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Growth of value added as a factor in the development of Ukrainian agriculture in the context of accelerated integration into the EU

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Abstract. The development of agriculture is a key factor in the sustainable development of society in the future. The country's integration into the European community creates new opportunities for agriculture and, at the same time, requires innovative approaches to the development and competitiveness of the sector in the globalised world. The study was aimed at analysing and improving the existing strategic approaches to the development of agriculture in Ukraine based on increasing gross

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value added in the context of accelerated integration into the EU. A variety of methods was used, such as analytical, statistical, functional, systems analysis, deduction, synthesis, and comparison. The analysis of the development and distribution of gross domestic product and gross value added in agriculture of Ukraine and the EU, including the specifics of the development of gross value added in Ukrainian agriculture, was carried out. The influence of European integration processes on the development of agriculture, in particular, their needs and opportunities to increase gross value added, was investigated. A model of a cybernetic system with management in agriculture for the growth of gross value added in the context of accelerated integration into the EU has been developed, which allows substantiating the forecast of changes in the format of development of Ukrainian agriculture to avoid the economy as a raw material appendage of the EU. The results of the study showed that the development of agriculture in Ukraine based on increasing gross value added in the context of accelerated integration into the EU involves the use of a comprehensive strategy that considers the specifics of the industry, European innovative approaches, and best practices of in-depth processing of products of the European Union countries. The practical significance of the study was to develop specific practical recommendations and strategies for public administration bodies, agricultural enterprises to optimise the use of the available natural resource potential for the growth of agricultural production, introducing advanced technologies for its deep processing in order to accumulate gross value added, which is the basis for the development of agriculture

Keywords: gross domestic product; gross value added; Russian military aggression; development; economy; conceptual model

INTRODUCTION

The development of individual industries is a component of the overall growth of the national economy of any country. The problem of development is particularly important in the context of agriculture, which is not only the main sector for many countries, but also a key element in solving food security and sustainable development of society. The development of Ukrainian agriculture is an urgent task that requires solving problems to optimise the use of not only resources, but also the entire production potential in the production of agricultural products with the maximum share of added value. Ukraine's integration into the European Union opens up wide opportunities for entering global value chains, which will give an impetus to the accelerated development of agriculture due to the growth of production and exports of products with a high degree of readiness. The main challenges of Ukrainian agriculture were improving the processes of processing and refining products to the highest degree of their readiness and compliance with their quality and safety with European standards. Such a statement of the problem requires substantiation of the areas of agricultural development based on in-depth processes of production and sale of finished products, which are now more important and justified from the standpoint of achieving successful integration into the EU.

The study by M. Shashyna (2020) proves that in the current conditions of rapid development and transformation in the global economic space, and in the context of globalisation and integration processes, one of the indicators that most fully reflects the development of individual business entities and economic systems in general is the amount of value added, which is considered from the standpoint of cost-oriented management. In other words, the value of the business is at the centre of analysis, not just the product. The researcher notes that strategic areas for the development of regional and sectoral economic systems of Ukraine require gradual development based on comprehensive modernisation at all levels. Therefore, in the context of the development of agriculture in Ukraine and accelerated integration into the EU, the industry needs innovative management models, including management, communications, structures, production range, and technologies. Consideration of conclusions in the development of strategic areas for the development of agriculture in Ukraine indicates the expediency of substantiating changes in management approaches and revising basic management models in the industry.

T. Mirzoieva and M. Stepasiuk (2023) determined that Ukraine's integration into the European Union will contribute to the development of agriculture by applying the experience of European farmers in the efficient use of resources based on the use of innovative technologies for agricultural production. The researcher considers the main chains of value added generation on the example of oilseeds and focuses on the processes of in-depth processing of sunflower. Thus, the substantiation of measures to spread the European experience of gross value added generation using innovative technologies of in-depth processing can become an effective area for accumulating the added value of products sold, which will create conditions for the development of agriculture in Ukraine.

Scientific concepts of value chain development in agriculture, according to V. Rossokha and O. Nechyporenko (2024), aimed at optimising the management of natural, material and working resources, which will create favourable conditions for the adaptation of European standards of agricultural production and

increase the competitiveness of the agricultural sector of the Ukrainian economy. In the context of balanced development of agriculture in Ukraine, it is advisable to substantiate measures to reform the resource management system in the industry, which in the future will become the main source of product competitiveness growth and the economic basis for the development of this industry.

Y. Pletnyova and V. Marchenko (2018) emphasises that Ukraine has great opportunities for integration into global value chains of such a sector as the production of machinery for the agro-industrial complex, which is the key to the competitiveness of agriculture in the international context. The findings can be used to develop areas for creating an attractive external environment for agricultural development. Integration into the EU requires substantiation of priority areas for updating and improving equipment, technologies for the production and processing of agricultural products in accordance with European standards, which will become the basis for improving the efficiency of functioning and economic development of the agricultural sector of the Ukrainian economy.

According to O. Svitovyi (2022), the problem of agricultural development in the context of accelerated integration into the EU can be solved by creating clusters, which will contribute to the rational use of production potential for the production of products with high added value. The researcher proves that one of the areas of increasing the production with high value added is the introduction of modern and highly efficient machinery and equipment in agricultural production, which would allow producing and selling not raw materials, but finished products with a high degree of deep processing and processing. Such arguments are the basis for developing recommendations to strengthen state regulation in the generation of added value at the level of enterprises, industries, and to improve the performance of agricultural business.

According to Z. Kalinichenko (2023) and T. Adebayo *et al.* (2024), European approaches to the development of value chains are based on innovative ecosystems, which can become the basis for the development of highly developed sectoral and regional clusters. European regionalisation of value chains in industries supported by R&D, design, procurement, production, distribution, marketing, and service is not a new trend. Thus, there is a need to study existing European approaches to regional and global integration in order to adapt it in the Ukrainian agricultural sector of the economy. Ukraine has a chance to join the EU's integration processes as an industrial and technological centre. Involving Ukrainian enterprises in such chains will create a synergistic effect, allowing participants to join forces to achieve common goals and opportunities to increase added value, which is critical for Ukraine's agricultural development.

Approaches to processing agricultural products need to be updated and improved to meet European approaches to the generation of gross value added and the development of the agricultural sector. Integration into the EU requires effective management of agricultural development and ensuring the competitiveness of the agricultural sector. The purpose of the study was to substantiate the areas of increasing gross value added in Ukrainian agriculture, considering compliance with European standards and sustainable approaches for its development of the agricultural sector in the context of accelerated integration into the EU.

