11th INTERNATIONAL SCIENTIFIC CONFERENCE
RURAL DEVELOPMENT 2023
BIOECONOMY FOR THE GREEN DEAL
26-28th September, 2023, Vytautas Magnus University Agriculture Academy, Lithuania

VYTAUTAS MAGNUS UNIVERSITY AGRICULTURE ACADEMY

Proceedings of the 11th International Scientific Conference Rural Development 2023

Edited by assoc. prof. dr. Judita Černiauskienė

ISSN 1822-3230 (Print)
ISSN 2345-0916 (Online)

Article DOI: https://doi.org/10.15544/RD.2023.028

EXPORT OF AGRICULTURAL PRODUCTS FROM UKRAINE AGAINST THE BACKGROUND OF CHALLENGES TO GLOBAL FOOD SECURITY: ILLICIT TRADE, LOGISTICS AND SOIL ECOLOGY DURING THE WAR

Ilona DUMANSKA, Department of International Economic Relations, Faculty of International Relations and Law, Khmelnytskyi National University, address: Instytutska Street, 11, UA-29016, Khmelnytskyi, Ukraine), dumanskai@khmnu.edu.ua

In the pre-war period, Ukraine's contribution to world food security was one of the largest, based on the export of its own agricultural products. Russia's military aggression has brought about a collapse in the production system and logistics chains of food supply in the world. The UN, the EU and a number of specialized international organizations are looking for optimal solutions to avoid a food crisis in Ukraine. The key problem is the fall in the volume of the harvest, which was planned for export, and the prerequisites for this were military actions on agricultural lands, soil pollution from ammunition and the development of illicit trade in conditions of scarcity. The purpose of the article was to prove the role of agricultural exports from Ukraine in global food security and, based on this imperative, to propose a theoretical approach in the collective coordination of the efforts of public institutions to counter logistical losses, illicit trade and soil pollution occurring in Ukraine during the war. The methods used are literature analysis, statistical data and visualizations, analytical modeling. The solution to the outlined problems of food security is proposed on the basis of the development of institutions of collective action from the standpoint of the theory of the «tragedy of the commons».

Keywords: *export, agricultural products, global food security, logistics, soil, illicit trade, institution of collective action, war.*

INTRODUCTION

Global food security is based on the ability to provide food for people in the world, solving the problem of hunger, and determines the specialization of individual countries and their role in such a complex process. FAO studies indicate the important role of the export of agricultural products from Ukraine in overcoming hunger in the world, especially in African countries (FAO, 2022). Professional scientific organizations in Ukraine indicate the need for Ukraine's support from the international community in solving the problem of export of agricultural products and identify various critical factors for its decline (Kyiv School of Economics, 2023). Illicit trade, disruption of stable supply chains and soil ecology during war are critical factors that need to be explored as key issues.

The impact of the Russian-Ukrainian war on global food security is the object of specialized studies by many researchers, in particular, existing scientific works in terms of the resilience of food systems to military conflict (Ben Hassen, Bilali, 2022), the cause-and-effect aspects of the beginning of the war on changes in the parameters of food security (Behnassi, El Haiba, 2022), generalization of the global effects of the first year of the war on the state of food supply (Glauber, Laborde Debucquet, 2023), aspects of the symbiosis of regional wars and political challenges to the global food security system (Abay et al., 2023), the study the impact of quantitative and qualitative data on the export of agricultural products on the development of the world food crisis (Al-Ababneh et al., 2021). The peculiarities of guarantees of the legality of trade in agricultural products in the system of global food security are based on financial instruments of control at the stage of primary financing of activities (Dumanska, 2018), an overview of types of crime and forms of fraud in food trade (Lindley, 2020), varieties of types of food crimes that occur in as a result of the illegal sale of low-quality and dangerous agricultural products for consumption (Rizzuti, 2020). The importance of logistics for ensuring food security is emphasized in studies on tracking the movement of agricultural products (Yusianto, Hardjomidjojo, 2019), the design of the supply chain of fresh food products from the perspective of food security (Orjuela-Castro, Adarme-Jaimes, 2018), the optimization of food security scenarios Namany et al., 2019), measuring food security in a global context (Cafiero et al., 2018). The role of soils in the parameters of food security is considered from the standpoint of human health, which depends on the quality of grown products and their environmental parameters (Oliver, Gregory, 2015), requirements for soil protection and the right to food for a better common future (Ruppel, 2021), understanding the role of soil security for food (McBratney et al., 2014). Local aspects of ensuring food

security from the standpoint of building the potential for selling agricultural products to foreign markets are considered from the perspective of the circular economy (Irani, Sharif, 2018) and by achieving potential (Pinstrup-Andersen, Herforth, 2008). At the same time, there are no comprehensive studies of the role of export of agricultural products from Ukraine, taking into account the factors of the development of illicit trade, logistics losses and soil ecology during the war against the background of challenges to global food security.

The purpose of the study was to prove the role of agricultural exports from Ukraine in global food security and, based on this imperative, to propose a theoretical approach in the collective coordination of efforts of state institutions to counter logistical losses, illicit trade and soil. pollution in Ukraine during the war. In order to fulfill the set goal, the following research tasks were formulated:

(1) determine the importance of agricultural exports from Ukraine in ensuring world food security;

(2) to investigate the vectors of reorientation of the supply logistics of importers of Ukrainian agricultural products as a result of the war;

(3) to investigate the problems of the impact of logistics, soil and illicit trade on the formation of food security in the agricultural sector of Ukraine;

(4) justify the feasibility of developing institutions of collective action in regulating the export of agricultural products from Ukraine against the background of global food security problems.

This approach to the implementation of research tasks is based on the need to ensure the avoidance of joint social losses and the integrity of understanding the global consequences of local military conflicts on the state of food security in the world.

