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THE ROLE OF LOGISTICS IN THE DEVELOPMENT OF AGRICULTURE OF UKRAINE IN THE WAR CONDITIONS

Introduction. *For solving the problem of agricultural development in the context of hostilities on the territory of the state, logistics have been gaining dominance, and its role has been conceptually understudied.*

Problem Statement. *The trajectory of agricultural development in Ukraine today is turbulent because of hostilities on the territory of the state, so logistics plays one of the key roles.*

Purpose. *The purpose of this research is to determine the role of logistics in the economic development of agriculture in the current conditions of the war in Ukraine.*

Material and Methods. *We have employed the synthesis methods; the analysis has been made with the use of a two-step least squares method and a model with fixed effects, the method of historical and logical modeling, the method of “from abstract to concrete,” the method of economic and mathematical modeling, and economic interpretation. From a practical point of view, we also have employed the method of grouping statistical data, statistical and econometric analysis, and the graphical method.*

Results. *The concepts of logistics and agrologistics have been considered, and the logistics of grain crops by railway, road, and river transport have been analyzed. The results of the study have revealed the trends that made it possible to identify the areas for the development of agriculture in Ukraine during the war, namely: increasing the amount of sown areas; increasing the number of jobs for rural residents; introducing (cultivating, purchasing) new varieties of crops; improving the quality of cultivated land; purchasing modernized equipment for processing, storage, and logistics of grain crops; increasing the grain harvest that may be exported in the future.*

Conclusions. *The directions for agricultural development of Ukraine in the conditions of the war have been determined. It has been proven that the effect of the outlined directions is impossible unless the appropriate measures for the development of logistics and the grain market in the country are introduced. The proven connection between “logistics – grain market – development of agriculture” characterizes the micro- and macroeconomic effects of this interaction and reflects the role of the socio-economic development of the state in this process.*

Keywords: logistics, agriculture, economic growth, grain, transport routes, and martial law.

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Effectively developed logistics in the country are key to its future development in terms of competitiveness in the world market. Today, when the state is able to protect its territories from military attacks by the occupying country, logistics are especially important for Ukraine in economic terms, as international trade in agricultural products is a significant part of gross domestic product, and Ukraine's main transport routes from Europe to Asia and from the Scandinavian countries to the Mediterranean region provide an opportunity to generate significant income and develop transit services. By the example of logistics of agricultural products, we can observe the effect of the development of logistics on the rate of agricultural development [1]. The existence of a link between logistics and the level of agricultural development is explained by the fact that the development of logistics helps to reduce the cost of production, the transportation / delivery time, the effects of negative externalities, and so on. Collectively, this leads to the economic development of agriculture, and in conditions of war to the survival of the country and its population.

The main prerequisites for Ukraine's economy to enter the field of logistics management have their own specifics, due to both temporary factors related to the transitional nature of the Ukrainian economic system and long-term and permanent factors, such as size and geographical location; types, quantity, quality and availability of natural resources; availability of intellectual potential and skilled labor resources; size, specialization and distribution throughout the country of production complexes and centers; level of integration into the world economic space [2].

The researchers of economic growth also link the development of logistics, especially its modernization for new technologies, not only with the maintenance and expansion of employment in the economy, but also with the expansion of agricultural opportunities. [3]. Therefore, there is a need to review the effect of logistics on the level of agricultural development.

Logistics have been researched and proposed by Ukrainian and foreign researchers, in particular: S. M. Boniar, Ya. R. Korniiiko, D. O. Palant, D. M. Lambert, M. C. Cooper, J. D. Pagh, M. Kadlubek, R. R. Larina, N. V. Popova, and O. O. Karpenko.

According to foreign authors S. M. Boniar and Ya. R. Korniiiko logistics can be defined as a key integrated activity related to the flows of material resources, work in progress or finished products by a particular vehicle in the logistics chain. It, in turn, consists of complex activities, including cargo handling, packaging, transfer of ownership of cargo, insurance [4].

D. O. Palant considers logistics as a clearly defined area of activity, covering the three main areas: the process of planning, organizing and performing the correct, efficient and rational transportation of goods (goods) from their places of production to the final destination; strict control over all transport and other operations carried out during the transportation of goods with the use of the latest means of communication, information and other information technologies; providing all documents and information to the owner of the goods [5].

