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MANAGEMENT OF THE LOGISTICS AND SALES SYSTEM OF THE AGRICULTURAL INDUSTRY IN THE CRISIS CONDITIONS OF THE ECONOMY

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Summary. The article examines the tasks and directions of transformation of logistics and sales management in the agricultural sector caused by the crisis. Quantitative statistical analysis of the Trade Policy Uncertainty Index proves that the level of challenges of the current crisis and the dynamics of changes in their impacts are significantly higher than during the crisis caused by the pandemic. The significance of these indicators demonstrates the presence of a threat not only to the sustainability of the activities of all business components of the logistics and sales system, but even to their survival in crisis conditions. At the same time, the significant pace of change in the challenges of the crisis complicates the process of management adaptation to them. To assess the level of management adaptation, a mathematical model of the dynamics of the logistics and sales process was developed, which allows determining the adequacy of the pace of change in management measures. The use of a systems approach made it possible to establish that important areas of logistics and sales process management also include supporting the resilience of not only the company, but also all components of the specified system - from the manufacturer to the sales markets. This necessitates the introduction of multi-purpose management and its construction on the principles of a hierarchy of management decisions. It is noted that this requires the interpretation of the logistics and sales chain as a system cycle, which in the process of optimizing sales logistics requires considering the set of risks as a mutually agreed system. The systems approach also necessitated the study of the components of the management of the logistics and sales system of the agricultural industry, including its institutional component. A comparative analysis of the components of the Logistics Efficiency Index by agricultural exporting countries indicated areas for improving Ukrainian institutional management. It is indicated that the dynamic reorientation of the directions of Ukraine's export logistics and sales activities leads to the formation of much longer logistics and sales chains, which reduces the possibility of participation in them not only of small but also of medium-sized agricultural producers, which radically changes the logistics and sales system of the country. In particular, this causes the need to involve logistics and sales companies on the principles of outsourcing or the formation of cooperatives specializing in logistics and sales of agricultural products.

Keywords: logistics and distribution, systemic approach, multi-purpose management, threat dynamics, adaptation to the crisis

1. INTRODUCTION

Managing logistics and sales activities in the agricultural sector is a rather difficult task for management, even in conditions of sustainable economic development. The difficulties are primarily due to the peculiarities of agricultural products: the seasonal nature of production, the ability to quickly lose their qualities and even the inclusion of live animals in the product range, the logistics and sales of which require specific skills and equipment. The difficulties are exacerbated by the insufficient development of the transport system and logistics infrastructure in developing countries, which can belong to both the category of suppliers and the category of consumers of agricultural products. At the same time, under conditions of sustainable development, the management of the logistics and sales system of agricultural enterprises gains experience and adapts to the specifics of the industry.

Crises not only radically affect all links of the logistics and sales chains, all relevant areas of activity, but they also require a transformation of management to neutralize the challenges that have arisen. Another significant problem is the dynamism of the emergence and action of threats generated by the crisis. The pace of change in threats requires not only the introduction of operational management measures, it requires a dynamic nature of management transformation, which will ensure the appropriate level of adaptation of the logistics and sales process both to the challenges of the crisis and to the new landscape of sales markets formed by the crisis (Bazaluk, 2017; Kotenko et al., 2021; Bazaluk et al., 2022).

The comprehensive nature of the impacts of the crisis also requires a broadening of the view of the logistics and sales system of the agricultural industry, and, accordingly, to the structure of its management (Ociepa-Kicińska et al., 2025). In the context of the crisis, it is worth including institutional management in the specified system, the actions of which determine the level of success of agricultural logistics in the supplying countries and the efficiency of the sales process in the consuming countries of agricultural products. A systemic view of the logistics and sales process also allows for the identification of the mutual influence of both crisis factors and managerial reactions to them, which helps to identify both positive and negative synergistic effects. The study of these aspects will contribute to both the effective transformation of logistics and sales management, as well as its adaptation to the conditions of the crisis and, accordingly, ensuring sustainable development for all components of the logistics and sales system.

2. LITERATURE REVIEW

Scientific research on the management of logistics and sales activities of agricultural enterprises is complicated by the involvement of various areas of activity in this issue, for example, such as distribution (Korniietskyi et al., 2025), transport (Spaskyi, 2022), integrated (Voloshchuk et al., 2020), logistics and the significant fragmentation of this system by functional areas, for example, agro-logistical hubs (Kustrich, 2022), logistics centers (Danylenko, 2020), by nomenclature: grain products (Zakharchuk et al., 2025), wine materials (Marchuk et al., 2025), volume of commodity batches (Malik et al., 2023), etc. Also, researchers are often limited to one of the functions of the logistics and sales activities of agricultural enterprises, in particular, marketing management of supply chains (Balanovska et al., 2025; Makarenko et al., 2025), digital management (Lagodiienko et al., 2023; Klius et al., 2023; Perevozova et al., 2024; Kwilinski et al., 2025), green (ecological) logistics (Chukurna et al., 2022; Sklavos et al., 2024), etc.