RESEARCH METHODS

The research used: statistical materials of the Statistics Service of Ukraine in the indicators of the export of agricultural products of Ukraine with an emphasis on 2022 (the beginning of the war) - 2023 (today's realities), the ITC Trade Map information resource to determine losses in the share of agricultural products supplied from Ukraine to its of the main importers under the influence of the war, analytical reports of the Kyiv School of Economics and Official Statistics of Ukraine, scientific and practical comments and periodic works of specialists in the field of agrarian economy to build an organizational model for the development of institutions of collective action to solve the problems of the country's food security. Histograms, pie charts using MS Excel programs, photographs, schematic modeling of the interaction of elements and organizational processes were used to present the data. The methods used are literature analysis, statistical data and visualizations, analytical modeling.

RESEARCH RESULTS AND DISCUSSION

The role of agricultural exports from Ukraine in ensuring global food security

According to the Sustainable Development Goals of the UN, eradicating hunger, ensuring food security and promoting the sustainable development of agriculture are top priorities for all of our planet (UN, 2015). This problem is especially relevant against the background of the crises of recent years:

- in 2017-2018, efforts to end hunger and food security were negatively affected by international conflicts, climate variability and extreme events;

– in 2019 – economic downturns, global recessions and a trade war between the USA and China;

– in 2020-2021 – the ongoing COVID-19 pandemic, export and import restrictions, a decrease in FDI volumes, a slowdown in international trade, as well as unprecedented outbreaks of desert locusts in East Africa;

– also in 2021 – natural anomalies;

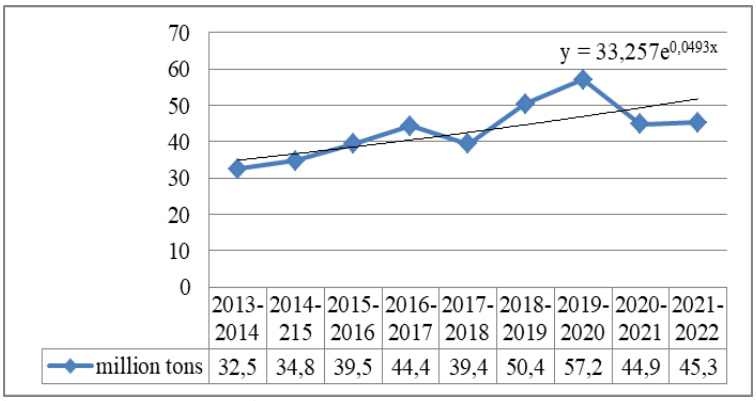
- in 2022 - the open military aggression of the Russian Federation against Ukraine, which led to sad results not only in Ukraine, but also in the history of the development of the European Union and the entire civilized world.

Ukraine's important role in the world agricultural market is provided by the ability to feed 40 million people, and today - more than 400 million. In 2019-2021, Ukraine accounted for almost 10% of the world's wheat exports, 15% of corn exports, 15% of barley exports, and almost 50% of sunflower oil exports, in addition, the agro-food sector of Ukraine is the basis of population employment and the size of the country's GDP indicator. (Kyiv School of Economics, 2023).

Every year, the USDA conducts an analysis of the agricultural market. According to these data, in 2019-2020, Ukraine's place in the export of grain crops is second, after the United States. In the period of 2021-2022, Ukraine is among the TOP-10 world exporters, which indicates the loss of leadership positions in terms of global food security, but at the same time the weight of the share remains significant. The share of sunflower oil exports is about 40%, sunflower seeds - 27%, barley - 5%, wheat - 3%, rapeseed - 3%, corn - 2% (USDA FAS, 2023).

It is worth noting that in 2021, Ukraine's harvest was a record, as its volume amounted to more than 106 million tons of grain and oil crops. The result of the growth of grain and oil crops was favorable weather conditions, the use of new varieties and hybrids of grain by agrarians; new technologies, including more modern technology (Latifundist, 2022).Ukrainian farmers harvested more than 84 million tons of grain and legumes, of which the lion's share is corn, wheat, and barley (40, 32.4, and 10.4 million tons, respectively). As for oil crops, according to the results of 2021, 22.6 million tons of them were harvested (Ministry of Agrarian Policy and Food of Ukraine, 2023). The trend of grain exports from Ukraine is presented according to dynamics in the period from 2013 to 2022 in Fig. 1. The selected period

demonstrates the potential of grain exports in marketing year indicators in the pre-war period (2013-2021) and losses during the war (2022).



Source: analytics of Ministry of Agrarian Policy and Food of Ukraine, 2013-2022

Figure 1. The volume of exports of grains and legumes and their processing products in 2013-2022 marketing years from Ukraine, million tons

Indicators of the volume of export of the presented agricultural products show a downward trend since the beginning of the war in Ukraine, determining its negative impact factor. At the same time, the 2022 indicator of the origin of grain exports does not reflect the real situation with the harvest, which was not fully realized and was stored in warehouses due to the blockade of sea supplies, the destruction of the infrastructure of ports and logistics facilities, and in conditions of open military operations.

In the opinion of the author, the current situation with the export of agricultural products from Ukraine is not typical for international experience, given the lack of involvement in military conflict in the world practice of a country that is one of the guarantors of food security in the world. This marks the first time since World War II that an available crop needed by a food-insecure countries has been deliberately destroyed by an aggressor country.

Reorientation of supply logistics in the main importers of agricultural products from Ukraine under the influence of the war

Despite the huge potential of Ukraine's agricultural production, the war seriously affects not only domestic, but also global food security (FAO, 2022). Blocked exports and the threatened sowing campaign of 2023 led to a sharp rise in prices on the world market, creating not only the risks of undermining the activity of the agrarian sector and the national economy of Ukraine as a whole, but also the prerequisites for the starvation of hundreds of millions of people around the world. Research (FAO, 2022; Kyiv School of Economics, 2023) revealed global dependence on Ukrainian grain supplies in countries such as Egypt, Yemen, Indonesia, Bangladesh, Ethiopia, Libya, Pakistan, where millions of people are in dire need of food, the basis of which is the import of agricultural products. A visual reflection of the dependence of these countries on the export of agricultural products from Ukraine is the comparative statistics of the import structure of these countries for 2021 (the pre-war period) and during the first three months of 2022 (the beginning of the war), presented in Fig. 2-4.