The foreign scholars such as D. M. Lambert, M. C. Cooper, and J. D. Pagh in their works they considered logistics as a process of interaction between consumer, seller and intermediaries [6].

M. Kadlubek reveals the characteristics and opportunities for the development of the market of transport and logistics services in Poland, intermodal logistics centers and transport and logistics companies [7]. B. Skovron-Grabovska offers a list of indicators for the characterization and evaluation of logistics centers [8].

The scholars such as R. R. Larina, N. V. Popova, and O. O. Karpenko in their research assign a significant role to the conceptual aspects of the creation and operation of transport and logistics centers, transport and logistics systems and transport and logistics clusters [9–11].

At the same time, studying the relationship between logistics and agricultural development in

Ukraine, we can see that in some literature you can find an interpretation of such a term as agrologistics, namely the authors: L. Frolova, I. Smurnov, T. Kosareva, M. Matzera, O. Volnova, and N. Makarenko [12–15]. Analysis of the work of these scientists shows that researchers are also focusing on general aspects of logistics of agricultural products.

According to L. Frolov, one of the main functional areas suitable for the use of logistics tools is the main activity of agricultural enterprises, which can be employed as tools of production (domestic) agrologistics to address the problems of optimizing the size of agricultural enterprises, determining the company's needs for fixed assets, organizing their productive use, maintenance, and repair of machinery, buildings, equipment, etc. [12].

I. Smurnov, T. Kosareva, and M. Matzera interpret the term agrologistics as a new applied direction of logistics related to the application of its provisions and methods in the field of agricultural production. The authors note that agrologistics in Ukraine is at an early stage of development, while the United States, Canada, Western Europe, and other countries have long appreciated the high efficiency of logistics approaches in agribusiness. Today, in many countries of the European Union, government agencies are taking the lead in implementing logistical approaches in the activities of agricultural enterprises. At the same time, scientists conclude that, in particular, the European experience of agro-logistics proves the high efficiency, environmental friendliness and diversity of the use of logistics in the field of agricultural production. In addition, the achieved high level of agribusiness development does not exclude government, business and research structures of countries from finding new logistical ways to increase the efficiency and environmental friendliness of agricultural production. The importance of agrologistics is understood and maintained at the highest level of government [13].

In her research, O. Volnova draws attention to the three important features of agricultural logistics, namely material flow can be biological in na-

ture and characterized by significant consumption of already produced goods within the production cycle (this applies to livestock industries: livestock, pigs and poultry); the feature of agricultural production is the use of living organisms that are included in the fixed assets of the agricultural enterprise and recorded in the financial statements; seasonality of agricultural production necessitates the creation of additional logistical stocks of raw materials, as well as finished products (crop, livestock) [14].

According to N. Makarenko, marketing activities of agricultural enterprises require the use of logistics tools and ideas in determining the sales strategy, choosing the structure of the logistics chain, deciding on forms of promotion of agricultural products, choosing shipping tactics, etc. [15]. It is the focus on the total logistics costs of all participants in the promotion of agricultural products allows determining the optimal technology for the promotion of crop and livestock products, the feasibility of creating wholesale food markets for agricultural products, attracting commercial and logistics processes to agricultural and domestic products in foreign markets [15].

At the same time, the authors do not pay attention to the formation of appropriate tools for assessing the effect of logistics on the level of agricultural development.

The purpose of the article is to determine the role of logistics in the economic development of agriculture in the current conditions of war in Ukraine. The objectives of the article are to consider the concepts of logistics and agro-logistics, and to analyze the volume of logistics of grain crops by rail, road and river. According to the results of the study to identify trends that will determine the directions for the development of agriculture in Ukraine during the war.

The efficiency of logistics development, both commercial and agricultural, is an important component for the competitiveness of the state. As international trade is a significant part of gross domestic product, and Ukraine is located at the intersection of transport links between Europe, Asia,

Profile logistics				
Transportation management, including warehousing			Advice on supply chains	
Related freight logistics				
Auto	Rail	Freight	Aviation	Water
Non-core logistics of freight				
Computer and related services	Retail	Courier / postal services	Services of commission agents	Rental of transport equipment
Technical testing and analysis services	Trade financial services	Other: business services	Other: telecommunication services	Marine, air and transport insurance services
Express delivery services	Maintenance and repair of transport equipment	Data and message transmission services	Sale, maintenance and repair of motor vehicles	Wholesale and packaging

Fig. 1. A set of services related to the logistics chains of Ukraine

Source: prepared by the author based on [16].

