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Veröffentlichungsversion / Published Version

Zeitschriftenartikel / journal article

Empfohlene Zitierung / Suggested Citation:

Ivanov, R. V., & Hurtovyi, Y. V. (2023). Agricultural Development Management in the Context of Ukraine's Foreign Economic Security. *European Journal of Management Issues*, 31(3), 160-176. <https://doi.org/10.15421/192314>

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JEL Classification: Q11, Q17, Q18

Agricultural Development Management in the Context of Ukraine's Foreign Economic Security

R. V. IVANOV[‡],
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Purpose: Unsolved pre-war problems of agricultural production are additionally burdened by ongoing military operations, which have caused inevitable changes in domestic and foreign markets. Identifying and eliminating threats to the development of the agricultural sector will increase the efficiency of agricultural production, which will increase the level of foreign economic security of the country and, at the same time, strengthen global food security.

Design/Method/Approach: Based on the data of domestic and international statistical services and organizations, we used economic and statistical methods (regression, trend analysis) and graphically presented the obtained results.

Findings: A critically low share of imports negatively affects foreign economic security and pricing in the domestic market. The products export of plant-origin and low-value metals, as opposed to the high-tech products import, is critical. The condition with the provision of fish and fish products, fruits, berries and grapes, eggs, vegetables, and melon food crops is unstable. It depends either on conditions in foreign markets or only on domestic factors. The geographical structure of foreign trade is unsatisfactory and threatening due to excessive imports from China. An inverse correlation between the export volume of Ukrainian agricultural products and the world level of food prices has been established.

Theoretical Implications: The work confirms the importance of the Ukrainian agricultural sector in the context of global food security.

Practical Implications: We offer a set of actions, the implementation of which will make it possible to eliminate problems in agricultural production that negatively affect the state of foreign economic security.

Originality/Value: Work on a highly specialized topic, which includes the development of agricultural processes against the background of ongoing military operations.

Research Limitations/Future Research: In further research, it is advisable to consider the importance of the agricultural sector in the system of economic security of different countries since this article is limited to the methodology of the Ukrainian government.

Paper Type: Empirical

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Keywords: Agriculture, Indicators of Foreign Economic Security, Export of Agricultural Sector Products, Global Food Security, Black Sea Grain Initiative.

Reference to this paper should be made as follows:

Ivanov, R. V., & Hurtovyi, Y. V. (2023). Agricultural Development Management in the Context of Ukraine's Foreign Economic Security. *European Journal of Management Issues*, 31(3), 160-176. doi:10.15421/192314.

Управління розвитком сільського господарства в контексті зовнішньоекономічної безпеки України

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Мета роботи: Невирішені довоєнні проблеми сільськогосподарського виробництва наразі додатково обтяжуються триваючими військовими діями, які викликали неминучі зміни на внутрішньому та зовнішньому ринках. Визначення та усунення загроз розвитку аграрного сектору дозволить підвищити ефективність сільськогосподарського виробництва, що збільшить рівень зовнішньоекономічної безпеки країни та одночасно зміцнить світову продовольчу безпеку.

Дизайн / Метод / Підхід дослідження: На основі даних вітчизняних і міжнародних статистичних служб і організацій ми використали економіко-статистичні методи (регресійний, трендовий аналіз) та графічно представили отримані результати.

Результати дослідження: Критично низька частка імпорту негативно впливає на стан зовнішньоекономічної безпеки та ціноутворення на внутрішньому ринку. Експорт продуктів рослинного походження та недорогочінних металів на протидію імпорту високотехнологічної продукції є критичним. Стан із забезпеченням рибою та рибними продуктами, плодами, ягодами та виноградом, яйцями, овочами і баштанними продовольчими культурами є нестабільним, бо залежить або від умов на зовнішніх ринках, або лише від факторів на внутрішньому. Географічна структура зовнішньої торгівлі є незадовільною та загрозливою внаслідок надмірного імпорту з Китаю. Встановлена зворотна кореляційна залежність між обсягами експорту української агропродукції та світовим рівнем цін на продовольство.

Теоретична цінність дослідження: Робота підтверджує важливість українського аграрного сектору в контексті глобальної продовольчої безпеки.

Практична цінність дослідження: Ми пропонуємо комплекс дій, виконання яких дозволить усунути проблеми у сільськогосподарському виробництві, що негативно впливають на стан зовнішньоекономічної безпеки.

Оригінальність / Цінність дослідження: Робота над вузькоспеціалізованою темою, що включає розвиток сільськогосподарських процесів на тлі триваючих військових дій.

Обмеження дослідження / Майбутні дослідження: У подальших дослідженнях доцільно розглянути значимість аграрного сектору в системі економічної безпеки різних країн, оскільки дана стаття обмежується методологією українського уряду.

Тип статті: Емпіричний

Ключові слова: сільське господарство, індикатори зовнішньоекономічної безпеки, експорт продукції аграрного сектору, світова продовольча безпека, Чорноморська зернова ініціатива.

1. Introduction

Agriculture is one of the main branches of the Ukrainian economy, as agro-industrial enterprises make a significant contribution to the final value of goods and services produced in the country.

Agriculture accounts for an average of 16% of gross value added in some regions, and farming plays a crucial role in ensuring food security (Prokopyshyn *et al.*, 2022). Holovachko *et al.* (2021) consider agribusiness to be the engine of the domestic economy due to the fact that about 25% of the world's chernozem volume is concentrated in Ukraine. In the conditions of a favourable temperate climate, the large size of cultivated areas, a significant number of the employed population, and high soil fertility create a unique agricultural potential of the agrarian sector. Thus, in recent decades, the volume of production of grain and leguminous crops, as well as sunflower, has been rapidly growing (Chub, 2022). Despite the large production capacities of agricultural enterprises, there is a gap between the available and the maximum possible productivity of agricultural production (Lupenko & Andros, 2020).

Processes related to the development of agriculture affect the economic security of Ukraine, determining the state of its components – food, production, and foreign economic, investment, macroeconomic, or currency security. The country's ability to achieve balanced growth, which includes economic, depends on this. If the economic security level is satisfactory, then the standard of living and the population's well-being are not under threat. Moreover, Pravydyets (2022) emphasizes that economic security is the highest function of the state. Unprovoked Russian military aggression disturbed Ukraine's economic security state, creating numerous problems and challenges from which agricultural production also suffers. Substitutability and temporary occupation of cultivated areas, destruction of the irrigation system of land in the south of the country, the basis of which was the Kakhovka reservoir, closure and relocation of enterprises in the agricultural sector, destruction of crops due to shelling, disruption of product supply chains – all these factors cause losses to agriculture, negatively affecting economic security. Today, the economic security of the state has been dealt the most powerful blow in all the years of independence (Mazaraki & Melnyk, 2022). Despite this, the agricultural sector continues to ensure the functioning of business and the basic needs of the population in food, support the economy, and provide jobs (Nehrey & Trofimtseva, 2022).

Moreover, in the context of the rapid increase in world food prices caused by the war in Ukraine and food shortages in certain countries, the state of the domestic agrarian sector is also weighty for international food security. Considering the increase in the share of agricultural products exports in the structure of total exports, which is a powerful source of foreign exchange earnings and improves the balance of foreign trade, as well as the importance of the Ukrainian agricultural sector in the world market, the level of development of agriculture directly affects the state of foreign economic security of Ukraine. Increasing the export potential of the domestic agricultural sector of Ukraine's economy is a strategically important tool for strengthening the country's foreign economic security (Urba, 2019b). That is why the assessment of agriculture development and its impact on the foreign economic security of the country as a component of economic security is gaining new relevance.

2. Theoretical Background

The economic security of Ukraine is a multifaceted aggregate value. Hnatenko (2021) characterizes this economic category as the protection of a country's national interests from external and internal threats, whose purpose is to maintain a balanced economy and the ability for sustainable development. On the one hand, economic security is a subsystem of national security and characterizes the set of conditions in which the state's economy is located. On the other hand, it includes many lower-order systems described by more than 130 separate indicators (Ministry of Economy of Ukraine, 2013). Each criterion corresponds to its weighting factor (determined by expert evaluation), which indicates the significance of the indicator's influence on the

economic security state. Kharazishvili (2015) agrees with the Ministry's proposed methodology for displaying the economic security state using indicators. However, in our opinion, the economic security level assessment by the integrated method does not single out the impact of agriculture itself. However, it is worth noting that such calculations still reveal a component of economic security, which is a destabilizer and is not within the defined optimal limits. An enormous advantage of the integrated indicator is the accumulation of multidirectional information about economic, ecological, or social development (Lund *et al.*, 2011).

The obtained result makes it possible to determine the state of the studied system and to formulate scientific solutions necessary for its sustainable development. However, they may differ depending on the set of defined indicators. A disadvantage of integrated assessment is that some components (or several factors) are difficult to include in the model (Stern, 2022). For example, the level of foreign economic security can be affected by the presence of corruption risks and the quality of the logistics infrastructure of the agricultural sector. However, an incorrect method of calculating the relevant relative indicators, which will enter the model as indicators, endangers the objectivity of the results of such a model.

