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DIVERSIFICATION OF TRANSPORT AND LOGISTICS SUPPLY CHAINS OF OILSEEDS AND OIL AND FAT PRODUCTS UNDER SEAPORTS BLOCKADE CONDITIONS

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Key words:
diversification, logistics chains, oilseeds, oil and fat products, transport logistics, export, multimodal transportation.

The article examines the problems and prospects of diversification of transport and logistics supply chains of oilseeds and oil and fat products in Ukraine under conditions of seaports blockade due to military aggression. The current state of production and export of oilseeds, the dynamics of changes in logistics routes and the economic consequences of cargo flow reorientation are analyzed. It is established that before the full-scale invasion, about 90% of exports of oil and fat products were carried out through seaports, which makes the industry vulnerable in the conditions of blocking traditional logistics routes. A detailed analysis of the effectiveness of four alternative logistics routes was conducted: western railway, south-western railway, Danube river and automobile. Comparative analysis showed that the most economically efficient is a combined route, which includes transportation by rail to the Danube ports of Ukraine and further by river transport to the port of Constanta with subsequent transshipment to sea vessels. However, all alternative routes are characterized by significantly higher costs (40-150% higher) compared to traditional sea exports through the Black Sea ports. Based on the analysis, key problems of diversification of logistics chains were identified, in particular: infrastructure constraints, insufficient capacity of border crossings, lack of specialized transport, high cost of transportation and low speed of delivery. To overcome these obstacles, a set of practical recommendations has been formed, including the development of multimodal transportation, investments in logistics infrastructure, creation of specialized logistics hubs, cooperation with European partners and digitalization of logistics processes. A model for calculating total logistics costs has been developed, which allows assessing the economic efficiency of different routes for different types of oil and fat products. The calculations showed that the implementation of the proposed measures will reduce the logistics costs for the export of sunflower oil by 15-20%, and delivery time - by 10-15%, which will increase the competitiveness of Ukrainian products in world markets. It is substantiated that effective diversification of transport and logistics chains should take into account not only economic but also strategic aspects related to Ukraine's integration into European transport networks and ensuring sustainable development of the oil and fat industry in conditions of geopolitical instability.

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ДИВЕРСИФІКАЦІЯ ТРАНСПОРТНО-ЛОГІСТИЧНИХ ЛАНЦЮГІВ ПОСТАЧАННЯ ОЛІЙНИХ КУЛЬТУР ТА МАСЛОЖИРОВОЇ ПРОДУКЦІЇ В УМОВАХ БЛОКУВАННЯ МОРСЬКИХ ПОРТІВ

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Ключові слова:
диверсифікація, логістичні ланцюги, олійні культури, масложирова продукція, транспортна логістика, експорт, мультимодальні перевезення.

У статті досліджено проблеми та перспективи диверсифікації транспортно-логістичних ланцюгів постачання олійних культур та масложирової продукції України в умовах блокування морських портів внаслідок військової агресії. Проаналізовано сучасний стан виробництва та експорту олійних культур, динаміку зміни логістичних маршрутів та економічні наслідки переорієнтації вантажопотоків. Встановлено, що до початку повномасштабного вторгнення близько 90% експорту масложирової продукції здійснювалося через морські порти, що робить галузь вразливою в умовах блокування традиційних логістичних шляхів. Проведено детальний аналіз ефективності чотирьох альтернативних логістичних маршрутів: західного залізничного, південно-західного залізничного, дунайського річкового та автомобільного. Порівняльний аналіз показав, що найбільш економічно ефективним є комбінований маршрут, який включає перевезення залізницею до дунайських портів України та далі річковим транспортом до порту Констанца з подальшим перевантаженням на морські судна. Проте всі альтернативні маршрути характеризуються значно вищими витратами (на 40-150% вище) порівняно з традиційним морським експортом через порти Чорного моря. На основі аналізу ідентифіковано ключові проблеми диверсифікації логістичних ланцюгів, зокрема: інфраструктурні обмеження, недостатню пропускну здатність прикордонних переходів, брак спеціалізованого транспорту, високу вартість перевезень та низьку швидкість доставки. Для подолання цих перешкод сформовано комплекс практичних рекомендацій, що включає розвиток мультимодальних перевезень, інвестиції в логістичну інфраструктуру, створення спеціалізованих логістичних хабів, співпрацю з європейськими партнерами та цифровізацію логістичних процесів. Розроблено модель розрахунку сукупних логістичних витрат, яка дозволяє оцінити економічну ефективність різних маршрутів для різних видів масложирової продукції. Проведені розрахунки показали, що реалізація запропонованих заходів дозволить знизити логістичні витрати на експорт соняшникової олії на 15-20%, а час доставки - на 10-15%, що підвищить конкурентоспроможність української продукції на світових ринках. Обґрунтовано, що ефективна диверсифікація транспортно-логістичних ланцюгів має враховувати не лише економічні, а й стратегічні аспекти, пов'язані з інтеграцією України до європейських транспортних мереж та забезпеченням сталого розвитку масложирової галузі в умовах геополітичної нестабільності.