MATERIALS AND METHODS

The study was based on official documents and reports of the State Statistics Service of Ukraine (Gross Regional Product in 2019, 2021; State Statistics Service of Ukraine, 2021), and materials from the official website of the European Union (Eurostat, n.d.), the UN System of National Accounts (System of National Accounts, 2008; Project of the Recovery Plan of Ukraine, 2022), the Resolution of the European Parliament and the Council standards on the European system of national and regional accounts of the European Union (National accounts, 2006; Regulation (EU) No. 549/2013, 2013). The methodology for the generation of gross domestic product and gross value added in Ukraine is fully harmonised with the international standards of the European Union, which simplifies analytical research on their generation not only in the national economy, but also makes it possible to compare with similar indicators of other countries and identify reserves for their growth in agriculture in Ukraine.

The information basis was statistical data from the State Statistics Service of Ukraine (2021) and the Food and Agriculture Organisation of UN (n.d.) for 2015-2023 in terms of: production of real gross domestic product and gross value added; export of agricultural products and determination of its share both in the total exports of Ukraine and in world production; products of refinement and processing with a higher degree of readiness**.** In addition, in the process of forecasting the development of Ukrainian agriculture, given the significant impact of hostilities, not only the state of production potential was considered, but also the specifics of managing the demining of agricultural land, solving the problem of replenishing labour resources, restoring fixed assets, increasing working capital; growth of investment resources; development of innovation processes, etc.

The study of the situation with the development of agriculture based on the accumulation of gross value added in Ukraine and the EU was carried out using methods that identify the content of the object. The analytical method was used to investigate certain aspects of the agricultural development management system based on the increase in gross value added to study their characteristics, relationships, and impact on

the overall result. The features of gross value added generation in agriculture of Ukraine and the EU were analysed to determine the areas of development of Ukraine's agriculture after the war based on increasing gross value added in the context of accelerated integration into the EU. The statistical method was used to investigate data on the level of gross domestic product and gross value added in agriculture and analyse its share in the structure of the main sectors of the national economy. The functional method was used to study the role of each element of the management system for the production, processing, and export of agricultural products. Highlighting the importance of in-depth processing of agricultural products at the expense of introduction of new technologies and creation of favourable conditions for effective activity in agriculture, opportunities for growth of gross value added in the industry were identified and the areas of development of the industry were substantiated.

System analysis provided an opportunity to consider the development of agriculture as a complex system where all components are interrelated, and to determine the impact various factors (social, economic, political) affect the management of its development, based on which the results are achieved. The use of the deduction helped to explore the general principles and concepts of gross value added generation in Ukraine and European countries. The synthesis combined various elements, concepts, and aspects of creating a new holistic concept in the context of gross value added growth, which helped to substantiate the areas of agricultural development in Ukraine, which combined modern advanced approaches of European practice in the production of products with high degree of readiness. The comparative approach was used to compare approaches to the generation of gross value added in agriculture in Ukraine and the EU. It helped to understand the advantages and disadvantages of each approach to determine the best option for achieving strategic goals for the development of Ukrainian agriculture.

Based on the results obtained, specific recommendations were developed for the growth of gross value added in agriculture in the context of accelerated integration of Ukraine into the EU and solving problems that will contribute to the development of agriculture in Ukraine. In general, the study was aimed at determining the feasibility of applying European experience and best international practices in the field of in-depth processing of agricultural products, which will ensure the growth of gross value added and the successful development of the agricultural sector and the country as a whole.

RESULTS AND DISCUSSION

Development is an economic category that is based on natural changes in the economic system and in its transition from one state to a qualitatively new one using innovative techniques, technologies and management methods in order to increase the volume of gross product and accumulate gross value added. Gross domestic product and gross value added are both macroeconomic indicators that fully characterise the level of development of the country's economy and, in particular, its industries, and microeconomic indicators that indicate the economic state of the enterprise. From a macroeconomic standpoint, gross domestic product reflects the total market value of created public goods for the year in all sectors of the state's economy that are intended for domestic consumption, export, and accumulation, regardless of organisational and legal forms of ownership of production resources. However, total value added additionally reflects the value created in the production process and is defined as the difference in the value of goods and services produced and fully used in the production (intermediate consumption) process according to the national classifier of Ukraine (2010). In relation to certain sectors of the Ukrainian economy, gross value added is calculated as the difference between gross output and intermediate consumption costs, and is determined in basic prices, considering subsidies for products and excluding taxes on them.

In other words, the components of gross value added are: remuneration of employees in the form of physical or monetary remuneration given by the employer for work performed, direct social payments and other taxes, except for production subsidies, gross profit including rents paid for the use of land, subsoil resources, patents to their owners by lessees, depreciation, and less taxes paid by enterprise owners for production activities regardless of sales or profitability of the enterprise (National accounts, 2006; Sustainable Development Strategy for Ukraine by 2030, 2017).

In terms of economic content, the concept of value added consists in managing resource costs throughout the entire product value chain, from the manufacturer to the end user. As for agriculture, the category of "gross value added" has its own characteristics, since natural resources (land, plants, natural and climatic conditions, etc.) are involved in the production process, and it is difficult to distinguish between human labour and the effects of natural processes. According to V. Zbarsky and M. Talavirya (2023) the combination of human labour and the influence of natural factors increases added value due to the increase in output, which determines agricultural activity as the most productive.

Dynamic relationships between different sectors of the economy are usually used to assess the impact of economic shocks. The generation of gross domestic product (GDP) is based on the concepts of supply and demand. The first approach to determining GDP assumes that total output is equal to total domestic demand, so GDP is the sum of public and private consumption, investment, and net exports. The second approach concerns the productive side of the economy, and states that GDP consists of gross value added (GVA) by sector, import duty,

and value added tax (Salimova *et al.,* 2020; Andreescu, 2021; Melembe *et al.,* 2021). To further study the priority of agricultural development in Ukraine, it is advisable to focus on the indicator of gross value added, since taxes and subsidies are usually very difficult to predict.

In agricultural production, value added is the part of the value that was increased not only in the process of production of agricultural products, grain, milk, meat of all kinds, honey, wool, etc., but also in the process of processing or refining to the stage of readiness, which the consumer is ready to buy and immediately consume. In other words, deepening the processing of agricultural products into finished food is currently an important component of agricultural production, which allows reducing the time for consumers to receive finished food and to add value for producers.

Agriculture plays a key role in the Ukrainian economy, providing 9% of GDP, 18% of business entities' employment, and 6% of tax revenues (Batatin, 2022; Sansika *et al.,* 2023). The importance of the agricultural sector in the national economy is growing from year to year. Summarising the empirical material for 2015-2023 on the share of agriculture in the real gross domestic product, its slight fluctuations in the years of economic crises are noticeable, which indicates the relative stability of the agricultural sector to crisis phenomena (Fig. 1). Among the main sectors of the national economy, the contribution of agriculture to the total gross value added of the national economy averaged 10.7% in 2015-2022, second only to the processing industry by 0.3%, ahead of the mining industry by 5.7%, and electricity and gas supplies by 7.1%. During the Russian war in Ukraine, 2022-2023, there was a decrease in the share of gross domestic product and gross value added. However, the decline in agricultural production shows a lower rate compared to other industries.

