# Food security: modern challenges and mechanisms to ensure

**Scientific monograph**

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The authors of the scientific monograph have come to the conclusion that ensuring food security during martial law requires the use of mechanisms to support agricultural exports, diversify logistics routes, ensure environmental safety, provide financial and marketing support. Basic research focuses on assessment the state of agricultural producers, analysing the financial and accounting system, logistics activities, ensuring competitiveness, and environmental pollution. The research results have been implemented in the different decision-making models during martial law, international logistics management, digital audit, agricultural lending, integrated marketing system, risk management and diversification of Ukrainian agricultural exports. The results of the study can be used in the developing of food security policies, programmes and strategies, agricultural production development, decision-making at the level of ministries and agencies that regulate food security management processes. The results can also be used by students and young scientists in the educational process and conducting scientific research on food security during martial law and Ukraine's recovery economy after the victory.

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# Contents

# INTRODUCTION

An important aspect of any country's economic policy is to ensure food security by providing the population with environmentally friendly and healthy food products produced domestically at scientifically sound standards and affordable prices, while preserving and improving the environment.

Russia's military aggression against Ukraine has demonstrated the vulnerability of both national and global food systems to anthropogenic (the impact of armed conflicts), economic (rising global food prices) and natural factors (increased impact of crop failures due to disruption of global food supplies).

As a result of the hostilities, the assets of agricultural producers are being destroyed, agricultural areas are becoming unsuitable for agricultural production due to mining and damage, the environment is being disrupted, and the logistics of exporting agricultural products abroad are being complicated by the blocking of seaports, which threatens food security in other countries.

The governments of Ukraine and other countries have joined in addressing food security issues and provide support through relevant legislative, regulatory, organisational, economic and technical instruments that promote the export of agrarian products through their territories, and develop new areas of supply diversification.

The purpose of writing this scientific monograph is to justify the theoretical and methodological foundations for the food security during martial law.

The object of the authors' research was current challenges and threats caused by russia's military aggression on the territory of Ukraine, mechanisms for ensuring food security, diversification of Ukrainian agricultural exports, instruments of state and international support for agricultural producers, formation of a marketing and logistics complex, mechanisms of financial support for agricultural sector entities, and ecologisation of agricultural production.

The subject of the study was decision-making models during martial law, marketing and logistics management instruments, financial ensure and risk management mechanisms, promotion of agricultural exports abroad, development of international cooperation and food security.

**Chapter 1**

# ENSURING FOOD AND ENVIRONMENTAL SECURITY DURING ARMED CONFLICTS

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## INFRASTRUCTURAL PROVISION FOR THE MANAGING OF AGRICULTURAL ENTERPRISES' INTERNATIONAL LOGISTICS ACTIVITIES IN THE CONTEXT OF FOOD SECURITY

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**Abstract**
*The agricultural sector is the "growth point" of the national economy of Ukraine and plays a key role in ensuring food security. But as a result of the research, it was established that acute problems of managing the international logistics activities of agro-industrial enterprises arose in the conditions of the war as a result of non-fulfilment of the terms of the contracts; emergence of risks of disruption of the sowing campaign; decrease in final harvest indicators and the level of food security; decrease in the volume of export deliveries of agricultural products; disruption of food supply chains; lack of adequate funding and critical infrastructure facilities; insufficiently effective use of marketing management tools and a network approach in the process of distributing agricultural products to the final consumer; increase in transaction costs, etc.*

*The article provides a statistical analysis of the main indicators of the development of foreign economic activity of enterprises of the agro-industrial complex of Ukraine in the pre-war period. Barriers that inhibit the effective organization of international logistics activities of agrarian enterprises during the war period have been identified. The priority areas of infrastructural support for the management of international logistics activities of agrarian enterprises are proposed, the essence of which is the activation of network interaction and partnership relations based on the creation of cross-border agro-cluster structures; unification of small farms for the proper execution of contracts, as well as joint activity in the agrarian sphere of two or more companies and different groups of stakeholders to achieve a common goal and a synergistic effect.*

**Keywords:** *national economy, agro-industrial complex, agricultural enterprises, logistics activity, foreign economic activity, structure of foreign trade, international logistics, export-import operations, threats, challenges, barriers, logistics problems, customer relationship management, logistics management, cluster approach, mechanism of cross-border interaction, agrarian cluster structure, synergistic effect.*

## Introduction

One of the key tasks of the state policy of Ukraine is recognized as creating proper conditions for the functioning of the agricultural sector. This type of economic activity is export-oriented and is of great importance in ensuring food security. And these questions are especially relevant in the modern conditions of the Russian-Ukrainian war.

This is confirmed by the results of surveys conducted by consulting companies and analytical centers. Thus, the American Chamber of Commerce in Ukraine conducted a survey in the period from June 9 to 21, 2022, in which 127 representatives of member companies were involved (these are the largest Ukrainian and international investors; among them 70% are company heads and 30% are top managers). During the survey, it was established that logistics and transport were recognized as the biggest challenges for companies during the war (55% of respondents); export-import operations (36%); lack of customers/orders (28%); supply deficit (19%), etc.

During the monthly survey of managers of 524 enterprises "Ukrainian business during the war" (February 2023), which was conducted by the non-governmental organization "Institute of Economic Research and Political Consultations", it was found that 59% of respondents indicated changes in their production or management processes and logistics activity This is primarily caused by the need to adapt business activities to a full-scale war, the occupation of part of the territories of Ukraine, the blocking of export and transportation routes through the territory of Ukraine, and the economic upheavals caused by the russian invasion.

**Materials and Methods**

The agro-industrial complex is recognized as one of the strategic sectors of the national economy, in which, in the pre-war period, an average of 12.4% of the gross added value (Table 1.1) and 9.3% of the all-Ukrainian GDP was formed.