Statement of the problem

The oil and fat industry is one of the key sectors in the structure of Ukraine's agricultural exports, providing significant foreign exchange earnings to the state budget. Ukraine has traditionally been among the top three exporters of sunflower oil in the world, controlling almost 50% of the global sunflower oil market [3]. In addition, the country is an important exporter of rapeseed, soybeans, and their processed products. According to the Ministry of Agrarian Policy and Food of Ukraine [10], in 2021, the export of oil and fat products brought the country more than $7 billion, which accounted for about 26% of the total agricultural exports.

Russia's military aggression against Ukraine, which began in February 2022, led to the blockade of Black Sea ports, through which up to 90% of oil and fat products were traditionally exported [2]. This situation forced producers and exporters to seek alternative logistics routes, accompanied by a significant increase in costs and time for delivering products to the end consumer. According to experts from the Ukrainian Club of Agrarian Business [9], the cost of logistics for the export of sunflower oil increased by 40-60% compared to the pre-war period, which significantly reduces the profitability of the industry and the competitiveness of Ukrainian products in world markets.

In addition to logistics problems, producers of oilseeds and oil and fat products face a number of additional challenges, including: reduction of sown areas due to the occupation of some territories, lack of qualified labor, disruptions in electricity supply to processing enterprises, difficulties with access to credit resources and risk insurance [11]. All these factors together create new

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realities for the functioning of the industry and require a systematic revision of development strategies both at the level of individual enterprises and the industry as a whole.

The search for optimal logistics solutions for the export of oilseeds and oil and fat products has not only economic but also social significance. The oil and fat industry provides jobs for more than 100,000 people in Ukraine and is also an important source of income for agricultural producers, especially small and medium-sized farms [7]. In addition, maintaining the export potential of the industry is critically important for global food security, as Ukrainian sunflower oil is supplied to more than 120 countries worldwide, including countries with a high risk of food crisis [6].

The transformation of logistics chains for the supply of oilseeds and oil and fat products should be considered in the context of Ukraine's integration into the European Union [5]. The development of multimodal transportation, modernization of transport infrastructure, implementation of European standards in the field of logistics will not only help overcome the current problems of the industry but also create a foundation for its competitive development in the long term. According to Melnyk T. and Puhachova K. [7], the integration of the Ukrainian transport system into European transport networks can become a catalyst for the modernization of the entire logistics infrastructure of the country.

Analysis of recent studies and publications

Problems of logistics of agricultural products, in particular oilseeds, have been studied by many domestic and foreign scientists. Thus, Nekrasenko L. and Tkachuk O. [1] investigated the current problems of grain logistics in Ukraine, noting that the volumes of transportation are related to the level of production within the country. The authors emphasize that "grain production is volatile and difficult to predict, so grain logistics chains must be reliable and elastic," which fully applies to oilseeds as well. Shults S. and Lutskiv O. [2] analyzed the problems of functioning of transport infrastructure and logistics of Ukraine during wartime, focusing on the need to diversify transport routes and cargo flows. They note that "due to the full-scale Russian aggression, six seaports suspended their activities in the field of transport logistics," which led to a radical change in logistics chains.

The issues of efficiency of export of oilseeds and their processed products were considered in detail by Kushnir T. and Berehovyi V. [3]. The authors note that "Ukraine's share in the global sunflower oil market before the full-scale invasion was about 50%," which demonstrates the strategic importance of this industry for the country's economy. The study indicates that about 90% of oil exports were carried out by sea transport, which makes the industry extremely vulnerable in the conditions of port blockade.

Logistics aspects of export of oil and fat products were studied by Lebedynska O. [4], who conducted a detailed analysis of the transport component in the formation of the export price of oilseeds and their processed products. The researcher notes that "in the structure of costs for the export of sunflower oil, the transport component accounts for 12% to 25%," which makes the optimization of logistics chains a key factor in improving the competitiveness of products. The author pays special attention to multimodal transportation, which, in her opinion, has the greatest potential for optimizing export flows in conditions of limited access to traditional sea routes.