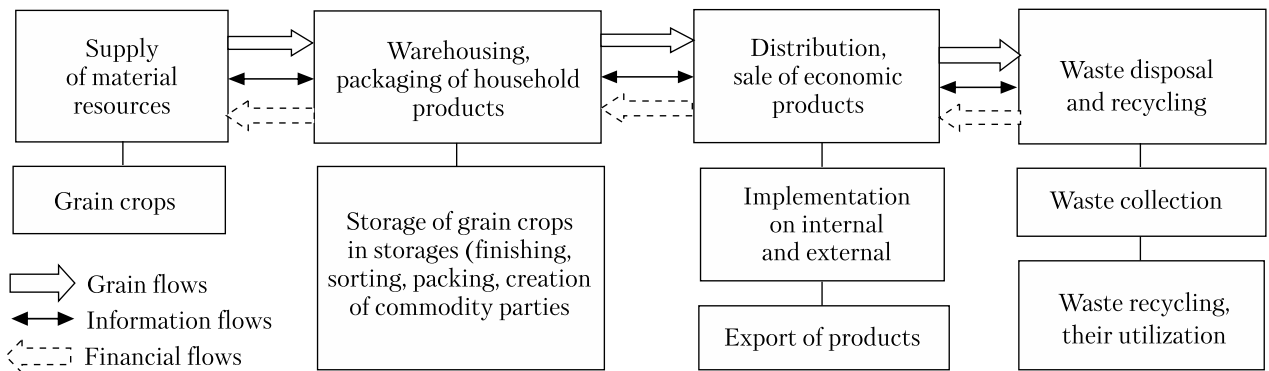


Fig. 2. Logistics chain for agricultural products

Source: prepared by the author.

and the Scandinavian countries to the Mediterranean region, logistics provide additional opportunities for the transit of goods. The set of services related to the logistics chains of Ukraine, according to the taxonomy of trade in services used by the World Bank is shown in Fig. 1.

Logistics services consists of the specialized services, the related logistics services, and the non-core logistics services in the field of freight. The profile freight logistics services include the consulting services and the transportation management services offered by logistics companies separately or together with other logistics services [17–19].

The second set of services is the related logistics services that include the transport services. Most logistics companies provide transport services, but these services can also be provided by companies that have their own equipment and transport [20–22].

The non-core logistics services include fleet maintenance and repair, packaging services, computer and related services, insurance services and management consulting [23].

The logistics chain for agricultural products is shown in Fig. 2.

Let us consider the amount of grain harvest in Ukraine in 2015–2021, which has increased sig-

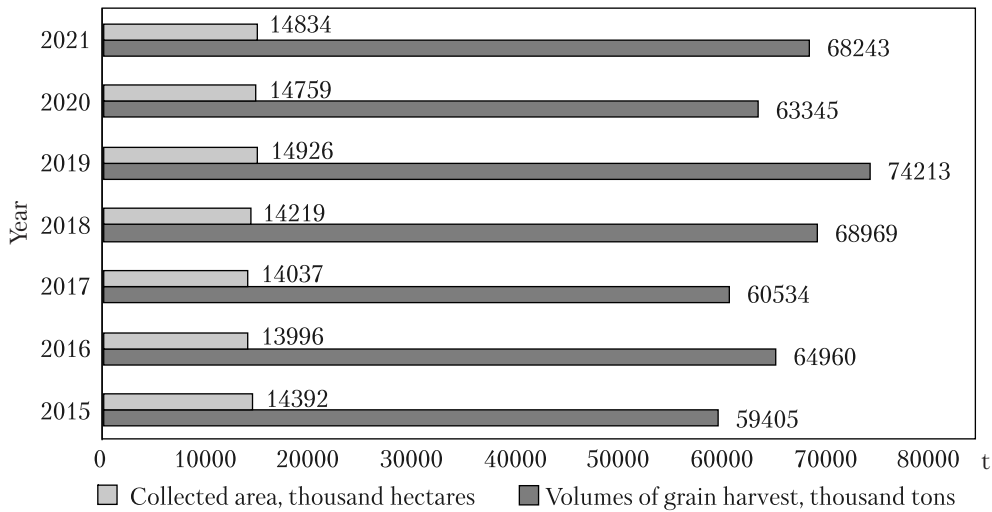


Fig. 3. Grain harvest in Ukraine

Source: prepared by the author.

