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Global changes in the development of the export potential of the grain sub-complex of the agrarian sector of Ukraine

Yurii Kyrylov*

Doctor of Economic Sciences, Professor
Kherson State Agrarian and Economic University
25031, 5/2 Universytetskyi Ave., Kropyvnytskyi, Ukraine
<https://orcid.org/0000-0001-5061-2644>

Marat Ibatullin

Doctor of Economic Sciences, Professor
National University of Life and Environmental Sciences of Ukraine
03041, 15 Heroiv Oborony Str., Kyiv, Ukraine
<https://orcid.org/0000-0001-8765-6261>

Anastasiia Konovalenko

Doctor of Economic Sciences, Professor
Dmytro Motorny Tavia State Agrotechnological University
69063, 66 Zhukovskiy Str., Zaporizhzhia, Ukraine
<https://orcid.org/0000-0001-9061-5989>

Zhanna Shylo

PhD in Economic Sciences, Associate Professor
National University of Water and Environmental Engineering
33028, 11 Soborna Str., Rivne, Ukraine
<https://orcid.org/0000-0002-2669-6734>

Nataliia Pochernina

PhD in Economic Sciences, Associate Professor
Dmytro Motorny Tavia State Agrotechnological University
69063, 66 Zhukovskiy Str., Zaporizhzhia, Ukraine
<https://orcid.org/0000-0002-6109-6099>

► **Abstract.** In modern conditions, the export of agricultural products is one of the main sources of income for the agricultural sector of Ukraine. Thus, conducting multi-faceted studies of foreign trade in this sector is relevant. The purpose of the study was to develop estimates of the possibility of developing grain exports in Ukraine based on the analysis of current data on the development of this sector, and individual global trends. The paper investigated global changes in the development of the export potential of the grain and food sub-complex of the agricultural sector of Ukraine. It is proved that the decomposition of the export potential of the grain sub-complex according to the sectoral system of the agrarian sector allows forming a step-by-step methodical assessment of its quantitative and qualitative indicators to determine the compositional integrity of the effective value of the object under study. A comprehensive functional-resource analysis of the parameters of the export potential of the grain sub-complex, which are grouped according to the process approach for calculating the food security of the export chain of grain production entities, is presented. The procedure for assessing the state of food security of the grain sub-complex of the state through the resource component allows diagnosing the export capabilities of subjects of foreign trade operations in the presence of numerous risks. The actual dependence of the gross domestic product of Ukraine on the export of products of the grain sub-complex was determined and its forecast value for a five-year period was calculated. A pessimistic-

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*Corresponding author



optimistic scenario of the growth (reduction) of Ukraine's gross domestic product at the lower and upper limits of realisation of the export potential of the grain sub-complex is given. The conclusions obtained in the framework of the study can be used to form a policy in the agricultural sector of Ukraine

► **Keywords:** industry system; military invasion impacts; war period trends; market integration difficulties; international trade

► Introduction

The agricultural sector now plays a huge role in the development of the Ukrainian economy. It has a significant impact on gross domestic product (GDP), promotes the attraction of foreign currency, and allows for more effective achievement of food security and the fight against hunger on the international stage (Jindo *et al.*, 2020; Pawlak & Kolodziejczak, 2020). In turn, grain production is one of the strategic directions in the structure of the agrarian sector. The reason for this is the growing demand for grain on the global market, which is compounded by growing food security problems around the world (Anghinoni *et al.*, 2021; Constantin *et al.*, 2023). This is happening in the context of the existing potential to increase grain production in Ukraine due to fertile soils, favourable natural and climatic conditions, the presence of seaports, and the constant modernisation of the existing warehouse, production and trade infrastructure in Ukraine.

Currently, Ukrainian grain producers face significant challenges in the European market due to high competition, political instability, and economic pressure increased by Russia's military aggression. This conflict disrupted the regulation of the agricultural market, weakened global logistics, and threatened Ukraine's food security (Penkova & Kharenko, 2023). Overcoming problems requires constant efforts on the part of the state and entrepreneurs to restore the consequences that arose during the war. Therefore, the export potential of the grain sector of Ukraine also remains insufficiently realised. War hinders the development of effective tools for development. The conflict also limited the use of national policies to increase grain exports and protect Ukrainian producers, since state tools in war conditions do not always work effectively due to, in fact, military actions (Yaheliuk *et al.*, 2024). To solve this problem, it is necessary to update the production infrastructure and introduce technological innovations, improve crop rotation, use better fertilisers and seeds, increase yields, and eliminate price imbalances. Given the role of agricultural exports for the country and for the world (in the context of ensuring food security), it is very important to promote its development (Skydan *et al.*, 2024). This can be achieved through new economic reforms that create functional links between agricultural and industrial enterprises to ensure reliable grain supplies.

In general, recognising and understanding the micro-level obstacles faced by exporters is the first step in creating effective export promotion strategies. The main barriers now consist of problems related to duties and quotas, and non-tariff restrictions, for example, the policy on value added tax (VAT) and currency control (Kutkowska & Szuk, 2020; Wang *et al.*, 2022). Agricultural enterprises that actively interact with international trade are key in this context, and their success largely depends on the business environment and the current regulatory framework (Králík *et al.*, 2023). It is important to consider that

the export potential of Ukraine is affected by various foreign economic barriers determined by political, economic, and social factors. These factors shape the structure and nature of export activities at the level of individual countries, regions, and industries.

The organisational and economic and other principles of the functioning and regulation of the development of foreign economic activity, the production and export potential of the agrarian sector were investigated by: N. Trusova *et al.* (2022). However, the continuous evolution of the international concrete environment, coexistence with unique features of internal socio-economic and socio-political conditions, and continuous changes in the activities of enterprises that export grain, introduce additional internal and some external restrictions. This requires a review of the export potential of the grain complex of Ukraine at the global level. It is particularly important to ensure a systematic, integrated, step-by-step and targeted state policy in this area.

The purpose of the study was to assess the possibilities of introducing economic tools to increase the export potential of Ukraine's grain by identifying its components in the agricultural sector. This allowed predicting new elements and characterise methodological approaches to assessing global economic opportunities for grain producers.