Makarenko S. and Antoshchenkova V. [5] in their studies highlight the main problems of logistics support for the export of agricultural products of Ukraine during the war. The authors emphasize that "the reorientation of export flows from sea to rail and road transport led to an increase in logistics costs by 120-180%," which significantly reduces the profitability of exports and the competitiveness of Ukrainian products in world markets. The paper also analyzes the possibilities of using river transport, in particular, the potential of Ukrainian Danube ports for the export of oil and fat products.

Among foreign researchers, the works of Gentilini M. [6] should be noted, who analyzes the global market of vegetable oils and the impact of the Russian-Ukrainian war on it. The author notes that "the blockade of Ukrainian ports caused an increase in world prices for sunflower oil by 30-45% during the first months of the war," which confirms the importance of Ukraine as a global player in the oil and fat products market. Also worth noting are the studies by Melnyk T. and Puhachova K. [7], who studied the transformation of logistics chains of agri-food products of Ukraine in conditions of war and post-war recovery. The authors propose a model for optimizing logistics routes taking into account the risks and uncertainties characteristic of wartime.

At the same time, the specifics of logistics of oilseeds and oil and fat products in the conditions of seaport blockade remains insufficiently studied, which determines the relevance of this work. In particular, there are no comprehensive studies on the effectiveness of alternative logistics routes and their economic feasibility for different types of oil and fat products.

Objectives of the article

The aim of this study is to analyze the possibilities and economic efficiency of diversification of transport and logistics supply chains of oilseeds and oil and fat products in the conditions of seaport blockade, as well as to develop recommendations for optimizing logistics routes.

The main material of the research

Ukraine is one of the leading producers of oilseeds in the world. The main oilseeds grown in Ukraine are sunflower, rapeseed, and soybean [3]. According to the State Statistics Service of Ukraine [8] and analytical materials of the Ukrainian Club of Agrarian Business [9], before the full-scale invasion, Ukraine controlled about 50% of the global sunflower oil market, which confirms the strategic importance of the industry for the country's economy. Table 1 presents data on the production and export of main oilseeds in Ukraine for 2019-2023.

As can be seen from Table 1, military actions have significantly affected the production and export of oilseeds and their processed products. Thus, in 2022, there was a significant reduction in the production of sunflower (by

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Table 1 – Dynamics of production and export of main oilseeds in Ukraine, 2019-2023, million tons

Crop	Показник	2019	2020	2021	2022	2023	Change 2023/2019, %
Sunflower	Production	15,3	13,1	16,9	10,5	12,4	-19
	Export	0,1	0,2	0,3	0,4	0,5	400
Sunflower oil	Production	6,8	5,9	7,3	4,2	5,1	-25
	Export	6,4	5,3	6,7	3,5	4,2	-34,4
Rapeseed	Production	3,1	2,6	2,9	3,2	4	29
	Export	2,9	2,4	2,7	2,5	3,4	17,2
Soybean	Production	4,5	3,1	3,5	3,7	4,8	6,7
	Export	2,1	1,8	2	1,9	2,5	19

Source: calculated by the author based on data [8, 9]

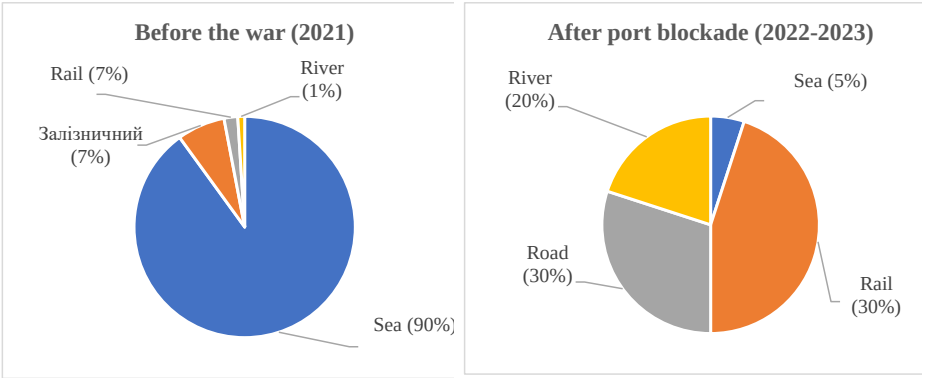

Fig. 1 – Structure of export of oilseeds and oil and fat products of Ukraine by types of transport, %

37.9% compared to 2021) and sunflower oil (by 42.5%). In 2023, the situation somewhat stabilized, but indicators still have not reached the pre-war level. These results correlate with the studies of Gentilini M. [6], who notes that the global sunflower oil market has undergone significant transformations due to the reduction of exports from Ukraine.