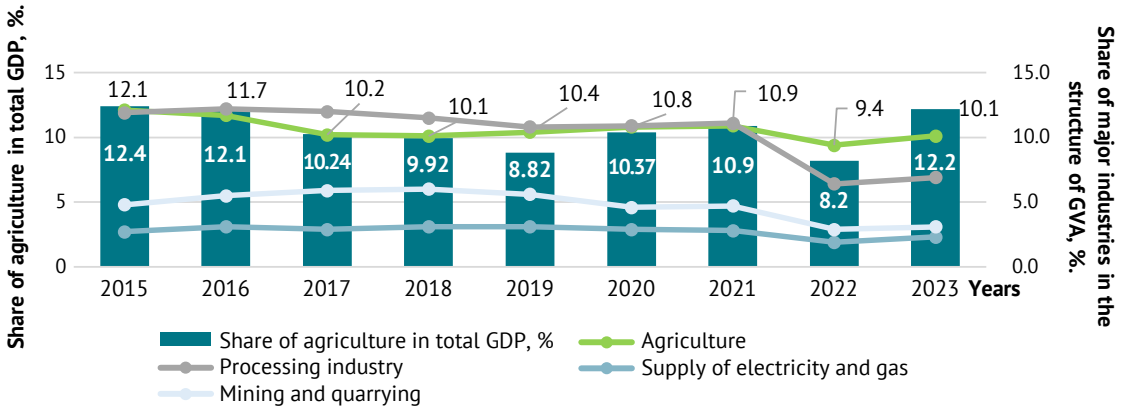

Figure 1. *Share of agriculture in real gross domestic product and gross value added of Ukraine, 2015-2023*
Source: *calculated according to the State Statistics Service of Ukraine, n.d.; Gross Regional Product in 2019, 2021; State Statistics, 2021)*

Ukrainian agriculture plays a key role not only for the economy of its state, but also contributes to global development by increasing the production and export of a significant amount of agricultural products as raw materials and finished food. However, the Ukrainian agricultural sector mainly supplies raw materials to the foreign market, which importing countries send for partial refinement, or for in-depth processing and receive goods with high added value. Such finished products are sent for sale to the foreign market, and from there they enter Ukrainian markets. Foreign companies that process and refine Ukrainian raw materials make profits ten times higher than Ukrainian producers who have grown agricultural products.

Back in 1581, the famous philosopher and economist John Giles noted that it is not economically profitable to sell raw materials for processing to other countries, and then buy the finished product from them. Four centuries have passed, and yet John Giles' scientific argument reflects the current situation of Ukraine on the international market, which gradually limits Ukraine's potential and negatively affects the economy. Thus, domestic producers contribute to the development of other countries and improve the well-being of foreign citizens, not Ukrainian society (Batatin, 2022).

Since gross value added is the basis not only for accelerated and balanced economic development of agriculture, but also for the Ukrainian economy, it is reasonable to recognise that the time has come to change the components of the food production chain in agriculture, which was developed during the years of independence and continues now. Its emergence is associated with an imperfect strategy of the state, the influence of world players in the global market and with stable international trade ties.

Agriculture in Ukraine plays a key role not only in the national economy. Ukraine is one of the world's largest exporters of agricultural and food products. And as a result of the war, there are already real problems

in the global food market. In particular, in 2022, due to Russia's full-scale invasion of Ukraine, agricultural production decreased by 4.2% and accounted for 8.2% of the total gross domestic product. However, in 2023, Ukrainian agriculture managed to increase the volume of gross domestic product by more than 4%, and gross value added by 0.7%. The economic growth rate of agriculture is the highest among other sectors of the economy, which proves the high stability of agricultural production to external challenges, such as war, increased imports, migration of labour resources, etc.

The main reason for the decrease in production volumes was the occupation and mining of part of the land, which belonged to agricultural land and were the base of production. The area of mined fields reaches 8 million hectares, of which 6 million hectares are located in the temporarily occupied territories, 2 million hectares – in the liberated ones. This land is a food source for about 81 million people worldwide. Ukraine can overcome this challenge only by an extremely effective organisation and support of the international community. Experts estimate the losses of agriculture as a result of a full-scale invasion on April 24, 2023 at USD 8.7 billion: USD 6 billion – losses of agricultural machinery, USD 2 billion – losses of products and resources as a result of theft or loss, USD 0.5 billion – damage to perennial crops, USD 0.3 billion – losses in animal husbandry and aquaculture. Millions of tonnes of Ukrainian grain are stuck in Black Sea ports, which has led to an imbalance in the global agricultural market (Interfax-Ukraine, 2023).

In 2015-2021, exports of Ukrainian goods to the world market grew every year, reaching USD 68.1 billion in 2021, with the share of agriculture at USD 27.7 billion (or 40.6%) (Fig. 2). In 2022, the volume of Ukrainian exports decreased by 23.92% and, in particular, agriculture by 12.8%. And in 2023, compared to 2022, exports from Ukraine decreased by 8.3% and agricultural products by only 0.3%. However, agricultural products accounted for the largest share of total Ukrainian exports, about 41%. In this case, agriculture is a strategic sector, the level of development of which determines the economic development of rural areas and the social well-being of 13 million people.

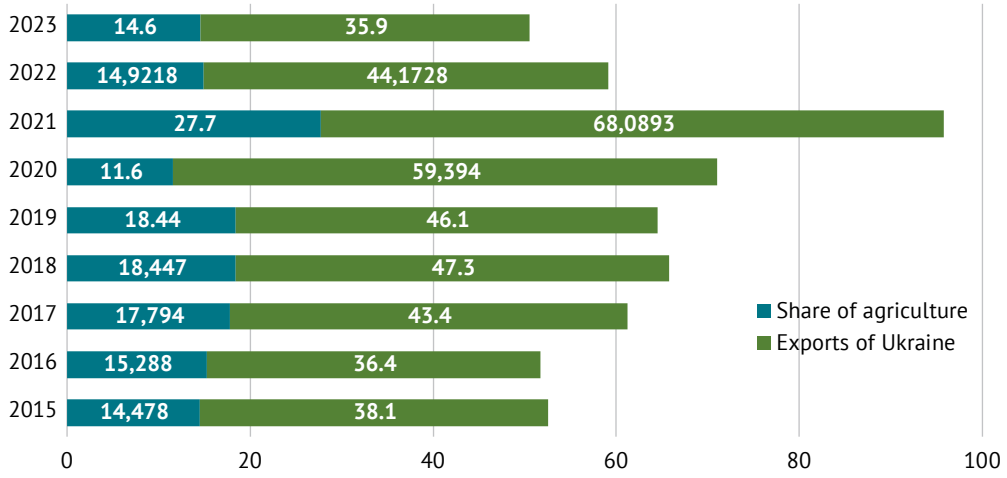

***Figure 2**. Share of agriculture in total exports of Ukraine, 2015-2023*
***Source:** calculated according to the State Statistics Service of Ukraine, n.d.; Gross Regional Product in 2019, 2021; State Statistics, 2021)*

Gross value added is generated in agricultural sectors unevenly. Therefore, it is advisable to analyse the trends in the development of sectors of the Ukrainian economy by the amount of gross value added created in 2015 and 2023. This would help to identify the industries that accumulate the largest GVA, and which should become a priority for recovery in the post-war period in the context of accelerated European integration. In recent years, Ukraine has become a leader in the export of low-margin products, while having successful cases in processing, in the field of crop production – sunflower oil, rapeseed, corn, soybeans, and in the field of animal husbandry – chicken, pork. In 2015-2023, sunflower was the fastest growing crop in Ukraine and the highest exports to foreign markets (Fig. 3). The share of its exports in the global market reached more than 51.2%. Sales volumes of barley, wheat, corn, and soybeans are slightly lower, but significant in the world agricultural market.