Kostiuk (2017) conducted a study in which he moved away from the country's economic security and defined the production security of agriculture. Although it combines all the components into one integrated indicator, more attention is paid to the indicator's evaluation and its comparison with the vector of threshold values.

When studying the development of agriculture and its impact on the foreign economic security of Ukraine, scientists suggested using economical and statistical as well as economical and mathematical methods, such as trend analysis (Choi *et al.*, 2019), variation analysis (Ma *et al.*, 2021), cluster analysis (Betáková *et al.*, 2018; Bogiday, 2019), regression analysis (Karkacier *et al.*, 2006), factor analysis (Weissenburger-Moser *et al.*, 2017; Laurett *et al.*, 2021) and time series analysis (Sathya & Karthiban, 2021). The specified methods allow us to demonstrate cause-and-effect relationships between the level of foreign economic security and indicators describing the functioning of the agricultural sector. As a result, certain areas of agricultural production can be identified, the direction of development of which is dangerous or critical (Bazylevych, 2014) if compared with the optimal values proposed by the Ministry of Economy.

It is worth emphasizing that this method of determining the economic security level is mainly widespread in the countries of the post-Soviet space. European states use more unified indices evaluating their development level, for example, the global competitiveness index calculated by the World Economic Forum. It makes it possible to rank the country included in the study in a fixed place, compare it to others, and evaluate its development over some time (Viškers & Volkova, 2017). Of course, the advantages of the Ukrainian system are taking into account the industrial and agricultural specialization of the country's economy. However, the global competitiveness index considers such meaningful indicators as corruption, inefficiency of public spending, quality of roads, and ability to retain a talented workforce. These indicators strongly influence the competitiveness of Ukraine. Considering the course toward European integration, the Cabinet of Ministers should improve the existing methodology (Varenyk, 2016), which includes Ukraine's specialization and foreign experience.

3. Problem Statement

Much more attention in economic science is paid to the assessment of economic security level in general, and the impact of the agricultural sector on economic security is less thoroughly studied. The least specialized topics are presented in scientific sources and publications, that is, the development of agriculture in the context of foreign economic security as a component of the country's economic security. It necessitates a detailed study of this topic.

The existing unsolved pre-war problems in agriculture, at present, are aggravated by ongoing military operations, which have caused inevitable changes in domestic and foreign markets. *Koshkalda et al. (2022)* single out the following as the main pre-war threats to the economic security of the agricultural sector of Ukraine: an imperfect mechanism of state support for agricultural production; tax pressure; loss of sales markets; low competitiveness of products; lack of an adequate system of protection against potential external dangers; adverse weather and climatic conditions; corruption; low level of availability of credit resources; non-professional management of agricultural sector enterprises; significantly worn and outdated technical base; land depletion. Eliminating the problems of the agricultural sector will undoubtedly have a positive effect. On the one hand, the state will be better able to ensure one of its functions – the economic security of its citizens, on the other hand, by supplying food to countries with food shortages – to strengthen a positive image in the international arena and increase the level of foreign economic security. Producers, in turn, will increase production efficiency and receive higher profits. It will allow them to expand their business and create new jobs.

4. Data and Methods

The conducted research based on the data available at the time of writing from the State Statistics Service of Ukraine, the UN Food Organization, the Ministry of Agrarian Policy and Food of

Ukraine, the International Grain Council, and the Ukrainian Grain Association. According to the Methodology of the Ministry of Economy of Ukraine, foreign economic security is represented by a set of indicators that characterize the effectiveness of foreign trade (including agricultural products). In accordance with this methodology, the necessary data for the study were collected, relating only to agricultural processes. The article uses the methods of economic and statistical analysis (correlation and regression analysis), synthesis, grouping, and graphic representation of results. We decomposed the overall indicator of foreign economic security into constituent elements, detailed by time, and used the techniques of relative and average values. As a result of the use of methods and techniques, areas of agricultural production and factors that are demotivators of the level of foreign economic security have been identified.

5. Results and Discussion

5.1. Indicators of Ukraine’s Foreign Economic Security Connected with Agriculture

Foreign economic security is one of the components of the economic security of Ukraine. According to the methodology of the *Ministry of Economy of Ukraine (2013)* it is described by a set of indicators, most of which take into account the agricultural processes presented in Fig. 1.

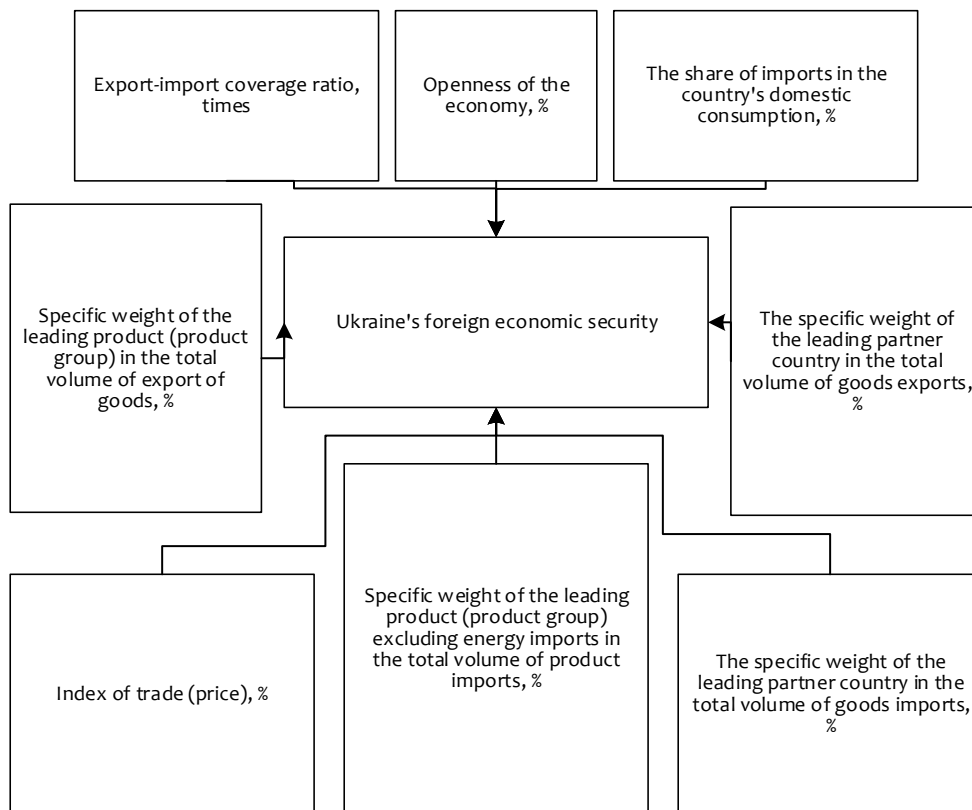


Figure 1: Indicators of foreign economic security related to agriculture

Source: Ministry of Economy of Ukraine (2013)

One of the indicators characterizing the foreign economic security of Ukraine from the point of view of the efficiency of the economy is the index of openness of the economy, which indicates the degree of dependence of the economy of Ukraine on international trade: with a high value of this index (1), fluctuations in foreign markets and financial and economic crises have a strong impact on the domestic market and the state of economic security.

$$I_{eo} = \frac{1}{2} \frac{(Ex + Im)}{GDP} \times 100\% \tag{1}$$

where I_{eo} = index of openness of the economy,
 Ex = export of goods and services,
 Im = import of goods and services,
 GDP = gross domestic product in actual prices.

The value of the index in the context of economic security is determined in accordance with Methodological recommendations (*Ministry of Economy of Ukraine, 2013*) and given in Tab. 1.

Table 1: Dynamics of the openness index of the economy of Ukraine in 2010-2022

Year	Gross domestic product in actual prices, million UAH	Export of goods and services, million UAH	Import of goods and services, million UAH	Openness Index of the economy, %	The value of the index in the context of economic security
2010	1,079,346	507,869	551,402	49.07	dangerous
2011	1,299,991	647,608	733,526	53.12	critical
2012	1,404,669	670,319	791,844	52.05	critical
2013	1,465,198	629,401	764,730	47.57	dangerous
2014	1,586,915	771,129	826,764	50.35	critical
2015	1,988,544	1,045,928	1,097,854	53.90	critical
2016	2,385,367	1,175,953	1,341,115	52.76	critical
2017	2,983,882	1,432,690	1,662,128	51.86	critical
2018	3,560,596	1,609,365	1,919,862	49.56	dangerous
2019	3,978,400	1,639,048	1,957,770	45.20	unsatisfactory
2020	4,222,026	1,639,060	1,702,946	39.58	optimal
2021	5,450,849	2,217,860	2,289,881	41.35	optimal
2022	5,191,028	1,840,563	2,712,325	43.85	satisfactory

Source: International economic activity (State Statistics Service of Ukraine, 2023a); own elaboration

The average growth rate of the index of economic openness, calculated as the geometric mean of the chain growth coefficients, is 99.1%. Thus, every year there is a decrease in the degree of integration of Ukraine's economy into world trade by an average of 0,9 and in 2022 the openness index was 43.85%. It should be noted that such a decrease is a stimulus for the level of economic security since the Ministry of Economy of Ukraine has determined the optimal value of the openness of the economy equals approximately 37.5%, and the critical value is 50% or more. Arkhireiska, and Panaseyko (2015) casts doubt on the optimal index

of the openness of the economy because in the most countries with balanced economies, this indicator is at approximately level 20-35% of GDP. That is why it is necessary to reduce the index of economic openness within optimal limits, which can be achieved by increasing GDP and controlling the reduction of imports.

