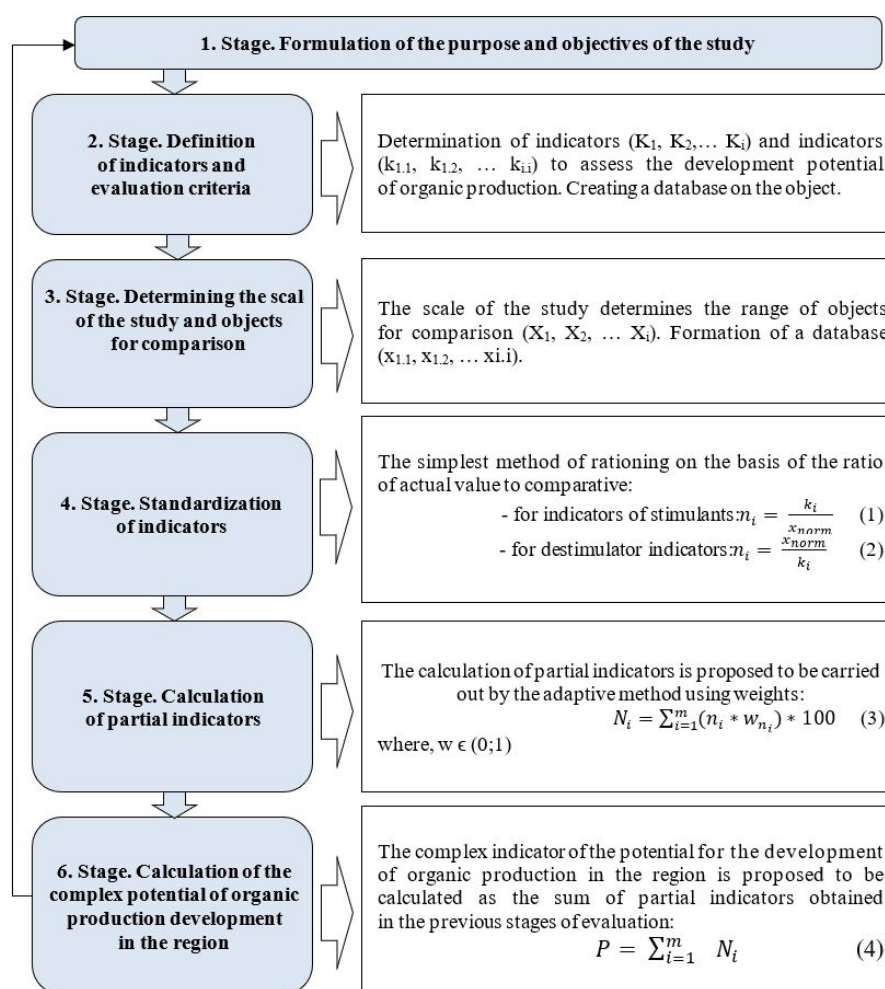
The formation and implementation of a strategy for developing organic production in the context of decentralization for OTG in which the rural population. Stimulating the development of the organic output and creating appropriate clusters, cooperatives, and other integration entities will help consolidate the people. Develop human potential, strengthen the economic base and infrastructure, and develop related economic activities: green tourism, green energy, and more.

In this context, we agree with Golyan et al. (2021) that "the creation of united territorial communities based on urban and rural settlements creates additional demand for organic agricultural products and enables local self-government to coordinate the activities of the subjects of organic farm production through the transfer of agricultural land and the provision of various financial preferences at the expense of local budgets. That is, decentralization has created additional opportunities for the accelerated development of organic agricultural production, which, provided the formation of appropriate institutional and financial support, will give new impetus to the socio-economic prosperity of united territorial communities.

The proposed method is based on the use of cluster and rating analysis tools and involves the following steps, shown in the Figure 1.

The first stage of assessing the potential of the region (territory) from the standpoint of organic production is to determine the purpose and objectives of such assessment. This will affect the selection of relevant indicators, indicators, and their ranking.