*Table 1.1*

**Dynamics of gross added value of agricultural production**

| Years | All types of economic activity *(in actual prices), UAH million* | *Including* agriculture, *UAH million* | Specific gravity in the total volume of gross added value, *%* |
|---|---|---|---|
| 2010 | 992175 | 82948 | 8.4 |
| 2015 | 1689387 | 239806 | 14.2 |
| 2018 | 3017896 | 360998 | 12.0 |
| 2019 | 3421628 | 356563 | 10.4 |
| 2020 | 3626725 | 393077 | 10.8 |
| 2021 | 4691619 | 580519 | 12.4 |

*Source: compiled based on information and analytical materials of the State Statistics Service of Ukraine*

As statistical analysis shows, the share of agricultural output by non-financial corporations and the state government sector increased in 2021 compared to 2000 by 29.8 percentage points or from 38.2 to 68% of total agricultural output. And the specific weight of the production of agricultural products of households decreased by 29.8 percentage points or from 61.8 to 32% of the total output of agriculture (Table 1.2).

*Table 1.2*

**Dynamics of production of agricultural products in Ukraine**

| Years | Total volume *(in actual prices), UAH million* | *Including* | | | |
|---|---|---|---|---|---|
| | | non-financial corporations and the public administration sector | | households | |
| | | *UAH million* | share, *%* | *UAH million* | share, *%* |
| 2000 | 54259 | 20735 | 38.2 | 33524 | 61.8 |
| 2005 | 92540 | 36273 | 39.2 | 56267 | 60.8 |
| 2010 | 189405 | 94630 | 50.0 | 94775 | 50.0 |
| 2015 | 544206 | 327346 | 60.2 | 216860 | 39.8 |
| 2018 | 847587 | 532683 | 62.8 | 314904 | 37.2 |
| 2019 | 842767 | 531465 | 63.1 | 311302 | 36.9 |
| 2020 | 892852 | 566248 | 63.4 | 326604 | 36.6 |
| 2021 | 1366456 | 928917 | 68.0 | 437539 | 32.0 |

*Source: compiled based on information and analytical materials of the State Statistics Service of Ukraine*

In 2010-2021, the share of the volume of agricultural products sold increased by 3.4 percentage points, or from 2.6 to 6% of the total volume of products sold by all types of economic activity (Table 1.3).

*Table 1.3*

**Dynamics of the volume of agricultural products sold**

| Years | All types of economic activity *(in actual prices), UAH billion* | *Including* agriculture, *UAH billion* | Share in the total volume, *%* |
|---|---|---|---|
| 2010 | 3692.6 | 97.7 | 2.6 |
| 2011 | 4302.6 | 122.1 | 2.8 |
| 2012 | 4563.8 | 159.6 | 3.5 |
| 2013 | 4437.3 | 158.2 | 3.6 |
| 2014 | 4609.0 | 210.2 | 4.6 |
| 2015 | 5716.4 | 357.4 | 6.3 |
| 2016 | 6877.1 | 397.3 | 5.8 |
| 2017 | 8467.0 | 447.5 | 5.3 |
| 2018 | 10148.8 | 516.2 | 5.1 |
| 2019 | 10725.4 | 550.1 | 5.1 |
| 2020 | 11285.6 | 602.0 | 5.3 |
| 2021 | 15240.1 | 910.3 | 6.0 |

*Source: compiled based on information and analytical materials of the State Statistics Service of Ukraine*

It was revealed that in the pre-war period there was an increase in the number of profitable agricultural enterprises. Thus, the specific weight of enterprises in the agricultural sector that made a profit increased during 2010-2020 by 13.2 percentage points or from 69.9 to 83.1% of the total number of enterprises. And the share of agricultural enterprises that suffered losses decreased during this period by 13.5 percentage points or from 30.4 to 16.9% of the total number of enterprises for all types of economic activity. However, the level of profitability of all activities of enterprises of the agro-industrial complex decreased for 2010-2020 by 3.6 percentage points, and from operational activities – by 5.5 percentage points. (Table 1.4).

*Table 1.4*

**Individual indicators of the activity of enterprises of the agro-industrial complex, %**

| Years | The share of enterprises that received | | The level of profitability | |
|---|---|---|---|---|
| | profits | losses | all activities | operation activity |
| 2010 | 69.6 | 30.4 | 17.5 | 24.5 |
| 2015 | 88.9 | 11.1 | 30.4 | 43.0 |
| 2018 | 86.7 | 13.3 | 14.2 | 18.9 |
| 2019 | 83.5 | 16.5 | 16.6 | 19.8 |
| 2020 | 83.1 | 16.9 | 13.9 | 19.0 |

*Source: compiled based on information and analytical materials of the State Statistics Service of Ukraine*

As the analysis shows, the number of active business entities in the agricultural sector decreased by 10.6% in 2010-2021. And the share of agricultural enterprises almost did not change and in 2021 amounted to 3.3% of the total number of economic entities for all types of economic activity (Table 1.5).

According to the information and analytical materials of the State Statistics Service of Ukraine, the volume of export deliveries of grain crops increased by 3.72 times during 2010-2022; products of plant origin – 3.41 times; fats and oils – 2.28 times; products of animal origin and live animals – 1.91 times (Table 1.6).

During this period, the share of export deliveries of vegetable products in the commodity structure of Ukraine's foreign trade increased by 22.7 percentage points (from 7.8 to 30.5%); grain crops

*Table 1.5*

**The number of active business entities in the agricultural sector**

| Years | All types of economic activity | *Including* agriculture | Specific gravity in the total amount, *%* |
|---|---|---|---|
| 2010 | 2184105 | 72697 | 3.3 |
| 2011 | 1701797 | 56197 | 3.3 |
| 2012 | 1600304 | 62878 | 3.9 |
| 2013 | 1722251 | 65238 | 3.8 |
| 2014 | 1932325 | 67967 | 3.5 |
| 2015 | 1974439 | 70721 | 3.6 |
| 2016 | 1865631 | 66837 | 3.6 |
| 2017 | 1805144 | 69536 | 3.9 |
| 2018 | 1839672 | 69596 | 3.8 |
| 2019 | 1941701 | 68675 | 3.5 |
| 2020 | 1973652 | 67121 | 3.4 |
| 2021 | 1956320 | 64960 | 3.3 |

*Source: compiled based on information and analytical materials of the State Statistics Service of Ukraine*