The fragmentation of the problem sometimes hides the systemic nature of logistics and sales activities. At the same time, there are studies devoted to the need to build a logistics system in the agricultural sector as a way to overcome the crisis (Radchenko, 2023; Kotenko et al., 2021). Moreover, scientists point out the need to highlight a separate category of logistics systems, which are proposed to be called the “agrologistics system” (Vinichenko et al., 2023). There are also works that indicate the importance of forming a logistics and marketing system for a separate cluster (Deineha et al., 2022) or even an enterprise (Gumenyuk et al., 2020). In view of the issues raised in the presented article the emphasis of the study by Gumenyuk et al. (2020) on the importance of forming specialized logistics and marketing enterprises primarily for agricultural products that quickly lose their consumer qualities, such as vegetables, is essential.

The systemic impact of the logistics and sales process in the agricultural industry is not directly confirmed in the article by Li et al. (2022), which states that the formation of stable and

resilient supply chains ensured the viability of agricultural household suppliers during the pandemic crisis. However, the systemic approach is supported mainly by qualitative rather than quantitative research into the process.

Also, the generalization of scientific conclusions is significantly complicated by different views on the nature of the current crisis, its causes, the directions of influence on the management of logistics and sales activities of agricultural products, the need for changes in management approaches, etc. Thus, in the articles by Stonozhenko et al. (2023) and Potwora et al. (2024), it is indicated that one of the main negative factors of the crisis is the uncertainty of its impacts. Mazur et al. (2025) focus on the threats of the crisis to the level of competitiveness of supplies to foreign markets, which, in their opinion, requires improving the logistics management strategy of agricultural enterprises. Lykholat et al. (2022) note that the crisis has led to the destruction of traditional logistics chains. The articles by Radchenko (2023) and Voronina et al. (2024) point out the threat of an increase in the cost of logistics services in Ukraine at a rate of 2-3 times per year, which destabilizes not only the national but also the global agricultural market.

Scientists also point out that the crisis requires a radical transformation of the logistics and sales activities of agricultural enterprises, in particular, given the need for logistical support for food security at both the national and global levels (Pavlyshyn, 2023). In the article by Maievska (2022), the main task of transforming the logistics and sales management of agricultural enterprises in times of crisis is to manage logistics chains in such a way that will provide maximum added value to each of the participants in these chains. In our opinion, such a statement of the management task is insufficiently substantiated.

Scientific studies rightly point out the significant difference in the importance of crisis factors on logistics and sales entities. Even the impact of the war is uneven for different regions of Ukraine, on whose territory the war is taking place. As noted in the articles by Shalyhina et al. (2025) and Mykolaichuk et al. (2025), frontline farms are characterized by significant fluctuations in crop yields and production volumes, which leads to a significant level of instability of the logistics and sales process for the domestic and, especially, for the foreign market where consumers are attentive to the fulfillment of contract terms. At the same time, Shalyhina et al. (2025) indicate that even under extremely harsh crisis conditions, there are signs of adaptation of both production and logistics and sales processes to existing threats. But this thesis is not supported by quantitative analysis.

Scientists use different methods to assess the impact of the crisis and optimize various aspects of logistics and sales activities. Thus, Kovalenko (2025) relies on a SWOT analysis of Ukrainian agricultural logistics, which is a qualitative method of analysis, reducing the relevance of scientific conclusions. When setting the tasks of optimizing the logistics and sales process of agricultural enterprises, scientists often limit themselves to improving resource provision (Aulin et al., 2018; Andriushchenko et al., 2021), minimizing costs (Dramaretska et al., 2018), improving the management of logistics of material flows (Rzhepishevska et al., 2017), offering either qualitative approaches (Panchenko, 2024) or quantitative approaches, where, even in times of crisis, exclusively economic and financial functions are chosen as goals (Vinichenko et al., 2023).

At the same time, the cardinal changes due to the crisis in all components of the logistics and sales system of the agricultural industry require a comprehensive, systemic view of management in this area, the conditions and directions of its transformation. The importance of such a view is enhanced by the decrease in the share of self-organization of some links of logistics and sales chains, inherent in a stable period of economic development, in the conditions of crisis, which leads to an increase in the level of integrated management.