During 2010-2022, a negative trade balance is observed, that is, an excess of goods imports over their exports, which is shown in Fig. 2.

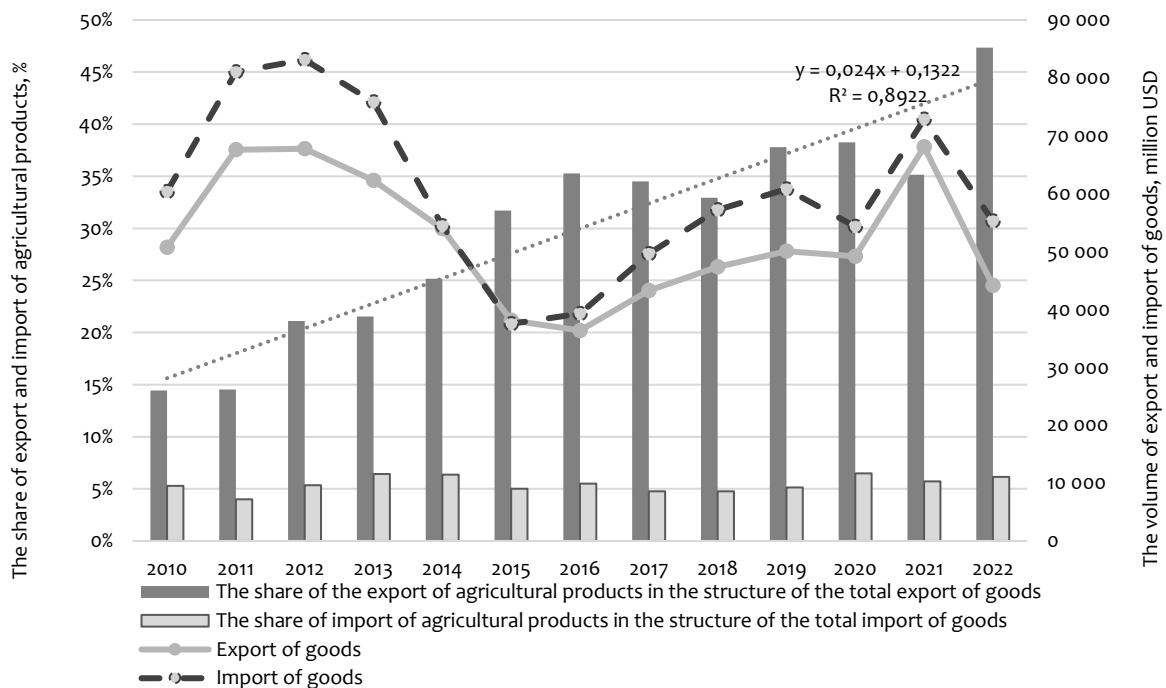


Figure 2: The dynamics of export and import of goods and the share of agricultural products in their overall structure in 2010-2022

Source: International economic activity (State Statistics Service of Ukraine, 2023a); own elaboration

The share of imports of agricultural products fluctuates around the value of 5.46%. According to the constructed trend line, in the structure of the total export of goods, agricultural products annually grow by an average of 2.4% and reach a maximum value of 47.34% in 2022. On the one hand, such dominance of farming production in exports is negative. It defines Ukraine as a country with a commodity-type economy of agrarian specialization with a low share of added value. On the other hand, this branch of the economy is characterized by a positive trade balance during 2010-2022, providing foreign currency inflows to the country, especially

when compared with the corresponding indicator for goods as a whole (Fig. 3).

Analyzing the data in Fig. 3, it can be stated that only in 2015, the value of export of goods covered the worth of import of goods by 610.71 million USD. That is, the coverage ratio was more than 1.00 (equaled 1.02), being within the optimal value in the context of the country's foreign economic security. In all other years, except for 2014 and 2015, this indicator had values lower than 0.95, which characterizes the economic security level as critical and dangerous.

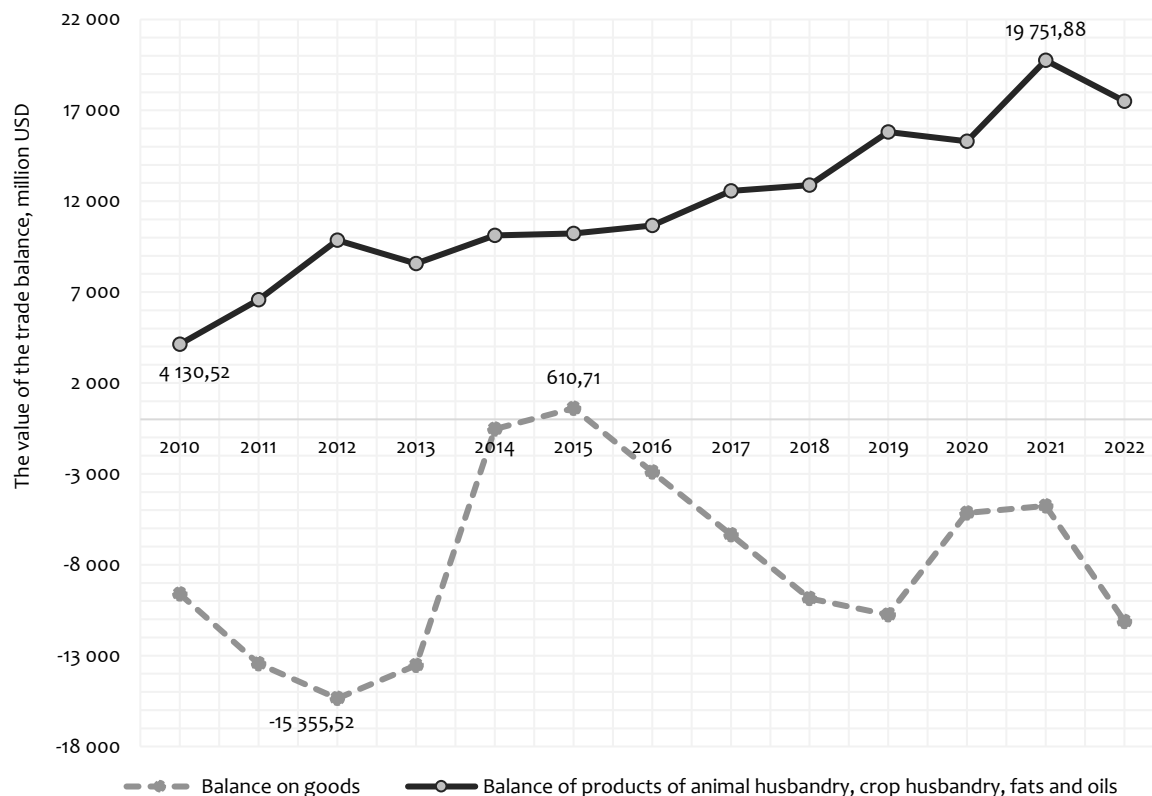


Figure 3: The dynamics of the values of the balance of the trade balance of Ukraine for goods and agricultural products in 2010-2022

Source: International economic activity (State Statistics Service of Ukraine, 2023a); own elaboration

The export-import coverage ratio is mixed in its economic meaning. To a certain degree, it stimulates the economic security level, but its significant excess is a disincentive that negatively affects the country's economic security level. In agricultural production, the export-import coverage ratio is not optimal for any food category: for example, in 2021, it equals 851.2 for corn but only

0.03 for fish and fish products. It indicates the production imbalance, excessive export of some food product types, and the country's import dependence on others. Tab. 2 calculates indicators characterizing the degree of provision of food needs, export-oriented agricultural products, and dependency on supplies from foreign markets.