The next step is to select the most relevant indicators and evaluation indicators. In connection



Source: processed by the authors

Figure 1: Stages of assessing the potential of regions in the field of organic production.

with the features and conditions necessary for the development of the agricultural output, as well as the availability of statistical data available for evaluation, we have proposed indicators grouped into three groups:

- 1) Resources (resource potential) - a set of resources necessary for developing agricultural production and production of organic products. In particular, these are the area of agricultural land suitable for growing crops and humus content as an essential characteristic of their quality, rural populations that can potentially be involved in organic production processes. And the market value of agricultural land, which characterizes its value and potential productivity for crop development. This

group of indicators in work is attributed to the stimulators of organic production.

- 2) Ecology (ecological potential) - the environmental condition of territories, which is an essential condition for growing organic products: waste of different safety classes, incineration and disposal of waste in the region, the level of wastewater treatment, and the concentration of emissions into the air. The indicators used to assess the environmental friendliness of the area with their content are disincentives that should be taken into account in the rationing process.
- 3) Experience (business potential) - indicators that characterize the region's

specific achievements in agribusiness and organic production in particular, as well as the level of support for producers at the level of local governments. All indicators used to assess this group are stimulants. The third stage determines the scope of the study (global market, country, region, territory) and identifies the object for comparison.

Table 1 shows the leading indicators and indicators proposed to assess the potential of regions in the field of organic production.

Resources (R)	
Area of agricultural land, thousand hectares	r ₁
Humus content in the soil, t/ha	r ₂
Availability of tractors at agricultural enterprises, units	r ₃
Rural population, thousand people	r ₄
Normative monetary valuation of agricultural land, UAH/1 ha	r ₅
Ecology (E)	
Waste generation of I-III hazard classes, t/km ²	e ₁
Generation of hazard class IV waste, t/km ²	e ₂
Waste incineration, thousand tons	e ₃
Emissions of pollutants into the atmosphere from stationary sources of pollution, thousand tons	e ₄
Discharge of contaminated return water into surface objects, million m ³	e ₅
Experience (P)	
Number of certified organic market operators, units	p ₁
Area of agricultural lands with organic status, ha	p ₂
The share of the region in the gross output of agriculture, %	p ₃
The share of investment in agriculture in the structure of gross investment in the region, %	p ₄
Regional support for the development of organic production (availability of existing regional programs or projects) (1=yes, 0=no)	p ₅

Source: systematized by the authors

Table 1: Indicators and indicators for assessing regional potential in the field of organic production.

Objects for comparison can be:

- similar (adjacent, competing, alternative) regions, economic entities, or territories;
- the most perfect in terms of organization of production and market activities, regions, businesses, or territories;
- a system of normative values of selected evaluation criteria.

In the context of our study, the object of comparison is the regions of Ukraine, and as benchmarks - the best values achieved in the areas at the time of the assessment. That is the maximum values of indicators of stimulants and the minimum values of indicators of disincentives for the development

of organic farming. The system of actual indicators for assessing the potential of regions in terms of hands is given in the appendices.

It is proposed to use weights to determine the selected indicators in certain numerical intervals and ranking of hands for the evaluation of needles depending on the purpose of assessment. In the context of our study, the weights of all indicators are set at 0.2.

Results and discussion

Standardization of indicators for assessing the development potential of organic agriculture in the regions was carried out, and partial indicators were calculated. The results of the calculations are shown in Tables 2 – 5.

The results of the calculations showed that Odesa (86.7), Kharkiv (85.2), Dnipropetrovsk (84.6), Poltava (80), Vinnytsia (77.2), and Kirovohrad (77.3) regions are in the lead in terms of resource provision. This is because these are the regions with the largest areas of agricultural land, a significant rural population, and relatively high quality of agricultural land. On the contrary, the lowest level of resource potential is concentrated in Zakarpattia, Volyn, Chernivtsi, and Rivne regions.

In general, the assessment of resource potential at this level is relevant for determining the development potential of agriculture in general. However, it is more appropriate for organic production to supplement the analysis with an assessment of the ecological potential of the regions, as one of the necessary conditions for growing organic products is the level of environmental safety of the territories. In addition, organic farming, in essence, contributes to the preservation of the environment and ecosystems and has a positive impact on the development of other ecologically oriented economic activities: livestock, hunting, tourism and recreation, and alternative energy.