An extended study is also required by a problem that has remained unnoticed by many scientists - the speed of change of crisis challenges, which determine not only the need for operational management responses to threats, but also pose the task of dynamically adapting to them the logistics and marketing system of agricultural production at all levels of its management - from the enterprise and cluster to the state level. This is not only a question of ensuring the proper level of sustainability of logistics and marketing of agricultural products, but it is also a question of the survival of all business links of the logistics and marketing chain and, in general, the issue of food security, both at the local and global levels.

3. MATERIALS AND METHODS

The study used mathematical methods of statistical analysis and group theory.

For quantitative statistical analysis of the impact of the crisis, the Trade Policy Uncertainty (TPU) Index was used, since it has been proven that changes in this indicator are closely related to changes in other global financial indicators: Dow Jones, STOXX 600 index, Hang Seng, Nikkei 225 and Shanghai Composite, etc. (Kantemyr et al., 2025). The TPU Index was introduced by the US Federal Reserve Board to numerically measure the level of trade policy uncertainty. The higher the numerical value of this indicator, the greater the risks for investment and trade. That is, a high TPU-Index value indicates a higher level of crisis. In the time interval presented in Fig. 1, there are signs of two crises: COVID-2019 and the current one, which, in terms of risks for trade, according to the comparison of TPU-Index values, exceeds the previous one by almost two times.

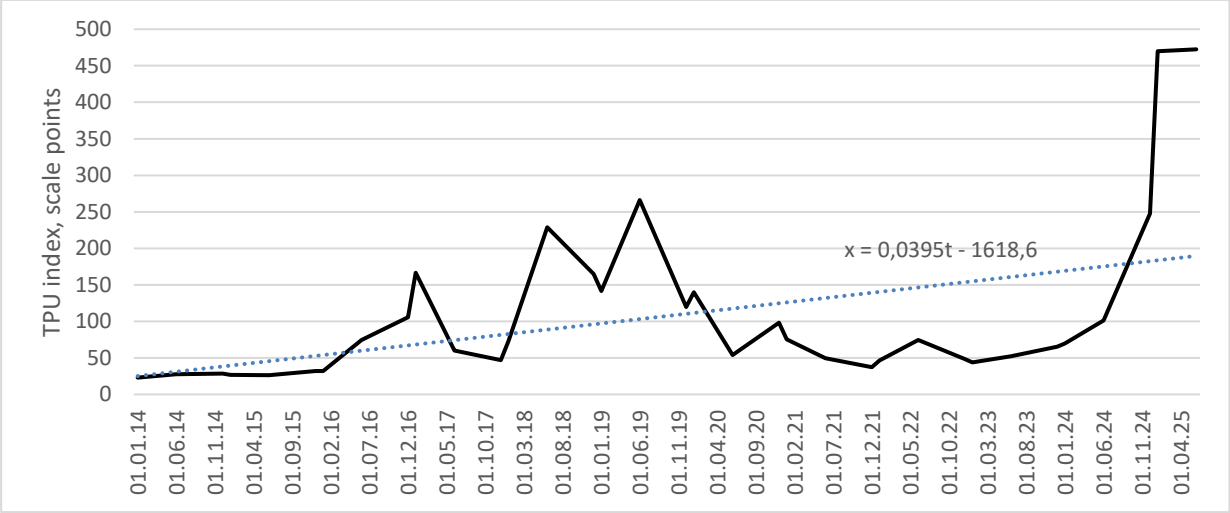

Fig. 1. Dynamics of Trade Policy Uncertainty Index for the period 01.2014 – 04.2025, scale points

Source: developed by the author based on data from the National Bank of Ukraine (2025)

The increase in TPU-Index values is not only an indirect indication of the level of challenges of the crisis to the logistics and supply chain in the agricultural sector, but also directly indicates a threat. Thus, the increase in the unpredictability of agricultural logistics in terms of delivery times, uncertainty in the cost of logistics operations in regions of hostilities, led to an increase in the risks of financial transactions with agricultural products on forward markets. Therefore, Ukrainian grain traders switched to the spot market. As it is

known, selling prices on the spot market are lower than on forward markets. This reduced the profitability of grain production, which, due to the increase in the cost of logistics operations, led to a crisis of all components of the logistics and marketing system of grain crops. The instability of demand satisfaction also increased due to the decrease in the flexibility of logistics and marketing chains due to the increase in threats to warehouses and elevators, and, accordingly, the reduction in opportunities for the formation of reserves.