Before the full-scale invasion of Russia into Ukraine, the export of oil and fat products was carried out mainly through the Black Sea ports. Figure 1 shows the structure of export of oilseeds and oil and fat products of Ukraine by types of transport before the war (2021) and after the blockade of ports (2022-2023).

As we can see from the figure, before the war, sea transport dominated in the export structure of oilseeds and oil and fat products (about 90%). After the blockade of ports, there was a significant reorientation of export flows to rail (45%), road (30%), and river (20%) transport, which led to an increase in logistics costs and delivery time.

In connection with the blockade of seaports, exporters of oil and fat products were forced to develop and implement alternative logistics routes. Based on the analysis of industry practices, the following main routes can be identified:

– *western railway route:* Ukraine – Poland – Baltic Sea ports (Gdańsk, Gdynia);

– *south-western railway route:* Ukraine – Romania/ Moldova – port of Constanta;

– *danube river route:* Ukrainian ports on the Danube (Reni, Izmail, Kiliya) – ports of Romania and Bulgaria;

– *road route*: Ukraine – EU countries (Poland, Slovakia, Hungary, Romania).

To assess the economic efficiency of alternative logistics routes, a comparative analysis of the costs of transporting 1 ton of sunflower oil from a producer in Central Ukraine to the final buyer in Europe, the Middle East, and North Africa was conducted (Table 2). This analysis methodology corresponds to the approaches proposed in the works of Lebedynska O. [4] and Makarenko S. [5].

As can be seen from Table 2, all alternative routes are characterized by significantly higher costs compared to traditional sea exports through the Black Sea ports. The most economically efficient among the alternatives is the Danube river route, but it is characterized by the longest delivery time.

For a more detailed analysis of the economic efficiency of different logistics routes, a model for calculating the total logistics costs for the export of oilseeds and oil and fat products has been developed:

$$LC = TC + SC + HC + IC + OC,$$

where: LC – total logistics costs for the export of 1 ton of products, USD/t;
TC – transport costs, USD/t;
SC – storage costs, USD/t;
HC – loading and unloading costs, USD/t;
IC – cargo insurance costs, USD/t;
OC – other costs (documentation, customs clearance, etc.), USD/t.

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Based on this model, the calculation of total logistics costs for different types of oil and fat products by alternative routes was performed (Fig. 2).

The analysis shows that the most economically efficient for the export of sunflower oil is a combined route, which includes transportation by rail to the Danube ports of Ukraine, and further by river transport to the port of Constanta with subsequent transshipment to sea vessels. This conclusion is consistent with the data from studies by Lebedynska O. [4] and Shults S. and Lutskiv O. [2], who also note the prospects of multimodal transportation for optimizing export flows.

Currently, there are a number of obstacles that complicate the effective diversification of logistics chains for the supply of oilseeds and oil and fat products:

– *infrastructure constraints* – the railway infrastructure of western regions of Ukraine and EU countries is not sufficiently developed to handle increased export volumes. A particular problem is the different rail gauge in Ukraine and the EU, which requires transshipment of products at the border;

– *insufficient capacity of border crossings* – waiting time at the border can be up to 10-15 days, which significantly increases the total delivery time and creates risks for product quality;

– *lack of specialized transport* – there is a shortage of railway tanks for oil transportation, as well as specialized vehicles (tank trucks);

– *high cost of transportation* – alternative routes are characterized by significantly higher costs compared to traditional sea exports, which reduces the competitiveness of Ukrainian products in the world market;

– *low speed of delivery* – alternative routes often involve longer delivery time, which creates additional risks for exporters.