The indicators of ecological potential of the regions calculated in Table 3 allowed us to determine the group of leaders in which the most optimal conditions from the point of view of the ecological situation are formed both for growing organic products and for determining this type of management as a priority in agricultural production. First of all, these are regions with a low concentration of heavy industry and a relatively

Regions	Normalized indicators					Resource potential, R
	r ₁	r ₂	r ₃	r ₄	r ₅	
Vinnitsia	0.78	0.57	0.93	0.77	0.81	77.2
Volyn	0.40	0.15	0.23	0.50	0.65	38.7
Dnipropetrovsk	0.97	0.92	0.91	0.52	0.90	84.6
Donetsk	0.79	0.64	0.41	0.63	0.92	67.9
Zhytomyr	0.58	0.36	0.30	0.51	0.64	47.8
Zakarpattia	0.17	0.06	0.05	0.80	0.81	38.0
Zaporizhzhia	0.86	0.64	0.80	0.39	0.74	68.8
Ivano-Frankivsk	0.24	0.24	0.11	0.78	0.78	43.0
Kyiv	0.62	0.49	0.80	0.68	0.79	67.7
Kirovohrad	0.79	0.81	0.97	0.35	0.95	77.3
Luhansk	0.74	0.49	0.55	0.59	0.81	63.6
Lviv	0.48	0.24	0.23	1.00	0.64	51.7
Mykolayiv	0.77	0.80	0.64	0.36	0.80	67.6
Odesa	1.00	0.74	0.88	0.80	0.92	86.7
Poltava	0.84	0.77	1.00	0.54	0.90	80.9
Rivne	0.36	0.17	0.15	0.62	0.65	39.0
Sumy	0.65	0.57	0.50	0.34	0.80	57.2
Ternopil	0.40	0.39	0.30	0.58	0.86	50.6
Kharkiv	0.92	1.00	0.87	0.52	0.96	85.2
Kherson	0.76	0.47	0.57	0.41	0.73	58.6
Khmelnitsky	0.60	0.44	0.46	0.55	0.91	59.3
Cherkasy	0.56	0.58	0.66	0.53	1.00	66.6
Chernivtsi	0.18	0.12	0.11	0.52	0.99	38.3
Chernihiv	0.80	0.45	0.54	0.36	0.72	57.1

Source: authors' calculation

Table 2: Standardized indicators and indicators for assessing the potential of organic farming in the regions of Ukraine by resource component.

Regions	Normalized indicators					Business potential, P
	P ₁	P ₂	P ₃	P ₄	P ₅	
Vinnitsia	0.77	0.04	1.00	0.52	1.00	66.7
Volyn	0.23	0.07	0.29	0.21	0.00	16.1
Dnipropetrovsk	0.27	0.27	0.74	0.08	1.00	47.0
Donetsk	0.01	0.00	0.36	0.06	0.00	8.6
Zhytomyr	0.41	0.56	0.48	0.44	1.00	57.6
Zakarpattia	0.22	0.02	0.15	0.04	0.00	8.6
Zaporizhzhia	0.22	0.27	0.48	0.24	0.00	24.2
Ivano-Frankivsk	0.13	0.01	0.24	0.17	0.00	11.0
Kyiv	1.00	1.00	0.71	0.28	1.00	79.8
Kirovohrad	0.14	0.24	0.63	0.82	0.00	36.8
Luhansk	0.14	0.00	0.25	0.66	0.00	21.1
Lviv	0.39	0.24	0.40	0.11	1.00	42.9
Mykolayiv	0.54	0.15	0.45	0.34	0.00	29.7
Odesa	0.48	0.70	0.49	0.19	1.00	57.2
Poltava	0.33	0.40	0.76	0.34	1.00	56.6
Rivne	0.27	0.17	0.30	0.26	1.00	39.9
Sumy	0.08	0.00	0.52	0.82	0.00	28.6
Ternopil	0.12	0.17	0.43	0.69	0.00	28.2
Kharkiv	0.30	0.07	0.67	0.27	0.00	26.1
Kherson	0.65	0.98	0.50	0.39	0.00	50.4
Khmelnitsky	0.30	0.21	0.63	0.48	0.00	32.4
Cherkasy	0.19	0.69	0.70	0.65	1.00	64.8
Chernivtsi	0.05	0.00	0.18	0.09	0.00	6.4
Chernihiv	0.19	0.19	0.55	1.00	1.00	58.6

Source: authors' calculation

Table 3: Standardized indicators and indicators for assessing the development potential of organic farming in the regions of Ukraine by environmental component.

low level of demographic load of the territories, namely: Zakarpattia (65.2%), Volyn (59.1%), Chernivtsi (51.7), Zhytomyr (40.6%) and Rivne (36%).