This has increased the impact of the crisis on the world market and, accordingly, created threats to global food security.

Therefore, this necessitates the need for statistical assessment and mathematical formalization of the analysis of changes in the TPU Index.

The average deviation of the TPU Index in the time interval 01.2014 - 04.2025 is:

$$a = n^{-1} \sum_1^n \left(x_i - \underline{x}_n\right) = 233{,}95 \tag{1}$$

where n is the number of years, x_i is the TPU Index value for the year $1 \leq i \leq n$, $\underline{x}_n$ is the average TPU Index value for n years.

At the same time, the deviation from the average value for the period as of 04.2025 is 54.3% more than this indicator, which is a significant confirmation of the crisis at this time. This increases the risks for investors and, as indicated, complicates forward trading, which is important for the agricultural sector.

Also, the rate of change of its indicators is significant for the logistics and sales process. This is due to the fact that the dynamic impact of the crisis does not allow companies to adapt their logistics and sales to it. This is especially important for agricultural products, which are characterized by a long production cycle and for a significant part of the product range, there are no possibilities for its storage without losing not only its qualities but, in some cases, even its suitability for consumption.

This allows for formulating the first prerequisite for effective management of the logistics and sales system of agricultural enterprises in crisis management conditions - not only a high level of adaptation to the challenges of the crisis, but also a high efficiency of the adaptation process.

The mathematical formalization of the rate of change is the first derivative of the indicator, or the slope ratio of its trend line. According to the trend equation established by the analysis:

$$x = 0{,}0395t - 1618{,}6 \tag{2}$$

first derivative TPU Index for the period 2014-2025:

$$\frac{dx}{dt} = 0{,}0395 \tag{3}$$

This value is integral, and for the COVID-19 crisis, the assessment period narrows to 2018-2019, and the first derivative of the TPU Index in this period is 3.63. At the same time, for the period 06.2024-04.2025, the first derivative of the TPU Index is 4.66. This indicates that the impact of the crisis 06.2024-06.2025 is more significant than during the pandemic.

The impacts of the crisis are characterized by the presence of many negative factors of different orientations. For each crisis factor j, there may be its own rate of change. This raises the question of determining the sufficiency of the rate of individual management measures to neutralize threats and the proper adaptation of management to them.

The condition for proper adaptability of management is such a rate of change of management action y_k (where k s the index of management action), aimed at neutralizing the integral impact of the crisis, which is not less than the maximum value of the rate of change of the crisis factor $g = (\frac{dx}{dt})_{max}$. This approach allows us to form two sets that do not intersect - the set of rates of change of crisis factors G and the set of rates of change of management actions, regarding the neutralization of crisis factors H. Then, according to the theory of groups, the left and right adjacent classes are formalized as the result of multiplying $(g + 1)$ by each element of the set H respectively, from the left and right:

$$(g + 1)H = \{(g + 1)h | h \in H\} \quad (4)$$

$$H(g + 1) = \{h(g + 1) | h \in H\} \quad (5)$$

Such conditions provide grounds to form a normal subgroup for the mathematically formalized requirement of ensuring the proper pace of managerial actions:

$$G\left\{\frac{dx_j}{dt}\right\} \trianglelefteq H\left\{\frac{dy_k}{dt}\right\} \quad (6)$$

The above not only simplifies the mathematical formalization of the dynamics of the logistics and sales process in the conditions of multifactorial impacts of the crisis, but also formally indicates the sufficiency or insufficiency of the pace of change in management measures for proper adaptation to the challenges of the crisis.

4. RESULTS

Logistics and sales activities are an integral part of the Agricultural and Food Supply Chains (AFSC) system, which, according to established scientific views, covers all logistics chains of agricultural product distribution from marketing, warehousing, to product delivery to the consumer, which determines the special importance of such activities as an integrating factor of the spheres of production and consumption.

The operational tasks of the logistics and sales process in scientific works indicate the formation and satisfaction of solvent consumer demand, but, first of all, the organization of distribution channels and logistics flows of agricultural products. This may include the trade and intermediary activities of companies that specialize in the logistics and sales process.