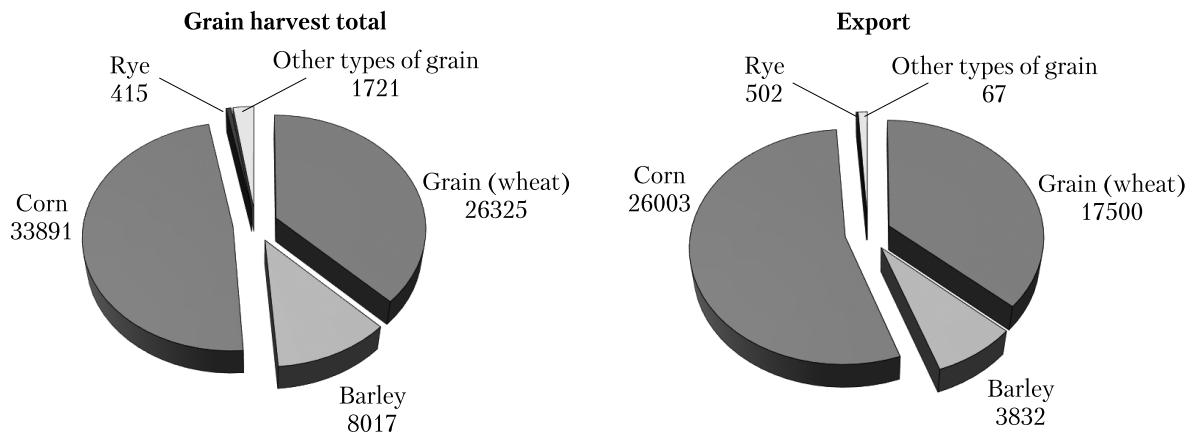


Fig. 4. Grain harvest and exports in Ukraine as of 2021 (thousand tons)

Source: prepared by the author.

nificantly in recent years (Fig. 3). As of 2021, the grain harvest amounted to 68,243 thousand tons, an increase of 7.72% as compared with last year, while the total harvested area remained unchanged. The best indicators for harvesting grain crops were observed in 2019, namely 74,213 thousand tons, with the collected area of 14926 thousand ha.

We propose to consider the share of grain in the total harvested grain crops in 2021 in Ukraine, and how many thousand tons were exported (Fig. 4). The Figures show that the wheat harvest in 2021

amounted to 26,325 thousand tons, out of which 17,500 thousand tons were exported. Also noteworthy is the corn harvest of 33,891 thousand tons, out of which 26,003 thousand tons are also exported.

Table 1 offers an analysis of the dynamics of logistics of cereals and in particular wheat from Ukraine during 2015–2021. In the 2018/2019 crop year, sales of all types of cereals amounted to 49,146.9 thousand tons.

During 2015–2021, the sales of agricultural products increased 1.5 times, the largest buyers of

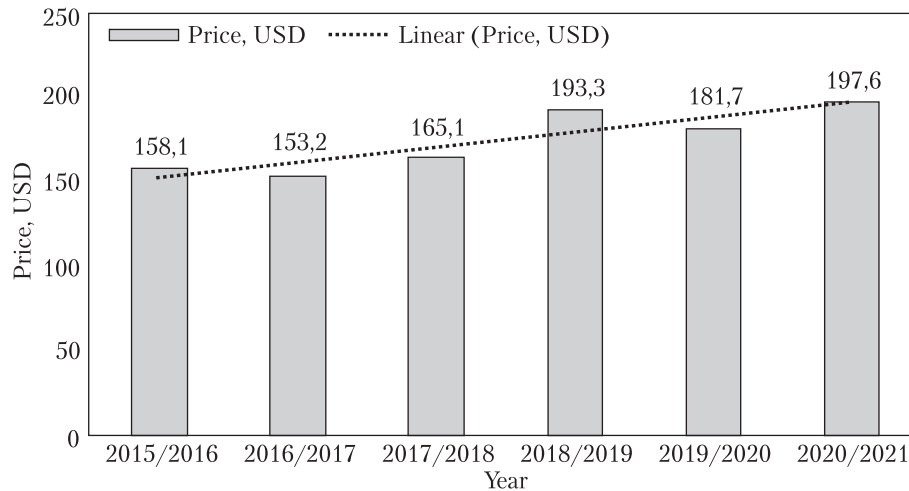


Fig. 5. Change in the wheat price in the period from 2015 to 2021 (USD)