*Table 1.6*

**Dynamics of the volume of export deliveries of domestic agricultural products, *million dollars US*A**

| Years | Name of agricultural products | | | |
|---|---|---|---|---|
| | Live animals; products of animal origin | Products of plant origin | including grain crops | Fats and oils of animal or vegetable origin |
| 2010 | 770.8 | 3949.9 | 2447.1 | 2605.0 |
| 2011 | 935.0 | 5514.5 | 3604.5 | 3380.8 |
| 2012 | 959.2 | 9173.1 | 6970.4 | 4184.6 |
| 2013 | 1083.1 | 8849.1 | 6351.7 | 3497.4 |
| 2014 | 1014.5 | 8736.1 | 6544.1 | 3822.0 |
| 2015 | 823.4 | 7971.5 | 6057.5 | 3299.8 |
| 2016 | 775.0 | 8093.7 | 6073.9 | 3963.0 |
| 2017 | 1108.8 | 9215.7 | 6501.1 | 4605.7 |
| 2018 | 1210.6 | 9886.1 | 7240.6 | 4496.5 |
| 2019 | 1277.0 | 12914.5 | 9633.3 | 4732.2 |
| 2020 | 1188.2 | 11883.2 | 9410.7 | 5746.9 |
| 2021 | 1345.3 | 15538.3 | 12343.9 | 7037.3 |
| 2022 | 1472.4 | 13478.5 | 9112.5 | 5949.4 |

*Source: compiled based on information and analytical materials of the State Statistics Service of Ukraine*

– by 15.8 percentage points (from 4.8 to 20.6%); fats and oils – by 8.4 percentage points (from 5.1 to 13.5%); products of animal origin and live animals – by 1.8 pp. (from 1.5 to 3.3%) (Table 1.7).

*Table 1.7*

**Dynamics of the share of export deliveries of agricultural products in the commodity structure of foreign trade of Ukraine, %**

| Years | Name of agricultural products | | | |
|---|---|---|---|---|
| | Live animals; products of animal origin | Products of plant origin | including grain crops | Fats and oils of animal or vegetable origin |
| 2010 | 1.52 | 7.78 | 4.82 | 5.13 |
| 2011 | 1.38 | 8.16 | 5.33 | 5.00 |
| 2012 | 1.42 | 13.53 | 10.28 | 6.17 |
| 2013 | 1.74 | 14.20 | 10.19 | 5.61 |
| 2014 | 1.88 | 16.21 | 12.14 | 7.09 |
| 2015 | 2.16 | 20.91 | 15.89 | 8.65 |
| 2016 | 2.13 | 22.26 | 16.70 | 10.90 |
| 2017 | 2.56 | 21.30 | 15.03 | 10.65 |
| 2018 | 2.56 | 20.89 | 15.30 | 9.50 |
| 2019 | 2.55 | 25.80 | 19.25 | 9.45 |
| 2020 | 2.42 | 24.16 | 19.13 | 11.68 |
| 2021 | 1.98 | 22.82 | 18.13 | 10.34 |
| 2022 | 3.34 | 30.53 | 20.64 | 13.48 |

*Source: compiled based on information and analytical materials of the State Statistics Service of Ukraine*

Analysis of statistical data shows that the volume of import deliveries of grain crops increased in 2022 compared to 2010 by 5.5%; products of plant origin – by 26.2%. The volume of imported supplies of fats and oils decreased by 34.9%, and products of animal origin and live animals – by 3.4% (Table 1.8).

At the same time, it should be noted that the specific weight of imported supplies of agricultural products in the commodity structure of Ukraine's foreign trade is insignificant. In 2022, the share of import of products of plant origin was 3.49% (2.53% in 2010); live animals and products of animal origin – 2.13% (in 2010 – 2.02%); fats and oils – 0.53% (in 2010 – 0.75%); grain crops – 0.28% (in 2010 – 0.24%) (Table 1.9).

*Table 1.8*

**Dynamics of the volume of import deliveries of Ukrainian agricultural products, *million dollars USA***

| Years | Name of agricultural products | | | |
|---|---|---|---|---|
| | Live animals; products of animal origin | Products of plant origin | including grain crops | Fats and oils of animal or vegetable origin |
| 2010 | 1216.7 | 1526.9 | 145.4 | 451.6 |
| 2011 | 1008.3 | 1774.3 | 219.5 | 468.6 |
| 2012 | 1681.3 | 2366.1 | 248.9 | 406.2 |
| 2013 | 1850.4 | 2607.6 | 306.5 | 403.3 |
| 2014 | 1124.1 | 2031.6 | 366.6 | 301.7 |
| 2015 | 548.2 | 1146.2 | 154.7 | 182.3 |
| 2016 | 626.3 | 1284.8 | 148.8 | 246.0 |
| 2017 | 731.5 | 1368.0 | 176.8 | 266.6 |
| 2018 | 918.0 | 1529.2 | 191.1 | 267.4 |
| 2019 | 1071.5 | 1794.6 | 180.8 | 253.3 |
| 2020 | 1258.1 | 1989.3 | 178.9 | 280.4 |
| 2021 | 1591.7 | 2129.6 | 166.1 | 444.2 |
| 2022 | 1174.8 | 1926.6 | 153.4 | 293.9 |

*Source: compiled based on information and analytical materials of the State Statistics Service of Ukraine*

In Ukraine, in the pre-war period, there was a tendency to increase the amount of investment in the development of agriculture (Table 1.10). In 2010-2021, the share of capital investments in the development of the agricultural sector increased by 4.1 percentage points, or from 6 to 10.1% of the total volume of capital investments for all types of economic activity.

Thus, this problem determined ***the purpose of this article***, which is to develop proposals for infrastructural management of international logistics activities of agrarian enterprises in the context of food security, taking into account the threats and consequences of a full-scale invasion of russia on the territory of Ukraine.

To achieve the goal, the following general scientific research methods were used: analysis and synthesis; comparison and classification; statistical analysis; expert survey; structural and logical generalization.