Logistics and sales activities in agricultural production are complicated by the peculiarities of the nomenclature of goods in this sector, since both products or raw materials with a short shelf life and live animals can be intended for sale, the overtime extension of which in the transportation process requires special organizational solutions, which significantly increase the cost of logistics services. This places additional demands on the logistics of the agricultural sector. Over a certain period of time, both producers, logisticians, and consumers adapt to these requirements and features. But the period of crisis is characterized by the fact that it forces the change of established procedures and business models, since the efficiency of the logistics and sales system is the key to the survival of the enterprise during this period. Thus, the beginning of large-scale hostilities in 2022 caused not only a disruption in the supply of agricultural products but also a permanent instability of agricultural logistics, which led to indirect losses for Ukrainian producers in the amount of 18.5 billion dollars.

The blocking of sea logistics routes for Ukrainian grain resulted not only in a temporary reduction in the supply of Ukrainian grain to the world market. This also led to drastic changes in the structure of crops, a decrease in the yield of subsequent periods due to violations of agricultural technologies, which increased the long-term negative impact on all participants in the logistics and sales chain of Ukrainian food.

This resulted in a shortage of supply in sales markets and an increase in prices not only for grains and products made from them, but also for other agricultural products. This, as well as an increase in risks for transport vessels even in the period after the opening of Ukrainian ports, led to a significant increase in logistics costs. These rising costs and declining profitability of grain production have resulted in a reduction in the area under grain cultivation in Ukraine, which has led to global changes in the global logistics of grain products. This has disrupted global logistics and supply chains and, accordingly, created threats to global food security.

This has forced consumer countries to diversify supplies and even introduce emergency measures, in particular, to limit or prohibit the export of their own agricultural products. The obstacle for food consumers in developing countries has become the high share of internal logistics costs and the inefficiency of the national transport system. Also, since the institutional measures of consumer countries in the face of increasing risks to external food supplies are mainly aimed at containing prices, this deepens the food crisis not only locally but also at the global level.

Therefore, important areas of management of the logistics and sales process of agricultural products in crisis conditions are also supporting the resilience of one's own company during the extension of the crisis period in time and adhering to the principle of complexity and systematicity. This requires changing the management goals and prioritizing them by introducing multi-purpose management of logistics and sales activities. In particular, it requires not focusing only on profit, but forming an appropriate level of sustainability of the entire logistics and sales system.

The priority of goals for the formation of logistics and sales supply chains necessitates changes in management and its reconstruction by introducing the principles of the hierarchy of management decisions. The logistics and sales chain in such circumstances should be considered as a systemic cycle of transforming available resources, not only material and financial, but also time resources, into the final result.

This systemic cycle must meet the requirements for optimizing both logistics and sales processes in real time, including minimizing the entire set of risks. The set of risks for this should also be considered as a mutually agreed system. This mutual agreement, in particular, consists in the fact that minimizing the risks of military damage to cargo requires operators to choose not the shortest, but the safest logistics route. At the same time, extending the transportation time of agricultural products, which have the property of quickly deteriorating, can lead to a deterioration in consumer quality and, as a result, loss of the sales market.

A systematic approach to the logistics and sales process also requires compliance with the conditions of the emergence of activities in the general logistics and sales system. The effect of the emergence of the system, as it is known, is provided by the synergy of the coordinated interaction of its components. This means that the management of logistics and sales activities in times of crisis should contribute to the resilience of both the manufacturer and the consumer to ensure not only the efficiency of their own business and its sustainability, but also the formation of the prerequisites for the survival of all participants in the logistics and sales chain.

For example, a rational reduction in prices for logistics services will allow reducing prices of agricultural products for the consumer, which can contribute to an increase in sales volumes, and, thereby, help to level the impact of the crisis on the agricultural products market. It should

be noted that the cost of logistics expenses for Ukrainian companies, in some cases, even in relatively safe periods of time, amounted to more than 30% of the total cost of agricultural production (Rzhepishevska et al., 2018). This indicator tends to grow in times of crisis, which puts agricultural production on the verge of survival. An example of this is the reduction in the area of grain crops in Ukraine, which, accordingly, reduces the volume of logistics services (Agriculture Logistics Market Size & Share Analysis - Growth Trends & Forecasts, 2025).

Also, the principle of complexity and systematicity in logistics and sales activities indicates that the requirements should apply not only to the management of logistics companies or specialized units of the agricultural business, but also to the management of the producer and even to public administration in this area.

Regarding the requirements for producer management, it is first of all worth noting that a certain problem is their adherence to the traditions of agricultural production, typical for developing countries, in particular Ukraine, which results in a mix of emphasis on the production of what is in demand and attempts to sell the products that agricultural enterprises are used to producing. This reduces adaptation to the challenges of the crisis, especially in conditions of dynamic changes not only in volumes but also in the range of products on local markets due to significant fluctuations in price ratios for the main product groups, which, in particular, significantly complicates the logistics and sales process. This requires a change in the psychology of management in traditional agricultural production. At the same time, the separation of logistics and sales from production activities allows, to some extent, to level the negative impact of traditional approaches to management, in particular by implementing process and project approaches and involving specialists in monitoring demand in local markets, managing material and financial flows in real time, organizing sales, etc.

