

FOOD SECURITY MANAGEMENT IN THE SYSTEM OF THE AGRICULTURE SUSTAINABLE DEVELOPMENT

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Abstract

Within the article, theoretical and methodological aspects of food security management in the system of sustainable development of agricultural production are discussed. The main tasks of agricultural management in the context of ensuring food security based on achieving the goals of sustainable development have been defined. The global experience of food security management in the system of sustainable development of the agricultural industry has been studied, and potential tools for implementation in Ukraine have been proposed. The analysis of the state of agricultural production in Ukraine with the beginning of the large-scale military aggression of the Russian Federation indicates a reduction in both crop and livestock production. The level of food security has been analyzed based on the definition of the Global Food Security Index. The method of preliminary assessment of food security has been proposed as a basic stage of synthesis monitoring at the regional level. It is appropriate to consider food security of the region as an elementary unit of the country's unified food security system with appropriate monitoring of fluctuations in its level under the influence of internal and external threats. Thus, each region must ensure its own economic security in the food sector depending on the production direction of the region. The field of monitoring tasks is expanded, it includes not only observation and analysis, but also early detection of opposing factors and adjustment in this context of the regional policy of the food security management. Based on the analysis of the state of agricultural production, the priority goals of the state administration in the field of food security management have been identified. The calculation of the food security coefficient of the region has been proposed.

Keywords: *food security, public administration, region, regional food security, agriculture.*

JEL Codes: *Q12, Q14.*

Introduction

The topic of food security is a priority in the activities of the United Nations and correlates with the main goals of sustainable development (elimination of poverty, good health and well-being, reduction of social inequality, responsible

consumption of resources, fight against climate change, preservation of sea and land ecosystems, partnership). The strategic goal in this direction is to solve the problem of hunger by 2030 (Food Security Information Network, 2023). According

to the definition given in the report “Our Common Future”, produced by the International Commission on Environment and Development of the United Nations in 1987, sustainable development is understood as development that allows meeting the needs of the present generation without limiting the ability to meet the needs of future generations. The use of the sustainable development model is aimed at harmonizing the goals of the socio-economic policy of the states with the ecological component and preservation of the environment for future generations. In the economic sense, this means the orientation of production processes towards greening, the introduction of resource-saving technologies in the leading spheres of the economy, including the agro-industrial complex. Changes in the biosphere, introduction of environmental restrictions as administrative tools of activities on the environmental protection testify to their dominance in the socio-natural development of agricultural production. In the future, this contributes to the transformation of the extensive development of agriculture. Ukraine, as a leading participant in the world agricultural market, is not isolated from global processes, therefore, the formation of effective state management measures to ensure food security in the context of sustainable development of agricultural production acquires relevance and scientific significance.

The aim of the paper is to develop theoretical and methodological framework of food security management under the sustainable development system of agricultural production in the conditions of wartime.

Literature review

The issue of food security management is widely researched by domestic scientists (Augustin et al., 2016; Dukhnytskyi, B., 2020), the priority areas of scientific work are the assessment of the food security level at the meso- and macro-level (Pugachov et al., 2021; Branca et al., 2013; Pryshliak et al., 2023; Marhasova et al., 2024; Pugachov et al., 2021), the development of the state policy in the field of food security (Kang, X. 2013; Berezyuk et al., 2023; Dziurakh, Yu., 2024), legal provision of food security (Kurman, T.V., 2022), state

support for agricultural producers (Burkovska et al., 2021; Grosu et al., 2021; Zhavoronok et al., 2022), impact of crisis conditions on the state food security (Pugachov et al., 2021) etc.

The relevance of the issue of scientific research is confirmed by the results of the bibliometric analysis of the publication activity of the world scientific community in one of the most prestigious scientometric databases - Web of Science. First, there is a gradual increase in the number of publications on the topic of the food security management in the system of the agriculture sustainable development, starting from 3 articles in 1991 to 227 articles in 2023. The bibliometric analysis allowed to determine the geographical structure of the authors of the publications: China, the USA, Germany, Australia, England, India, the Netherlands and Italy. Using the VOSviewer information tools, we could analyze the relationship between keywords in scientific publications, the titles of which contain the words “food security”, “management”, “agriculture” and “sustainable development”, the results of the use of which confirmed the increased interest of scientists in this topic of research.