Table 2: The degree of Ukraine's food supply and dependence on the situation on foreign markets

The type of food	Level of products provision, %	Export-import coverage ratio	The share of imports in consumption, %
Fish and fish products	18.99	0.03	84.12
Other types of grain	159.46	4.17	51.27
Vegetable oil	961.03	19.19	51.24
Fruits, berries, and grapes	79.28	0.30	48.48
Barley	285.28	103.82	26.83
Corn	553.13	851.21	18.35
Other types of meat	88.24	0.33	18.18
Sugar	114.56	0.22	14.23
Pork	87.76	0.11	13.35
Poultry meat	132.27	3.67	12.27
Milk and dairy products	95.21	0.47	9.37
Beef and veal	103.67	1.71	5.69
Vegetable and melon food crops	106.08	0.80	5.00
Potatoes	101.47	0.13	4.60
Wheat	432.95	156.66	3.18
Eggs	112.45	24.25	0.62
Rye	137.59	137.00	0.29

Source: International economic activity (State Statistics Service of Ukraine, 2023a); own elaboration

Analyzing the given data on food products, the provision of fish and fish products is critically low (a decrease in its level is observed from 28.39% in 2017 to 18.99% in 2021) due to underdeveloped production, the share of imports in consumption is enormous and

amounts to 84.12%. There are other types of grain crops, the production of which is insufficient, and consumption is ensured at the expense of imports – rice, chickpeas, lentils; a high share of oil imports is explained by the importation of olive oil and other

vegetable oil types, in particular, soybean oil, amaranth oil, sesame oil, walnut oil and so on. The production of fruits, berries, and grapes and even a significant volume of imports does not fully satisfy the population's needs, creating a partial deficit. The supply volume and demand on the market come to a state of equilibrium due to the high price that not all consumers can afford. It is also

worth noting the decline in the production of milk and dairy products, the supply level of which decreased from 107.71% in 2017 to 95.21% in 2021, while the share of imports in consumption increased from 1.55% to 9.37% in corresponding years. Stagnation in the development of the dairy industry can be graphically displayed using the scheme presented in Fig. 4.

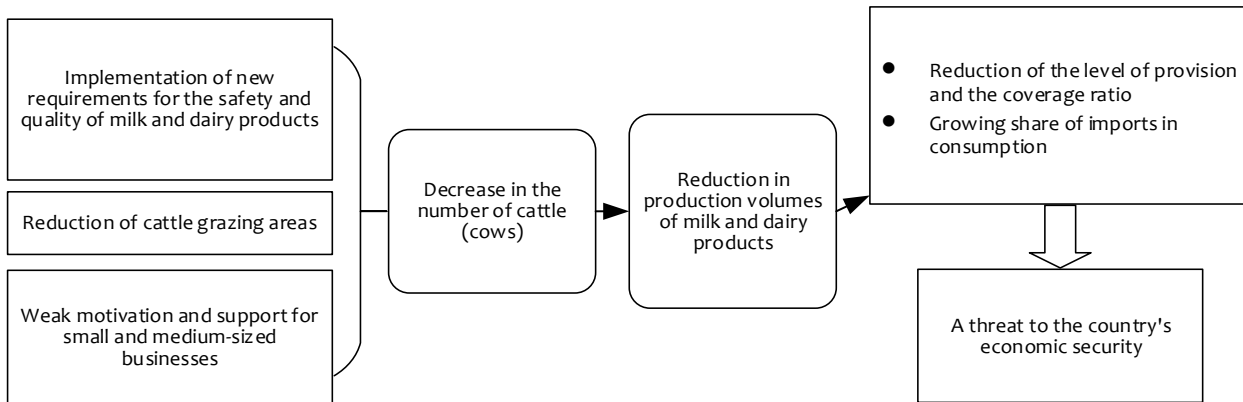


Figure 4: The influence of the state of the components of agriculture on the level of economic security of the country on the example of the production of milk and dairy products

Source: own elaboration

According to a similar scheme, processes in the development of agricultural production and factors that negatively affect the economic security state can be determined. That is, the level of food security, the export-import coverage ratio, and the share of imports in consumption are indicators of economic security. Their assessment makes it possible to identify problems, the elimination of which will lead to a greater economic security level.

It is worth noting that both a high share of imports in consumption (more than 30%) and a low one (less than 5%) are critical for economic security because this indicator is both a stimulant and a disincentive. Thus, a small share of imports means either a low-security level or security at the expense of domestic production only, in which there may be no competition in the quality of manufactured products, or monopolization of production, which leads to the establishment of high prices or their significant fluctuation depending on the situation in the country.

For instance, egg production is characterized by a critically low share of imports, which amounted to 0.62% in 2021, and therefore depends exclusively on a combination of factors occurring within the country. Fig. 5 shows the dynamics of the price index for chicken eggs (the price level as of March 1, 2017, was taken as the basis of comparison). Average annual prices in 2018-2021 are calculated using the chronological average due to the presentation of the initial data in the form of a moment series of dynamics. Thus, in 2020, the price of chicken eggs decreased in light of the reduction in the intensity of economic relations – the suspension of business activities, a drop in trade volumes, and a drop in consumer demand caused by coronavirus restrictions. After that occasion, the economy began to recover. The price index for 2022-2023 is presented monthly to identify seasonality in egg production. Thus, in the cold season from October to March, domestic chickens lay less, and therefore there is a shortage of the product on the market, which causes a significant increase in prices.

In addition to the trend and seasonal components, in 2022, the dynamics of the price index had a decisive influence on the random element: egg incubation for the production of young birds was partially stopped due to military operations, and some enterprises significantly reduced or absolutely suspended their activities (Ministry of Agrarian Policy and Food of Ukraine, 2022). Also, the rapid increase in the price of chicken eggs was influenced by frequent power outages used to maintain the temperature regime

in poultry farms. Considering the above factors, starting in September 2022, the price index began to rise rapidly, reaching its maximum value of 348.27% in December 2022 compared to the base period. Compared to the price as of June 1, 2022, the egg price has increased by 2.5 times.

Thus, the low share of food imports is a threat indicator to the country's economic security. When a shortage occurred caused by the war, for example, chicken egg pricing was under the influence of only internal factors of production. In the future, it is necessary to increase the share of imports in consumption, help such industries move to safer places, and, if possible, provide financial support.

Tab. 3 shows the grouping of agricultural products depending on the average share of imports in consumption and defines the critical types of food according to the methodological recommendations of the Ministry of Economy of Ukraine.

Table 3: The influence of the import volume of agricultural products on the state of economic security in 2021

Characteristic values of indicators	Average share of imports in consumption, %	Average share of imports in consumption, %
Critical value	2.74%	Rye, eggs, wheat, potatoes, vegetables, and melon food crops
	58.78%	Rye, eggs, wheat, potatoes, vegetables, and melon food crops
Dangerous value	5.69%	Beef and veal
	26.83%	Barley
Unsatisfactory value	9.37%	Milk and dairy products
Satisfactory value	12.27%	Poultry meat
Optimal value	16.03%	Corn, sugar, pork, other types of meat

Source: State Statistics of Ukraine (2022); own elaboration

Thus, potatoes, vegetables, and melon food crops are at risk of rapid price increases due to the action of internal factors.

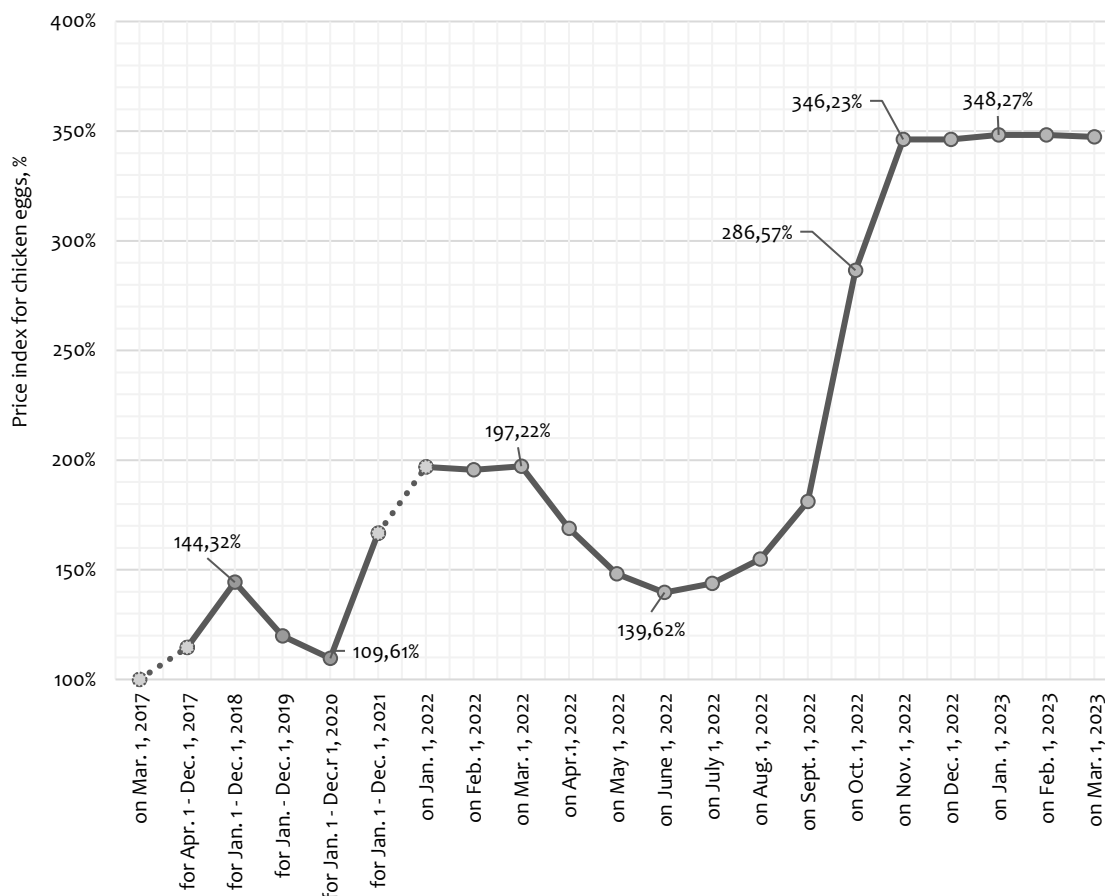


Figure 5: Dynamics of the price index for chicken eggs as of March 1, 2017 - March 1, 2023