The presence of shortcomings in institutional management that affect logistics and sales activities is indicated by a comparison of the components of the Logistics Efficiency Index of European agricultural exporting countries (see Table 1).

Tab. 1

Components of the Logistics Efficiency Index by country, scores in the range of 1-5

Components	Country						
	Bulgaria	Romania	Poland	France	Spain	Ukraine	Ukraine 2023 to 2018, %
Customs	3.1	2.7	3.4	3.7	3.6	2.4	3.8
Infrastructure	3.1	2.9	3.5	3.8	3.8	2.4	9.1
International shipments	3.0	3.4	3.3	3.7	3.7	2.8	10.3
Logistics competence	3.3	3.3	3.6	3.8	3.9	2.6	-9.2
Timeliness	3.5	3.6	3.9	4.1	4.2	3.1	-10.3
Tracing	3.2	3.5	3.8	4.0	4.1	2.6	-19.6

Source: developed by the author using data from the World Population Review (2025)

As can be seen from Table 1, Eastern European countries, both members of the European Union and Ukraine, are significantly inferior to Western European countries, in particular, France and Spain, in terms of the level of components of the Logistics Efficiency Index.

A comparison of Ukraine's indicators before and after the start of large-scale aggression also confirms the significant impact of the crisis caused by the war on the components of the Logistics Efficiency Index. Thus, the shortage of personnel for logistics and sales activities due to emigration and personnel mobilization led to a significant decrease in the "Logistics Competence" indicator, and the bombing increased the risks for transportation, forcing maneuvering in real time along the routes of transportation of agricultural products. The challenges of war also lead to the inefficiency of digital means of managing the logistics process and, accordingly, excessive delays in the supply of agricultural products, which resulted in the decrease in the value of the "Timeliness" and "Tracking" delivery indicators.

It is also worth noting that the inconsistency of Ukraine's institutional management of agricultural product logistics in some cases even exacerbates the effects of the crisis. Thus, in 2023, citing the increase in losses for the transport industry in war conditions, the Ministry of Infrastructure increased railway tariffs by 70%, later reducing them to 30%, which put certain areas of agricultural product logistics on the verge of survival.

At the same time, the data in Table 1 confirm that, despite the impact of war risks on logistics processes, Ukraine is able to improve its performance in some components of the Logistics Efficiency Index compared to the period before the start of intensive hostilities. In general, the data in Table 1 indicate key problems in the logistics and sales process that should be immediately addressed by the institutional management of agricultural exporting countries.

A peculiarity of the logistics and sales system of the agricultural sector is that in times of crisis, farmers, unlike most other industries, cannot always change the target function of logistics. The crisis encourages logistics services, for example, of industrial enterprises, to ensure the reliability of supplies, minimizing risks on logistics routes. At the same time, the logistics of agricultural enterprises often have to rely on the implementation of the “short run” principle, which ensures the speed of delivery, since agricultural products tend to deteriorate and quickly lose their consumer qualities, which increases the risks for carriers. Therefore, in the conditions of the crisis caused by the war, Ukrainian farmers will choose the tactic of centralizing distribution, forming large batches, as a means of minimizing transportation costs and speeding up the logistics process. But this increases the vulnerability of transport to air attacks, which is primarily inherent in logistics, mostly maritime logistics, of grain crops during the harvest period. Also, this approach does not always allow for a prompt response to dynamic changes in demand, especially in foreign markets.

At the same time, there is a tendency for a dynamic integrated reorientation of export logistics and sales activities for Ukrainian farmers (see Fig. 2).

As can be seen from Fig. 2, even in a relatively short period of time, one year, there is a significant reduction in the volumes of the logistics and sales process for Ukrainian agricultural products towards EU countries and an increase in these volumes for the countries of the Asian continent.

Thus, when comparing this indicator in 2024 to its values in 2023, there was a reduction in volumes for Slovakia - by 14.53%, for Poland - by 7.16% and for Romania - by 54.42%. At the same time, the volumes of supplies to the Chinese market have almost not changed, but for Kyrgyzstan they have increased by 2.4%, for Kazakhstan they have increased by 9.37%, for Azerbaijan they have increased by 10.52%.