However, implementation of the sustainable development concept of agriculture in the conditions of threats to the national security of Ukraine and military aggression of the Russian Federation actualizes the development of new theoretical, methodological and applied approaches to the food security management.

Methodical approach

Methodological problems in this direction are formed by the choice of a unified way of describing the processes taking place in regional development and agro-industrial production based on a single technology of data collection and processing, as well as processing of reliable information in the conditions of rapid loss of its relevance.

The implementation of the synthesis monitoring is a controlled process, which is considered as:

- 1) an organization of search, collection, processing of information regarding selected components of the regional food security;

2) a system of criteria used for periodic assessment of transformations of the state food security management system, taking into account the goals of sustainable development.

The formation of the level of food security in the conditions of martial law is influenced by many factors, and for a specific region of Ukraine, depending on its socio-economic and agro-industrial specifics, the set of components of food security is peculiar, which makes it impossible to conduct monitoring based on single standardized indicators.

Conducting the synthesis monitoring involves an assessment of prerequisites, which can be carried out both on an objective and on a subjective basis. At the same time, it is expedient, in our opinion, to implement the following stages:

1) assessment of the impact of food security factors on the level of food security in a specific region;

2) formation of a matrix of ranks of food security factors by groups of components;

3) calculation of the food security indicator for each group of factor indicators and comparison of the obtained values;

4) ranking of the indicators according to the obtained coefficient of ensuring food security.

We propose to single out the following grouped factors that allow for synthesis monitoring of food security in the region:

I. Natural resource component:

1. Availability of land resources (X_1).

2. Degree of degradation of agricultural land (X_2).

3. Share of land unsuitable for growing agro-industrial products due to chemical or biological pollution (X_3).

4. Specific weight of cultivated areas in the total amount of agricultural land (X_4).

5. Degree of the renewed fixed assets (X_5).

II. Market component:

6. The level of the pressure monopolization the domestic food market (X_6).

7. Specific weight of imported agricultural products on the domestic market (X_7).

8. Specific weight of export products in the total output of agricultural products (X_8).

9. Price level of agricultural products (X_9).

10. Specific weight of the products of small agricultural enterprises in the total volume of agro-food products of the region (X_{10}).

III. General economic component:

11. Unemployment level in the region (X_{11}).

12. Specific weight of state support in the total costs of agricultural producers (X_{12}).

13. Specific weight of profit in the cost price of agro-food products (X_{13}).

14. Specific weight of investments in fixed capital in the total amount of investments (X_{14}).

15. Specific weight of effective organizational and legal forms of management (X_{15}).

To assess the prerequisites for the synthesis monitoring, it is advisable to use the simple ranking method. The indicator receives a score from 1 to 12 depending on the importance of the feature for the given region, where 0 is the minimum value of the assessment, 12 is the maximum value. The regions that are the leaders in the production volume of agricultural products were selected for the assessment.

The next stage is the calculation of the coefficient of food security of the region, which is proposed to be carried out as follows:

$$K_{in} = 100 - V_m \quad (1)$$

where, K_{in} are the food security factor;
 V_m - coefficient of variation.

$$V_m = \frac{\sigma_m * 100}{\bar{x}} \quad (2)$$

where, σ_m is the root-mean-square deviation in terms of ensuring food security;

x – sum of ranks;

\bar{x} – average sum of ranks.

$$\sigma_m = \sqrt{\frac{\sum (x - \bar{x})^2}{n}} \quad (3)$$

Results

Sustainable development of the agrarian sphere consists in coordinating the interests of agribusiness and territorial communities and the

population of rural areas. This actualizes the importance of new management approaches to ensure food security, since the refusal to use the principles of sustainable development and insufficient attention to ecological aspects can negatively affect the prospects for the development of the national agricultural sector, solving social problems of the development of rural areas. The orientation of agricultural management as a branch of the agro-industrial complex to ensure food security poses the following tasks:

- strategic management in the direction of increasing food potential and development of processing industries;

- compliance of the production of food products with the needs of the population;

- ensuring food safety;

- innovative development of agricultural production, introduction of modern technologies for production and storage of raw materials and food;

- development of the state policy that provides equal opportunities for all business entities;

- balanced social policy that provides a solution to the problem of providing food and employment for the poorest sections of the population;

- development of export-import relations and use of the advantages of the international division of labor.