► Materials and methods

The study used statistical data taken from relevant internet sources, such as United States Department of Agriculture (USDA significantly increased..., 2022) (export volumes of major wheat producers, the level of export growth of these products, Ukrainian wheat exports), Sown areas of crops by type (n.d.) (share of exports of grain products of Ukraine in the structure of export-import operations of the European Union countries), the Agriculture, forestry, and fishing, value added (% of GDP) – Ukraine (n.d.). Statistical data were evaluated over different time periods depending on the data type, but in general, the time interval was between 2012 and 2024. Graphs and charts were used to visualise the data and analysis results, which helped to better understand the dependencies and existing trends between the data. Conclusions in the framework of the study were developed using analysis, which allowed evaluating the obtained quantitative and qualitative data.

An important method used in the study was the correlation-regression approach, which determined the degree of relationship between two variables, simulated it and predicted the future development of events. Correlation measured the strength and direction of a linear relationship between two variables. The most commonly used correlation coefficient was the Pearson correlation coefficient, which is denoted as r , and is within $[-1; 1]$. Correlation analysis, in turn, involved determining the relationship between a dependent variable (response variable)

and one or more independent variables (predictor variables). A common approach was to form a regression using a line (linear regression), which was used in the work. Excel software and its tools for calculating and constructing data of this kind were used to perform these estimates.

The study also used the calculation of indicators such as variance and standard deviation. If variance is a measure of the scattering of data around their mean and shows the mean square of the deviation of each value from the mean, the standard deviation is the square root of the variance, is also a measure of data scattering, but is expressed in the same units of measurement as the data itself, which makes it more intuitive. The equation (2) for calculating the standard deviation is as follows:

$$\sigma = \frac{\sqrt{\sum(\text{Ex}_{if} - \text{Ex}_{ic})^2}}{N}, \quad (1)$$

where σ – standard deviation; Ex_{if} – actual export volume of products of the grain group from Ukraine in the i -th year; Ex_{ic} – forecast value of growth (reduction) in the volume of GDP from foreign economic trade of subjects of the grain sub-complex of Ukraine in the i -th year; N – the number of observations.

Another indicator, “deviation from the forecast”, was calculated as shown in equation (2):

$$D = \sqrt{1 - R^2} + \sigma. \quad (2)$$

That is, the deviation of the model dependence of GDP on foreign economic trade of subjects of the grain sub-complex of Ukraine amounts to USD 505.43 million. The upper and lower limits of the forecast values were determined by equation (3):

$$\text{UL}_i = \text{Ex}_{ic} + D; \text{LL}_i = \text{Ex}_{ic} - D, \quad (3)$$

where UL_i , LL_i – upper and lower limits of the forecast.

As part of the study, based on the data analysis performed, a regression equation was constructed using the least squares method. The equation in the study was of the third degree, in which the dependent variable was the volume of exports, and the independent variable was the

level of GDP (gross domestic product); the equation where the dependent variable was under the logarithm was also used. These methods of constructing the equation were chosen due to the fact that they had the highest value of R^2 (percentage of variation of the dependent variable). However, the general view of this method was as follows (4):

$$y = \beta_0 + \beta_1 x_1 + \dots + \beta_n x_n, \quad (4)$$

where y – dependent variable; x_n – independent variables; β_n – indicator for an independent variable.

All calculations were performed using Microsoft Excel software suite.

► Results

In the period before the war, the development of the export potential of the grain sub-sector within the sectoral system of the state agricultural sector was determined by various factors that contributed to the growth of this industry. Among these factors, the following can be distinguished: the ability to achieve competitive positions in the most profitable global agricultural markets, an increase in the number of marketing actions of grain producers from Ukraine, a reduction of the risks that consisted in dependence on the domestic market, development and expansion of logistics opportunities, introduction of innovative modernizations, and a change of approach from excessive dependence on raw materials through the development of integrated grain clusters (Lin & Zhang, 2020; Khan *et al.*, 2021).

In Ukraine, the grain sector has a great potential for the development of foreign trade. In 2021, wheat became the main export product in this industry. In the period from 2019 to 2021, Ukraine ranked third among the main exporters to the EU countries, second only to the United States (USD 12.3 billion) and Brazil (USD 11.7 billion). Exports of agricultural products from Ukraine to the EU countries in 2019 amounted to USD 7.3 billion, which indicates a positive trend in international trade relations. An important indicator is the growing role of EU countries in bilateral trade in grain products, which occurs not only in the export, but also in the import of these goods. More information is presented in Figure 1.

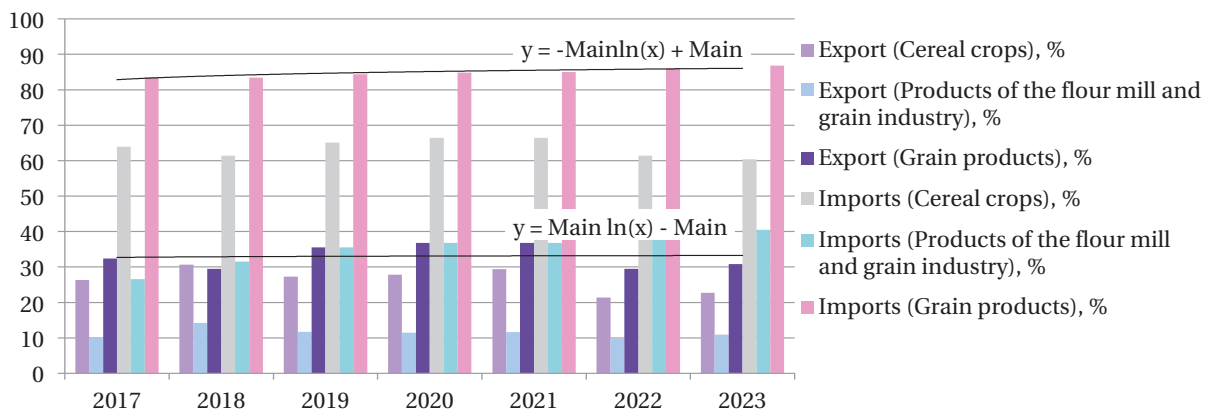


Figure 1. Share of exports of grain sub-complex products of Ukraine in the structure of export and import operations of EU countries for 2017-2023, %

Source: compiled by the authors based on Sown areas of crops by type (n.d.)