*Table 1.9*

**Dynamics of the share of imported supplies of agricultural products in the commodity structure of foreign trade of Ukraine, %**

| Years | Name of agricultural products | | | |
|---|---|---|---|---|
| | Live animals; products of animal origin | Products of plant origin | including grain crops | Fats and oils of animal or vegetable origin |
| 2010 | 2.02 | 2.53 | 0.24 | 0.75 |
| 2011 | 1.24 | 2.19 | 0.27 | 0.58 |
| 2012 | 2.02 | 2.85 | 0.30 | 0.49 |
| 2013 | 2.44 | 3.44 | 0.40 | 0.53 |
| 2014 | 2.07 | 3.73 | 0.67 | 0.55 |
| 2015 | 1.46 | 3.06 | 0.41 | 0.49 |
| 2016 | 1.60 | 3.27 | 0.38 | 0.63 |
| 2017 | 1.47 | 2.76 | 0.36 | 0.54 |
| 2018 | 1.61 | 2.67 | 0.33 | 0.47 |
| 2019 | 1.76 | 2.95 | 0.30 | 0.42 |
| 2020 | 2.32 | 3.66 | 0.33 | 0.52 |
| 2021 | 2.19 | 2.92 | 0.23 | 0.61 |
| 2022 | 2.13 | 3.49 | 0.28 | 0.53 |

*Source: compiled based on information and analytical materials of the State Statistics Service of Ukraine*

*Table 1.10*

**Dynamics of capital investments in the development of the agricultural sector in Ukraine**

| Years | All types of economic activity *(in actual prices), UAH million* | *Including* agriculture, *UAH million* | Specific weight in the total volume of capital investments, *%* |
|---|---|---|---|
| 2010 | 180575.5 | 10817.7 | 6.0 |
| 2011 | 241286.0 | 16140.9 | 6.7 |
| 2012 | 273256.0 | 18564.2 | 6.8 |
| 2013 | 249873.4 | 18175.0 | 7.3 |
| 2014 | 219419.9 | 18388.1 | 8.4 |
| 2015 | 273116.4 | 29309.7 | 10.7 |
| 2016 | 359216.1 | 49660.0 | 13.8 |
| 2017 | 448461.5 | 63400.7 | 14.1 |
| 2018 | 578726.4 | 65059.4 | 11.2 |
| 2019 | 623978.9 | 58555.4 | 9.4 |
| 2020 | 508217.0 | 50189.4 | 9.9 |
| 2021 | 673899.3 | 67992.6 | 10.1 |

*Source: compiled based on information and analytical materials of the State Statistics Service of Ukraine*

**Research and Discussion**

As a result of the research (Bezpartochnyi, 2021; Bezpartochna *et al.,* 2022; Bezpartochnyi *et al.,* 2022; Bezpartochnyi *et al.,* 2023; Kwilinski *et al.,* 2022), it was established that at this stage, the management of international logistics activities of agricultural enterprises needs drastic changes. This is due, first, to the blocking of domestic Black Sea ports. In the pre-war period, 90% of grain and oil crops were exported through the Danube rivers and with the help of maritime infrastructure. But today there is a reorientation of cargo to the ports of EU countries. At the same time, these ports are unable to process such volume of export deliveries, therefore part of product shipments must be carried out through the western borders by rail and road transport.

According to expert assessments of the Ministry of Agrarian Policy and Food of Ukraine, more than 30% of crops or 5 million hectares were lost due to the war. In this regard, the unearned revenue of agrarian business will amount to 5-7 billion dollars. Animal husbandry is destroyed by 15%, which will amount to approximately 2 billion dollars losses. More than 90 million tons of grains were blocked in the ports of Ukraine. Only in March 2022, the domestic agricultural sector lost 2.5 billion dollars in real prices. The total losses from the war in the field of agriculture are estimated at approximately 15 billion dollars. According to the calculations of the Center for Economic Strategy, the volume of export deliveries of agricultural products has been reduced by 4 times. According to the Ukrainian Grain Association, the volume of grain exports decreased 6 times (from 6 to 1 million tons per month).

According to expert assessments of the Kyiv School of Economics (KSE), as of February 2023, the total amount of damage caused to the infrastructure of Ukraine as a result of a full-scale russian invasion is 143.8 billion dollars. Of them, the amount of losses of the agro-industrial complex and losses of land resources amounts to 8.7 billion dollars or 6.1% of the total amount of damages.

All this led to the problems of managing the international logistics activities of agricultural enterprises, including:

– decrease in the volume of export deliveries of agricultural products due to blocking of seaports;

– violation of food supply chains;

– improper fulfilment of terms of foreign economic contracts;

– increase in transaction costs and logistics;

– threats of losing part of the 2022/2023 marketing year harvest;

– reduction of the final indicators of the harvest and the level of food security;

– insufficiently effective use of marketing management tools (Bezpartochna & Trushkina, 2021; Hnatyshyn *et al.,* 2022; Trushkina *et al.,* 2020a; Trushkina *et al.,* 2020b) in the process of distributing agricultural products to the final consumer, as well as a network approach to management partnership relations with consumers (Trushkina *et al.,* 2022) in the logistics management system;

– a limited amount of direct investment in the formation and operation of the relevant critical infrastructure (terminals, warehouse complexes, logistics centers, network structures (Khaustova & Trushkina, 2022; Kyzym *et al.,* 2022; Trushkina *et al.,* 2021); agricultural cluster formations (Liashenko *et al.,* 2021; Liashenko *et al.,* 2022).

In addition, it should be noted that, despite the positive steps taken to facilitate the border crossing between Ukraine and the EU, on the Ukrainian side, thousands of wagons and trucks are waiting for customs clearance. For example, according to the European Commission, the average waiting time for wagons is 16 days, and in some places even 30 days. At the same time, domestic wagons are not compatible with most railway networks of the European Union countries due to different track widths. That is why products often have to be transported by trucks.

Therefore, in order to restore the agricultural sector of Ukraine, it is advisable to form a flexible logistics system that would be able to quickly respond to external threats and adapt to them. For this you need:

1) direct the joint efforts of representatives of the government, business, scientific, educational, public, international community to overcome the challenges that arise in the conditions of war;

2) reorient the existing critical infrastructure (Kyzym *et al.,* 2022; Bezpartochnyi *et al.,* 2023; Khaustova *et al.,* 2023);

3) change the direction of all export flows from southern ports to western land ports.