In the modern economy, the food security management is considered in the context of the interaction of economic, ecological, political and social components. The main indicator that characterizes the state of food security in the country and the effectiveness level of the state policy in this area is the Food Security Index.

Food security management in the system of sustainable agricultural development is a key aspect of ensuring a stable and safe food supply.

The main goal of food security management is to provide each person with a sufficient amount of food products to lead an active and healthy life, promote the sustainable development of the agricultural sector, and preserve natural resources for future generations.

The Global Food Security Index is a global study and ranking of the countries of the world by the level of food security, which is produced by the British research company Economist Intelligence Unit (an analytical division of the British publishing group Economist Group) (Economist Impact, 2022). The methodology for assessing food security has been carried out since 2012 and is currently the most complete set of indicators of the state of food security in different countries of the world. The index is an indicator that reflects the level of state policy and the efficiency of government institutions in food security. The calculation is based on the following criteria:

- Level of food availability and consumption.

- Availability and sufficiency of food.

- Level of food quality and safety (Economist Impact, 2022).

These categories include 68 different indicators, the values of which are measured over a two-year period.

The calculation of the global index of food security in the countries of the EU and North America shows its high level, but in general, as experts testify, in connection with the COVID-19 pandemic and the increase in prices for agricultural raw materials, the situation in the world has worsened over the past 6 years. So, in 2022, Finland, Ireland and Norway, France, Japan and Canada had the highest value of the Index. According to the calculations of the Index, Ukraine was in 71st place (Table 1).

Table 1. Rating of the countries of the world by the level of food security (English Economist Intelligence Unit: Global Food Security Index 2022)

Position in the rating	Country	Overall assessment	Economic availability of food resources	Physical availability of food for the population	Quality and safety of food resources	Sustainable development and adaptation of agriculture
1	Finland	83.7	91.9	70.5	88.4	82.6
2	Ireland	81.7	92.6	70.5	86.1	75.1
3	Norway	80.5	87.2	60.4	86.8	87.4
4	France	80.2	91.3	69.0	87.7	70.3
6	Japan	79.5	89.8	81.2	77.4	66.1
7	Canada	79.1	88.3	75.7	89.5	60.1
9	Great Britain	78.8	91.5	71.6	77.6	71.1
13	USA	78.0	87.1	65.1	88.8	69.4
19	Germany	77.0	87.9	67.0	79.9	70.8
25	China	74.2	86.4	79.2	72.0	54.5
32	Kazakhstan	72.1	78.0	67.2	76.3	65.4
68	India/Algeria	58.9	59.3	62.3	62.1	51.2
71	Ukraine	57.9	66.6	48.1	71.3	43.5

*Source: (Economist Impact, 2022).

The military aggression of the Russian Federation had a decisive influence on the drop in Ukraine's ratings. Thus, according to the "Availability of food" indicator, Ukraine was in the 26th place among European countries and in the 96th place in the world, which is due to the increase in food prices and the limitation of state protection and state support programs. According to the indicator "Sustainability and adaptability", which reflects the problems of the water resources management and shortcomings in the risk management system, Ukraine ranks 94th. The best indicator in this rating was the country's 52nd place in terms of food quality and safety.

Among the factors that for a long time limit the provision of food security of Ukraine at a sufficient level, researchers single out the following (Pugachev et al., 2021; Zorya et al., 2021):

- Unbalanced food consumption;
- Inconsistency of the consumption of livestock products with the established norms of rational nutrition;
- Significant differentiation of the cost of food by social groups;

- Slow pace of introduction of international food quality standards;

- Satisfactory state control over food security of the population;

- Monopolization of land resources and consolidation of agricultural enterprises;

- Increasing social tension due to the impossibility of implementing the current legislation regarding the right of combatants to land plots (up to 2.0 hectares).