Source: prepared by the author.

Ukrainian wheat are Egypt, Tunisia, Thailand, Turkey, and the Philippines. The trend of changes in the price of wheat is shown in Fig. 5 and may indicate an increase in the price of wheat to 197.6 USD per ton of grain at the price of 2018/2019.

The growing purchases of grain products in Ukraine by other countries indicates a high de-

mand for Ukrainian agricultural products, so we can say that this can serve as a great potential for agricultural development in Ukraine.

It should be noted that the main methods of logistics of grain products to the countries that purchase these products are rail, road and water transport. Ports mainly process bulk cargo, but there is also a significant amount of stacked cargo (transported in batches and / or with a certain number of cargo spaces), such as cast iron, steel and wood. The main bulk export cargo is grain. In 2016, Ukraine was the largest exporter of grain in the world, accounting for about 11% of world exports. The share of the United States was 22%, that of Russia was 19%, while the EU exports were 14% (Table 2).

The analysis of logistics has shown an increase in traffic in 2021 as compared with the previous year by 2.71%, for railway transport, by 0.39%, for road transport, and by 0.21%, for river transport. The trend of increasing the volume of logistics has been observed for many years, which may indicate a positive trend in the development of logistics in Ukraine. Therefore, we propose to consider priority measures in the field of grain logistics, which promote the development of agriculture (Fig. 6).

Table 1. Dynamics of Grain Logistics (2015–2021)

Period	Culture	Quantity, thousand tons	Cost, thousand USD	Price, USD
2015/2016	Whole grains	39006.2	6093468	156.2
	Wheat	16927.8	2676471	158.1
2016/2017	Whole grains	43913.4	6689493	152.3
	Wheat	17533.4	2685758	153.2
2017/2018	Whole grains	39426.7	6367395	161.5
	Wheat	17154.6	2832013	165.1
2018/2019	Whole grains	49146.9	8587451	174.6
	Wheat	15579.3	3010780	193.3
2019/2020	Whole grains	56068.6	9611128	171.4
	Wheat	20521.4	3728550	181.7
2020/2021	Whole grains	25775.4	4911769	190.6
	Wheat	12491.9	2468966	197.6

Source: prepared by the author.