And in view of this, the cross-border interaction of Ukraine with Slovakia and Poland as countries of the Visegrad Four becomes a key direction of infrastructural support for the management of international logistics activities of agrarian enterprises. That is, new opportunities and prospects for cooperation with Slovakia and Poland as strategic partners have appeared. For example, the Polish seaport of Kolobrzeg, located on the coast of the Baltic Sea between Swinoujscie and Gdynia, offered to tranship Ukrainian export agricultural products at the company's facilities. Several pilot projects have already been implemented.

At the same time, it can be noted that currently Ukraine and Poland have signed a memorandum on strengthening bilateral cooperation in the field of railway transport, according to which it is planned to create a joint logistics enterprise. This, in turn, will allow to radically increasing the volume of rail transportation of Ukrainian exports to the EU and to world markets through Europe.

In addition, a Memorandum was signed between the Ministry of Economic Development and Technologies of Poland and the Ministry of Economy of Ukraine, the main purpose of which is to develop tools to strengthen bilateral economic cooperation to simplify foreign trade operations. The implementation of this Memorandum will contribute to the growth of export-import operations in the structure of foreign trade with Poland. Thanks to insurance instruments, Ukrainian business will be able to attract the maximum number of Polish logistics companies to service the necessary volume of export-import operations.

As a result of the conducted research, it was established that in order to intensify the cross-border cooperation of Ukraine and Poland on international logistics activities of enterprises in the agrarian sector, it is expedient to create cross-border agrarian clusters on the basis of joint initiatives and concluded agreements. These clusters are proposed to be created in the form of partnerships of business structures, scientific institutions, institutions of higher education, institutions of critical infrastructure (transport, logistics, innovation, information, agro-industrial, etc.), and authorities.

**Conclusions**

As a result of the conducted research, it was established that, despite the challenges and threats associated with russia's aggression against Ukraine, state and local self-government bodies are doing significant work to solve the urgent logistical problems of the agrarian industry in foreign trade in order to ensure national and global food security.

For more effective and timely adaptation and transformation of export opportunities for producers of agricultural products in wartime, public authorities (the relevant Committees of the Verkhovna Rada of Ukraine, the Ministry of Economy of Ukraine, the Ministry of Agrarian Policy and Food of Ukraine, the Ministry of Infrastructure of Ukraine) are actively involving international experts, representatives of Trade and the Chamber of Industry of Ukraine, the State Institution "Office for the Development of Entrepreneurship and Export", agrarian business specialists.

Joint efforts are being made to develop alternative logistics routes for the supply of domestic agricultural products abroad; new rules, institutions, opportunities for export, mechanisms and special customs regimes of transit are defined; searching for partners; additional control measures for organic products from Ukraine, which were implemented in 2015-2021, are eliminated; strategic programs of state support of the agrarian industry on foreign trade issues are being formed. For example, the Ministry of Economy of Ukraine is discussing with representatives of the ministries of various European countries a number of alternative options regarding combined routes and the possibility of cancelling customs duties and quotas for Ukrainian exports, including agricultural products.

According to the estimates of the Food and Agricultural Organization of the United Nations (FAO), 115.4 million dollars are needed for financial support for the development of the Ukrainian agricultural sector.

According to the estimates of the World Bank, the cost of restoring the national economy of Ukraine after the end of the war started by russia is 411 billion dollars. This is 2.6 times higher than the expected GDP of Ukraine in 2022. According to preliminary estimates of the Government of Ukraine, more than 17 billion dollars will be needed to finance reconstruction projects in 2023.

It should be noted that in order to solve the existing problems of the export of agricultural products, the European Commission has developed the Action Plan "Paths of EU-Ukraine Solidarity". It envisages alternative logistics routes for the organization of export supplies of agricultural products from Ukraine using all types of transport, i.e. on the basis of multimodality and environmental friendliness. This programming document contains a series of steps:

1) provision of additional ships and trucks by participants of the European market; creation of a logistics platform for the coordination of demand, offers and requests, establishment of contacts, establishment of contact points according to the "single window" principle;

2) increasing the throughput of transport networks and transhipment terminals;

3) acceleration of customs procedures and checks at the border between Ukraine and the European Union;

4) temporary storage of goods on the territory of the EU;

5) increasing the capacities of the infrastructure of export corridors and improving communication between Ukraine and the EU in the medium term.

For example, Lithuania and Ukraine should take concrete steps, in particular, aimed at identifying important projects for the implementation of the corridor from Klaipeda to Odesa and cooperation with EU institutions. That is, the countries plan to develop new transport corridors from Klaipeda to Odesa and other Ukrainian ports, to improve railway connections between the countries and to increase the volume of cargo transportation of agricultural products.

One of the priority areas of infrastructural support for the management of international logistics activities of agrarian enterprises should be the activation of network interaction and partnership relations based on the creation of cross-border agro-cluster structures, the association of small farms for the proper execution of contracts (cooperation), as well as joint activities in the agrarian sphere of two or more companies and different groups of stakeholders to achieve a common goal and a synergistic effect (collaboration).

In order to provide effective infrastructural support for the management of international logistics activities of agrarian enterprises, it is necessary to determine the appropriate institutional prerequisites. In particular:

1) to introduce changes and additions to a number of legislative and regulatory acts that regulate the development of cross-border cooperation and issues of state regional policy. Namely:

– to include in the Law of Ukraine "On Cross-Border Cooperation" the organizational principles of creating a cross-border agricultural cluster (infrastructure) and the main provisions of the mechanism of clustering and cluster initiatives;

– supplement the State program for the development of cross-border cooperation for 2021-2027 with mechanisms for ensuring the creation and functioning of cross-border agricultural cluster formations for the sustainable development of border regions;

2) finalize the content of strategic documents that regulate the spatial development of the border territories of Ukraine for the period until 2027, in terms of the formation of appropriate institutional, organizational, economic, and financial foundations for the creation of cross-border agro-clusters;

3) develop and approve the Concept of the National Strategy for the Formation and Development of Cross-Border Clusters, in which to define the principles and tools of financial support for the functioning of agro-industrial infrastructure, namely: venture investing, crowd investing, crowdsourcing, public-private partnership, resources of credit unions, international investment funds, etc.