It is worth noting that despite the change in the export vector of Ukraine, the Middle East and North Africa still remain the main buyers of wheat and corn, so the problem of food security concerns these countries the most (Kyiv School of Economics, 2022). At the same time, the change in logistics routes led to a reorientation of the supply logistics of the main importers of agricultural products from Ukraine under the influence of the war and the replacement of the supplier due to the port blockade (FAO, 2022).

In 2021, wheat supplies from Ukraine provided a third of Indonesia's wheat supply needs. With the beginning of the war, the share of wheat from Ukraine decreased, its place was taken by imports from Australia and Argentina (Fig. 2), which were not key before (Kyiv School of Economics, 2022).

a **b**

Source: ITC Trade Map resource data and Kyiv School of Economics

Figure 2. (**a**) Wheat imports from Ukraine to Indonesia, 2021 (million USD); (**b**) Wheat imports from Ukraine to Indonesia, March 2022 (million USD)

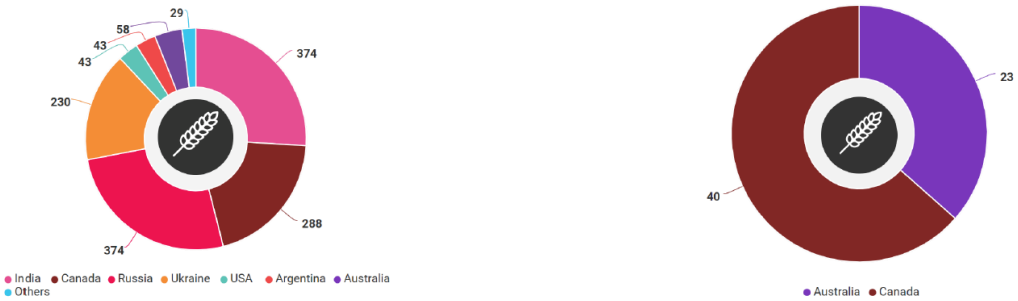
In the pre-war year 2021, Turkey's dependence on wheat from Russia was 75% (first place), and from Ukraine - 20% (second place). Since the beginning of the war, thanks to the grain agreement, Turkey has been able to continue importing wheat from Ukraine without interference from Russia. At the same time, the riskiness of such imports required the search for uninterrupted supplies. In response, Turkey began to cooperate closely with the countries of South America. At the same time, such cooperation strengthened their role in the positions of global suppliers of agricultural products.

a **b**

Source: ITC Trade Map resource data and Kyiv School of Economics

Figure 3. (**a**) Wheat imports from Ukraine to Turkey, 2021 (million USD); (**b**) Wheat imports from Ukraine to Turkey, March 2022 (million USD)

The indicators of Bangladesh in 2021 demonstrate the diversity of wheat suppliers, where the volume of Ukraine is significant in terms of share and amounts to 230 million USD (fourth place) (Figure 4). However, in March 2022 wheat came only from Australia and Canada. This shows that Ukraine, the Russian Federation, India and the USA have stopped supplying Bangladesh. Canada's share in imports in March 2022 was about 65% (20% in 2021). It can be assumed that Bangladesh will import South American wheat in the coming months to have different sources of grain supply.



a **b**

Source: ITC Trade Map resource data and Kyiv School of Economics

Figure 4. (**a**) Wheat imports from Ukraine to Bangladesh, 2021 (million USD); (**b**) Wheat imports from Ukraine to Bangladesh, March 2022 (million USD)

In Morocco and Tunisia, Ukraine is also among the top three importers, among which are Canada, France and Bulgaria. The share of grain imports from Ukraine for these countries ranges from 16 to 30% (Kyiv School of Economics, 2023). Before the war, the Russian Federation was the largest exporter of wheat to Egypt (45%), followed by Ukraine (23%) and Romania (16%). Egypt is currently looking at Argentina and France as new major wheat suppliers (Bloomberg, 2023).

The presented situation of the diversification of the supplier of agricultural products from Ukraine to other suppliers shows the problems of logistics in the conditions of war and the crisis of supplies by sea in connection with the blockade of ports. The opening of the «grain corridor» did not ensure the full export of corn, wheat, and sunflower grain for the 2021-2022 harvests, and river logistics and throughput across the Danube River to the western borders also turned out to be quite low. The cost of logistics was also added, which, in turn, made the export of agricultural products from most of the country unprofitable. An additional negative factor for exporters, especially for those who did not work with the countries of the European Union, were the requirements for the quality of exported products, in particular regarding the residues of pollutants, diseases, pests and toxicity. Most of the exporters did not have experience and knowledge of the EU legislation, and therefore, this logistics route did not give a 100% guarantee that the products would not be returned due to non-compliance (Latifundist, 2023). As a result, problems with logistics were exacerbated by the shortcomings of institutional crises, which, despite Ukraine's export potential, led to a supply crisis and grain surpluses in warehouse storage without the possibility of its full implementation.

The influence of logistics, soil and illicit trade problems on ensuring food security by the agricultural sector of Ukraine

The blockade of the Russian Black Sea Fleet after the Russian invasion of Ukraine led to the cessation of supplies to markets around the world and a sharp rise in grain prices. Residents of the world's poorest regions rely on food supplies

from the Black Sea, and feared that skyrocketing prices would lead to famine. Although the unblocking of the seaborne export route has helped to deal with the global food security crisis and lower grain prices, there are still huge export reserves (UNIAN, 2023).