Source: Chicken eggs price index (Minfin - vse pro finansy, 2023); own elaboration

Another indicator of the country's foreign economic security, which is also related to agriculture, is the price index of the terms of trade, which characterizes the trends in the development of foreign trade activity and shows to what extent the country gains or losses due to changes in the price of goods in foreign trade for the corresponding period (State Statistics Service of Ukraine,

2023b). The indicator is a stimulator of economic security with an optimal value of 110% and a critical value of 85%. The higher its value, the more the country gains in foreign trade and the greater its economic security level nation has. Tab. 4 shows the assessment of the price index level in the context of the country's foreign economic security.

Table 4: The price index level of foreign trade terms of Ukraine's agricultural products in 2021-2022

The price index level of foreign trade terms of Ukraine's agricultural products in 2021-2022	Index of trade terms (price) in 2021, %	Index of trade terms (price) in 2022, %
In total	optimal 119	critical 78.86
Agriculture	optimal 115.62	dangerous 92.70
01 live animals	optimal 113.2	optimal 118.77
02 meat and edible offal	optimal 118.8	optimal 112.66
03 fish and crustaceans	unsatisfactory 102.3	critical 105.87
04 milk and dairy products, poultry eggs; natural honey	optimal 120.4	satisfactory 109.05
05 other products of animal origin	optimal 119.5	critical 78.54
06 live trees and other plants	dangerous 93.5	critical 80.07
07 vegetables	optimal 129.2	critical 78.21
08 edible fruits and nuts	optimal 132.6	critical 78.20
09 coffee, tea	dangerous 94.8	dangerous 93.17
10 grain crops	optimal 121.9	critical 75.50
11 products of the flour mill and grain industry	optimal 110.9	unsatisfactory 100.69
12 seeds and fruits of oil plants	optimal 142.6	critical 81.66
13 natural shellacs	dangerous 92.4	critical 78.88
14 plant materials for production	optimal 124.8	optimal 116.89
15 fats and oils of animal or vegetable origin	optimal 117.4	critical 82.32

Source: International economic activity (State Statistics Service of Ukraine, 2023a); own elaboration

After analyzing the table above, the country had the optimal value of the index of trade conditions for both all goods and agricultural products in 2021. In 2022, for all goods, this indicator decreased to 78.86%, which means that trade is inefficient: the average prices paid for the export of goods are lower than the average prices received for imports, and the average revenue from the export of goods exceeds the import costs by 21.14%. The situation in agriculture is less critical but is identified as dangerous because the country loses an average of 7.3% of revenue as a consequence of export-import operations. The most hazardous situation is with grain crops, vegetables, edible fruits, and nuts. Although Ukraine is considered one of the largest exporters of grain crops to foreign markets, in 2022, 24.50% of income was not received compared to 2021 due to the price drop. That is why it is vitally important to continue the work of the grain initiative and establish other product sales channels to minimize losses in the agrarian sector and increase the economic security level.

5.2. Commodity and Geographical Structure of Export-Import Operations

One of the less important indicators of foreign economic security, influenced by the development of the agricultural sector, are the specific weight of the leading commodity group (commodity) in the structure of exports and imports, as well as the share of the country that is the largest partner in the exports and import's structure (excluding energy imports *Sliusarenko, and Klyuchnik (2020)* emphasized that commodity geographical differentiation reflects the state of dependence on demand for one or another type of product in a certain market. Therefore, the analysis of the dominant product and the leading partner country in the export and import structure allows us to determine the place of agriculture in foreign trade. The optimal value for these indicators is about 5%. *Tab. 5* calculates the shares of the leading product group in the structure of the total export of goods in 2020-2021 and the dominant product in the specified leading group.

Table 5: The specific weight of the leading product group in the total volume of goods exports and imports (excluding energy imports) in 2020-2021

Indicator of foreign trade	Leading product group	The share of the leading product group in the structure of export or import of goods, %	The dominant product within the leading product group	The share of the dominant product in the leading product group, %
Export in 2020	II. Products of plant origin	24.16	10 grain crops	79.19
Export in 2021	XV. Non-precious metals and products from them	23.49	72 ferrous metals	87.24
Import in 2020	XVI. Machines, equipment, and mechanisms; electrical equipment	21.26	84 nuclear reactors, boilers, machines	52.60
Import in 2021	XVI. Machines, equipment, and mechanisms; electrical equipment	19.50	84 nuclear reactors, boilers, machines	56.31

Source: *International economic activity (State Statistics Service of Ukraine, 2023a); own elaboration*

The share of the leading product group in the structure of the total export of goods indicates its suboptimality and imbalance: the country exports products of plant origin (cereal crops) and low-value metals (ferrous metals), which are raw materials, and imports, on the contrary, high-tech products. For economic security, such values are critical, especially considering that the coefficient of similarity of the export structure in 2020 and 2021 is 92.93%. It indicates the absence of a strategy for the export reorientation from raw materials to goods with a more share of added value. Bearing in mind the full-scale invasion, threats to sea and rail transportation, and risks for investors, the current goal is to preserve the existing structure of exports in 2020-2021. But in the future, it is necessary to develop our own production of equipment and mechanisms. Such a step will allow reducing the share of imports, as well as part nonprecious metals supplied for export will be used in certain types of products manufacture. In agriculture, grain crops must be processed into food products (flour, wheat groats, pasta, couscous, bulgur, semolina, malt, starch, bran or flakes, and granola). It will give more foreign exchange earnings together with an increase in the employment level in the country. The state should promote the expansion of capacities for processing agricultural raw materials (*Shubravska & Prokopenko, 2022*).

An analysis of the geographical structure of Ukraine's exports and imports in 2020 and 2021, with the help of the corresponding coefficient, indicates its similarity by more than 90%. *Tab. 6* shows the list of countries in which the most products were exported in the indicated years.

Thus, most domestic products are exported to China: in 2021, the share of exports was 11.76%. In the economic security context, the share of the leading partner country China is satisfactory, and that of other partner countries is optimal. It is worth noting that the list of partner countries has practically not changed, except for the displacement of Belarus from 10th place in 2020 (2.71%) to 14th

place in 2021 (2.17%). Thus, the geographical structure of exports does not cause threats and is mainly optimal.

Table 6: Top 10 countries with the largest export share of Ukrainian products in 2020-2021

List of countries	Share of export of goods, %		List of countries
	2020	2021	
China	14.43	11.76	China
Poland	6.65	7.68	Poland
Russian Federation	5.50	6.09	Turkey
Turkey	4.95	5.10	Italy
Germany	4.21	5.02	Russian Federation
India	4.01	4.21	Germany
Italy	3.92	3.66	India
The Netherlands	3.66	3.32	The Netherlands
Egypt	3.29	2.86	Egypt
Belarus	2.71	2.46	Spain
Other countries	46.67	47.84	Other countries

Source: *International economic activity (State Statistics Service of Ukraine, 2023a); own elaboration*

It is essential to analyze the change in the share of exports of agricultural products with the countries that were among the ten largest partners in 2020-2021 (*Tab. 7*).

So, on average, the export of agricultural products to the ten largest partner countries by the share of export increased by 16.54% from 2499.37 to 2912.85 million USD. At the same time, the structure share of exports decreased by 1.32 percentage points. Traditionally, countries with significant food shortages due to adverse weather conditions or a preponderance of consumption

over production, such as China, India, and Egypt, have large volumes. Thus, agriculture is one of the decisive branches in the structure of geographical export.

Table 7: The specific weight of the agricultural products exported in the value of the export of goods to partner countries in 2020-2021

List of countries	Export value in 2020, million USD	The share of agricultural products export, %	Export value in 2021, million USD	The share of agricultural products export, %
China	7099.95	42.70	8003.56	45.55
Poland	3272.68	15.20	5227.41	13.10
Russian Federation	2705.98	0.40	3414.09	0.36
Turkey	2436.27	34.90	4142.63	30.30
Germany	2071.74	24.10	0.18	26.10
India	1972.10	73.50	2494.44	78.00
Italy	1928.91	27.00	3469.27	20.00
Netherlands	1802.21	75.10	188.44	74.50
Egypt	1617.76	79.10	1944.56	78.30
Belarus	1335.27	18.20	1479.57	15.51
Spain	1250.21	74.00	1677.24	68.00
On average	2499.37	42.20	2912.85	40.88

Source: *International economic activity (State Statistics Service of Ukraine, 2023a)*; own elaboration

Tab. 8 shows the countries list from which the most goods were imported to Ukraine in 2020-2021.