Prospects for further research consist in the substantiation of the conceptual provisions of the development of critical infrastructure in the context of the restoration of the agricultural sector from the standpoint of food security.

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# RISKS OF TOXIC ENVIRONMENTAL POLLUTION FROM MILITARY OPERATIONS

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**Abstract**
*The article identifies the scale of the war waged by russia on Ukrainian soil, which has contributed to the deterioration of the food security situation in Ukraine and has also affected global food security. In addition, the toxic risk of environmental pollution caused by the war was identified, affecting the ecology and health of the Ukrainian population.*

**Keywords:** *toxic action, military actions, food production, pollution of environment, ecology, heavy metals, radiation.*

## Introduction

Historically and geographically, Ukraine is at the crossroads of global geopolitical interests, global trade economic routes, and civilizational processes. Ukraine is at the focal point of dramatic planetary change and is one of Earth's hotspots (Melnyk & Radziievska, 2022).

The war in Ukraine, launched by russia on 24 February 2022, has caused extensive damage and loss of life and sparked massive displacement – more than 3.6 million Ukrainians had been forced to abandon their homes, millions more are internally displaced (FAO, 2022). Key cities continue to be heavily bombed, leaving people isolated (FAO, 2022) and facing severe shortages of food, water and energy supplies (FAO, 2022; The State of Food Security and Nutrition in the World 2022, 2022). The war has resulted in a massive, and deteriorating, food security challenge in Ukraine and has also affected global food security (Deinychenko, 2022; FAO, 2022; Hassen & Bilali, 2022; Melnyk & Radziievska, 2022; Osendarp *et al.*, 2022; Rawtani *et al.*, 2022; The State of Food Security and Nutrition in the World 2022, 2022).

## Actuality of theme

Due to the war that russia unleashed on the territory of Ukraine in 2022, the threat to the environment acquired an acute format and created many environmental risks (Fernandez-Lopez *et al.*, 2022; Melnyk & Radziievska, 2022).

It is not only the release of pollutants into the air and the huge amount of debris left behind by military operations that pose a risk to human health and the environment. Many other factors are the remains of fuel and lubricants, the remains of projectiles, damage to the land by heavy metals, emissions that enter groundwater and reservoirs, gunpowder residues, damage from the detonation of particularly dangerous and prohibited phosphorous shells, explosions of chemical, metallurgical, industrial enterprises and warehouses, damage to land plots by shells and their fragments, radiation danger, increase in the total amount of household and technical waste, etc.

Unfortunately, when military operations are conducted, no one thinks about the damage caused to nature. The consequences that await us can be unpredictable and extremely dangerous. Damage to

cultivated areas and water bodies will lead to the fact that it will be impossible to use them for growing agricultural products due to the large amount of xenobiotics that will be contained in such food. This will lead to the need to purchase raw materials and products from abroad, because domestic production may not be enough to meet the needs of the population of Ukraine, which will significantly affect the country's food security.

But we should not forget that Ukraine is one of the most important exporters of agro-industrial raw materials in the world. Such products as grain crops, sunflower oil, corn, products of the flour and grain industry, etc. are exported (Bilousova, 2021; FAO, 2022; The State of Food Security and Nutrition in the World 2022, 2022). Importing countries will not purchase dangerous products or products of inadequate quality (Skrynnyk & Kuzmin, 2022; Yurchenko *et al.*, 2022; Zaporozhan *et al.*, 2022), which will negatively affect the country's economy.

Environmental restoration during and after hostilities will be important. It will be appropriate to develop the agricultural and chemical industries of Ukraine, which are able to develop or improve existing technologies for the restoration of lands (Zasyadko, 2022) and water bodies. For this, chemical, biological, and agrotechnical methods are used (Fernandez-Lopez *et al.*, 2022). Before carrying out restoration work, it will be extremely important to conduct a study of the state of the environment with the help of domestic and invited experts and scientists.

Hence, there is an urgent need to make the scientific community and society, and in particular the military society, aware of the risks posed by the emission of organic contaminants as a result of military activities and to advance risk minimization approaches. Therefore, new strategies to prevent negative effects on the environment and human health will have to be presented by international policies such as those related to NATO, European Green Deal, and the EDA (Fernandez-Lopez *et al.*, 2022).

**The aim** of the research is to establish the toxic risks of environmental pollution as a result of military operations.

**Materials and methods**

In the course of the research, the research of Ukrainian and foreign scientists and experts in the fields of ecology and food industry was used.

**Results and discussions**

Any human action has an environmental impact, but it is military action that is characterized by significant and severe consequences. In today's conditions, wars have become an environmental disaster of a global scale.

Military activities that potentially release organic contaminants on land could be classified as infrastructure and base operations, training exercises and armed conflicts (Fernandez-Lopez *et al.*, 2022; Obniavko, 2015) – pose risks and threats from the following types of military-technical factors to the environment (Obniavko, 2015):

*(a) Mechanical impact on the environment:*

– loss of fertile soil layer or decrease in fertility due to military-technogenic impact;

– violation of the fertile soil layer by automobile and armored vehicles;

– contamination of the fertile soil layer due to explosions of ammunition and unexploded ammunition;

– falling into the soil of metal parts of ammunition, remnants of unused damaged military equipment;

– destruction and demolition of soils by wind after damage by military equipment and ammunition explosions due to the destruction of forests;

– soil destruction by surface water, waterlogging after damage by military equipment and ammunition explosions, etc.;

*(b) Chemical effects on the environment:*

– air and soil pollution by emissions from the operation of internal combustion engines;

– air and soil pollution from petroleum products, propane, butane, fuels and lubricants;

– air and soil pollution from heavy metal emissions during hostilities;

– air and soil pollution from emissions of powder gases and residues of explosive substances;

*(c) Physical impact on the environment:*

– wave pollution of the environment as a result of firing weapons, operation of military equipment, etc.;

– an excess of night lighting that disrupts the natural rhythms of the biosphere;

– supernatural noise impact due to firing, explosions of ammunition, operation of military equipment;

– supernatural thermal influence in places of operation of military equipment;

– the impact of electromagnetic radiation in the locations of radar stations, radio communication, navigation, radio engineering systems, etc.);

*(d) Biotic effects on the environment:*

– destruction and suppression of biological systems due to the use of weapons and military equipment;

– impoverishment of biodiversity;

– causing damage and death of biological objects;

– degradation of ecosystems;

– accumulation of harmful substances.