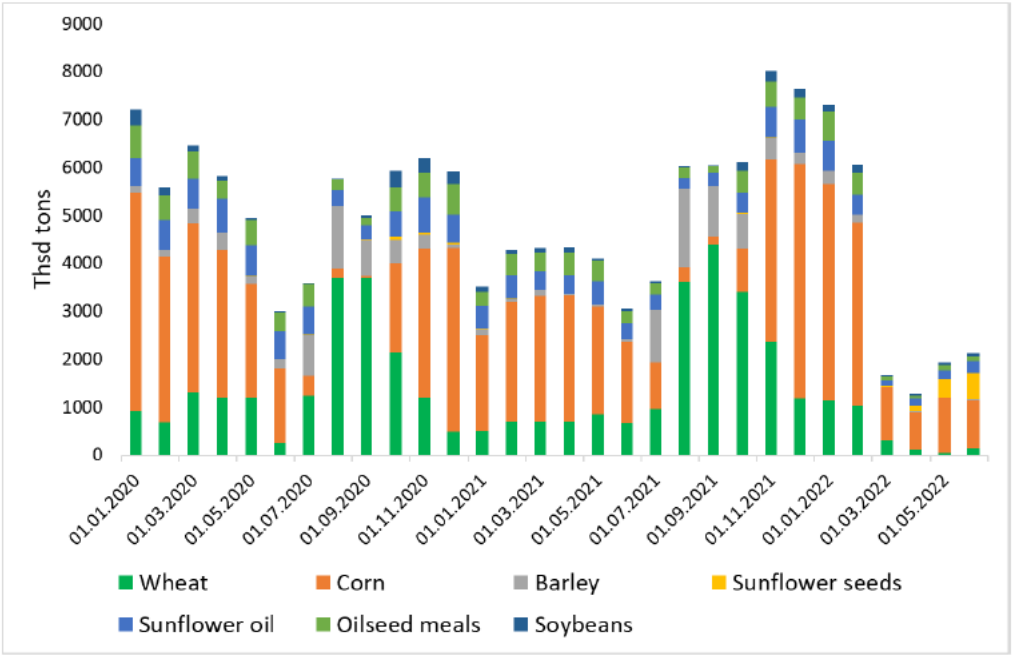
More than 30 million tons of grain and other products were shipped under the Black Sea Grain Agreement. Corn accounted for more than half of all grain - 51%, followed by wheat - 27%, followed by sunflower seeds and sunflower oil. Grain from three key Ukrainian ports on the Black Sea - Odesa, Chornomorsk and Yuzhne - was sent to world markets (Kyiv School of Economics, 2022). Most of the grain went to China, Spain and Turkey (Fig. 5).

a **b**

Source: analytics of UNIAN, 2023

Figure 5. (**a**) The structure of export agricultural products from Ukraine during the sea grain deal; (**b**) Key importers of agricultural products from Ukraine within the framework of the sea grain deal

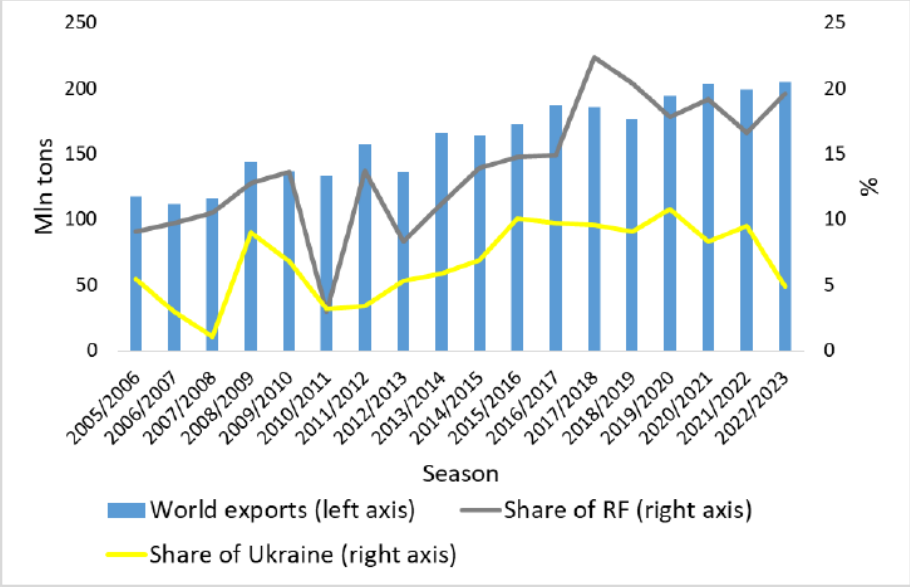
For Ukraine, the 2022/2023 marketing year was the first season that was completely spent in the conditions of the war with Russia and the loss of control over a large part of the territories. The war affected not only the indicator of the volume of exports, but also its structure, where the export of corn and wheat dominates (Fig. 6).



Source: official data of the State Statistics Service of Ukraine, 2020-2022

Figure 6. Export of grain and oil from Ukraine, thousand tons

Since the beginning of the war, the role of the Black Sea region in global food security has become increasingly noticeable against the background of maritime logistics problems. As of the 2022/2023 season, the gap between the stock-to-use ratio is 2.5% (USDA FAS, 2023). Fig. 7 shows the gap between the ratio of stocks to use in 2022-2023, which is 2.5% (USDA FAS, 2023), indicating that a significant part of the world's grain stocks is accumulated in the Black Sea region and is not realized in the world.