EU countries are interesting for exports because of their great strength and financial stability. In addition, their high standards of competition, emphasis on food quality and safety, and increasing the competitiveness of the Ukrainian grain industry make them attractive markets.

In 2023, Ukraine exported 3.9 million tonnes of grain and leguminous crops abroad, which is 17% less than in

2022, when exports amounted to 4.7 million tonnes. Despite this decline, the constant volume of exports in the range of 3.5-4.0 million tonnes per month allowed Ukraine to fully realise the export potential of the grain sector within the agricultural sector. In total, in the period from July 1, 2022 to June 30, 2023, Ukraine exported 48.9 million tonnes of grain and leguminous crops. This data can also be seen in Figure 2.

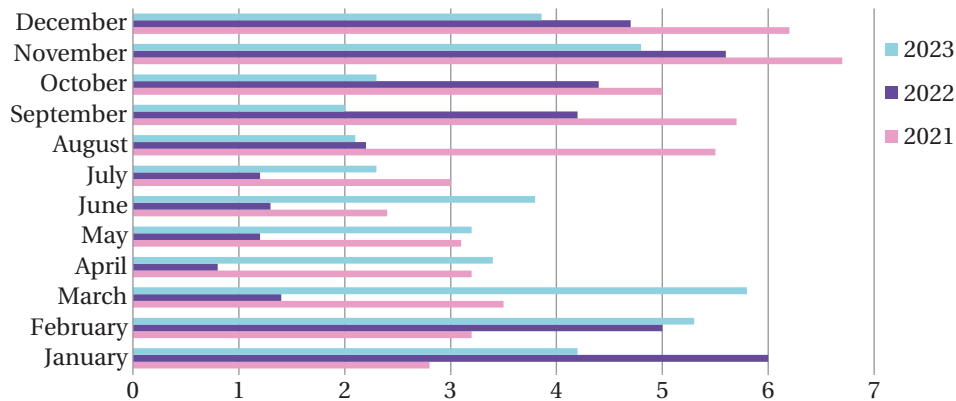


Figure 2. Monthly transit of export shipments of grain sub-complex products to Ukraine for 2021-2023, million tonnes

Source: compiled by the authors based on M. Samoiliuk & Y. Levchenko (2024)

In 2023, Ukraine faced problems in grain exports due to disruptions caused by the Russian invasion, including the destruction of the Kakhovka Hydroelectric Power Plant and logistics blockades. Despite these obstacles, Ukraine introduced a new sea route along the eastern coast of the Black Sea, which allowed Ukraine to successfully export 99.8 million tonnes of goods, including increasing the export of metal and semi-finished products by 40%, rolled steel – by 45.3%.

The value of grain exports from the country decreased by 18.7% to USD 35.8 billion, which reflects an overall decrease in foreign trade turnover by 1.4% to USD 98 billion compared to 2022. However, total sea exports in 2023 increased by 1 million tonnes. Container exports increased by 86% by rail and 36% by road, especially value-added products. But due to the blockade of Polish borders, grain exports by road decreased by 18.3%, although the overall decline was only 0.7% year-on-year

Revenue from corn exports also declined, despite a 5% increase in physical volumes, falling by 16.8%. This was influenced not only by the global drop in prices, but also by logistical problems and the redistribution of profits to neighbouring countries, where Ukrainian grain is often resold. Imports rose to USD 62.2 billion, with notable imports including fuel, medicines, and agricultural products such as fertilisers. Forecasts indicate stable wheat production in Ukraine at the level of 19.5 million tonnes with an increase in exports to 11 million tonnes. Corn production and exports are expected to grow significantly: production will grow by 5 million tonnes to 30 million tonnes, while exports will increase by 3.5 million tonnes to 12.5 million tonnes. Worldwide wheat production reached record levels, mainly due to growth in Russia, Australia, and China, while India and EU countries experienced some declines. Wheat consumption and trade also increased, especially in Australia, with a slight decline in stocks around the world. These data are shown in Figures 3, 4.



Figure 3. Wheat supply in major eight* exporting countries for 2012-2024F (forecast), thousand tonnes

Note: the eight largest wheat exporters in 2022 were Australia, the United States, Canada, France, Russia, Argentina, Ukraine, Germany, India, and Romania

Source: compiled by the authors based on USDA significantly increased its forecast for Ukraine's corn production and exports in 2022/2023 MY (2022)

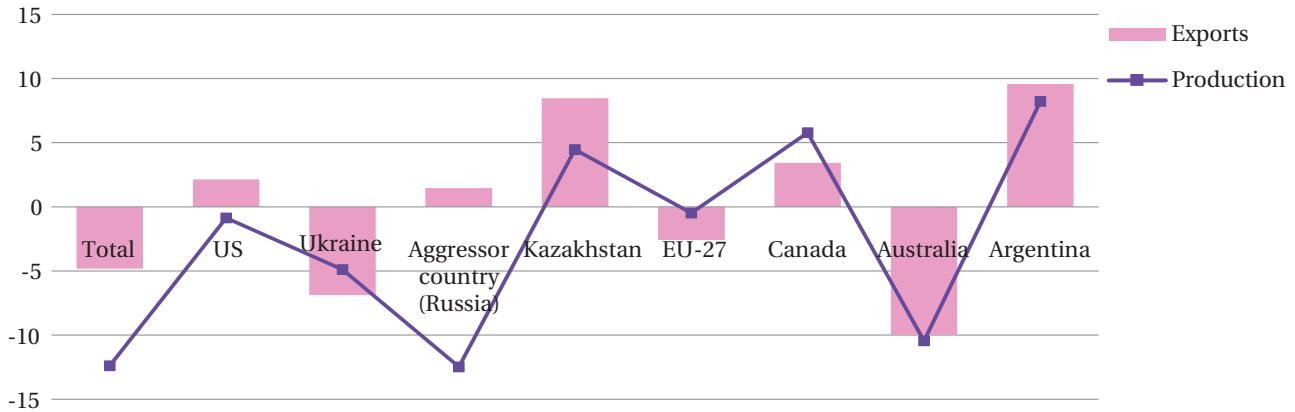


Figure 4. Projected year-on-year changes in wheat production and exports (2023-2024F to 2022-2023), thousand tonnes