In the conditions of martial law, many factors influence the formation of the level of food security, namely: physical security, economic instability, destruction of transport infrastructure, social and demographic changes, damage and relocation of production facilities, restrictions on international trade, politics and legal regulation, environmental conditions and information security. Factors such as the destruction of crops and damage to agricultural land, inflation, disruption of logistics chains, population displacement, reduced access to resources and environmental pollution make it difficult to ensure food security in the complex conditions of war. Effective management of these factors is critical to maintaining stable food

supplies and resilience of food systems during conflict.

The study of foreign experience in ensuring food safety is a relevant vector for the development of food safety management policy in the context of sustainable development. For the economy of every country, the problem of food security is actualized in the period of crises, stagnation, economic and political instability, military operations. Foreign experience will make it possible to form the basis of the national policy of ensuring food security in the conditions of military aggression of the Russian Federation, aggravation of economic and social problems, especially since the leading countries of the world have a unique potential for the formation of mechanisms for ensuring food security in the national economy.

Conducting an analysis and generalization of the current tools for regulating the level of food security in the leading countries of the world will allow to single out important areas of development of the food security base, to develop effective mechanisms of the state policy in the field of development of agriculture and agro-industrial production, to form an effective model of state support. It is also appropriate to take into account the activities of international organizations and national institutes dealing with the problems of ensuring food security. Analyzing existing approaches to the implementation of state regulatory tools in the field of food safety, we draw the following conclusions:

1. The priority trend in the EU countries in ensuring food security is the emphasis on the ecological component and the use of “green” technologies, the achievement of ecological stability, the introduction of new technologies of agricultural production, social guarantees for the less protected sections of the population. Economic development, GDP growth are not considered as correlating indicators for assessing the level of food security.

2. In developing countries, the priority is given to the development of the agro-industrial complex as an export-oriented branch of the economy; it is important to make a profit by agricultural corporations, and the introduction of innovative technologies in agro-industrial

production is complicated by the problem of insufficient financial resources.

Approaches to the management of food security in different countries of the world are determined by both financial opportunities and the social capacity of society to solve global problems, natural and climatic conditions and the level of provision of natural resources. The analysis, generalization and systematization of the received information made it possible to identify a number of national models that have developed in the field of food safety, certain criteria of which can be further adapted for use in our country (Fig. 1).

Diversification of the sales markets of agricultural products, as well as the technologies and equipment, which are basic for the functioning of enterprises in the industry, should be mentioned among the priorities. The development of a cooperative form of management and the provision of financial benefits to agricultural producers, motivation for the introduction of digital innovative resources can become the basis for the creation of a new type of farms. Orientation to the rational nature management should be generated in the minds of agricultural producers to ensure their effective functioning, which will in the future have a positive impact on their international image and reduce the costs of restoring agricultural resources. In addition, this direction is a very significant aspect for foreign partners who are interested in the safety and environmental friendliness of products.

The use of media resources of Internet platforms and social networks, which are actively developing, also deserve attention. These opportunities can be actively used to promote domestic products on interregional and foreign markets.

The approach to considering the food security of the country as a set of food security of individual regions is impossible due to simultaneous provision of regional economic security. To consider food security from the point of view of providing only food products of own production, in our opinion, is inappropriate, since intra-regional exchange is important for economic stability. The approach to assessing food security of the region as the ability to pay

for imported products is also incorrect, since in the event of a crisis, food is purchased at the expense of the state budget at the macroeconomic level, and the use of one's own regional financial reserves may not always be sufficient. The methodology of the Food and Agricultural Organization of the United Nations,

based on which the level of food security is determined by grain stocks, is also impractical under the conditions of food security management at the regional level, since not every region specializes in the cultivation of grains and the development of grain processing.