Source: analytics of SDA FAS, 2023

Figure 7. The share of Black Sea wheat in world exports, 2005-2022 (%)

The blockade of sea ports in Ukraine negatively affected the export of agricultural products from Ukraine due to disruption of sustainable logistics (more than half of deliveries to other countries were carried out by sea). With the beginning of the war, large volumes of non-exportable products were accumulated in Ukrainian warehouses, namely 27 million tons of grain, oil crops and oil (Kyiv School of Economics, 2022), which became objects of illicit trade and were illegally imported under the conditions of «gray» zones of uncontrolled territory against the background of war. Statistics on the illicit trade in stolen wheat are not kept due to the impossibility of making miscalculations in the conditions of military operations.

The total amount of losses caused to the agricultural sector of Ukraine as a result of the full-scale invasion of the Russian Federation has already amounted to $4.3 billion. At the same time, the country suffered the largest losses due to damage to agricultural land and the inability to harvest in the war zones - $2.14 billion (Rubric, 2022). The photographs below show the state of the fields affected by military actions (Fig. 8).

a **b**

Figure 8. (**a**) Photographs of a field in the Izyum district of the Kharkiv region, about 500 shell holes (Rubric, 2022); **(b)** Wheat field on fire after shelling in southern Ukraine (Focus, 2022)

Half of the total damage to the Ukrainian agricultural sector was due to damage to agricultural land, destroyed and unharvested crops ($2.14 billion), 22% - to the loss of agricultural machinery ($926 million), 14% - to already produced products of the agricultural sector ($613 million), 6% - on granaries ($272 million), 3% each - on animal husbandry ($136 million) and commodity values, including fuel and fertilizers ($120 million), and 2% - on perennial plantings ($89 million). As a result of the war in Ukraine, more than five million hectares of agricultural land have been contaminated. According to preliminary estimates by the Ministry of Environmental Protection and Natural Resources of Ukraine, the Russian full-scale invasion caused more than 19 million hryvnia of damage to Ukrainian soil (Ecodia, 2023). The following types of soil destruction as a result of military operations were the most dangerous:

1. Mechanical — changing the structure of the soil cover. It occurs when the fertile layer is destroyed or mixed with other layers due to the digging of trenches, trenches by soldiers for shelter from shelling. After such changes, the soil loses its fertile properties, retains moisture less well and becomes less suitable for growing crops. The movement of military equipment also leads to mechanical pollution - the soil is compacted and becomes more arid.

2. Physical pollution — change in soil properties. Military equipment causes vibrations, and explosions or fires, in addition to direct destruction, disturb the temperature regime that determines the moisture supply of plants.

3. Chemical — occurs as a result of fuel leaks, combustion products settling on the ground from the air, and toxin from explosives in shells. However, the explosion of ammunition is not only a chemical pollution, but also a mechanical one. The blast wave leads to soil erosion, which further exacerbates the issue of climate change and adaptation to it.

4. Biological — the death of all living things in the soil, primarily microbiota, which is responsible for its health and fertility. It dies both from over-compaction of the soil, heat shocks, destruction of soil horizons, and from explosive toxic substances.

The consequences of hostilities for the soil environment are often underestimated when compared to the loss of human lives and infrastructure, but the deterioration of soil quality properties is long-term, which significantly reduces its productive functions, and is a long-term process to restore its properties (Ecodia, 2023).

Another factor in the crisis of the agricultural sector of Ukraine was the theft and illegal export of grain from the occupied territories of Ukraine. Since the beginning of the war, Russia has exported several hundred thousand tons of grain from the Kherson, Zaporizhzhya, Luhansk, and Donetsk regions. According to official data, 1.5 million tons of grain were stored in these territories before the start of the war. The estimated market value of 1.5 million tons is at least $300 million (Forbes, 2022). At the same time, it is not possible to estimate the real volume of illicit trade in grain due to the continuation of military operations, the further illegal export of grain from Ukrainian fields and the blocking of the «grain corridor» by sea.

Thus, military operations on the territory of Ukraine became a significant threat to ensuring food security not only of Ukraine, but also of many other countries of the world that depend on the domestic export of legumes and grain crops, which, despite the diversification of suppliers, retained a significant share of dependence on the import of agricultural products from Ukraine.

The development of institutions of collective action in regulating the export of agricultural products from Ukraine against the background of global food security problems