Source: compiled by the authors based on USDA significantly increased its forecast for Ukraine's corn production and exports in 2022/2023 MY (2022)

Global corn production declined by 6.3 million tonnes from 2018 to 2022, with a marked decline in the US and EU countries partially offset by growth in Ukraine, Malawi, and Turkey. Forecasts point to a potential decline in wheat production for major exporters such as Australia and Ukraine, while growth is expected in Argentina, the EU, and Canada. Dry weather conditions, including droughts in Australia and Canada, could further negatively affect global wheat production. Wheat exports from Ukraine may also decrease, although current wheat crops are increasing, estimated production is 16-17 million

tonnes, and exports are 8-10 million tonnes, mainly by sea. Ukraine can export more than 6 million tonnes of wheat to Europe each season, but restrictions on wheat imports from neighbouring countries due to EU policies may persist as European countries start the new season with sufficient reserves of the previous crop. This leaves Ukrainian grain producers primarily as transit intermediaries to these countries, although with limited export volumes. The main demand for Ukrainian wheat comes from Asia and North Africa, but their purchases decreased in 2022-2023 (Fig. 5, 6).



Figure 5. Ukraine wheat production and exports, million tonnes

Source: compiled by the authors based on USDA significantly increased its forecast for Ukraine's corn production and exports in 2022/2023 MY (2022)

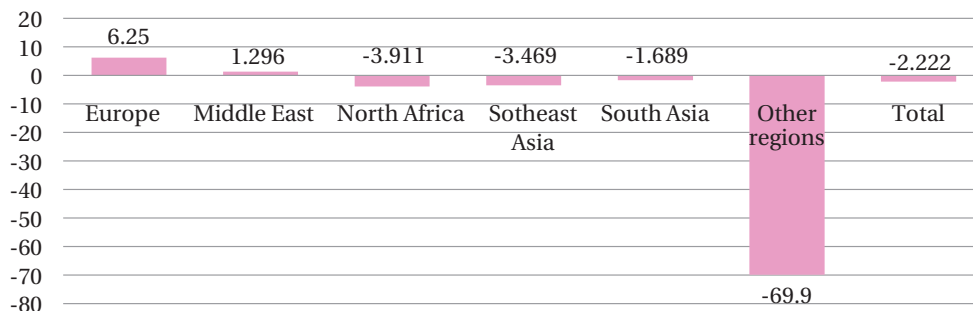


Figure 6. Difference between Ukraine wheat exports in 2022-2023 and 2020-2021, thousand tonnes

Source: compiled by the authors based on USDA significantly increased its forecast for Ukraine's corn production and exports in 2022/2023 MY (2022)

During 2022-2023, several countries in Asia and North Africa shifted their wheat purchases to alternative suppliers such as Russia, France, and Australia, reducing their dependence on Ukrainian wheat. For example, Egypt, Pakistan, and Morocco, increased purchases from France and Russia, and Indonesia – from Australia. However, these countries remain open to buying Ukrainian wheat if certain conditions are met, in particular, the price and reliable

sea exports. In terms of corn trade, Ukraine, along with Serbia and Zambia, saw an increase in exports, while the EU and the US experienced a decline. In 2023-2024, there are different prospects for exporting Ukrainian wheat to different regions, depending on factors such as demand, local production, quality, and competition from other suppliers. Remaining export stocks of corn in 2022-2023 decreased by 6.2 million tonnes to 306.7 million tonnes (Fig. 7).

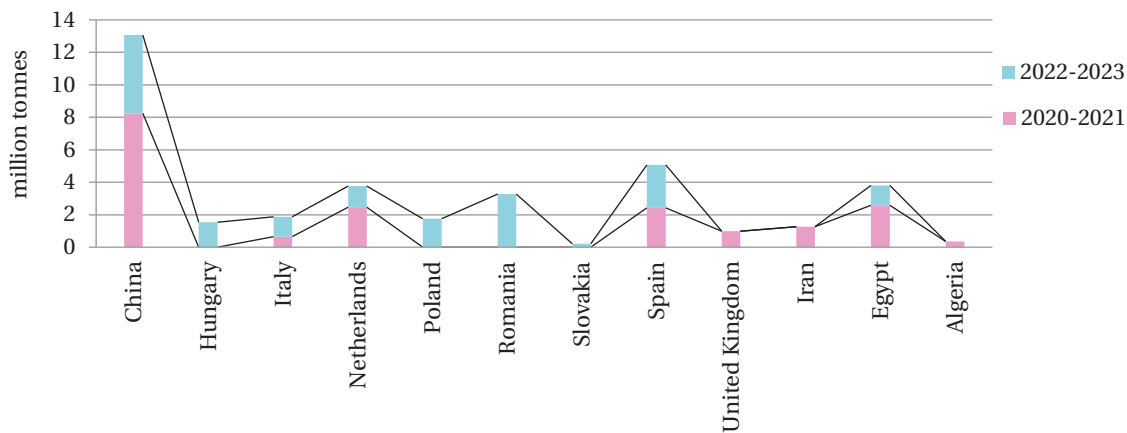


Figure 7. Export of corn in Ukraine for 2020-2023, million tonnes

Source: compiled by the authors based on USDA significantly increased its forecast for Ukraine’s corn production and exports in 2022/2023 MY (2022)

In Ukraine, corn production may decrease due to a decrease in acreage. However, if there are no problems with yield, producers can expect a harvest of approximately 22-23 million tonnes (Fig. 8-9). The available production estimates, together with significant reserves, allow predicting

the export of approximately 19 million tonnes of corn during the 2023-24 season. It is also worth noting that corn exports largely depend on sea routes, since in 2023 70% of the export volume was carried out through deep-sea transportation.