Table 8: Top 10 countries from which Ukraine imported the most goods in 2020-2021

List of countries from which imports were made	The share of goods imports in 2020, %	The share of goods imports in 2021, %	List of countries from which imports were made
China	15.31	15.08	China
Germany	9.83	8.63	Germany
Russian Federation	8.36	8.35	Russian Federation
Poland	7.62	6.81	Poland
USA	5.65	6.62	Belarus
Belarus	5.29	4.58	USA
Turkey	4.45	4.48	Turkey
Italy	3.92	3.67	Italy
France	2.70	3.43	Switzerland
Hungary	2.58	2.42	France
Other countries	34.29	35.93	Other countries

Source: *International economic activity (State Statistics Service of Ukraine, 2023a)*; own elaboration

The analysis of the above table shows that only these countries account for more than 64% of product imports. The largest partner country is China, the share of imports from which is unsatisfactory in the context of economic security and amounted to 15.08% in 2021. The list of partner countries underwent minor changes: Switzerland replaced Hungary in 11th place in 2021 (2.16%) and took 9th place (3.43%) in this ranking. Thus, it is necessary to reduce the share of imported goods from China, replacing them with analogs from other countries, considering the price-quality ratio. Moreover, economic relations should be built according to established strategy, taking into consideration the existing

geopolitical situation and diplomatic relations between countries. Therefore, it is impossible to allow the concentration of exports or imports in one country because then the economic security of the national economy will be under the influence of the actions of the partner country. *McIntyre et al. (2018)* agrees that diversification of exports or imports reduces the risks associated with the volatility of world markets and promotes the economic development of small states.

5.3. The Impact of Ukraine's Agricultural Products Export on World Food Security

Ukraine's foreign economic security and the development of agriculture are closely related to global food security. Having significant resource capabilities, the industry provides not only consumers in the domestic market but also the needs of other countries in food products, thus influencing global economic security. With the beginning of Russia's large-scale war against Ukraine, there was a disruption in the logistics chains of food supply to the world market, as most goods were transported by sea, which has the advantage of lower transportation costs and the possibility of exporting to distant countries. It caused a sharp increase in world prices for agricultural products (Fig. 6) and aggravation the problems of the global food shortage.

Thus, according to the *FAO (2023)* the food price index reached a record value of 143.7%. It is 18 percentage points more than the figure for 2021, in which the national economies of countries began to recover after the coronavirus restrictions and production shutdowns. In the first place, the rapid growth of this index occurred due to the increase in the price level of vegetable oil, grain, and dairy products. According to the methodology of determining this index, the price level for various types of meat and sugar is also included in addition to the specified product groups.

Compared to 2021, the grain price index showed the maximum increase, which amounted to 23.5 percentage points, and reached a value of 154.7% in 2022. In the same year, the level of world prices for vegetable oil was 187.8%, and for dairy products – 142.5%. It is worth noting that sunflower seeds are used in vegetable oil production, while keeping and fattening cattle requires fodder, which is also made from various plant crops, including cereals. And Ukraine is one of the largest exporters of grain.

Thus, the increase in world prices for agricultural products was caused not only by constantly growing demand but also by the significant destruction of markets and sales channels due to the Russian invasion, as well as by uncertainty and the growth of energy prices.

Thus, the processes of the development of the agricultural sector of Ukraine determine not only the economic security of Ukraine but also affect the state and development of the national economies of other countries, which provide the needs of their citizens with the help of imports. According to the *International Grain Council (2022)*, in 2016-2022, the total global consumption of cereals exceeded their whole production. As a consequence of harvesting and selling the crop in the 2021-2022 marketing year, the deficit amounted to 6.1 million tons. According to the forecast of the harvest of grain crops in 2022-2023, this deficit will increase and amount to about 19 million tons, while the Ukrainian domestic market of agricultural products will have a surplus of about 32 million tons with a forecast production value of 58.3 million tons. This surplus is obviously destined for export and can cover the deficits of several countries, presented in Fig. 7. As of January 27, 2023, according to the *Ministry of Agrarian Policy and Food of Ukraine (2023a)* 52.6 million tons of grain and legumes have already been harvested from 96% of the sown areas.



Figure 6: Dynamics of the food price index in 2006-2022

Source: Food and Agriculture Organization of the United Nation (FAO), 2023; own elaboration

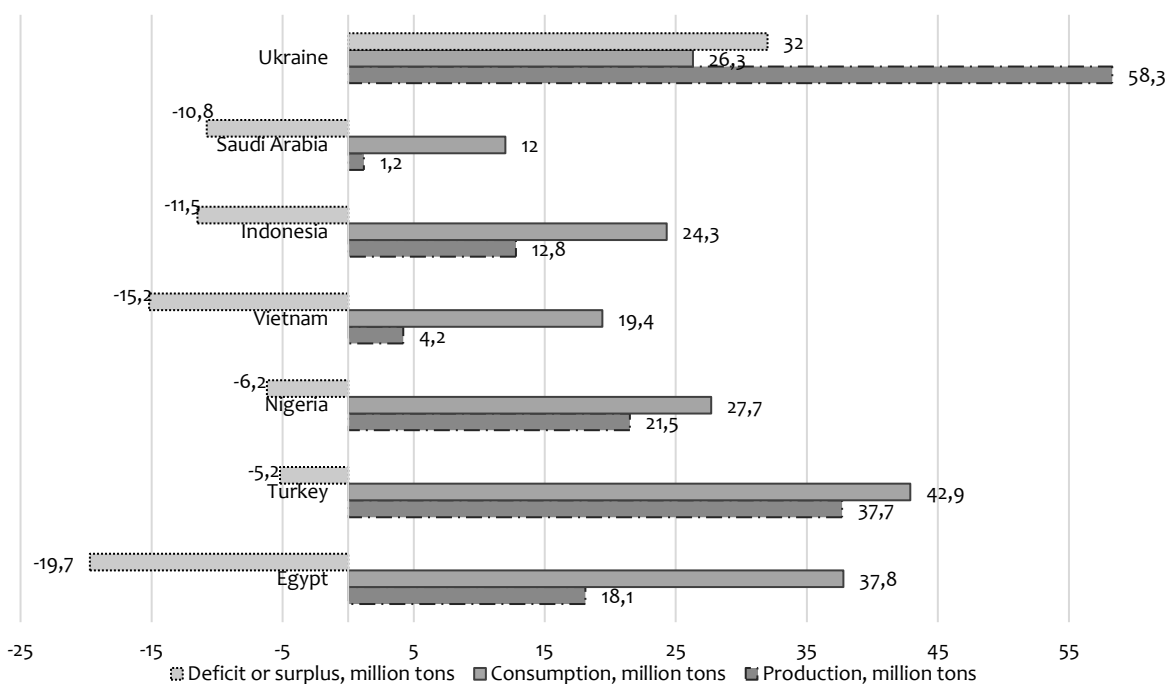


Figure 7: Total production, consumption, and deficit in the grain market of countries after harvest in 2022-2023

Source: International Grain Council (2022); own elaboration

Considering the current economic situation, one of the most important tasks to the executive authorities' is added – the improvement of the logistics infrastructure of the agricultural market. The low level of adjustment of logistics processes and logistics infrastructure, which currently exists, is a restraining factor for the further development of agriculture in the country (Kustrich, 2022). It provides transport and service organizations that will quickly deliver the produced products to foreign markets because during the actual half-year blockade of Ukrainian seaports, many provisions lost their consumer quality, and producers were unable to sell their products and suffered losses, which could

negatively affect the next sowing campaign and endanger food security.

According to the data of the Ministry of Agrarian Policy and Food of Ukraine (2023b) for March-December 2022, Ukraine exported 38.94 million tons of grain, oil crops, and their processing products, which is presented in Fig. 8. The leaders of exports among agricultural products are corn – 15.56 million tons were delivered to partner countries, wheat – 8.56 million tons, sunflower seeds and sunflower oil – 5.95 million tons.