Chemicals may include potentially toxic compounds, energetic compounds, chemical warfare agents and military chemical compounds. Fuel components, PFASs, TNT, RDX and dyphenylcyanoarsine are examples of organic contaminants of environmental concern (Fernandez-Lopez *et al.*, 2022).

In the course of hostilities and military conflicts, the limits of the use of natural conditions and resources of territories are exceeded, the environment is used as a repository for "waste" and by-products of military operations, which poses a threat to the foundations of human life and other living organisms (Boychuk *et al.*, 2016).

In Ukraine, from the first days of the war, shelling and bombing of industrial and energy facilities, burning of forests, detonation of oil depots, pollution of the Black and Azov seas (primarily due to the sinking of ships) by russia were recorded.

If we talk about fuel and lubricant pollution, then their emissions can occur as a result of the movement of heavy military equipment, its burning, detonation and destruction of fuel canisters and tanker trucks. As a result, land, groundwater, and air are polluted.

When considering the effect of fuel and lubricant materials on the

human body, one should take into account the fact that their toxic effect also depends on the way the fuel enters the body (Franchuk & Nikolyak, 2007). Their remains can fall both from the air, and their remains can contain food products. In soils impregnated with fuel and lubricants, water permeability decreases, oxygen is displaced, and biochemical and microbiological processes are disrupted. As a result, the water and air regimes and the circulation of nutrients deteriorate, the root nutrition of plants is disturbed, their growth and development are inhibited, which causes death.

If we talk about heavy metals, since 2014, scientists have been conducting studies of the condition of the lands after artillery shelling in the areas of Donetsk and Luhansk regions, where the situation is currently worsening. Soil samples taken in funnels from artillery shells and in their immediate vicinity showed an excess of the permissible background norm by several times of such heavy metals as manganese, copper, iron, lead, cadmium, chromium, tin, gallium, nickel, titanium, yttrium, zirconium, cobalt, strontium and zinc.

According to environmentalists, growing any agricultural crops near artillery pits is extremely dangerous for health. Heavy metals may not be removed from the soil for hundreds of years.

Along with this, it should be noted that during the explosion of the projectile, toxic organic substances may be formed, which will be spread over large areas by wind currents and groundwater.

Phosphorus munitions cause the greatest damage to buildings, soil, and various communications, as war weapons containing white phosphorus spread an incendiary compound. At the same time, the combustion temperature exceeds 800 °C.

According to the degree of possible negative impact of heavy metal pollutants on the soil, plants, animals and humans, three classes of danger are distinguished: highly dangerous, dangerous and low-hazard substances. The first class includes arsenic, cadmium, mercury, selenium, lead, cobalt, zinc, fluorine; to the second – boron, cobalt, nickel, molybdenum, antimony, chromium; to the third – barium, vanadium, manganese, strontium.

Part of man-made emissions entering the natural environment in the form of fine aerosols is transported over considerable distances and causes global pollution. The other part flows into waste water bodies,

where heavy metals accumulate and become a source of secondary pollution, that is, the formation of dangerous pollution during physical and chemical processes that occur directly in the environment.

Heavy metals accumulate in the soil, especially in the upper humus horizons, and are slowly removed during leaching, consumption by plants, erosion and deflation – blowing of soils. The half-life or removal of half of the initial concentration is a long time: for zinc – from 70 to 510 years, for cadmium – from 13 to 110 years, for copper – from 310 to 1500 years and for lead – from 740 to 5900 years. In the humus part of the soil, the primary transformation of the compounds that got into it takes place (Biatova, 2019).

Heavy metals and their compounds, like other chemical compounds, are able to move and redistribute in living environments, i.e. migrate. Migration of heavy metal compounds occurs to a large extent in the form of an organo-mineral component. Some of the organic compounds with which metals bind are represented by products of microbiological activity. Mercury is characterized by the ability to accumulate in the links of the food chain. Soil microorganisms can produce mercury-resistant populations that convert metallic mercury into substances toxic to higher organisms. Some algae, fungi and bacteria are able to accumulate mercury in their cells.

For example, lead belongs to substances that have the property of accumulating in the human body. The main symptoms of lead damage are severe disorders of the nervous and digestive systems, kidneys and other organs: headache, dizziness, cold sweat, sweet metallic taste in the mouth, salivation, loss of appetite, nausea, sometimes vomiting, pain and weakness in the legs, decreased acuity vision, insomnia.

Manganese is quickly absorbed into the blood and circulates in it in the form of an unstable complex with proteins. When manganese enters the body, it causes severe circulatory disorders, sudden shortness of breath, and fainting. In mild cases of poisoning, irritation of the mucous membrane of the respiratory tract, cough, and headache are observed. Manganese compounds exhibit highly allergic properties, which causes the development of chronic bronchitis with a pronounced asthmatic component, and in some cases – bronchial asthma (Khromiak & Tarnavskyi, 2015).

During the detonation of rockets and artillery shells, a number of chemical compounds are formed: carbon monoxide (CO), carbon dioxide ($CO_2$), water vapor ($H_2O$), brown gas (NO), nitrous oxide ($N_2O$), nitrogen dioxide ($NO_2$), formaldehyde ($CH_2O$), vapors of cyanic acid (HCN), nitrogen ($N_2$), as well as a large amount of toxic organic matter, the surrounding soils, wood, turf, structures are oxidized.

During the explosion, all substances are completely oxidized, and the products of the chemical reaction are released into the atmosphere. The main ones – carbon dioxide and water vapor – are not toxic, but harmful in the context of climate change, since both are greenhouse gases. In the atmosphere, oxides of sulfur and nitrogen can cause acid rain, which changes the pH of the soil and causes plant burns, to which conifers are especially sensitive.