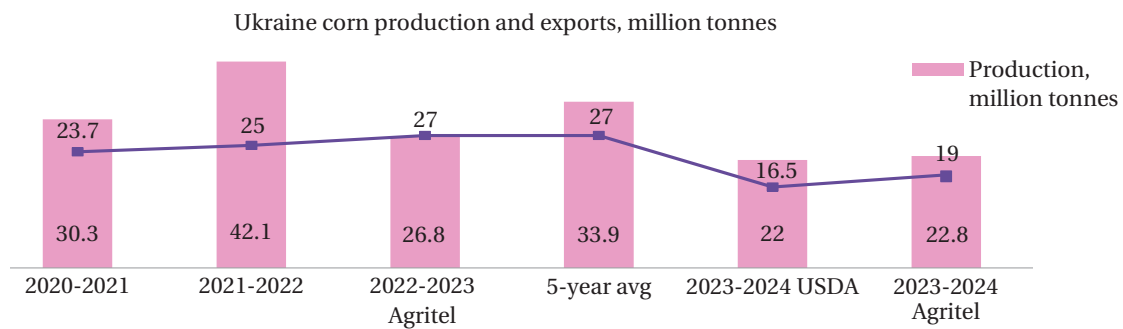


Figure 8. Production and exports of corn in Ukraine, million tonnes

Source: compiled by the authors based on USDA significantly increased its forecast for Ukraine’s corn production and exports in 2022/2023 MY (2022)

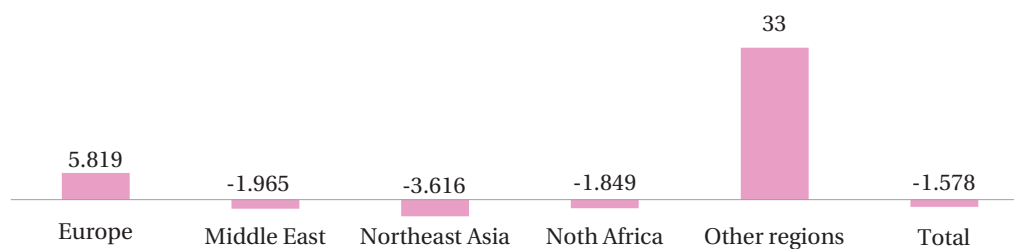


Figure 9. Difference between Ukraine corn exports in 2022-2023 and 2020-2021, thousand tonnes

Source: compiled by the authors based on USDA significantly increased its forecast for Ukraine’s corn production and exports in 2022/2023 MY (2022)

Corn exports to Europe will become more problematic in 2024. Given the forecast of production of more than 12 million tonnes, EU demand for this crop is likely to decrease. This is compounded by a ban on exports to five neighbouring countries and intense competition between corn-producing countries around the world due to the large supply volume (Seok & Moon, 2021). In Europe, Ukraine competes with Brazil. The only possible advantage for Ukraine may be that China opens its own market for Brazilian corn, since China most often buys corn from Brazil. However, Ukrainian corn has competitive advantages both in China and in the world due to the absence of genetically modified impurities. Thus, the prospects for

2024 indicate that the EU-27 should remain a major buyer, although demand could be lower due to a sharp expected rebound in local production by 12 million tonnes. Additionally, there will be rising competition from Brazil in China, alongside record US production and a sharp rise in Argentinean corn output. Sustainable seaborne exports will be crucial to maintaining Ukraine's position in the global market.

Ukrainian barley will continue to lose its position on the world market, and this is due to a decrease in the volume of production of this crop. The export potential of the grain sub-complex of Ukraine for this product in 2024 is forecasted at the level of only 1 million tonnes (Fig. 10).

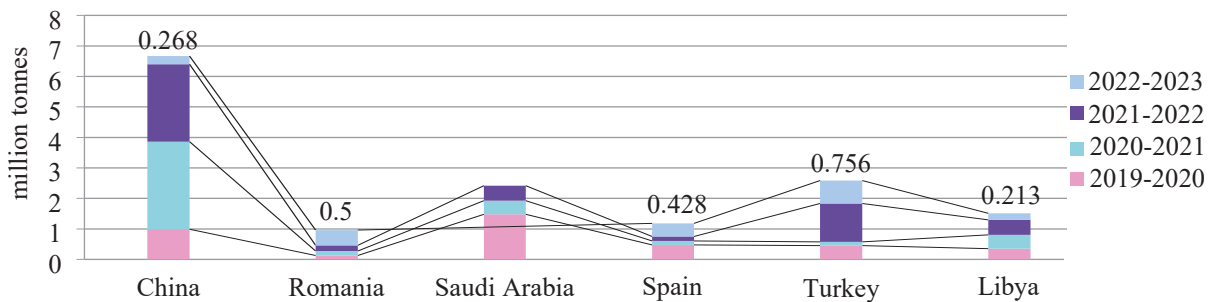


Figure 10. Export of barley in Ukraine in 2019-2023, million tonnes

Source: compiled by the authors based on USDA significantly increased its forecast for Ukraine's corn production and exports in 2022/2023 MY (2022)

Ukraine to continue losing its share in global barley market. The prospects for 2023-2024 indicate that the projected barley export potential for 2024 is very limited, making it difficult for Ukraine to regain its position on the global market. Lower demand from major importers is expected as China has started diversifying its barley imports, focusing on France, Canada, and Argentina. Additionally, Australia is set to return to China's market, and Turkey is expected to further reduce barley imports due to rising domestic supply and high import duty. Romania anticipates higher local production, while Saudi Arabia has switched to importing from Australia, the EU, and Russia. There should be some demand from the Middle East, North Africa, and Spain. Such export potential will be easier to implement, especially given that the leading importers of Ukrainian barley (China and Saudi Arabia) have diversified their purchases in 2022-2023 and will be able to do without Ukrainian barley.