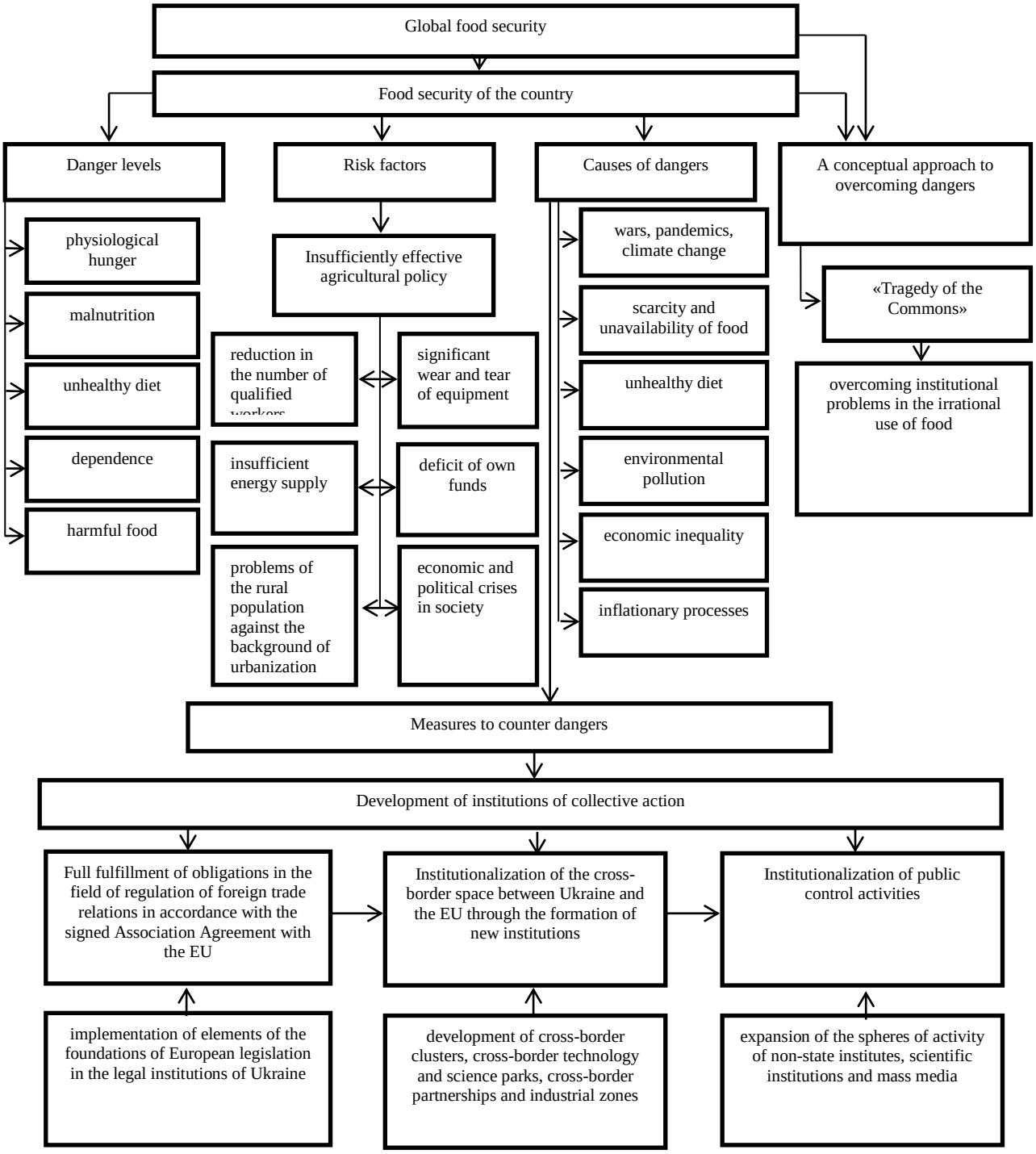
According to forecasts, in the next 40 years (until 2050), food production in the world must increase by 70% in order to feed the entire population of the planet, which is projected to grow to 9.3 billion people. And in particular, the demand for grain for food and fodder consumption will reach 3 billion tons in 2050 (FAO, 2022). That, taking into account the current production of grain, which is 2.1 billion tons, its increase should be almost 1 billion tons (48%). Extrapolating the development of recent years, the state of global food supply and agriculture in particular, the possibility of providing the growing population with the necessary food is questionable in view of the war started by Russia on the territory of Ukraine.

The proven value of the export of agricultural products from Ukraine indicates the existing potential of the state in solving the problems of global food security. Agricultural products are the basis of everyone's private good - food, which is necessary for the human body to function, and is limited by the factors of scarcity, purchasing power and safety for consumption. At the same time, minimizing the effects of these factors requires the development of a three-centered management system, which is combined with market rules, interstate institutions and collective actions. It is advisable to implement such an approach taking into account the assets of the concept of «tragedy of the commons», which was first substantiated in the article «The Tragedy of Communities» (Hardin, 1969). Since then, the term began to be widely used as an interdisciplinary concept. For example, the three-volume work «Treatise on Human Nature» (Hume, 2003) is relevant even now, describing an example of farmers losing their own harvest due to mutual distrust and inability to cooperate.

Today, the main meaning of the term «tragedy of communities» is the process of environmental degradation, which should be expected in situations of excessive use by many members of a community of a certain limited resource or the consequences of a war on the territory of one country, which have an impact on the food security of other countries. The described approach of the «tragedy of the commons» is appropriate for implementation in the practice of building institutions of collective action to ensure global food security, while their role should be regulatory and aimed at overcoming existing dysfunctions in the institutionalization of food security in Ukraine in combination with rational consumption of resources (Ivashina, 2009) .

It is worth emphasizing that institutional support is one of the key factors in strengthening Ukraine's food security. Thus, in particular, the presence of an effective institutional base stimulates the growth of the efficiency of export-import operations, avoids the development of illicit trade, and spreads the practice of rational logistics. It is obvious that in modern conditions, the improvement of the institutional provision of global food security depends on the state of food security of the countries that provide it. Ukraine's food security should focus not so much on administrative levers of influence, but on overcoming existing institutional dysfunctions that distort market signals and deform the economic behavior of economic agents under the influence of war (Vlasyuk, 2014). In order to counter global food threats, an organizational model for the development of institutions of collective action to solve the problems of export of agricultural products from Ukraine was developed and proposed for implementation (Fig. 9).

The implementation of the proposed model for solving the problems of exporting agricultural products from Ukraine against the background of global food security problems is based on the realities of war and concerns the gaps in customs and tariff and non-tariff regulation, which should be overcome by improving regulatory and legal regulation on the way to EU membership, expanding cooperation with neighboring countries within the framework of cross-border cooperation and expanding the spheres of activity of non-state institutions in the field of public control.



Source: interpretation of scientific concepts (Hardin, 1969; Ivashina, 2009; Vlasyuk, 2014)

Figure 9. Organizational model of the development of institutions of collective action to solve the problems of export of agricultural products from Ukraine against the background of global food security problems

CONCLUSIONS

1. Ukraine is among the TOP-10 world exporters of agricultural products, which indicates the importance of the state in ensuring global food security. Russia's war against Ukraine has caused deep economic shocks that will affect the liquidity of agricultural producers, increase global demand for agricultural products, reduce food supplies in many countries, increase food prices, and accelerate inflation.