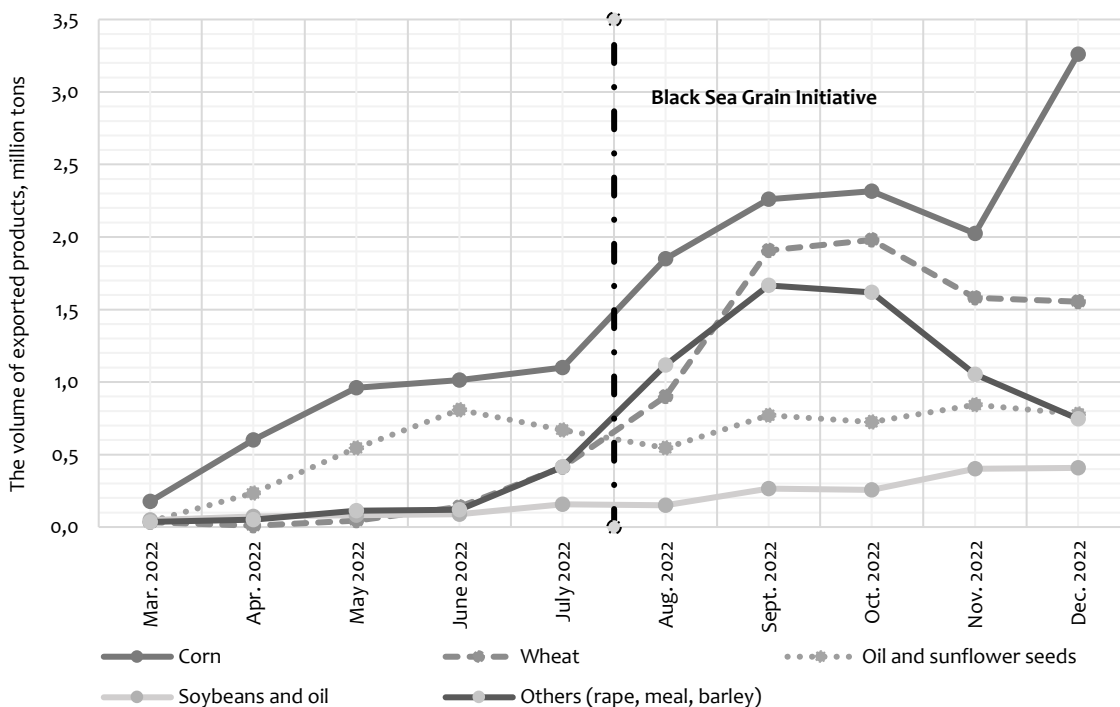


Figure 8: Dynamics of exports of grain, oil crops, and their processing products in March-December 2022

Source: Ministry of Agrarian Policy and Food of Ukraine (2023b)

Starting in August 2022, a significant export revival occurred due to the Black Sea Grain Initiative—the signing of agreements between Ukraine, Turkey, and the UN. It made it possible to unblock some Ukrainian ports. This decision had a positive impact on Ukraine's foreign economic security. It allowed Ukrainian farmers to sell their surplus products and receive income from sales. Equal importance

is the decrease in the world price index for grain. Schwirtz and Kozliuk (2023) in The New York Times noted that a sea corridor had partly alleviated the global food crisis set off by the war. After the unblocking of sea transportation, the price index for grain products in August fell to the minimum value of 145.6% in the studied period (Fig. 9).

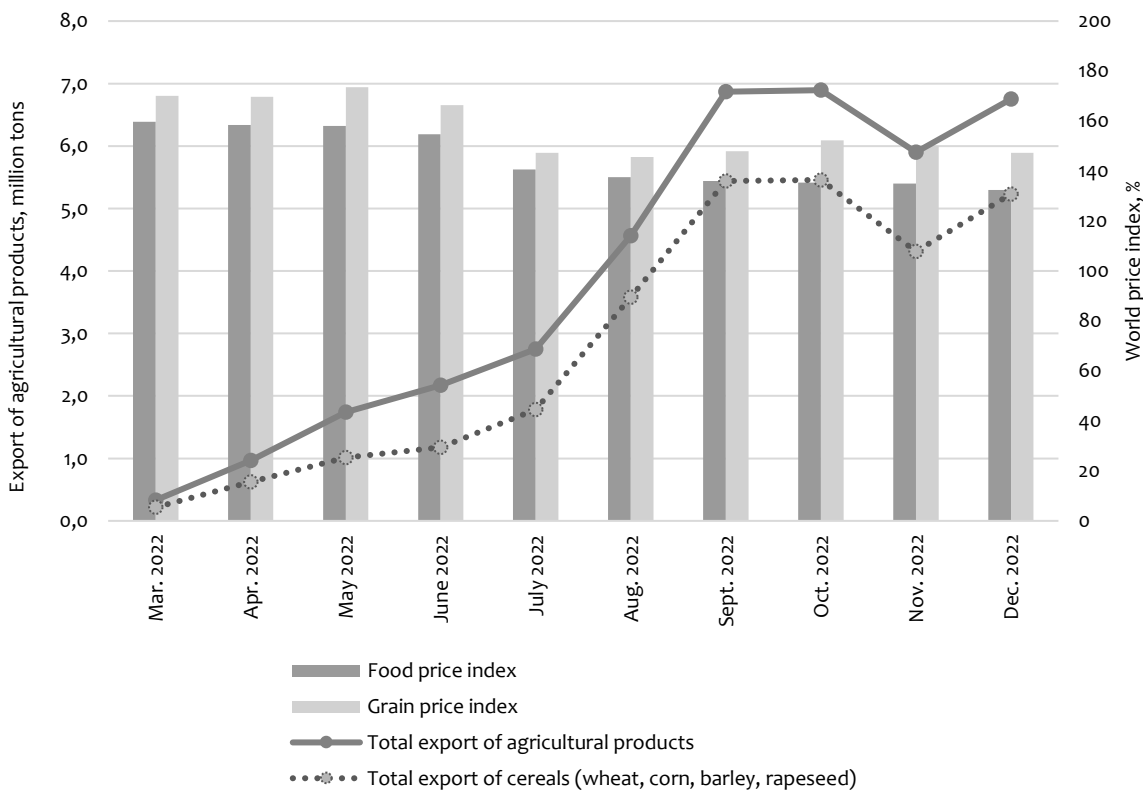


Figure 9: Dynamics of export of agricultural products and the level of world prices for them in March-December 2022

Source: Ministry of Agrarian Policy and Food of Ukraine (2023b), FAO (2023); own elaboration

With the help of the method of increasing the intervals, there is a tendency to decrease both price indices, which is presented in Tab. 9.

Table 9: The average change in the level of world prices in March-December 2022

Period	Average food price index, %	Average grain price index, %
March-July	154.3	165.38
August-December	135.28	148.64
Reduction of the price index, percentage points	-19.02	-16.74

Source: own elaboration

Thus, there is an inverse correlation dependence: the more agricultural products Ukraine supplies to the foreign market, the lower the world price level for them. Having built the simplest regression model between the factor and the resulting feature, the hypothesis is confirmed by the coefficient of determination (86.95% of the variation in the food price index is related to the change in the total export of Ukrainian agricultural products), and

the Fisher coefficient less than 0.05, which indicates the statistical significance of the constructed models (Tab. 10).

Undoubtedly, the global food market is much more complicated than the constructed regression model and is determined by many factors, not only by the volume of Ukrainian exports of agricultural products. Only under the condition that all other factors remain unchanged, when Ukraine's aggregate export of agricultural products increases by 1 million tons, the world food price index decreases by 4.09 percentage points. However, in this analysis, the most important thing is to confirm the hypothesis of inverse correlation dependence: an increase in the volume of Ukrainian exports reduces the level of food prices in the world because Ukraine is the breadbasket of Europe (Lin et al., 2023).

Ukraine exported 32.85 million tons of agricultural products to around 46 countries as part of the Grain Initiative. The largest deliveries under the Initiative went mainly to developing countries, in particular the Middle East and North Africa (Poursina et al., 2023). According to the *Ukrainian Grain Association (2023)* most grain was sent to China, whose production capacity does not meet total consumption. Almost 79.18% of the grain was delivered to the countries (Fig. 10).

Table 10: Statistical indicators of the constructed regression model

Regression statistics	Coefficients				
Plural R	0.9325	a_0	160.72		
R-squared	0.8695	a_1	-4.09		
Standard error	4.3638				
Number of observations	10				
Variance analysis	df	SS	MS	F	The F-Test of overall significance
Regression	1	1014.61	1014.61	53.28	0.00
Residual	8	152.34	19.04		
Total	9	1166.95			

Source: own elaboration

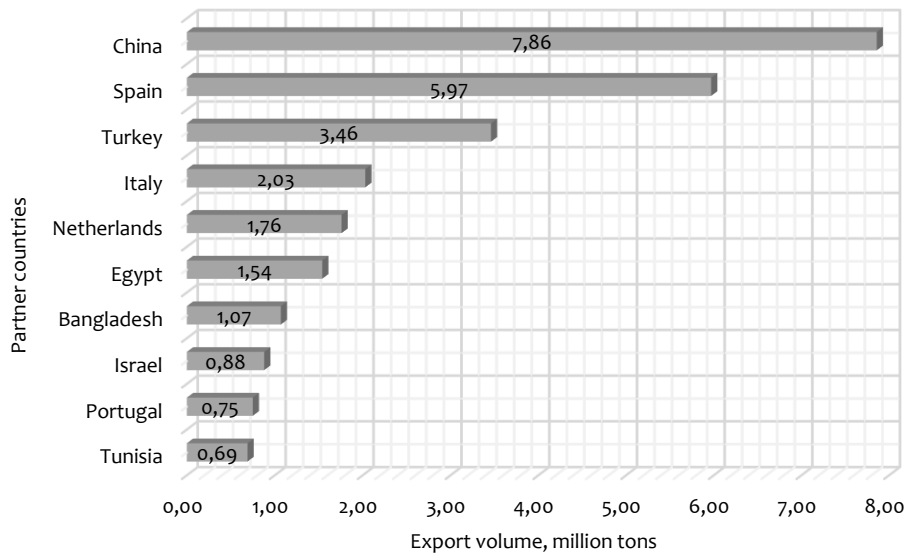


Figure 10: Countries to which most agricultural products were exported by sea transport under the Black Sea Grain Initiative

Source: *Ukrainian Grain Association (2023)*; own elaboration

The Black Sea Grain Initiative was terminated in July 2023 due to Russia's withdrawal from the agreement, after which the aggressor state systematically destroyed the Ukrainian port infrastructure that served the agricultural sector, creating another threat to global food security.