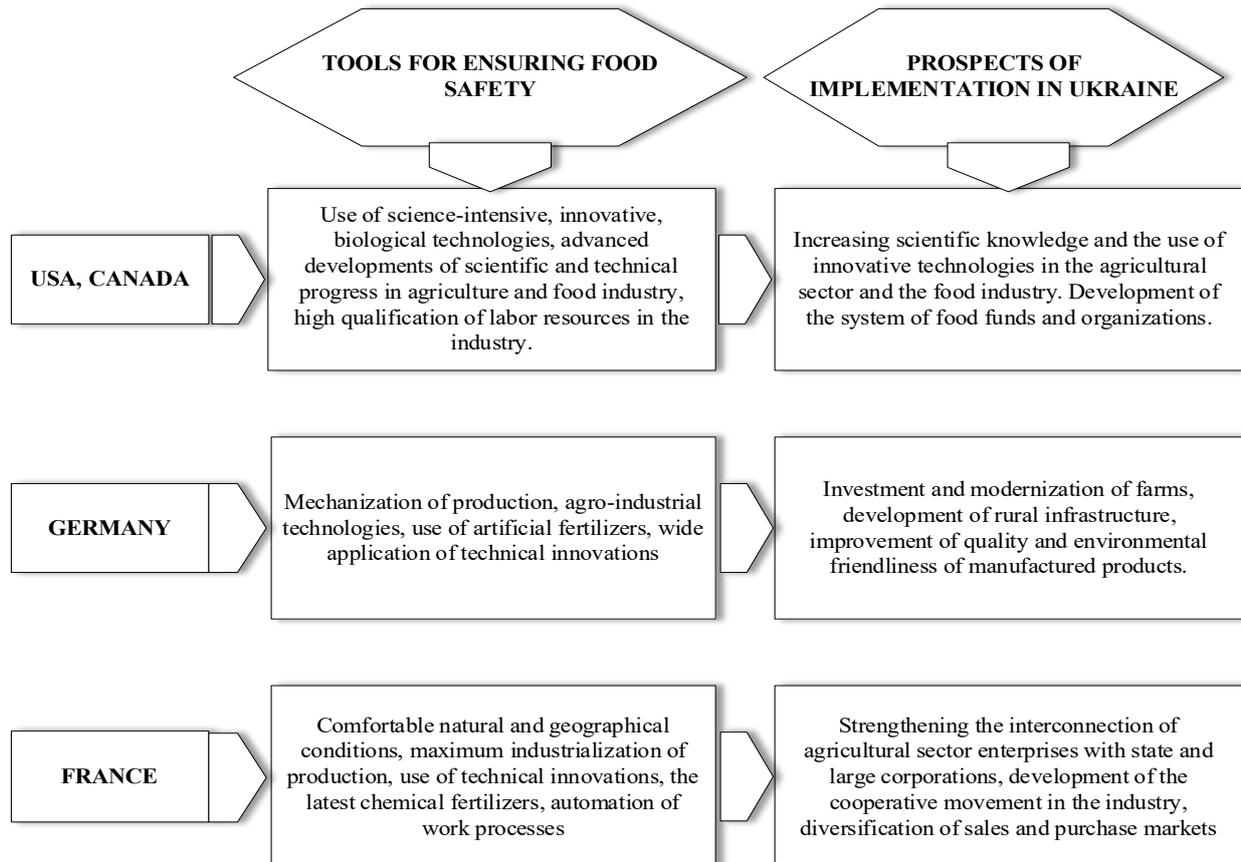


Figure 1. Foreign experience of implementing food safety tools

*Source: systematized by the authors based on Augustin M. A. et al., 2016.

It is appropriate to consider food security of the region as an elementary unit of the country's unified food security system with appropriate monitoring of fluctuations in its level under the influence of internal and external threats. Thus, each region must ensure its own economic security in the food sector depending on the production direction of the region. In agrarian regions, priority is given to the production of agricultural products, including food products, the development of the agro-industrial complex, due to which the support of food products is provided to regions that, due to

their specialization, are incapable of providing themselves with sufficient agricultural products. On the other hand, it is advisable for regions with an industrial orientation or bordering EU countries to ensure the purchase, delivery and distribution of food at the expense of the sale of their industrial products.