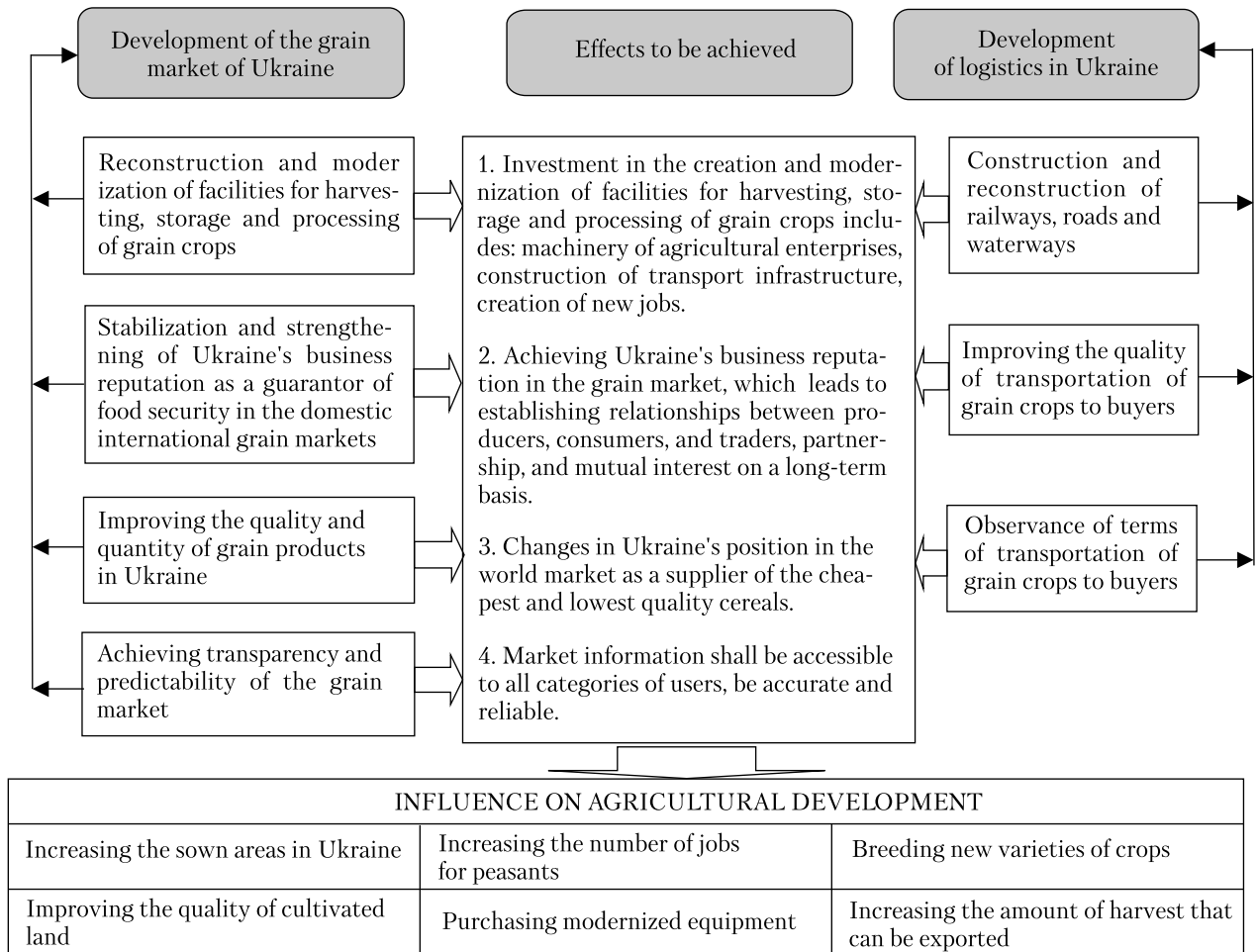


Fig. 6. Priority measures in the field of grain logistics and their effect on the development of agriculture in Ukraine
 Source: prepared by the author.

The development of the grain market of Ukraine should be developed by such measures as: reconstruction, modernization, as well as, if necessary, the acquisition of facilities for harvesting, storage and processing of grain crops; stabilization and streng-

thening of Ukraine’s business reputation as a guarantor of food security in the domestic international grain markets; improving the quality and quantity of grain products in Ukraine and achieving transparency and predictability of the grain market.

Table 2. Dynamics of Logistics of Grain Crops by Different Modes of Transport

Transport, volume, thousand tons	2016	2017	2018	2019	2020	2021	%
Railway	2874.1	3125.6	3331.8	4638.4	5276.1	5546.3	+2.71%
Auto	198.1	212.8	324.1	730.6	834.2	873.1	+0.39%
River	32.5	48.2	53.6	523.4	780.3	801.3	+0.21%

Source: prepared by the author.

The logistics market in Ukraine can be developed through measures such as the construction and reconstruction of railways, highways and waterways of Ukraine, which are a means of logistics of grain crops to countries that have purchased grain in Ukraine; improving the quality of transportation of grain crops to customers and meeting the deadlines for transportation of grain crops to customers.

All these measures in the future will allow achieving the following effects:

1. Increasing investment in the creation and modernization of facilities for harvesting, storage and processing of cereals includes: machinery of agricultural enterprises, construction of elevators, development of transport infrastructure and job creation.

2. Achieving Ukraine's business reputation in the grain market is necessary in the future to ensure global goals of sustainable development, which leads to stabilizing relations between producers, consumers, and traders, partnership, and mutual interest on a long-term basis.