In order to minimize losses in the agricultural sector due to logistical problems, it is necessary to either restore the Black Sea Initiative or find alternatives. One of the options could be river transport through ports on the Danube, although they are unlikely to replace sea transport fully. Even if the agreement is extended, there is an urgent need for the development of railway and road infrastructure, which will allow for diversification of the potential

risks associated with the repeated blocking of seaports. For agricultural producers of the southern regions, who have trade relations with Romania, it is possible to use the Orlivka-Isaccea ferry crossing. Improving the logistics infrastructure of the agricultural market will revitalize the agricultural process development, which will lead to an increase in the Ukraine's foreign economic security level. It will become a safeguard against the rise in world food prices, curbing hunger in countries with food shortages.

6. Conclusion

Thus, agriculture has an impact on 8 out of 11 indicators characterizing the country's foreign economic security in accordance with the Methodological recommendations of the Ministry of Economy regarding the calculation of the

economic security level. Only 3 indicators (the specific weight of raw and low-grade industrial exports and a load of transit capacities of the oil and gas transportation system) have no connection with the development processes of the agricultural sector.

In the context of foreign economic security, in 2021, only the openness index of the economy, the specific weight of the leading partner country in the export structure, and the price index of the trade terms (compared to 2020, the year of the pandemic) are within optimal values. Currently, the available data on the price index of the trade terms indicate the trade deterioration and the loss of part of the country's revenue due to the fall in prices. Other indicators pose a threat to the country's economic security. The assessment of the impact of agriculture on the state of foreign economic security is shown in Fig. 11.

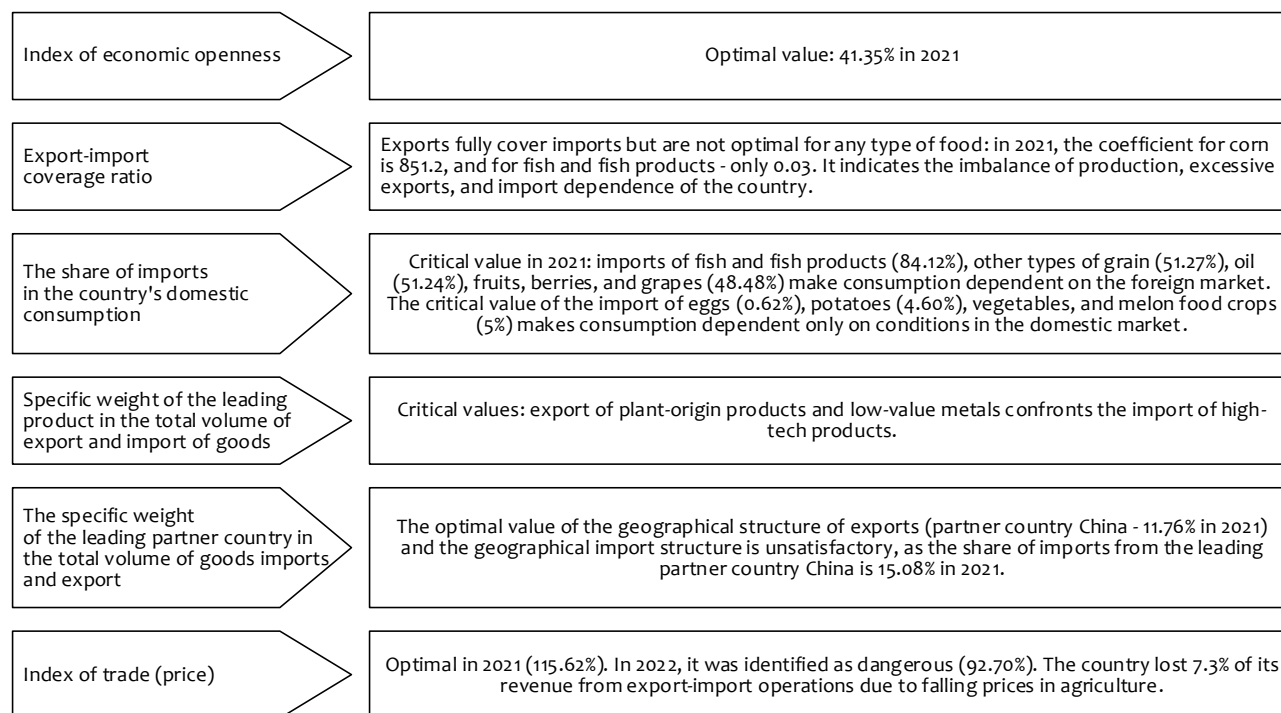


Figure 11: The influence of agricultural processes on the state of Ukraine's foreign economic security

Source: own elaboration

Thus, agriculture is one of the components that significantly affect Ukraine's foreign economic security. It is possible to assess the state of agriculture in 2022 fully and its relationship with foreign economic security after the publication of the collected data by the State Statistics Service and international organizations. Obviously, it suppresses both the domestic and foreign markets of agricultural products. "Small farmers are taking a gamble: They'll blow up or not," published by Schwirtz and Kozliuk (2023) y The New York Times. It means there is enormous mine contamination of the agricultural area. Moreover, small, and medium-sized enterprises in the agrarian sector can receive losses and stop economic activity. Thus, Ukraine's economic security is under constant threat.

Russia's invasion of Ukraine has caused a significant increase of food prices on global markets (European Council, 2023). Although Ukrainian grain was supplied to the foreign market as part of the Black Sea Grain Initiative, reducing the world food crisis, the world economy continues to suffer from the Russian invasion of Ukraine. Restrictions on sea transport led to an increase in exports via Poland and neighboring countries by road and rail. Inexpensive products, which were supposed to be delivered by sea to developing countries, entered the domestic markets and lowered prices in Poland, as well as in Romania, Hungary, Bulgaria, and Slovakia (Tilles, 2023).


In order to eliminate significant problems in agriculture that negatively affect economic development in the context of foreign economic security, it is necessary:

- to review the optimal value of the openness index of the economy, focusing on the ratio of export-import operations and GDP of developed countries of the world;
- to form a strategy for the development of the production and sale of corn, the coefficient of which the export-import coverage exceeds the optimal values by 850 times, and the security level of the national economy equaled 553.13% in 2021. This processing into food products will simultaneously reduce the pointed indicators and increase the population employment and the share of the created value;
- to develop its production of possible types of fish and fish products, rice, chickpeas, lentils, various types of vegetable oil, fruits, and berries, for which there is a demand of the population, which is mainly provided by imports;
- to support producers of milk and dairy products so that their products meet the implemented quality requirements, to stimulate households to increase the number of cattle. *Urba (2019b)* highlighted that the existing financial support for the domestic agricultural sector development remains insufficient and does not meet real needs. In most cases, the financial resource is unavailable to business entities.


- to increase the import of goods, the shortage of which arises as a result of the action of unpredictable factors in the domestic market (for example, chicken eggs);
- to continue the action of the grain initiative signed between Ukraine, Turkey and the UN, or to develop an alternative to it in order to minimize the loss of revenue of the agricultural sector and to establish other sales channels in order to achieve the optimal price index of the terms of trade;
- to form a course for the reorientation of exports from raw materials to more technological products;
- to search for analogues of goods imported from China, with the aim of reducing its specific weight from unsatisfactory to optimal in the context of foreign economic security;
- agricultural producers should monitor support programs provided by the international community. In particular, for bringing much-needed grain to the global market, the U.S. Agency for International Development (USAID) plan to make combined investments of more than \$44 million to support storage and infrastructure expansion in Ukraine's agriculture sector (USAID, 2023).

The elimination of existing threats and new ones that may be revealed in a more detailed study of other agricultural development processes will increase both the country's foreign economic security and global food security.

7. Funding

 This study received no specific financial support.

8. Competing interests

 The authors declare that they have no competing interests.

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