Dnipropetrovsk (3.9), Zaporizhia (5.8), Kharkiv (6.8), Poltava (3.9), and Ivano-Frankivsk regions are the least suitable from the ecological point of view for the development of organic agriculture.

Business potential or the potential of experience characterizes specific achievements of regional farmers in the field of organic production, the level of support of local governments in this type of management, and the path of certification of land and products. As shown by the results of calculations (Table 4), the highest level of business potential at the end of 2019 demonstrates Kyiv (79.8), Vinnytsia (66.7), Cherkasy (64.8), and Zhytomyr regions. On the contrary, the worst indicators are in Zakarpattia, Donetsk, Chernivtsi, and Ivano-Frankivsk regions.

The complex indicator of the potential of each region is calculated, and the corresponding rating. Odesa (179), Kyiv (176), Vinnytsia (170), Cherkasy

(152), and Chernihiv oblasts lead the ranking with the highest total potential of 140 points. The business potential gives these regions the highest scores in the evaluation process. In particular, the Odesa region leads in the production of organic oilseeds; the Vinnytsia region grows organic wheat and oats, Kyiv region, in particular the city of Kyiv, uses the high potential of the domestic market as a competitive advantage in Zhytomyr, Chernihiv and Poltava regions - a high level of administrative support for organic production.

It should be emphasized that an essential characteristic of the potential is the balance of its components, the use of which will provide a synergistic effect in the production of organic products.

Comparing the three components of the assessment based on the results of our calculations, the most balanced are the components of the potential of the Zhytomyr, Rivne, and Ternopil regions.

In other regions, the potential is not balanced by the main components. An approach based on determining the region vector on a matrix

Regions	Normalized indicators					Business potential, P
	P ₁	P ₂	P ₃	P ₄	P ₅	
Vinnytsia	0.77	0.04	1.00	0.52	1.00	66.7
Volyn	0.23	0.07	0.29	0.21	0.00	16.1
Dnipropetrovsk	0.27	0.27	0.74	0.08	1.00	47.0
Donetsk	0.01	0.00	0.36	0.06	0.00	8.6
Zhytomyr	0.41	0.56	0.48	0.44	1.00	57.6
Zakarpattia	0.22	0.02	0.15	0.04	0.00	8.6
Zaporizhzhia	0.22	0.27	0.48	0.24	0.00	24.2
Ivano-Frankivsk	0.13	0.01	0.24	0.17	0.00	11.0
Kyiv	1.00	1.00	0.71	0.28	1.00	79.8
Kirovohrad	0.14	0.24	0.63	0.82	0.00	36.8
Luhansk	0.14	0.00	0.25	0.66	0.00	21.1
Lviv	0.39	0.24	0.40	0.11	1.00	42.9
Mykolayiv	0.54	0.15	0.45	0.34	0.00	29.7
Odesa	0.48	0.70	0.49	0.19	1.00	57.2
Poltava	0.33	0.40	0.76	0.34	1.00	56.6
Rivne	0.27	0.17	0.30	0.26	1.00	39.9
Sumy	0.08	0.00	0.52	0.82	0.00	28.6
Ternopil	0.12	0.17	0.43	0.69	0.00	28.2
Kharkiv	0.30	0.07	0.67	0.27	0.00	26.1
Kherson	0.65	0.98	0.50	0.39	0.00	50.4
Khmelnysky	0.30	0.21	0.63	0.48	0.00	32.4
Cherkasy	0.19	0.69	0.70	0.65	1.00	64.8
Chernivtsi	0.05	0.00	0.18	0.09	0.00	6.4
Chernihiv	0.19	0.19	0.55	1.00	1.00	58.6

Source: authors' calculation

Table 4: Standardized indicators and indicators for assessing the potential of organic farming in the regions of Ukraine according to the component of experience.

with coordinates (0; x; y; z) is proposed to determine the main strategies for developing organic production in regions. Three components of estimating their potential depends on the degree of balance and predominance of one or another part. The resulting vector begins at the zero point of the y-axis, and its orientation to a particular sector of the multidimensional plane will determine the primary strategy for developing organic production in the region.