To overcome these obstacles and improve the efficiency of logistics chains for the supply of oil and fat products, the following measures are proposed, which are partially based on the recommendations of Melnyk T. and Puhachova K. [7]:

– *development of multimodal transportation* – combining different types of transport allows optimizing costs and delivery time. Particularly promising is the combination of rail and river transport;

– *investments in logistics infrastructure* – construction of new and modernization of existing elevators, terminals, warehouses, and transshipment complexes, especially in the western regions of Ukraine and at the border with the EU;

– *creation of logistics hubs* – formation of specialized logistics centers for storage, transshipment, and processing of oilseeds and oil and fat products;

– *cooperation with European partners* – expansion of cooperation with European logistics companies and port operators to increase the efficiency of export operations;

– *digitalization of logistics processes* – implementation of digital technologies for optimization of logistics routes, monitoring of cargo movement, and simplification of document flow.

Table 2 – Comparative analysis of costs for exporting 1 ton of sunflower oil by alternative logistics routes, USD/t

Route	To EU	To Middle Eas	To North Africa	Average delivery time, days
Traditional sea (before the war)	40	55	60	15-20
Western railway	85	130	140	25-30
South-western railway	75	110	120	20-25
Danube river	65	100	110	25-35
Road transport	95	150	160	15-20

Source: calculated by the author based on data from logistics companies and expert assessments

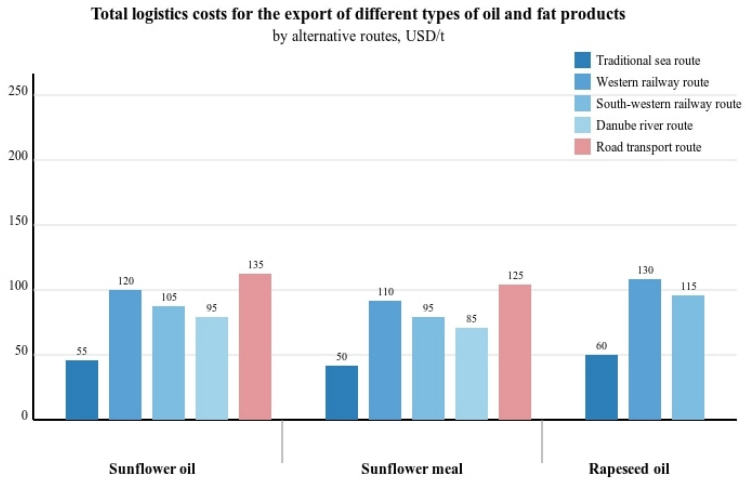

Fig. 2 – Total logistics costs for the export of different types of oil and fat products by alternative routes, USD/t

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Table 3 – Projected indicators of the efficiency of logistics chains for the supply of oil and fat products

Indicator	Current state	After implementing measures	Change, %
Average logistics costs for the export of sunflower oil, USD/t	110	90	-18,2
Average delivery time to the end consumer, days	25	22	-12
Capacity of border crossings, thousand t/month	450	600	33,3
Share of multimodal transportation in the total export volume, %	30	50	66,7
Volume of export of oil and fat products, million t/year	5	6,5	30

Source: calculated by the author based on expert assessments and forecast calculations

The calculations show that the implementation of the proposed measures will reduce the logistics costs for the export of sunflower oil by 15-20%, and delivery time – by 10-15%. Table 3 presents the projected indicators of the efficiency of logistics chains for the supply of oil and fat products with the implementation of the proposed measures.

It is important to note that the diversification of transport and logistics chains for the supply of oilseeds and oil and fat products creates not only economic advantages but also ensures strategic sustainability of the industry in conditions of geopolitical instability. The formation of alternative export routes reduces the industry's dependence on individual transport directions and reduces risks associated with possible restrictions or blockade of individual transport corridors. This is especially important in the conditions of ongoing military aggression, which creates a high level of uncertainty regarding the use of traditional export routes through the Black Sea ports [2].

It should also be taken into account that military actions have caused significant migration of the population, including qualified specialists in the logistics industry. According to the Ministry of Infrastructure of Ukraine [13], the deficit of truck drivers and railway transport operators is about 25-30%. This creates additional challenges for the effective functioning of new logistics routes and requires the development of training and retraining programs for the transport and logistics sphere. The implementation of digital technologies and automation of logistics processes can partially compensate for the deficit of personnel, but require significant investments [7].

Deepening the integration of Ukraine into the European transport system opens new opportunities for modernizing the logistics infrastructure and implementing modern technologies for transportation and storage of oil and fat products. According to experts from the Ukrainian Club of Agrarian Business [9], about 65% of exporters of oilseeds and oil and fat products have already reoriented their logistics chains to European directions, with 42% of them planning to continue using these routes even after the full restoration of Black Sea ports. This indicates the formation of stable business relationships with European partners and the integration of Ukrainian producers into European logistics networks, which will have a long-term positive impact on the competitiveness of the domestic oil and fat industry in

Conclusions

The blockade of Ukrainian seaports due to Russia's military aggression has led to the need for diversification of transport and logistics supply chains of oilseeds and oil and fat products. The main alternative routes have become the western and south-western railway routes, the Danube river route, and road transportation.