An analysis of the state of agricultural production in Ukraine with the beginning of the large-scale military aggression of the Russian Federation indicates a reduction in both crop and livestock production. The Kherson, Donetsk, and Luhansk regions significantly lost their positions

as a result of military operations. But the leading producers at the end of 2022 were Vinnytsya (1.22 bln EUR), Poltava (1.06 bln EUR),

Cherkasy (0.93 bln EUR), Dnipropetrovsk (0.89 bln EUR) Khmelnytskyi (0.89 bln EUR) region (Fig. 2).

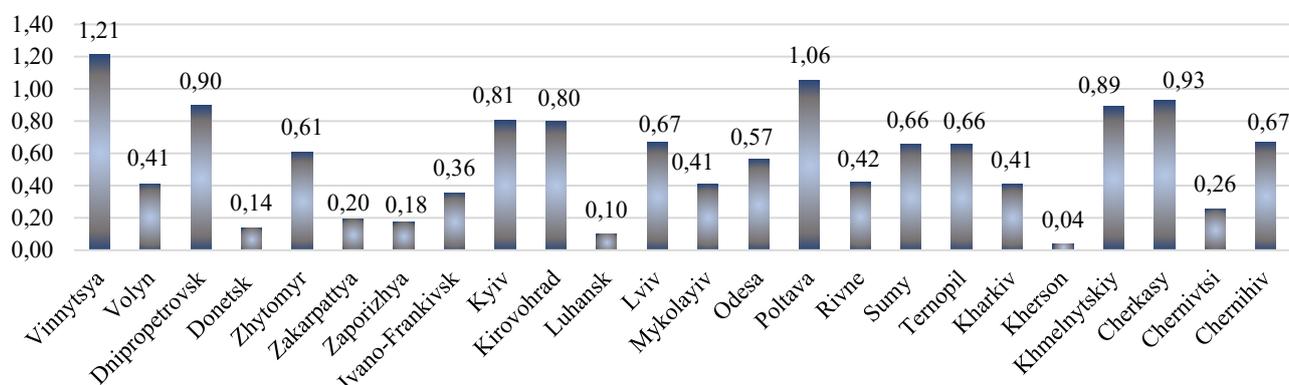


Figure 2. Agricultural goods output for 2022, bln EUR

**the calculation in EUR was made at the exchange rate of the National Bank of Ukraine as of December 31 of the corresponding year.*

**Source: State Statistics Service of Ukraine.*

The fall in the gross production of crop production in 2022 occurred due to a decrease in the production volumes of the vast majority of its species, namely due to a reduction in the production of grain and leguminous crops, sugar beets, potatoes, vegetables, and melon crops. Poltava region (0.91 bln EUR), Vinnytsya region (0.79 bln EUR), Kirovohrad (0.71 bln EUR), Khmelnytskyi (0.72 bln EUR). In comparison with the previous period, the overall drop in crop production was 28% (according to the data of the State Statistics Service of Ukraine).

Regarding the volume of livestock production, the situation also indicates a drop in production volume. Livestock production is more expensive for both the producer and the consumer in terms of cost, and in terms of profitability, it is not always profitable. This trend was the result of a decrease in the interest of private capital in investing its funds in this branch of agriculture due to its unprofitability and unpredictability of profit, which is caused by various risks (possible loss of livestock, fluctuations in purchase prices for meat and the uncertain position of the state in

relation to agriculture, military actions). Vinnytsya region (0.43 bln EUR), Cherkasy region (0.29 bln EUR) and Kyivska (0.23 bln EUR).

State regulation of food security in Ukraine currently has to take into account the instability of the external environment, military actions and political processes. Accordingly, the following methods of determining the level of food security are relevant, which allow taking into account external and internal threats and fluctuations, the orientation of agricultural production in a specific region, taking into account the natural resource potential, which becomes possible on the basis of the implementation of synthesis monitoring of the region's food security. The field of monitoring tasks is expanded, it includes not only observation and analysis, but also early detection of opposing factors and adjustment in this context of regional food security management policy.

According to the results of the expert assessment, we will form a matrix of the distribution ranks of the selected factors-indicators of food security (Table 2-4).