Determination of the vector (A of each region in the field of organic production is proposed to be carried out according to the formulas:

$$\vec{A} \begin{cases} X = Ri - \bar{R} \\ Y = Pi - \bar{P} \\ Z = Ei - \bar{E} \end{cases} \quad (5)$$

where, P, R, E - integrated assessments of the potential of the i -th region in terms of resource, environmental, and business potential; $\bar{P}, \bar{R}, \bar{E}$ - average values of integrated capacity assessment achieved in all regions of the sample.

SECTOR (R; P; E) - Relatively high level of all components of potential. Strategy for the formation of a regional model of organic-oriented multidisciplinary agriculture. Creating conditions for the potential transition of agricultural enterprises to organic technologies. This will complete the preconditions for organic food production, organic livestock, and related sectors of environmentally oriented economic activities. It is possible to develop an innovative component for implementing SMART specialization projects.

SECTOR (R; P; -E) - Characterized by a relatively high level of resource and business potential development with reasonably low environmental performance. A strategy focused on the most efficient use of the region's limited environmentally friendly resources for the cultivation and processing of organic products for the domestic market is proposed for interregional cooperation and development of the processing industry.

SECTOR (-R; P; E) - A sector that combines relatively high business potential and environmental benefits with a relatively low level of resources, including a shortage of suitable arable land for organic production. Proposed to grow crops that do not require significant areas of cultivation: vegetables, berries, fruits, and spices: Eco-oriented positioning in the domestic and foreign markets, multidisciplinary specialization, and intersectoral cooperation.

SECTOR (-R; -P; -E) - Relatively low competitive advantages in organic farming development. It is proposed to give preference to traditional approaches to agricultural activities.

Sectors with one advantage need further research to develop another advantage. For example, suppose there is a purely environmental advantage. In that case, it is advisable to research the development of business preferences in the region (financial, administrative, and informational support at the local government level, search for niches in the domestic market, attract investment) or focus on other economic activities in the region. If there is a purely business advantage - research the development of resource potential in certain areas - narrower territorial specialization, and internal market development. If there is only a resource advantage - to conduct additional analysis of environmental suitability of land resources and (or) to develop inner potential in the field of traditional management.

The proposed strategies are a logical generalization of the situation about a specific ratio of components of the potential for developing organic farming in a given region. The development of more detailed production, financial and market strategies requires additional analysis of the conditions for the development of organic agriculture at the level of districts or individual united territorial communities and the impact of such products on the economic situation and food security of certain administrative-territorial entities. They are using the proposed approaches the coordinates of the vector of the organic production development strategy for the Ukraine regions are calculated. The results of the calculations are shown in Table 5.

According to the results of the calculations, the sector with the most optimal conditions for developing organic production can include Kyiv, Odesa, and Cherkasy regions. On the other hand, the industry with the least favorable in the context of the analysis combines Sumy and Ivano-Frankivsk regions. Therefore, in the different areas, combined strategies should be used.

Russia's war against Ukraine led to the execution of the most extensive territories, characterized by agricultural product cultivation. Kharkiv, Luhansk, Donetsk, Kherson, Mykolaiv, and Zaporizhia oblasts, where hostilities are taking place and victims of occupation are potential for organic production and have significant areas for agricultural production. We emphasize that