Thus, it should be noted that Ukraine is in for a difficult grain season in 2024. The production of the grain group in Ukraine will decrease significantly. Blockage of grain export routes by the aggressor country, and by other world-producing countries, can lead to complete uncertainty and limitation of the Grain Corridor with neighbouring EU countries. Transit shipments and deliveries through Danube ports remain. In addition, in the new season of 2024, Ukraine will have to compete quite hard for the markets that are still left for the country.

A correlation-regression approach was used to develop a predictive model of the development of the export potential of the grain sub-complex according to the sectoral system of the agrarian sector of the economy of Ukraine. It confirms that for 2012-2023, the dependence

of GDP on the export of products of the grain sub-complex in Ukraine has a close relationship (the coefficient of determination $R^2 = 0.7836$) (5):

$$y = 0.001x^3 - 0.4263x^2 + 72.961x - 1903.3, \quad (5)$$

where y – export of subjects of the grain sub-complex; x – GDP.

To estimate the forecast error (Fig. 11), the actual volume of exports of the grain sub-complex of Ukraine was compared with the forecast value of growth (reduction) in the volume of GDP from foreign trade of grain production entities.

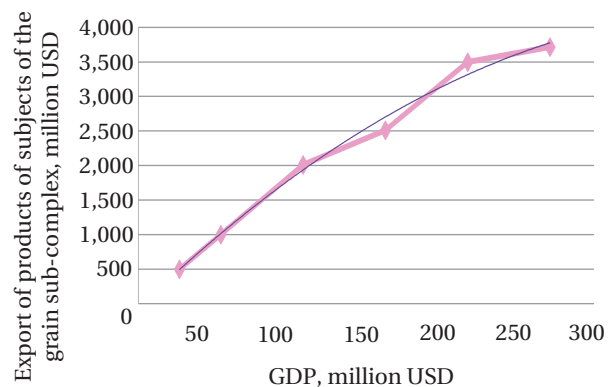


Figure 11. Dependence of GDP on the export of products of the grain sub-complex of Ukraine

Source: compiled by the authors based on Sown areas of crops by type (n.d.); Agriculture, forestry, and fishing, value added (% of GDP) – Ukraine (n.d.)

The deviation of the forecast values is calculated by the (2). That is, the deviation of the model dependence of GDP

on foreign economic trade of subjects of the grain sub-complex of Ukraine amounts to USD 505.43 million (Fig. 12).

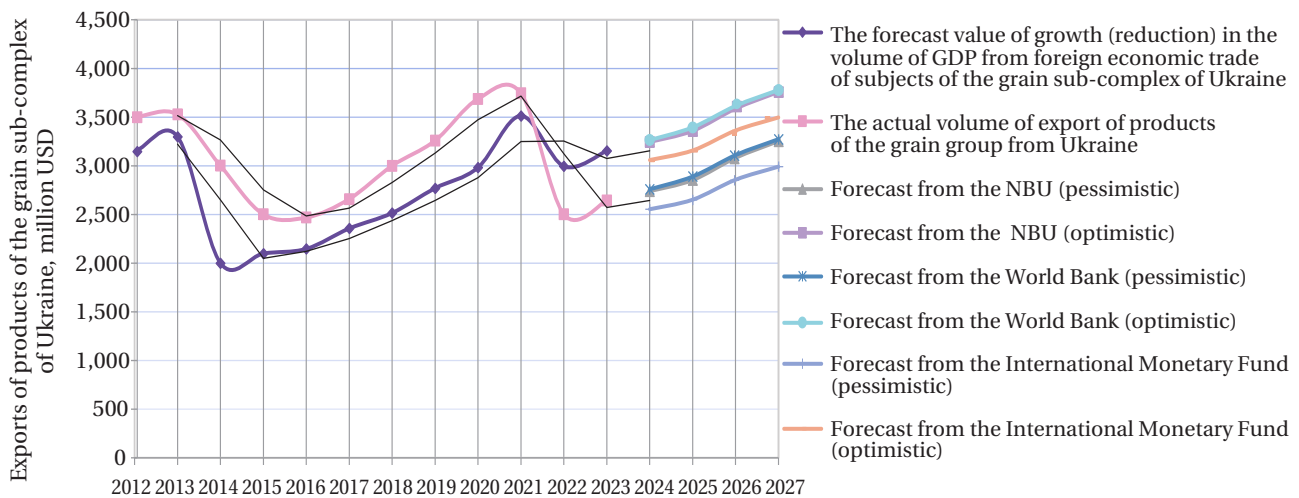


Figure 12. Forecast value of growth (reduction) in the volume of GDP

from foreign economic trade of subjects of the grain sub-complex of Ukraine for 2024-2027, million USD

Source: compiled by the authors based on Sown areas of crops by type (n.d.); Agriculture, forestry, and fishing, value added (% of GDP) – Ukraine (n.d.)

The upper and lower limits of the forecast values are determined by the (3): the National Bank of Ukraine (NBU), World Bank, and International Monetary Fund (IMF) provided varying forecasts for GDP growth from foreign trade in Ukraine's grain sub-complex. The NBU projected growth from 2.9% to 4.8%, the World Bank – from 3.5% to 4.5%, and the IMF – from -3.0% to +4.0%, outlining both pessimistic and optimistic scenarios. The NBU's pessimistic-optimistic forecast for 2024-2027 ranges from USD 2,739.4 million to USD 3,759.02 million. The World Bank's forecast predicts growth from USD 2,758.39 million USD to USD 3,778.56 million during the same period. Meanwhile, the IMF's forecast anticipates growth from USD 2,553.42 million to USD 3,496.39 million for the same period.

Thus, the study showed trends in the export potential of Ukraine in the pre-war period: it was shown that it grew at a significant pace, while in 2021 wheat became the main export product of Ukraine. After the start of Russia's full-scale invasion of Ukraine, the situation changed somewhat, but Ukraine managed to export 48.9 million tonnes of grain and leguminous crops in 2023. In recent years, global wheat production has reached record levels, driven by the development of Asian and North African markets (Wang & Liu, 2023). Corn exports are heavily dependent on sea routes, and forecasts point to possible problems in the coming years regarding trade in this type of product. As for the barley export, it is also likely to continue to decline.