The trend of selling low-margin types of products will continue in the future, since in the structure of crops 89 are low-margin crops, this leads to a decrease in profit compared to what can be obtained from the sale of crops with a higher margin. For comparison, developed countries mainly grow high-margin crops (80% in the structure of crop production in the Netherlands, Spain, and Italy). Ukraine is noted for its high productivity in the cultivation of grains and industrial crops,

but a significant portion of its grain crops is exported. For example, 79% of corn, 66% of wheat, and 59% of barley are intended for export. The situation with wheat is particularly noteworthy, with 35% of the harvest intended for non-food use exported as first-stage raw materials. Every year, the gross harvest of grain and oilseeds increases, but existing granaries limit the ability to store increasing volumes of grain. It is important to note that it is high-margin crops that are more profitable, although they require a longer payback period (Regulation (EU) no 549/2013, 2013; Global value chains..., 2014; Gross Regional Product in 2019, 2021).

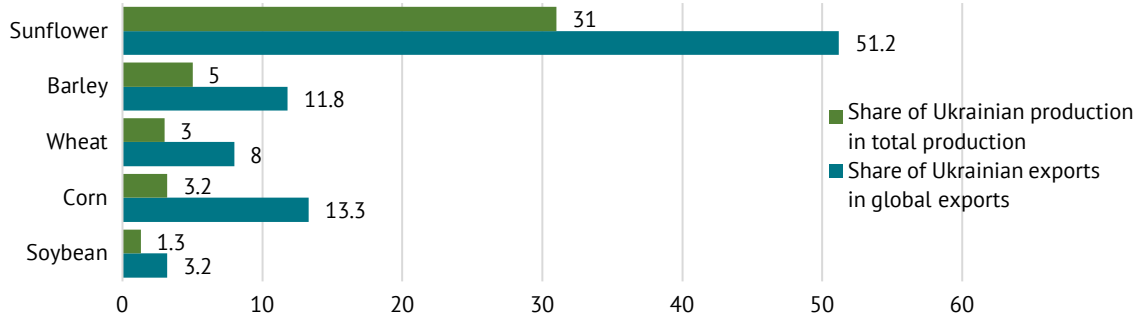

***Figure 3**. Ukraine's share in world production and export of agricultural products, 2015-2023, %*
***Source:** calculated based on State Statistics (2021) and Global value chains... (2014)*

In the structure of agriculture, the livestock sector occupied 21.1% in 2018, and in 2022 it decreased by 2.5% and amounted to 18.6%. In 2015-2023, there was a trend of decreasing the number of pigs, sheep, and cattle, including the dairy herd. The number of poultry increased by 6.7% in large industrial poultry farms and decreased by 0.4% in households. The main reasons for the decline in livestock in animal husbandry are its unprofitability. In 2018-2022, the profitability of cattle meat production was -24.2%. Pig meat was profitable at 2.6% and milk at 20.4%. In recent years, there has been a loss-making rate in poultry farming, in particular, poultry meat -0.2%, and eggs -19.2%. However, the increase in the number of poultry is substantiated by the increase in demand for poultry meat and eggs due to low prices and their dietary nature.

In terms of livestock products, in 2018-2023, the production and export of milk and dairy products, beef, and pork decreased, while only chicken increased. In particular, in Ukraine, the share of milk production in the total production of livestock products reaches 2%, while in the EU countries – 8-23% (Gross Regional Product in 2019, 2021). In 2021, milk production fell to a record low of 8.7 million tonnes, which is a historic low for Ukraine. This led to higher prices for dairy raw materials on the domestic market and led to the spread of falsification of dairy products, illegal imports, and problems with monopolies in trade. In addition, the lack of a legal alternative for the mandatory construction of local wastewater treatment plants for milk processing enterprises complicates the situation. The reason for these results is its poor quality. The main difference between the production of milk and dairy products, beef, and pork is the high capital intensity of products and a long payback period. Now animal husbandry is dominated by a low level of automation, manual human labour, and a small number of premises and technologies for its further processing. As a result, low-quality and low-cost products are produced. In comparison of the production processes of raising cattle, pigs, and poultry, it is advisable to note that the production of poultry meat is less capital-intensive, labour-intensive and risky to infect poultry with diseases. The poultry industry is characterised by high export orientation and depth of chicken processing.

Over the past decades, Ukrainian agriculture has been characterised by the supply of crop and livestock products to the world market in the form of raw materials, while its processing industries occupy the lowest share in the sector. The highest share in the total supply is made up of unprocessed products intended for export, in particular, barley – 46%, corn – 84%, wheat – 54%. The share of products used for industrial processing is low: barley – 13%, corn – 3%, wheat – 19%. Milk processing volumes have tended to decrease over the past 5 years (by 17%) (Regulation (EU) No. 549/2013, 2013; Global value chains..., 2014; Statistical collection of Ukraine, 2021). In general, in 2018-2023, in the structure of agricultural exports, finished products ranged from 11% to 14%, primary processing – from 21% to 34%, and the largest part was raw materials, from 55% to 64% (Fig. 4).

As the dynamics of the structure of agricultural exports shows, in recent years, a large share was occupied by raw materials and only their primary processing. However, the number of trade agreements concluded has increased in the context of adapting quality growth processes to European standards. It is important to note that raw material prices are much lower than prices for finished processed products. Due to the fact that processing adds significant cost and allows achieving the highest quality standards, the Ukrainian processing sector has a significant potential for growth.

The transition to each subsequent stage of processing leads to an increase in value added. The shadow sector creates obstacles to the development of agriculture, with grain production and land lease being the main objects of shadow activity. Insufficient regulation of the shadow sector of the economy primarily affects the processes of refinement and primary processing of agricultural products. The quality of exported products is mainly controlled by the customer, and the largest amount of them is sold through shadow sales channels.