3. Changes in Ukraine's positioning on the world market as a supplier of the cheapest and lowest quality grain crops. The gradual improvement of the quality of cereals exported to other countries can serve as a long-term perspective for the evolutionary development of the grain market in constant conditions, on the part of buyers, to improve the quality of cereals.

4. Market information shall be accessible to all categories of users, be accurate and reliable. During the trading session, market information on cereals should be able to ensure the practical application to all participants in the trading session and to promote the efficiency of production decisions.

Achieving the above effects inevitably influences the development of agriculture in Ukraine in terms of:

1. Increasing the sown areas, as according to the law "demand generates supply", in order to increase its capacity, Ukraine will need to respond appropriately to the world market demand for

grain crops. Namely, in order to increase the amount of harvested crops, it is first necessary to increase the amount of sown areas in Ukraine.

2. Improving the quality of cultivated land and the introduction of new varieties of crops will also have a favorable effect not only on the quality of land and grain, but also on yields, namely the amount of harvested crops.

3. Increasing the harvest covers the requirements primarily of the domestic client, i.e. the population of Ukraine. In second place is the logic of surplus crops grown, which allows for the development of enterprises engaged in agricultural activities in Ukraine. This, in turn, will increase the number of jobs for rural residents, increase the salaries of company employees and purchase modernized equipment needed for grain production.

As a result of the analysis, we can conclude that despite the cultural features that determine the trends and approaches of logistics in Ukraine, it is possible to identify the following areas for agricultural development in Ukraine:

- 1) Increasing the amount of sown areas;
- 2) Increasing the number of jobs for rural residents;
- 3) Introducing (cultivating, purchasing) new varieties of crops;
- 4) Improving the quality of cultivated land;
- 5) Purchasing modernized equipment for processing, storage, and transportation of grain crops;
- 6) Increasing the amount of harvested grain that may be exported in the future.

It should be noted that the effect of the outlined directions of development will not be possible without appropriate measures aimed at the development of logistics in Ukraine and the grain market.

The research data have confirmed the existence of the connection "logistics – grain market – agricultural development," characterize the micro- and macroeconomic effects of this interaction and reflect the role of socio-economic development of the state in this process.

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РОЛЬ ЛОГІСТИКИ У РОЗВИТКУ СІЛЬСЬКОГО ГОСПОДАРСТВА УКРАЇНИ В УМОВАХ ВІЙНИ

Вступ. Траєкторія розвитку сільського господарства в Україні на сьогодні є турбулентною через військові дії країни-агресора, тому роль логістики є однією з ключових.

Проблематика. При вирішенні проблеми розвитку сільського господарства в умовах військових дій на території держави домінуючого значення набуває логістика, концептуальному осмисленню ролі якої наразі не надано належної уваги.

Мета. Визначення ролі логістики в економічному розвитку сільського господарства в сучасних умовах війни в Україні.

Матеріали й методи. Застосовано методи синтезу, аналізу (двокроковий метод найменших квадратів) та модель із фіксованими ефектами, метод історичного та логічного моделювання, метод «від абстрактного до конкретного», метод економіко-математичного моделювання та економічної інтерпретації, метод групування статистичних даних, статистичний та економетричний аналіз, графічний метод.

Результати. Проведено аналіз об'ємів логістики зернових культур залізничними, авто- та річковими шляхами. З'ясовано тенденції, які дали можливість визначити напрями для розвитку сільського господарства України в умовах війни, а саме: збільшення об'ємів посівних площ, збільшення кількості робочих місць для жителів сільської місцевості, введення (вирощування, закупівля) нових сортів посівних культур, підвищення якості оброблюваних земельних площ, придбання модернізованої техніки для обробітку, зберігання та логістика зернових культур, збільшення обсягів врожаю, який може бути експортованим.

Висновки. Визначення напрямів розвитку сільського господарства України в умовах війни дало можливість довести, що ефект від окреслених напрямів не можливий без введення відповідних заходів, спрямованих на розвиток логістики в країні та зернового ринку. Доведено зв'язок «логістика — зерновий ринок — розвиток сільського господарства», який характеризує мікро- і макроекономічні ефекти цієї взаємодії та відображає роль суспільно-економічного розвитку держави цьому процесі.

Ключові слова: логістика, сільське господарство, економічне зростання, зерно, транспортні шляхи, військовий стан.