2. The change in logistics routes and the blockade of sea ports led to a reorientation of supply logistics for the main importers of agricultural products from Ukraine. Despite the change in the export vector, the Middle East and North Africa remain the main buyers of wheat and corn from Ukraine, therefore the problem of food security concerns these countries the most. Problems with logistics were aggravated by the shortcomings of institutional crises, which,

despite Ukraine's export potential, led to a supply crisis and grain surpluses in warehouse storage without the possibility of its full realization.

3. The key challenges to export flows of agricultural products from Ukraine are logistical problems (violation of established supply chains, limited capacity of deliveries by railway transport due to the difference in track width in the EU and Ukraine, congestion of river ports and blockade of sea routes, including ignoring agreements in within the framework of the «grain corridor»), the condition of the soil of the cultivated areas (one third of the cultivated areas remains unusable due to hostilities and extensive mining), the development of illicit trade in stolen grain and oil crops from the occupied territories of Ukraine.

Possible ways to overcome barriers to the export of agricultural products can be seen in the reorientation of logistics from the blocked Black Sea to the overland supply of European countries to the Baltic Sea with further routing to importing countries. At the same time, the necessary actions on the part of the government of Ukraine should be: signing intergovernmental agreements on the recognition of Ukrainian certificates for agricultural products by other states; support of diplomatic missions of Ukraine in organizing meetings of delegations of Ukrainian producers with representatives of foreign countries (in order to avoid conflicts with local agricultural producers); involvement of Ukrainian agricultural producers in the work of intergovernmental commissions on economic and trade cooperation, which will ensure simplified and accelerated access of Ukrainian producers to foreign markets and increase exports.

4. Strengthening global food security requires the creation of an effective system of institutional support for food security of countries that provide it, from the perspective of the «tragedy of the commons» theory. An organizational model for the development of institutions of collective action to solve the problems of export of agricultural products from Ukraine against the background of global food security problems has been developed and proposed for implementation.

At this stage, the presented scientific research requires a wider disclosure of the problem of loss of export of agricultural products from Ukraine under the influence of military actions due to the loss of agricultural land that cannot be used for growing plant products (which can potentially be exported), due to soil contamination by military shells, chemical substances and soil degradation due to loss of fertility.

Further scientific research will be related to the monitoring of the variability of the map of hostilities and the movement of the front line on the territory of Ukraine with the aim of mapping the fund of agricultural land available for the cultivation of agricultural products, and the possibility of providing the obtained harvest from the areas of internal needs of Ukraine and the fulfillment of export agreements with other countries.

Acknowledgements. The research of this publication is partially covered by a scholarship of the Cabinet of Ministers of Ukraine for young scientists.

REFERENCES

1. Abay, K. A., Breisinger, C., Glauber, J., Kurdi, S., Laborde, D., & Siddig, K. 202). The Russia-Ukraine war: Implications for global and regional food security and potential policy responses. *Global Food Security*, 36, 100675. https://doi.org/10.1016/j.gfs.2023.100675
2. Agriculture. Export. State Statistics Service of Ukraine. Available at: https://www.ukrstat.gov.ua/operativ/menu/menu_u/cg.htm.html (accessed on 17.09.2023).
3. Al-Ababneh, H. A., Osmonova, A., Dumanska, I., Matkovskyi, P., & Kalynovskyy, A. 2021. Analysis of export of agricultural products in the context of the global food crisis. *Agricultural and Resource Economics: International Scientific E-Journal*, 7 (4), 5-26. https://doi.org/10.51599/are.2021.07.04.01
4. Behnassi, M., & El Haiba, M. 2022. Implications of the Russia–Ukraine war for global food security. *Nature Human Behaviour*, 6, No 6, 754-755. https://doi.org/10.1038/s41562-022-01391-x
5. Ben Hassen, T., & El Bilali, H. 2022. Impacts of the Russia-Ukraine war on global food security: towards more sustainable and resilient food systems? *Foods*, 11(15), 2301. https://doi.org/10.3390/foods11152301
6. Cafiero, C., Viviani, S., & Nord, M. 2018. Food security measurement in a global context: The food insecurity experience scale. *Measurement*, 116, 146-152. https://doi.org/10.1016/j.measurement.2017.10.065
7. Dumanska, I. Y. 2018. Banking lending in the system of financial providing innovative process of AIC. *Financial and credit activity: problems of theory and practice*, 2, No 25, 17–26. https://doi.org/10.18371/fcaptp.v2i25.135975
8. Egypt Wheat Imports May Fall to 9-Year Low as War Disrupts Trade. Bloomberg 2023. Available at: https://www.bloomberg.com/news/articles/2022-03-29/egypt-wheat-imports-may-fall-to-9-year-low-as-war-disrupts-trade (accessed on 17.09.2023).
9. Fire goes through the wall»: the occupiers set fire to wheat fields in the south of Ukraine. Focus 2022. Available at: https://focus.ua/uk/voennye-novosti/521679-ogon-idet-stenoy-okkupanty-podzhigayut-pshenichnye-polya-na-yuge-ukrainy-video https://rubryka.com/article/soil-ukraine/ (accessed on 17.09.2023).
10. Glauber, J. W., & Laborde Debucquet, D. 2023. How will Russia's invasion of Ukraine affect global food security?. IFPRI book chapters, pp. 10-14. https://doi.org/10.2499/9780896294394_01
11. Grain Ukraine - statistics of agricultural markets. Ministry of Agrarian Policy and Food of Ukraine 2023. Available

at: https://minagro.gov.ua/pidtrimka/grainukraine-by-bogdan-tymkiv (accessed on 17.09.2023).