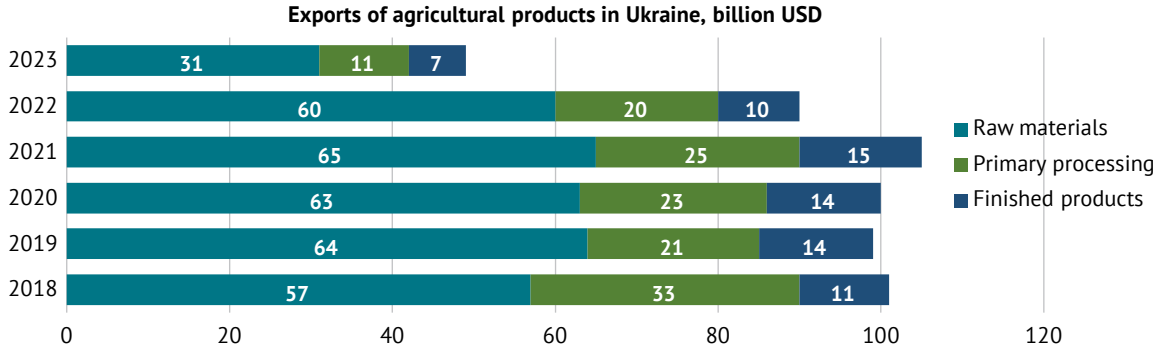

***Figure 4**. Dynamics of agricultural exports from Ukraine for 2015-2023, billion USD*
***Source:** calculated based on data (State Statistics Service of Ukraine, n.d.; Gross Regional Product in 2019, 2021; State Statistics, 2021)*

Thus, the agricultural productivity of Ukraine is significantly lower than that of highly developed competing countries. Value added per employee in Ukraine is significantly lower than in the leading countries in agricultural production (91% lower than in France and 67% lower than in Turkey due to the radically different distribution of crop and livestock production in the sector. In Ukrainian production, crop production accounts for 83%, and animal husbandry -17%. The structure in other countries is somewhat more balanced, the distribution is approximately 50/50%, for example, in the EU, where crop production is 57%, animal husbandry is 52% (Global value chains..., 2014; Regulation (EU) no 549/2013, 2013; Gross Regional Product in 2019, 2021).

The reason for this condition is low capacity and low degree of processing and refinement of agricultural products. Ukraine has already taken a leading position on the world market in the supply of raw agricultural products. The quality of raw materials is important for increasing the share of exports. The main reasons for the low quality of agricultural products are unsatisfactory: quality and non-compliance with scientifically based standards for the use of chemical fertilisers, the level of technological efficiency of agricultural production, transportation processes by outdated technical means, etc.

Now, monitoring the processing and refinement of agricultural products to the highest degree of their readiness will solve the problem of increasing gross value added. The lengthening of the chain of creating the gross value added of the final finished product in agriculture is the multiplier that not only leads to an increase in prices on the product market, but is also the foundation for the economic development of Ukrainian agriculture. An example of the successful extension of the value added chain in Ukraine's agriculture is the growing share of processing sunflower seeds into finished oil, which allowed Ukraine to become a leader in sunflower oil exports on the world market in a short time. While for the oilseed crop of soybeans, there is a decrease in export volumes due to a decrease in the volume of its processing.

Ukraine is in the spotlight, and this historic opportunity can radically change the position of Ukrainian agriculture on the world market. Now it is important to focus on processing raw materials supplied by the Ukrainian agricultural sector. One agricultural crop, such as corn, can serve as the basis for the production of at least 15-20 types of products with high added value. The concept of creating a deep processing food sector of the economy is already being successfully implemented in world practice. Therefore, it is important to prepare the ground for the fastest recovery of Ukraine's agriculture after the war, which can be as difficult as the period of war. An important condition for the restoration of agriculture with deep processing is the access of farmers to advanced technologies.

Unfortunately, Ukraine's agriculture remains vulnerable in the production of products with a high level of gross value added. This situation is explained by the lack of necessary advanced technologies. Ukrainian agricultural producers who want to process grain into citric acid, fuel ethanol, glucose monohydrate, and other products are technologically limited and do not have

the ability to do so. In addition, there is no infrastructure for implementing such technologies. However, there is a need to create favourable conditions for investors not only to build their plants within international holdings for the agricultural sector of the economy on Ukrainian territory, but also to provide access to advanced technologies. This would allow developing and adapting such technologies to Ukrainian geographical and climatic conditions, which would facilitate the introduction of the latest technologies in agricultural production for its further development.

The paper by O. Ivanenko *et al.* (2021) identified that one of the main aspects of the financial policy of EU member states is budgetary allocations for economic, environmental, technical, technological, and social purposes. The costs of environmental protection are significant compared to the costs in Ukraine. This contributes to the development of innovative technologies for recycling waste and, in particular, the development of biotechnologies in agricultural production, the use of which ensures the efficiency of their use, the manifestation of which is an increase in the production of agricultural products per unit of resource consumption and an increase in profitability.

The problem of access to advanced technologies is important, and it should be understood that there are a limited number of technology development companies in the world that are willing to provide access to them. Therefore, such a "bottleneck" should be taken into account. This refers not only to the creation of factories, but also the development of complete multi-productive complexes for deep processing of agricultural products. Without the implementation of a programme of deep processing of agricultural products, Ukraine may remain in the shadows in European civilisation. Given the military situation in the country, it is important to understand that this slows down the development of agricultural production. Forecasts of Ukraine's GDP growth by 2050 by an average of 2-3% per year are limited. If this rate continues, more than 70 years will not be enough to reach the level of today's Poland, let alone reach the level of developed countries such as France or Germany.

The implementation of the programme of deep processing of agricultural products can help accelerate the restoration and development of agriculture in Ukraine. Ukrainian ambitions should reflect the desire to create a powerful agricultural production that can generate a significant amount of foreign exchange earnings and create hundreds of thousands of jobs, promote the activation of the introduction of new technologies, and create favourable conditions for business activities in agriculture, attracting both external and internal investors. This is the time to consolidate efforts and develop comprehensive solutions for the stable growth of Ukrainian agriculture in the post-war period.

The big agro-processing programme is an important step in this area. Changing the strategy of agricultural production plays an important role in the development and stabilisation of Ukraine both in the military and post-war periods. Christian Ben Hell, head of Agriculture sector of the EU Delegation to Ukraine, stressed that the EU funding for this FAO project aims to restore or strengthen the functionality of agricultural value chains, which will help meet the food needs of the local population and internally displaced people in western Ukraine. This approach contributed to solving the problem of food security in the country in the near and short term and was crucial in preventing a food crisis in 2023 (Bulletin on the state of trade relations..., 2023).

Having an economy focused on raw materials, and not introducing effective tools for its transformation, the Ukrainian economy is becoming more and more dependent on imports every year. This increases the vulnerability of Ukrainian agriculture to the global market. To change this situation, it requires comprehensive projects and decisions at the state level aimed at fundamentally transforming the economy. Especially in the post-war period of agricultural restoration.