The paper showed that grain exports from Ukraine decreased by 17% in 2023 compared to 2022, but still retained a significant volume of exports. Corn exports also faced a decline due to falling world prices and logistics problems. The reason for this was primarily the naval blockade and other difficulties for exporting products abroad due to the war; despite this, exports of some other types of products increased, in particular, metals and semi-finished products. It is expected that the 2024-2025

grain season will be difficult for Ukraine, with a significant reduction in production and potential blocking of export routes. Nevertheless, Ukrainian farmers should form their long-term development strategies in this way, which would allow them to survive the difficult conditions in which they now operate in a high-quality way.

► Discussion

The implementation of economic tools of the export potential of the grain sub-complex according to the sectoral system of the agrarian sector by identifying its components plays an important role in stimulating economic development and expanding the boundaries of the foreign economic activity of grain production entities, attracting and effectively distributing capital, ensuring the support of their export opportunities in conditions of martial law in country. Due to the state of war in Ukraine, the growth of the following indicators was levelled off: export of products of the grain sub-complex per capita; the ratio of the Ukrainian export of agricultural products to the global export; an indicator of the efficiency of the export possibilities of the grain sub-complex. Meanwhile, in 2022-2023, there were no positive trends of acceleration of such indicators as: the share of grain sub-complex products in the structure of the total export of the agrarian sector; the ratio of grain sub-complex export to GDP; the ratio of the export of products of the grain sub-complex to the volume of production (Maqbool *et al.*, 2020; Mesagan *et al.*, 2021). The lack of significant changes in the dynamics of these indicators is explained by the general recession of the Ukrainian economy. However, in 2023, significant changes took place. GDP from the export of products of the grain sub-complex in the total amount of offers of the agrarian sector grew by 5.3%. Such restorative growth took place after a sharp drop in GDP by 28.8% in 2022. In the 1st quarter of 2023, GDP had downward dynamics. But in the

2nd-4th quarters of 2023, its growth was observed. However, this indicator is a quarter smaller than in 2021. Its growth took place based on low GDP base in relation to 2022. In fact, the economic recovery has stopped. In each quarter of 2023, real GDP from the export of grain sub-complex products was lower than real GDP in the corresponding quarter of 2021 (Sown areas of crops by type, n.d.; List of supplying markets..., n.d.).

At the current stage, the real danger that has arisen in the agrarian sector of Ukraine restrains the development of the export potential of the grain sub-complex, and this, in the future, may lead to irreversible processes and become an obstacle to the post-war recovery of the country. The key issues include low quality management of the grain sub-complex, ignoring innovations in the technological process, and a lack of standardisation of enterprise activity. There is also an insufficient level of funding, despite significant financial assistance from partner countries. The depreciation of fixed assets and a decrease in the degree of material support of the industry, along with an insufficient supply of enterprises with modern production equipment, further exacerbate the problem. The level of innovative development of enterprises is insufficient, and there are unsettled legislative norms regarding joint foreign trade activities with European countries. Additionally, the influence of uncontrollable and unpredictable factors on production results, as well as the imperfection of economic regulators, contribute to these challenges.

European markets are the most attractive for Ukrainian subjects of the grain sub-complex due to geographical proximity and the same sectoral orientation by types of export products (Kryvovyzyuk & Shulha, 2023). However, access to them is complicated by the high level of competition. As practice shows, the inability of the grain sub-complex of Ukraine to overcome the barriers of the European market is connected with the improper adaptability of grain production subjects to its requirements and standards (Kucherenko *et al.*, 2023).

The impact of the war in Ukraine on international trade and economy was also investigated by T. Glauben *et al.* (2022). They noted that the crisis caused by the conflict in Ukraine and aggravated by the COVID-19 pandemic underscores the importance of an open and competitive global market for agricultural products. Import-dependent countries with low per capita incomes are at increased risk of food security. Therefore, to overcome potential food shortages, it is extremely important to maintain open and competitive agricultural markets around the world. Such actions should focus on promoting adaptation, innovation, and efficient use of resources in globally integrated agricultural systems to promote growth and international trade. Researchers suggest that this is the most effective way to achieve this in modern conditions. The current study made similar conclusions: the need to preserve the role of Ukraine in world trade in agriculture and grain in particular was noted. Thus, state representatives should devote as much effort in this area as possible, both in the context of international relations and the internal development of the industry.

The specifics of conducting export policy in the context of exporting products to the EU countries from India were studied by V.R. Renjini *et al.* (2021). They noted that

the export of processed food products to the EU accounts for a significant share of the country's exports, and it is constantly growing. However, due to various kinds of bans and restrictions, there are problems for increasing the volume of imports of products into the country. Researchers compare the situation with China, where it is much easier to increase market share. As part of the current study, attention was also drawn to the fact that in the EU countries there are quite serious standards that complicate the process of importing products to the association. Although the quality of Ukrainian products is generally suitable for such requirements, however, sometimes there are also difficulties for entering the market. This may be partly due to the high competitive advantages of Ukrainian grain in comparison with the products of EU producers. Thus, in order to further deepen cooperation and increase exports, it is necessary to form closer ties with the producers of these countries, and with representatives of state authorities, for a more loyal attitude to imported Ukrainian products (Musayeva *et al.*, 2024).

The impact of agricultural indicators on the concentration of foreign trade and competitiveness of this sector based on data from Romania was investigated by J.V. Andrei *et al.* (2020). They argued that the implementation of appropriate policies in the sector plays an important role for the greater efficiency and competitiveness of the agricultural sector in Romania. In addition, they stressed the importance of assessing the social and economic components of the sector. The researchers also concluded that an increase in agricultural production along with domestic processing can increase exports and replace imports. The current study also concluded that policies aimed at improving the situation in the sector can lead to significantly better results in the sector. Nevertheless, there are doubts about how much Ukraine will be able to pursue such a policy in the context of war.