Table 2. Ranking matrix of indicators of the natural resource component

Region	Factors of influence				
	X ₁	X ₂	X ₃	X ₄	X ₅
Vinnytsya region	9	7	8	6	6
Poltava region	8	4	6	5	6
Cherkasy region	7	7	8	6	5
Dnipropetrovsk region	8	8	6	5	5
Khmelnytskyi region	4	4	8	3	2

Sum of ranks	36	30	36	25	24
Deviation from the average sum of ranks	5.8	-0.2	5.8	-5.2	-6.2
Standard deviation	33.64	0.04	33.64	27.04	38.44
Factor rank	2	5	3	4	1

*Source: compiled by the authors.

Table 3. Ranking matrix of indicators of the market component

Region	Factors of influence				
	X ₆	X ₇	X ₈	X ₉	X ₁₀
Vinnitsia region	4	9	5	10	6
Poltava region	3	9	5	8	3
Cherkasy region	3	9	5	4	3
Dnipropetrovsk region	5	4	1	9	2
Khmelnitskyi region	7	3	4	7	8
Sum of ranks	22	34	20	38	22
Deviation from the average sum of ranks	-5.2	6.8	-7.2	10.8	-5.2
Standard deviation	27.04	46.24	51.84	116.64	27.04
Factor rank	4	3	2	1	5

*Source: compiled by the authors.

Table 4. Ranking matrix of indicators of the general economic component

Region	Factors of influence				
	X ₁₁	X ₁₂	X ₁₃	X ₁₄	X ₁₅
Vinnitsia region	8	9	6	9	6
Poltava region	8	4	6	8	9
Cherkasy region	3	9	2	10	3
Dnipropetrovsk region	7	8	4	9	2
Khmelnitskyi region	2	7	9	4	7
Sum of ranks	28	37	27	40	27
Deviation from the average sum of ranks	3.8	5.2	-4.8	8.2	-4.8
Standard deviation	14.44	27.04	23.04	67.24	23.04
Factor rank	5	2	3	1	4

*Source: compiled by the authors.

Therefore, according to the assessment, the highest level among the factors of the natural-resource component has such influencing factors as the degree of renewal of fixed assets, the share of land unsuitable for growing agro-industrial products due to chemical or biological pollution and provision of land resources. Among the factors of the market component under these conditions, the priority belongs to the level of prices of agricultural products and the indicator of the specific weight of export products in the total output of agricultural products. The priority factors influencing the overall economic component are the specific weight of investments in fixed capital in the total amount of investments and the specific weight of state support in the total costs of agricultural producers.

According to the calculations of the food security factor of the region, the influence of the natural resource component on food security is 0.816; market - 0.796; general economic - 0.825. This makes it possible to conclude that, according to a subjective approach, the greatest influence on the food security of the regions of Ukraine under modern economic conditions is the own capabilities of agricultural enterprises in terms of investments, innovative development and increasing the production of agricultural products. The use of the proposed methodology will make it possible to determine the priority monitoring goals and basic indicators of food safety, which should be paid attention to in the process of implementing the tools of state regulation of food safety in the system of sustainable development.

Conclusions

Food security of Ukraine and its regions is considered as the state's ability to guarantee the satisfaction of food needs at the level that ensures the normal life of the population. The degree of food security of the state depends primarily on the basic potential of agricultural production. The agrarian policy in the field of ensuring food security should be aimed at providing assistance to domestic agricultural producers. When determining the appropriateness of food safety management tools, attention should be paid to the following aspects:

- taking into account the sectoral features of agriculture, increasing the economic fertility of the land, the ratio of the increase in the volume

of production and net income per unit of land area;

- provision of mechanization and automation of agricultural production;

- assessment of the economic and ecological consequences of food production not only from the point of view of individual farms, agriculture as a branch, but also of the economy in general.

All these aspects of agro-industrial production should be in an optimal, balanced combination. Sustainable development of the agro-industrial complex and especially agriculture is a crucial condition not only for increasing and qualitatively improving food resources while reducing costs, but also for the progressive development of the economy.

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