In July 2022, the National Council for the recovery of Ukraine from the consequences of the war presented a draft Recovery Plan, which presented a strategy for the development of the national economy until 2032, and outlined the priority of restoring economic activities for the transfer from a transition economy to a developing economy in the context of accelerated integration into the EU. Integration of Ukraine's agriculture into global chains of gross value added creation, which allows substantiating the priority areas for its recovery after military aggression based on value added. The strategic goal of agriculture in the context of globalisation should be to increase the competitiveness of Ukrainian products and ensure food security.

In the study by V. Bugaychuk *et al.* (2019) identified that one of the main aspects of the financial policy of EU member states is budget allocations for economic, environmental, technical, technological, and social purposes. The costs of environmental protection are significant compared to the costs in Ukraine. This contributes to the development of innovative technologies for recycling waste and, in particular, the development of biotechnologies in agricultural production, the use of which ensures the efficiency of their use, the manifestation of which is an increase in the production of agricultural products per unit of resource consumption and an increase in profitability. Based on the analysis (Table 1), the following areas and stages of development of Ukrainian agriculture are proposed.

***Table 1**. Areas of development of agriculture in Ukraine after the war based on increasing gross value added in the context of accelerated integration into the EU*

Stages of post-war development of agriculture in Ukraine	Industries and subsectors of agriculture	Areas of development of agriculture in Ukraine after the war based on increasing gross value added in the context of accelerated integration into the EU
Sustainability – before December 2024	**Crop production:** grain production ■ feed production ■ vegetable production ■ potato growing ■ flax growing ■ hop growing **Animal husbandry** ■ cattle breeding (meat and dairy) ■ pig breeding ■ sheep breeding ■ poultry farming ■ beekeeping	■ Obtaining EU candidate status, followed by full membership; ■ establishment of logistics routes for the necessary resources for agricultural production and marketing of finished products with Western European countries; ■ compliance with quality standards of finished agricultural products; ■ overcome the influence of the shadow sector of the economy on the lease of land resources and the sale of agricultural products under corruption schemes; ■ monitoring of processing and refinement of agricultural products to the highest degree of their readiness.
Recovery – 2024-2025	**Crop production:** ■ grain production ■ feed production ■ vegetable production ■ potato growing ■ flax growing ■ hop growing **Animal husbandry** ■ cattle breeding (meat and dairy) ■ pig breeding ■ sheep breeding ■ poultry farming ■ beekeeping	■ Transition from exporting raw materials to processing should be focused on the industries where gross value added is most possible; ■ access of agricultural producers to innovative technologies of deep processing of products; ■ improving the quality standards of finished agricultural products; ■ development of multi-productive complexes for deep processing of agricultural products; ■ conditions for creating hundreds of thousands of jobs in the agricultural sector, using advanced technologies and promoting the development of business activities, which opens up wide opportunities for investors, both domestic and foreign.
Structural modernisation, integration into the EU – 2026-2032	**Crop production:** ■ grain production ■ feed production ■ vegetable production ■ potato growing ■ flax growing ■ hop growing **Animal husbandry** ■ cattle breeding (meat and dairy) ■ pig breeding ■ sheep breeding ■ poultry farming ■ beekeeping	■ obtaining the status of an EU candidate; ■ unlimited access to the markets of agricultural products of the European Union and the G7 countries; ■ development and application of advanced technologies for the production and processing of agricultural products; ■ an impetus for the transition from the export of raw materials to processing in the field of crop and animal husbandry, where the largest export revenues can be generated; ■ sale of agricultural products with a high degree of readiness; ■ building an agricultural economy based on the principles of deregulation and liberalisation.

***Source:** compiled by authors based on sources (Gross value added at basic prices, 2021; National classifier of Ukraine, 2010)*

The processes of development of agriculture in Ukraine after the war based on increasing gross value added in the context of accelerated integration into the EU can be presented as a model of a cybernetic system, that is, a system with management, which means that the information aspect of system analysis will be reliable and a priority, since the description and modelling of management processes involves the use of methods of statistical information theory and cybernetics (Fig. 5).

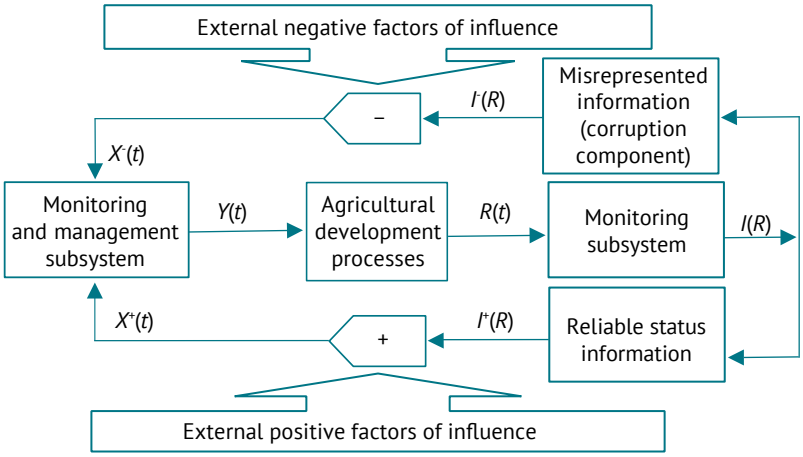

***Figure 5**. Cybernetic system model*

***Source:** compiled by the authors*

Thus, within the framework of statistical information theory, the source of messages X (information on the state of agricultural development by industry, namely production in the fields of crop production, animal husbandry, industrial refinement and processing of agricultural products, and external influences) is characterised by entropy H(X), as a measure of uncertainty of the observer's information (control subsystem) regarding the state of observation objects (development processes based on the growth of gross value added). The entropy value can be written as the mathematical expectation of the amount of information I(X) according to the well-known Shannon formula.

$$H(X) = \sum_{i=1}^{n} p(x_i) I(x_i) \cdot = - \sum_{i=1}^{n} p(x_i) \cdot \log_2 p(x_i), \quad (1)$$

where $X = (x_1, x_2, \ldots, x_i, \ldots, x_n)$ – source of statistically independent messages; $p(x_i)$ – probability of i-th message.