Reorientation of export logistics and sales activities leads to the formation of much longer logistics and sales chains. This, in turn, leads to the formation of business models that cannot be supported not only by farming households, small agricultural producers, but even by medium-sized farms. This process is negatively contributed to by the increase in costs for transport services, the reduction in the efficiency of transport networks, in particular due to

the increase in military risks of damage to transport hubs, the increase in the share of coastal voyages for sea transportation of grain, etc.

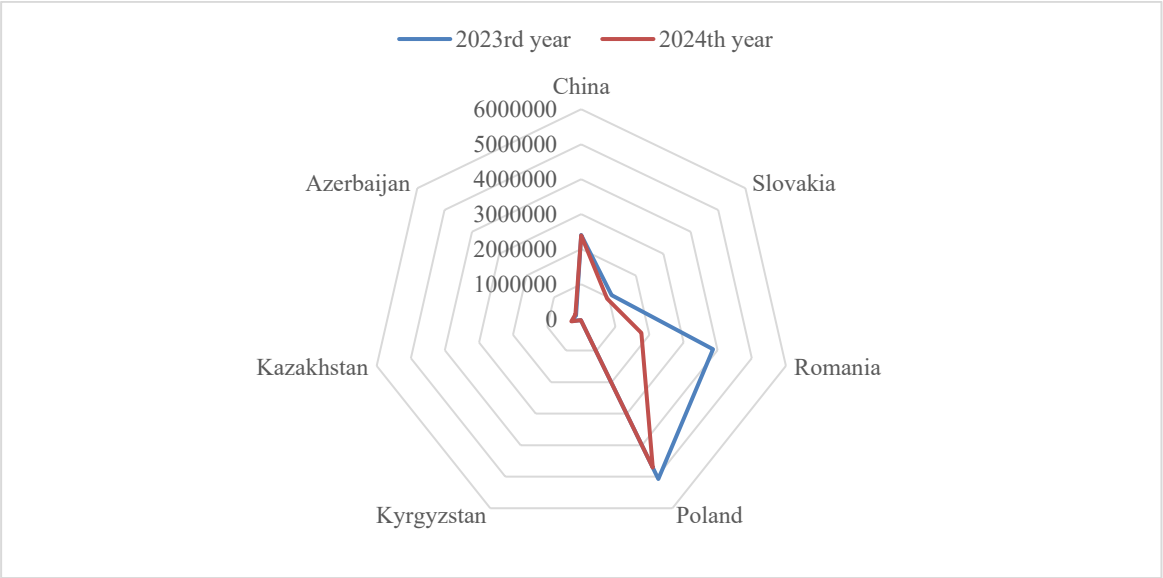

Fig. 2. Volumes of the export-oriented logistics and sales process for Ukrainian agricultural products, thousand USD
Source: developed by the author based on data from the State Statistics Service of Ukraine (2025)

Thus, the differentiation of threats to the logistics and sales process requires the concentration of logistics and sales services, which leads to the displacement of small businesses from this process, radically changing the logistics and sales system of the country.

The increase in the number of participants in the logistics and sales process as a result of the extension of transport routes due to the effects of the crisis, also results in an increase in formal and informal relations, which reduces the level of partnership and trust between participants. This also leads to an increase in the final price of agricultural products by 2.5-3.5 times the producer price. This affects the reduction in sales volumes and, accordingly, a decrease in production volumes. This necessitates the involvement of logistics and sales companies on the principles of outsourcing or the formation of cooperatives specializing in the logistics and sales of agricultural products.

Companies specializing in the logistics and sales process are able to provide a systematic approach to the movement of agricultural product flows at all stages of the logistics process at the modern level, organize effective risk control on each of the logistics routes and, in accordance with the level of risks, coordinate changes in transport flows, establish not only accounting for logistics costs but also optimize them even in conditions of dynamic changes in threats. This allows for the optimal organization of the interaction of functional links of the logistics and sales process and, thus, ensures effective management of agricultural product flows.

The dynamics of military threats to logistics routes in Ukraine reduce, as noted above, the use of standard digital business process automation (BPA) systems. A possible solution in the context of military risks is the diversification of transport management. An example of this is the introduction by the Ukrainian company Kernel of the digital network platform Transithub, with real-time establishment of risks on each route and placing responsibility for the transportation of agricultural cargo directly on drivers or forwarders, who are given the right

not only to plan transportation but also to change routes at their own discretion in real time. Route geotags remain in the transportation history on the digital platform, which allows for post-facto assessment of the carrier's actions. This simplifies logistics management in conditions of threats.