12. Hardin, G. 1968. The Tragedy of the Commons. Science. (In Ukrainian). https://doi.org/10.1126/science.162.3859.1243
13. How the UN supports the Sustainable Development Goals in Ukraine. UN 2015. Available at: https://ukraine.un.org/uk/sdgs (accessed on 17.09.2023).
14. How does war affect soil fertility and food quality? Ecodia 2023. Available at: https://ecoaction.org.ua/vijna-vplyvaie-na-grunty.html (accessed on 17.09.2023).
15. Hume, D. 2003. Treatise on human nature. K.: Universe. (In Ukrainian).
16. Irani, Z., & Sharif, A. M. (2018). Food security across the enterprise: a puzzle, problem or mess for a circular economy? *Journal of Enterprise Information Management*, 31(1), 2-9. https://doi.org/10.1108/JEIM-03-2017-0045
17. Is it possible to easily replace Ukrainian wheat? Analysis of trade flows. Kyiv School of Economics 2022. Available at: https://kse.ua/wp-content/uploads/2022/08/CHi-mozhna-legko-zaminiti-ukrai--nsku-pshenitsyu_-Analiz-torgovelnih-potokiv.pdf (accessed on 17.09.2023).
18. Ivashina, O. 2009. Institutionalization of economic development. Nauka ta osvita. (In Ukrainian).
19. Lindley, J. 2020. Food security amidst crime: harm of illegal fishing and fish fraud on sustainable oceans. The Palgrave handbook of climate resilient societies, pp. 1-19. https://doi.org/10.1007/978-3-030-32811-5_127-1Munitions and Chemicals: How War Damages Soils and What Are the Solutions? Rubric 2022. Available at: https://rubryka.com/article/soil-ukraine/ (accessed on 17.09.2023).
20. McBratney, A., Field, D. J., & Koch, A. 2014. The dimensions of soil security. *Geoderma*, 213, 203-213. https://doi.org/10.1016/j.geoderma.2013.08.013
21. Namany, S., Al-Ansari, T., & Govindan, R. 2019. Optimisation of the energy, water, and food nexus for food security scenarios. *Computers & Chemical Engineering*, 129, 106513. https://doi.org/10.1016/j.compchemeng.2019.106513
22. Oliver, M. A., & Gregory, P. J. 2015. Soil, food security and human health: a review. *European Journal of Soil Science*, 66, No 2, 257-276. https://doi.org/10.1111/ejss.12216
23. Orjuela-Castro, J., & Adarme-Jaimes, W. 2018. Evaluating the supply chain design of fresh food on food security and logistics. In Applied Computer Sciences in Engineering: 5th Workshop on Engineering Applications, WEA 2018, Medellín, Colombia, October 17-19, 2018, Proceedings, Part I 5 (pp. 257-269). Springer International Publishing. https://doi.org/10.1007/978-3-030-00350-0_22
24. Pinstrup-Andersen, P., & Herforth, A. 2008. Food security: achieving the potential. *Environment: Science and Policy for Sustainable Development*, 50(5), 48-61. https://doi.org/10.3200/ENVT.50.5.48-61
25. Profession - looter. The Russians exported hundreds of thousands of tons of grain from the south of Ukraine. How the robbery is organized on a national scale. Forbes 2022. Available at: https://forbes.ua/inside/voruyut-zerno-i-ne-tolko-rossiyane-vyvezli-s-yuga-ukrainy-sotni-tysyach-tonn-zernovykh-kak-ustroen-grabezh-v-masshtabakh-strany-03052022-5788 (accessed on 17.09.2023).
26. Record 2021 — more than 100 million tons of harvest. Can we get used to the «hundred» or is it an exception? Latifundist 2022. Available at: https://latifundist.com/spetsproekt/956-rekordnij-2021--bilshe-100-mln-t-vrozhayu-mozhemo-zvikati-do-sotki-chi-tse-vinyatok (accessed on 17.09.2023).
27. Review of Food Security and Policy. Kyiv School of Economics 2023. Available at: https://kse.ua/ua/oglyad-prodovolchoyi-bezpeki-ta-politiki/ (accessed on 17.09.2023).
28. Rizzuti, A. (2020). Food crime: A review of the UK institutional perception of illicit practices in the food Sector. *Social Sciences*, 9(7), 112. https://doi.org/10.3390/socsci9070112
29. Ruppel, O. C. 2021. Soil protection and the right to food for a better common future. *Environmental Policy and Law*, 51(1-2), 57-73. https://doi.org/10.3233/EPL-219007
30. The western border and the «grain corridor» are at a fever pitch. What will happen to agricultural exports? Latifundist, 2023. Available at: https://latifundist.com/blog/read/2988-zahidnij-kordon-i-zernovij-koridor-lihomanit-shcho-bude-z-agroeksportom (accessed on 17.09.2023).
31. The grain agreement: what and where was exported from Ukraine across the Black Sea. UNIAN 2023. Available at: https://www.unian.ua/economics/agro/zernoviy-koridor-shcho-ta-kudi-eksportuvali-z-ukrajini-po-chornomu-moryu-12331365.html (accessed on 17.09.2023).
32. The impact of the Ukrainian-Russian conflict on global food security and related issues within the framework of the mandate of the Food and Agriculture Organization of the United Nations. FAO 2022. Available at: https://www.fao.org/3/ni734en /ni734en.pdf (accessed on 17.09.2023).
33. Ukraine: FAIRS Export Certificate Report Annual. USDA FAS 2023. Available at: https://www.fas.usda.gov/regions/ukraine (accessed on 17.09.2023).
34. Vlasyuk, T. 2014. Ensuring the foreign trade security of Ukraine on the world market of agricultural products is a general direction. *Economy of the agricultural industry*, 12 (242), pp. 76–83. https://doi.org/10.30875/28e9078f-en

35. Yusianto, R., & Hardjomidjojo, H. 2019. Intelligent Spatial Logistics DSS for tracking and tracing in horticultural food security. In 2019 International Seminar on Application for Technology of Information and Communication (iSemantic) (pp. 1-5). IEEE. https://doi.org/10.1109/ISEMANTIC.2019.8884292