The analysis of the economic efficiency of alternative logistics routes showed that the most optimal is a combined route, which includes transportation by rail to the Danube ports of Ukraine with further transportation by river and sea transport. However, all alternative routes are characterized by significantly higher costs compared to traditional sea exports through the Black Sea ports, which reduces the competitiveness of Ukrainian products in the world market.

To improve the efficiency of logistics chains for the supply of oil and fat products, a set of measures has been proposed, including the development of multimodal transportation, investments in logistics infrastructure, creation of logistics hubs, cooperation with European partners, and digitalization of logistics processes. The implementation of these measures will reduce the logistics costs for the export of sunflower oil by 15-20%, and delivery time – by 10-15%.

References

1. Nekrasenko, L.A., & Tkachuk, O.V. (2024). Aktualni problemy zernovoi lohistyky v Ukraini [Current problems of grain logistics in Ukraine]. *Collection of scientific works of DUIT. Series "Economics and Management"* № 56. pp. 59–66.
2. Shults, S.L., & Lutskiv, O.M. (2022). Problemy funktsionuvannia transportnoi infrastruktury ta lohistyky Ukrainy v umovakh voiennoho chasu [Problems of functioning of transport infrastructure and logistics of Ukraine in wartime]. *Regional economy* № 2. pp. 85–93.
3. Kushnir, T.M., & Berehovyi, V.K. (2023). Suchasnyi stan ta perspektyvy eksportu oliinykh kultur z Ukrainy [Current state and prospects of export of oilseeds from Ukraine*]. Economy and society* № 45. pp. 32–38.
4. Lebedynska, O.I. (2023). Optymizatsiia lohistychnykh vytrat pry eksporti maslozhyrovoi produktsii z Ukrainy [Optimization of logistics costs in the export of oil and fat products from Ukraine]. *Ahrosvit* № 5. pp. 18–26].
5. Makarenko, S.D., & Antoshchenkova, V.V. (2022). Lohistychne zabezpechennia eksportu ahrarnoi produktsii Ukrainy v umovakh viiny [Logistics support for the export of agricultural products of Ukraine in wartime]. *Ekonomika APK* № 8. pp. 45–54.

ISSN Print 2786-5150
ISSN Online 2786-5169

6. Gentilini, M. (2023). Global sunflower oil market: impact of Ukraine-Russia war and future prospects. *Journal of Agricultural Economic*s № 74(2). pp. 321-335.
7. Melnyk, T.O., & Puhachova, K.M. (2023). Transformatsiia lohistychnykh lantsiuhiv ahroprodovolchoi produktsii Ukrainy v umovakh viiny [Transformation of logistics chains of agri-food products of Ukraine in war conditions]. *Ekonomika Ukrainy.* № 6. pp.73-87.
8. Derzhavna sluzhba statystyky Ukrainy [State Statistics Service of Ukraine]. URL: http://www.ukrstat.gov.ua/.
9. Ukrainskyi klub ahrarnoho biznesu [Ukrainian Club of Agrarian Business]. URL: http://ucab.ua/.
10. Ministerstvo ahrarnoi polityky ta prodovolstva Ukrainy [Ministry of Agrarian Policy and Food of Ukraine]. URL: https://minagro.gov.ua/.
11. Asotsiatsiia «Ukroliiaprom» [Association "Ukroliyaprom"]. URL: http://www.ukroilprom.org.ua/.
12. Ekonomichna pravda [Economic Truth]. (2024). Cherez ukrainski porty u 2023 rotsi eksportuvaly ponad 56 milioniv tonn vantazhiv [More than 56 million tons of cargo were exported through Ukrainian ports in 2023]. URL: https://www.epravda.com.ua/news/2024/01/24/709110/.
13. Ministerstvo infrastruktury Ukrainy [Ministry of Infrastructure of Ukraine]. URL: Retrieved from https://mtu.gov.ua/.
14. Analitychnyi tsentr "UkrAhroKonsalt" [Analytical Center "UkrAgroConsult"]. URL: http://www.ukragroconsult.com.
15. Food and Agriculture Organization of the United Nations. URL: http://www.fao.org/