The direction of management activities to accelerate the adaptation of the logistics and sales process in the agricultural sector to crisis conditions is the operational change of logistics flows in the event of dynamic variability of demand between sales markets. Therefore, permanent marketing of all types of markets - consumer, agricultural and production, intermediary, national, local and global ones - becomes important.

This is necessary for both logistics and sales activities in the field of agricultural raw materials (including grain and legume crops, dairy and livestock products, both sugar beets and sugar, etc.) for its processing, logistics and sales activities in the field of finished agricultural products (honey, vegetables, fruits, berries, etc.) and for logistics and sales activities in the field of agricultural products with a higher level of added value (flour, cereals, oil, etc.). Such permanent marketing will ensure, if necessary, the appropriate level of management response to dynamic changes in both production and consumption of agricultural products in each type of market.

This also increases the need for dynamic customization of finished agricultural products and agricultural products with a higher level of added value, especially in foreign markets.

The formation of distributed sales networks also becomes important, possibly involving several logistics operators in the supply of products. This can, in times of crisis, in particular with a dynamic change in the level of military threats to both transport routes and individual links of logistics chains, ensure the reliability of supply, avoid losing the local sales market, and even contribute to increasing the level of food security.

5. CONCLUSIONS

Analysis of the dynamics of the TPU index quantitatively confirmed the extraordinary magnitude of the threats of the current crisis for the logistics and sales system of agricultural enterprises. It was established that the level of threats of the current crisis is almost twice as high as during the crisis caused by the pandemic. It was also established that the dynamics of the challenges of the current crisis is more than during the COVID-19 period by a third. Accordingly, this poses a threat to the sustainability and even survival of all business components of the logistics and sales system. This determines the importance of adapting the management of the logistics and sales process in the agricultural sector to the dynamic challenges of the crisis. Effective adaptation of logistics to the conditions of the crisis can reduce the costs of logistics and sales activities, thereby reducing the prices of agricultural products for the consumer, which can contribute to increasing sales volumes, and, thereby, help to level the impact of the crisis on the agricultural products market. Therefore, a mathematical formalization of the dynamics of the logistics and sales process is proposed, which allows determining the sufficiency of the pace of change in management measures for proper adaptation to the challenges of the crisis.

The versatility of the negative impacts of the crisis on the logistics and sales system of agricultural enterprises and the formation of threats to global food security are studied. It is indicated that important areas of management of the logistics and sales process of agricultural products in crisis conditions also support the resilience of one's own company during the extension of the crisis period in time and adhere to the principle of complexity and

systematicity. This requires a change in management goals or their priority for the introduction of multi-objective management, and requires not to focus only on financial results, but to form an appropriate level of sustainability of the entire logistics and sales system. The priority of the goals of the logistics and sales system also requires a change in management and its reconstruction for the introduction of the principles of the hierarchy of management decisions. The logistics and sales chain in such conditions should be considered as a system cycle that must meet the requirements of optimizing both logistics and sales processes in real time, including minimizing the entire set of risks. It is proposed to consider the set of risks as a mutually agreed system.

It is indicated that the use of a systems approach necessitates the observance of the condition of the emergence of activities in the general logistics and sales system. This means that the management of logistics and sales activities in times of crisis should contribute to the resilience of both the producer and the consumer to ensure not only the efficiency of their own business and its sustainability, but also the formation of prerequisites for the survival of all business components of the system. The non-resilience and fragmentation of the logistics system lead to an increase in prices for agricultural products, which reduces the resilience of producers and consumers.

Also, the principle of complexity and systematicity in logistics and sales activities indicates that the requirements should apply not only to the management of logistics companies or specialized units of the agricultural business, but also to the management of the producer and, even, to public administration in this area. In particular, a factor in ensuring the efficiency of logistics and sales activities in foreign markets is the proper use of institutional potential for cross-border trade. An indicator of this is the Logistics Efficiency Index. Therefore, a comparative analysis of the components of the specified Index was performed by agricultural export countries. This allowed to identify both the adaptation of Ukraine's institutional management to the challenges and the gaps in this management activity.

A trend of dynamic reorientation of the directions of export logistics and sales activities of Ukraine has been established. It is indicated that this reorientation causes the formation of much longer logistics and sales chains, which reduces the possibility of participation in them not only small but even medium-sized agricultural producers. This reduction is also facilitated by the differentiation of threats to the logistics and sales process, which results in the concentration of logistics and sales services, causing the need to involve logistics and sales companies on the principles of outsourcing or the formation of cooperatives specializing in the logistics and sales of agricultural products.

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