In turn, the interdependence between economic growth and agricultural exports in the framework of their study was found by S. Udeorah & K. Oluwafemi (2023). The study found a positive association between agricultural exports and economic growth, with each increase in agricultural exports associated with a significant increase in economic growth in the long term. In other words, the results showed the importance of agricultural trade for economic growth and development in countries. Based on this, recommendations were created for the development of more open trade, economic diversification, increased financing and lending schemes for agriculture, and the study of alternative financing options to increase agricultural productivity and stimulate economic growth. As part of the current study, a similar conclusion was also made that agriculture, namely its exports, is causing the rapid development of this sector. In addition, the recommendations provided in the framework of the work are also similar to those described in the paper above. This confirms the results obtained in the current study.

In order to get Ukraine out of the economic recession caused by the Russian invasion, it is advisable to consider the strategy of economic stimulation, in particular, those components that use financial and credit instruments to develop the export potential of the grain sub-complex. First of all, the strategy should determine the target

(priority) areas for the development of the grain sub-complex and should be the basis of development and the driving force behind the stabilisation of the country's economy in post-war recovery.

► Conclusions

The purpose of this study was to assess the development opportunities of the agricultural sector of Ukraine, namely, the grain industry and its export potential. It was concluded that Ukrainian grain exports developed quite rapidly in the past, before the war began: Ukraine became one of the leading exporters to the European Union countries. However, with the start of Russia's full-scale invasion in 2022, the situation changed: Ukraine faced a 17% reduction in grain exports compared to 2022, due to disruptions due to the Russian invasion, infrastructure destruction and logistics blockades. Despite these difficulties, Ukraine managed to maintain export volumes due to new sea routes and increased transportation by rail and road. As part of the study, it was shown that forecasts for wheat and corn production in Ukraine remain optimistic, despite the challenges caused by the war. The paper showed that the expected wheat is at the level of 19.5 million tonnes, and exports – 11 million tonnes, while corn production is expected to grow by 5 million tonnes to 30 million tonnes, and exports – to 12.5 million tonnes. However, it should also be taken into consideration that Ukrainian grain faces tough competition

on the international market: despite this, wheat exports may decline due to production problems and competition from countries such as Russia, France, and Australia. The main demand for Ukrainian wheat is Asia and North Africa, but these regions have diversified their suppliers, reducing their dependence on Ukraine. Similarly, corn exports are under threat due to competition from Brazil and the United States. In addition, Ukrainian barley production and exports are expected to significantly decrease, which will limit Ukraine's ability to regain its global market share. In general, the Ukrainian grain export sector faces a difficult but sustainable future, where market adaptation and diversification are key goals to overcome the difficult conditions that have arisen for Ukraine.

The conclusions help to better understand the prospects for the development of the grain industry in Ukraine, and based on these data to create a strategy for the development of both the state and enterprises. It is important for further study to assess the development opportunities of other sectors of the economy, such as mechanical engineering, information technology, in particular in war conditions.

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► Conflict of interest

The authors of this study declare no conflict of interest.

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Глобальні зміни у розвитку експортного потенціалу зернового підкомплексу аграрного сектору України

Юрій Кирилов

Доктор економічних наук, професор
Херсонський державний аграрно-економічний університет
25031, просп. Університетський, 5/2, м. Кропивницький, Україна
<https://orcid.org/0000-0001-5061-2644>

Марат Ібатуллін

Доктор економічних наук, професор
Національний університет біоресурсів і природокористування України
03041, вул. Героїв Оборони, 15, м. Київ, Україна
<https://orcid.org/0000-0001-8765-6261>

Анастасія Коноваленко

Доктор економічних наук, професор
Таврійський державний агротехнологічний університет імені Дмитра Моторного
69063, вул. Жуковського, 66, м. Запоріжжя, Україна
<https://orcid.org/0000-0001-9061-5989>

Жанна Шило

Кандидат економічних наук, доцент
Національний університет водного господарства та природокористування
33028, вул. Соборна, 11, м. Рівне, Україна
<https://orcid.org/0000-0002-2669-6734>

Наталія Почерніна

Кандидат економічних наук, доцент
Таврійський державний агротехнологічний університет імені Дмитра Моторного
69063, вул. Жуковського, 66, м. Запоріжжя, Україна
<https://orcid.org/0000-0002-6109-6099>

► **Анотація.** В сучасних умовах експорт сільськогосподарської продукції є одним з основних джерел доходів для аграрного сектору України. Тому проведення різнобічних досліджень зовнішньої торгівлі в цьому секторі є актуальним. Метою дослідження була розробка оцінки можливостей розвитку експорту зернових в Україні на основі аналізу поточних даних щодо розвитку цього сектору, а також окремих світових тенденцій. У роботі досліджено глобальні зміни у розвитку експортного потенціалу зернопродуктового підкомплексу аграрного сектору України. Доведено, що декомпозиція експортного потенціалу зернопродуктового підкомплексу за галузевою системою аграрного сектору дозволяє сформувати поетапну методичну оцінку його кількісних та якісних показників для визначення композиційної цілісності ефективної вартості досліджуваного об'єкта. Представлено комплексний функціонально-ресурсний аналіз параметрів експортного потенціалу зернопродуктового підкомплексу, які згруповано відповідно до процесного підходу до розрахунку продовольчої безпеки експортного ланцюга суб'єктів зерновиробництва. Методика оцінки стану продовольчої безпеки зернопродуктового підкомплексу держави через ресурсну складову дозволяє діагностувати експортні можливості суб'єктів зовнішньоторговельних операцій в умовах наявності численних ризиків. Визначено фактичну залежність валового внутрішнього продукту України від експорту продукції зернопродуктового підкомплексу та розраховано її прогнозне значення на п'ятирічний період. Наведено песимістично-оптимістичний сценарій зростання (скорочення) валового внутрішнього продукту України за нижньої та верхньої межі реалізації експортного потенціалу зернопродуктового підкомплексу. Висновки, отримані в рамках дослідження, можуть бути використані для формування політики в аграрному секторі України

► **Ключові слова:** галузева система; наслідки військового вторгнення; тенденції воєнного періоду; труднощі ринкової інтеграції; міжнародна торгівля