In a qualitative control system, a necessary condition is to reduce the entropy of the controlled subsystem to zero, which characterises a deterministic system, and vice versa, the maximum entropy NMax corresponds to a system without control. Model of the post-war agricultural development system of Ukraine based on increasing gross value added in the context of accelerated integration into the EU with governance (Fig. 5) can be described by a set of states of the managed object (recovery processes of Ukraine)

$$R(t) = (r_1(t), r_2(t), \ldots, r_i(t), \ldots, r_n(t)) \; i = \overline{1,n},$$

and multiple control influences

$$Y(t) = (y_1(t), y_2(t), \ldots, y_i(t), \ldots, y_n(t)) \; , i = \overline{1,m}.$$

It is possible to consider the lack of reliable information or its distortion in the real conditions of the system's existence by introducing the conditional entropy H(R/Y), which varies within the limits that show the degree of definition of the system with control:

$$0 \leqslant H(R/Y) \leqslant H(R)_{max}. \quad (2)$$

The difference between maximum and conditional entropy determines the amount of mutual information $I(R, Y)$. This value can be taken as an indicator of the effectiveness of management in the system of agricultural development of Ukraine after the war based on increasing gross value added in the conditions of accelerated integration into the EU, which shows a decrease in the entropy of the managed subsystem by the amount of information received. Considering the properties of mutual information, it can be presented as:

$$I(R, Y) = H(R)_{max} - H(R/Y) = H(Y) - H(Y/R). \quad (3)$$

After elementary transformations from (3), an expression that defines the limiting possibilities of control in the system is obtained:

$$H(R/Y) = H(R)_{max} - H(Y) + H(Y/R). \quad (4)$$

Equation (4) allows drawing conclusions in the form of recommendations for improving the management efficiency of the agricultural development system of Ukraine after the war based on increasing gross value added in the context of accelerated integration into the EU, which should be considered as a decrease in the conditional entropy $H(R/Y)$:

support the process of agricultural development of Ukraine after the war based on increasing gross value added in the context of accelerated integration into the EU, as a managed subsystem, in the form of an "open system", that is, reduce the entropy of $H(R)$ by destroying the diversity (Wiener-Ashby cybernetics law) of possible states of the managed subsystem (unprofitable,

low-margin, and vulnerable agricultural production facilities) and increase the diversity of managing influences of stability and development of H(Y), and actively influence the identification and reduction of destabilising external and internal (corruption) factors of influence *H*(*Y*/*R*) on the system.

In general, among the branches of the national economy, agriculture of Ukraine before the military aggression of Russia, having a significant natural resource potential, demonstrated a slowing development not only within the state, but also with a focus on global trends. Therefore, considering the priority areas of development of agriculture in Ukraine after the war based on increasing gross value added in the conditions of accelerated integration into the EU, it is important to compare the pace of development with industries that had faster growth rates above it, namely: processing, mining, supply of electricity, and gas industry, based on a conceptual approach in the form of a "cascade" model of economic dynamics of agricultural development processes, which is based on a nonlinear differential equation of logistics type:

$$\frac{dR(t)}{dt} = D\left[1 - \frac{R(t)}{R_{max}}\right]R(t), \qquad (5)$$

where *D* – coefficient of dynamics of processes in the relevant sectors of the state economy, the value of which is determined by the result of the analysis of the ratio of gross value added for a certain period, considering the corrective realities of military aggression of the Russian Federation and the priority of restoring the relevant sectors of the national economy of Ukraine (Fig. 6).

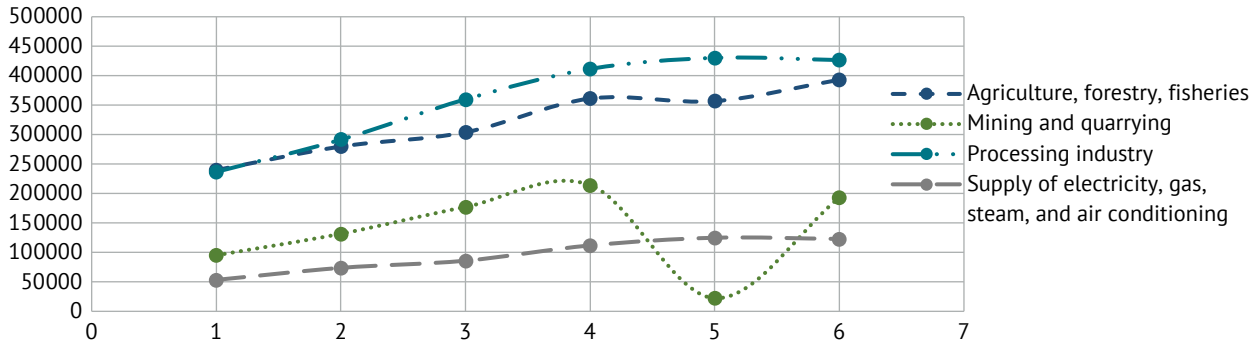

***Figure 6**. Forecast for the development of agriculture in Ukraine after the war based on the growth of gross value added in the context of accelerated EU integration*

***Source:** calculated based on data (State Statistics Service of Ukraine, n.d.; Gross Regional Product in 2019, 2021; State Statistics, 2021)*

According to Figure 6, based on the forecasts for the development of priority sectors of the national economy, the development of agriculture, which produces food and raw materials for the processing industry in order to solve food security problems not only in Ukraine, but also in the world as a whole, is envisaged first of all. It should be considered that the policy of the European Union is characterised by the inconsistency of sustainable development goals in the context of food security, in particular, in such areas as: migration policy, which increases inequality and problems of public access to food; limited internal resources of EU countries, in particular, the area of land for the development of organic production in order to ensure the quality and safety of food (Ireland, Denmark, Germany and Finland); the lack of effect of state funding for research and development of the agricultural sector in the event of excessive distribution of industry funds; excessive regulation of technology development to ensure production growth due to population bias towards potential risks. This means that the production approach to maintaining food security cannot be effective due to the numerous contradictions between environmental and food safety issues. Therefore, it is advisable to transform the EU's food security policy in the context of sustainable development by developing goals for technological sustainability of the agricultural sector (Ivanenko *et al.,* 2021).

The essence of the conceptual approach is to develop a mechanism for the development of agriculture in Ukraine after the war based on increasing gross value added in the conditions of accelerated integration into the EU according to the priority scheme of effective "connection" of the relevant sectors of the Ukrainian economy at certain points in time, which, according to the belief, are determined by the maximum dynamics of recovery of priority objects of the socio-economic system (Fig. 7).

In Figure 7, the values $R_1(t)$ and $R_2(t)$ indicate the states of processes for restoring the corresponding sectors of the state's economy according to certain priorities. Figure 8 analyses the dynamics of the forecast of gross value added in agriculture after the war in the context of accelerated European integration.