Regions of Ukraine	R	P	E	Strategy sector
Vinnitsia	16	29	-1	SECTOR (-R; P; -E)
Volyn	-23	-21	33	SECTOR (-R; - P; E)
Dnipropetrovsk	23	10	-22	SECTOR (R; P; -E)
Donetsk	7	-29	-11	SECTOR (R; - P; -E)
Zhytomyr	-14	20	14	SECTOR (-R; P; E)
Zakarpattia	-23	-29	39	SECTOR (-R; - P; E)
Zaporizhzhia	8	-13	-20	SECTOR (R; - P; -E)
Ivano-Frankivsk	-18	-26	-18	SECTOR (-R; - P; -E)
Kyiv	6	42	3	SECTOR (R; P; E)
Kirovohrad	16	-1	-11	SECTOR (R; - P; -E)
Luhansk	2	-16	2	SECTOR (R; - P; E)
Lviv	-10	5	-12	SECTOR (-R; P; -E)
Mykolayiv	6	-8	-16	SECTOR (R; - P; -E)
Odesa	25	20	9	SECTOR (R; P; E)
Poltava	20	19	-22	SECTOR (R; P; -E)
Rivne	-22	2	13	SECTOR (-R; P; E)
Sumy	-4	-9	-14	SECTOR (-R; - P; -E)
Ternopil	-11	-9	5	SECTOR (-R; - P; E)
Kharkiv	24	-11	-19	SECTOR (R; - P; -E)
Kherson	-3	13	1	SECTOR -R; P; E)
Khmelnytsky	-2	-5	10	SECTOR (-R; - P; E)
Cherkasy	5	27	2	SECTOR (R; P; E)
Chernivtsi	-23	-31	26	SECTOR (-R; - P; E)
Chernihiv	-4	21	10	SECTOR (-R; P; E)

Source: authors' calculation

Table 5: Coordinates the vector strategy of the development of organic production in the context of the regions of Ukraine.

in the other war in Ukraine, there will be a reduction in agricultural production, including organic, which will lead to a violation of food security in most countries.

It should be emphasized that the representative data obtained during the study are due to the subjective choice of the author of the evaluation criteria, the scale of the compared sample, weights, and optimality criteria. However, in general, the proposed methodological approaches are pretty universal. Therefore, they can be used as analytical tools for developing strategies and programs for developing organic production in the regions and individual OTG, justification of business projects, and business plans for the organization or transition of business entities in the organic segment. Presentation at the micro-level optimization of structural models of the region's economy, taking into account the principles of sustainable development. The authors' team considers combining territories into clusters for their socio-economic development (Nadtochiy et al., 2022). The authors discuss the advantages of forming clusters in agriculture while determining the growth of employment of the population

of the respective territories. They point out that wages in clusters are usually higher than in non-clustered firms or average wages in the region. Transaction costs are reduced in the division of labor and subcontracting (Zheliakov et al., 2015).

Shcherbina et al., (2020) consequently the model of rural region territorial cluster is useful in making guidelines for land-use planning for sustainable development of rural settlement system. Directions for future research are in making recommendations for integrated rural development, taking into account local resources and characteristics.

The clusters in question produce several social and environmental benefits as an integral part of their business strategies. This should be clear by their contributions to the education and training of the local workforce, the creation of new jobs, the improvement of local incomes, the production of sustainable energy, and the production of healthy, sustainable, and additive-free food, etc (Martinidis et al., 2021).

Most of the robust clusters relating to the modern branches of the economy are concentrated in the larger urban areas of Sweden, though in some

cases, also in other larger regional urban centres. The most surprising result was perhaps that clusters of employment within such modern branches are relatively over-represented in certain parts of some lagging areas, a fact that may reflect the effects of regional policy measures on the decentralisation of R&D and post secondary education (Ceccato et al., 2002).

Therefore, the clustering of territories according to rural-Boyersky purposes can become a tool for ensuring road safety in the conditions of Russia's war against Ukraine. Many of today's food crises are linked to war and violent conflicts. This paper elaborates four logics of war that have an impact on food insecurity: a) destruction; b) conflict-induced displacement; c) food control; d) hunger as a "weapon of war". These logics explain why governments or belligerents are often unable or unwilling to respond to food crises, and why humanitarian assistance faces challenges in reaching people in need, while simultaneously avoiding exacerbating conflict (Birgit et al., 2022).

Despite USDA's optimistic 2022-2023 forecast for increased wheat production "World wheat production in 2022/2023 is estimated at 783.92 million metric tons, about 4.32 million tons more than forecast of the previous month" (US Department of Agriculture, 2022), it can be confidently stated that further military actions on the territory of Ukraine will lead to its decrease. In fact, Ukraine occupies a significant share of world food: about 27% of sunflower seeds, 5% of barley, 3% each of wheat and rapeseed, and 2% of corn (Gordiychuk, 2022).