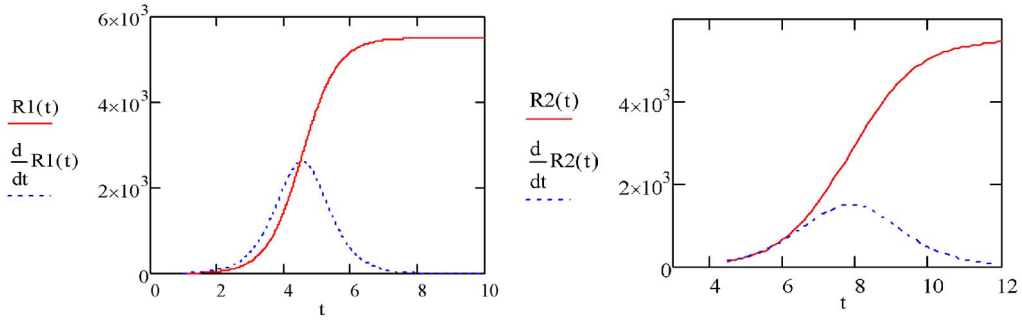

***Figure 7**. Illustration of "cascade" recovery at moments of maximum dynamics*
***Source:** compiled by the authors*

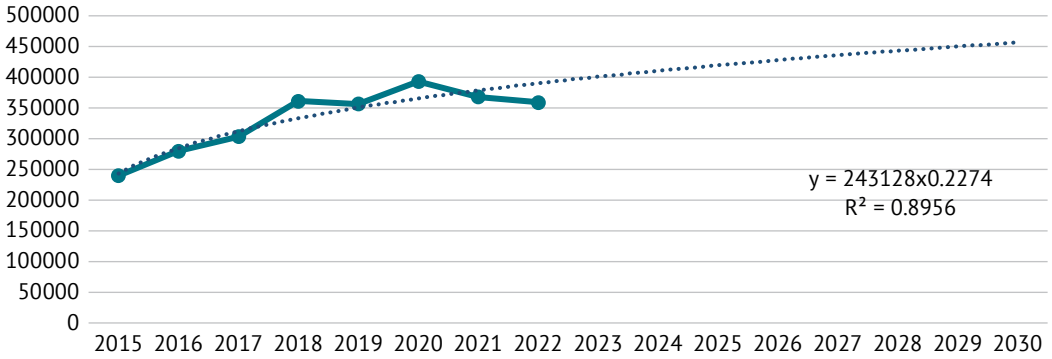

***Figure 8**. Forecast of gross value added of agriculture in Ukraine until 2030*
***Source:** compiled by the authors*

In the context of post-military restoration of agricultural production, the accumulation of gross value added becomes important, which is the basis for applying the achievements of scientific and technological progress to ensure the balanced development of all its branches and improve the social standards of living of the rural population. Therefore, for the agriculture of Ukraine, development means a transition from an economy with the potential of raw material exports to one that will export the finished product with the generation of gross value added. The priority of the development of agriculture in Ukraine will provide opportunities to solve the problems of food security in the world by increasing the export of agricultural products. Given this, Ukrainian agriculture can become the "engine" of the country's recovery after the war, which can affect the development of other sectors of the national economy due to the multiplicative effect.

CONCLUSIONS

The study found that the development of Ukrainian agriculture involves an increase in the volume of gross product and the accumulation of gross value added. However, in 2022-2023, there was a decrease in the share of gross domestic product and gross value added. However, the decline in agricultural production was less significant compared to other industries. In particular, in 2022, during Russia's full-scale invasion of Ukraine, agricultural production decreased by 4.2%, which was 8.2% of the total gross domestic product. However, in 2023, Ukrainian agriculture managed to increase the volume of gross domestic product by more than 4%, and gross value added by 0.7%. The economic growth rate of agriculture was the highest among other sectors of the economy, which indicates the high stability of the agricultural sector to external challenges, such as war, increased imports, migration of labour resources, etc.

It was revealed that in 2015-2023, the share of agricultural exports in the national market was 40.6%. However, in 2022-2023, in the context of Russia's military aggression, the volume of Ukrainian exports decreased by 24% and the contribution of agriculture in it decreased by 12.8%. The share of total domestic exports of agricultural products is about 41 %. However, over the past decades, the share of unprocessed products exported is more than 64%. It was proved that agriculture is a strategic branch of the national economy, the level of development of which depends on the socio-economic state of Ukraine and an important condition for its development is deep processing of products.

The areas of development of Ukrainian agriculture after the war based on increasing gross value added in the context of accelerated integration into the EU were developed in the following stages: sustainability –

in which Ukraine will receive the status of an EU candidate, followed by full membership. The next stage will be recovery, during which there will be a transition from the export of raw materials to its processing in those industries where the largest mass of gross value added is accumulated. And the third stage will be successful in developing and applying advanced technologies for the production and deep processing of agricultural products.

A forecast of the development of agriculture in Ukraine after the war based on the increase in gross value added in the context of accelerated integration into the EU is proposed based on the model of a cybernetic system with control, and it is proved that among the priority sectors of the national economy, the development of agriculture, which produces food and raw materials for the processing industry, is the first priority, which is one of the areas of further scientific research.

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CONFLICT OF INTEREST

None.

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Зростання доданої вартості як чинник розвитку сільського господарства України в умовах пришвидшеної інтеграції до ЄС

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Анотація. Розвиток сільського господарства є ключовим чинником сталого поступу суспільства у майбутньому. Інтеграція країни до європейського співтовариства створює для сільського господарства нові можливості та водночас, вимагає інноваційних підходів до розвитку та досягнення конкурентоспроможності галузі у глобалізаційному просторі. Дослідження спрямоване на аналіз і вдосконалення наявних стратегічних підходів розвитку сільського господарства України на основі нарощування валової доданої вартості в умовах пришвидшеної інтеграції до ЄС. У дослідженні використовувалися різноманітні методи, такі як аналітичний, статистичний, функціональний, системний аналіз, дедукція, синтез і порівняння. Проведено аналіз формування і розподілу валового внутрішнього продукту та валової доданої вартості у сільському господарстві України та ЄС, включаючи особливості формування валової доданої вартості в українському сільському господарстві. Досліджено вплив процесів євроінтеграції на розвиток сільського господарства, зокрема їх потреби та можливості до нарощування валової доданої вартості. Розроблено модель кібернетичної системи з управлінням у сільському господарстві щодо зростання валової доданої вартості в умовах пришвидшеної інтеграції до ЄС, яка дозволяє обґрунтувати прогноз зміни формату розвитку українського сільського господарства з метою уникнення економіки, як сировинного придатку ЄС. Результати дослідження показали, що розвиток сільського господарства України на основі нарощування валової доданої вартості в умовах пришвидшеної інтеграції до ЄС передбачає використання комплексної стратегії, яка враховує специфіку галузі, європейські інноваційні підходи та передовий досвід поглибленої переробки продукції країн Європейського Союзу. Практичне значення дослідження полягає у розробці конкретних практичних рекомендацій і стратегій для органів державного управління, сільськогосподарських підприємств до оптимізації використання наявного природно-ресурсного потенціалу щодо зростання обсягів виробництва сільськогосподарської продукції, запроваджуючи прогресивні технології її глибокої переробки з метою акумуляції валової доданої вартості, що є основою розвитку сільського господарства

Ключові слова: валовий внутрішній продукт; валова додана вартість; військова агресія рф; розвиток; економіка; концептуальна модель