In 2020, Ukraine exported 217,210 tons of organic products to the EU. The key product categories are cereals and oilseeds (the largest exporter to the EU), soybeans, honey, fruit and vegetables and the products of their processing. Russia and Ukraine mostly supplied wheat (pdf) to countries in eastern Europe, the Middle East, and Africa, but their crops also traveled as far as Nicaragua (World Economic Forum, 2022). The total organic export from Ukraine in 2020 amounted to 332 thous. tons and USD 204 mln. Since 24 February 2022 (the beginning of Russia's full-scale invasion of Ukraine) the organic sector as well as the entire agrarian industry has been suffering from aggression (Organicinfo, 2022). Many regions, such as the Middle East and North Africa, are heavily dependent on wheat and other exports, including maize, barley, and sunflower oil,

from Russia and Ukraine. Together, the two countries represent 12 percent of the global market share in calories. Our research shows that the current crisis is disproportionately affecting the poor in developing countries (Glauber et al., 2022)

On May 24 2018, the United Nations (UN) Security Council unanimously passed a resolution condemning the use of food insecurity and starvation as a tactic of war. It was the first time the Council had ever addressed the issue, acknowledging a threat to the lives of tens of millions of people. Aimed at countries currently engaged in international or civil wars, the resolution implores all parties to leave food stocks, farms, markets, and other distribution mechanisms intact. It demands parties in conflict permit humanitarian aid workers unimpeded access to populations in dire need and states that "using starvation of civilians as a method of warfare may constitute a war crime." (National Geographic, 2022).

At the time of war in Ukraine the EU is introducing new measures to strengthen food security. In particular, on 23 March the European Commission presented a range of short-term and medium-term actions to enhance global food security and to support farmers and consumers in the EU in light of rising food prices and input costs, such as energy and fertilisers, accelerated by Russia's invasion of Ukraine. The proposed measures are aimed at the agricultural supply chains becoming more resilient and sustainable in line with the Farm to Fork strategy. Support to organic production in Ukraine and implementation of the measures provided for in the Farm to Fork and Biodiversity strategies may ensure sustainability in general productivity of agriculture.

Despite international law and accepted international conventions to ensure global food security, the mechanism of exporting agricultural products from Ukraine during the war remains an unresolved issue. That is why developing a strategy for the further development of organic production in Ukraine in war conditions is a prospect for further research.

Conclusion

The authors proposed methodical approaches for assessing the potential of the regions of Ukraine in the field of organic production. The proposed methodological approaches make it possible to form clusters of regions based on the prospects

for developing organic production in the conditions of war in Ukraine, where appropriate specific strategies will operate. So, for example, according to the results of calculations in the industry, the most optimal conditions for developing organic production as of 2019 were Kyiv, Odesa, and Cherkasy regions. That is why the authors proposed for these regions the use of the strategy of forming a regional model of organically oriented multidisciplinary agriculture. This will create prerequisites for producing organic food products, organic animal husbandry, and related branches of ecologically oriented economic activity. The opposite is the results of the analysis where Sumy and Ivano-Frankivsk regions are combined, where the development of organic production with insignificant favorable conditions, the existing potential and structure do not allow farms to be completely converted to organic technologies for the production of agricultural products. The regions of Ukraine most affected by hostilities and occupation (Kharkiv, Luhansk, Donetsk, Kherson, Mykolaiv, and Zaporizhzhya) are potential for organic production. It has been determined that the additional economic losses of the industry from the war in 2022 alone are expected in the amount of about 22 billion dollars,

and a decrease in the income of agriculture and related sectors - from 10 to 30%. According to the results of 2021, the share of the agro-industrial complex was 10.6% of the national GDP. However, the assessment of the consequences of hostilities for the agricultural industry is complicated by the lack of an analogy, when a country with such a large-scale and important for the world market agricultural sector as Ukraine would be involved in the war.

They have significant areas for the production of agricultural products, which is why it is suggested to use combined strategies. It is predicted that the war in Ukraine will lead to a reduction in the production of agricultural products, including organic ones, and this will lead to food security in most countries. The article's authors emphasize the non-fulfillment of international law and accepted international conventions by the aggressor country, which will increase global food security. It is proposed to develop a mechanism for exporting Ukrainian organic products and to develop relevant production strategies at the regional level and the level of individual united territorial communities in wartime conditions.

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