On a smaller scale (but with a greater variety of impacts), the source of pollution is also burnt tanks, vehicles, downed planes and other remnants of hostilities (Omelchuk & Sadohurska, 2022).

Radiation pollution is equally important and dangerous. The invasion of occupation forces on the territory of a nuclear power plant is in itself insane and deadly in case of damage to the operating reactors. It is known that russian troops actively moved heavy equipment, dug trenches, and moved on the territory of the Chernobyl nuclear power plant, which caused the rise of radiation dust in the exclusion zone. The danger is also caused by the fact that gusts of wind can spread this radioactive dust at a distance that expands the radius of damage. When leaving the station, the russian military used their equipment to spread radioactive sand and soil that remained on the wheels and track.

It is important to note that any contamination of lands, water bodies and air by any type of toxic substances, which are formed as a result of hostilities, will most likely end up on the consumer's table in the form of food products.

The circulation of substances in nature will take place as follows: toxic substances enter the environment (soil, water bodies, air) → accumulation of these substances in the environment occurs due to the movement of groundwater, precipitation, wind movement, etc. → the agro-industrial complex uses poisoned environments for growing products → plants/animals/fish absorb toxic substances (plants do

this directly from the soil, animals by consuming toxic feeds/plants, fish directly from reservoirs/feeds) → in the process of growth, toxic substances accumulate in the future product → the resulting product does not meet the norms of regulatory documentation on safety indicators → it is disposed of or unscrupulous sellers sell it to the consumer, as a result of which we have food poisoning and end-consumers end up in hospitals with varying degrees of health damage. Fatal cases of poisoning by heavy metals and other substances can be no exception. Therefore, a very important stage will be the restoration of the environment.

Various methods should be used to restore the environment, which will reduce the risk of exposure of toxicants to land, water bodies, etc.

Reclamation of lands disturbed as a result of military actions is carried out in two stages: technical and biological. The essence of the technical stage is the preparation of territories for the next target use. It consists in planning, as well as applying soil or fertile rocks to a leveled surface. The biological stage is a set of measures to restore the fertility of disturbed lands (Fernandez-Lopez *et al.*, 2022). It includes agrotechnical and reclamation measures aimed at restoring flora and fauna (Figure 1.1).

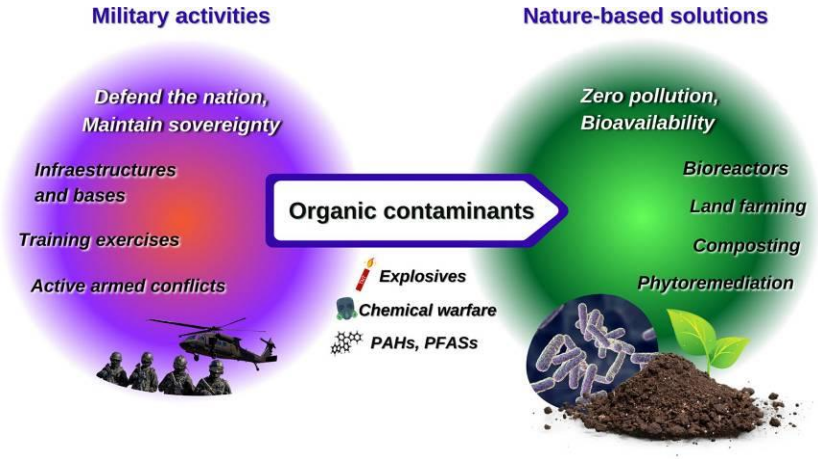


**Figure 1.1 Control by the environmental regulatory frameworks**
*Source: Fernandez-Lopez et al., 2022*

The technical stage includes: soil removal and transportation; import of soil; filling in funnels, fortification lines, trenches; dismantling of wooden and reinforced concrete structures; filling the dugouts with soil followed by planning; carrying out anti-erosion measures on eroded areas and territories, filling ravines; planning the surface and applying a fertile layer with subsequent enrichment with mineral and organic fertilizers.

The biological stage should be started taking into account the following conditions: features of the microclimate; physical and chemical properties of soils; the natural process of self-growth.

In this regard, the following areas of biological reclamation can be used: agricultural (restoration of disturbed lands for use as pastures, hayfields, berry gardens, gardens, etc.); forestry (creation of forest plantations, forest protection strips, anti-erosion plantations, forest plantings, forest crops on renewable lands).

The biological stage of reclamation includes: selection of plant assortments from among local species of flora, landscaping and creation of the most productive plantations, regulation of self-growth in the right direction, forest amelioration and phytomelioration, development of cost-effective methods of creating phytocenoses.

**Conclusions**

It can be argued that environmental pollution, which is currently being applied to the environment throughout the territory of Ukraine, will continue to affect the ecology and health of the population of Ukraine for many years to come. Looking at the areas where active hostilities took place, the state of damage to land covers is nothing short of horrifying, the restoration of such areas will take decades due to the degree of damage. Powder residues, heavy metals, ammunition residues, bomb funnels, fuel and lubricant materials, remains of mutilated heavy equipment – all this is the real present of Ukraine, which will affect the state of the air and environment over time, until all lands are restored. Carefully approaching the restoration of many ecosystems individually, taking into account all the features of certain territories, will require considerable effort and money. But Ukraine will cope with all challenges and persevere. Glory to Ukraine!

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# INTEGRANION OF ENVIRONMENTALLY FRIENDLY REPRODUCTION INTO A RURAL LIFESTYLE IS A CONDITION FOR THE PRODUCTIVITY OF A NEW SOCIAL-ECONOMIC STRUCTURE OF POST-GLOBALITY

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**Abstract**
*In the context of the development on a global scale of "green economy" technologies, there is an active movement to more humane organizational-technological chains in production and cooperation. The requirements for industrial ecology are increasing (of course, including ecology of human). Hyper-industrialization and ecology of life are two aspects of the necessary foundations of the formation of new socio-production structure. The emphasis of high-tech and environmentally friendly cycles is organically supplemented by growing ideas about the standards of humane attitude to nature, society, to man. And the inclusion of the "human of the village" in the formation of not only ideas about society, but also real management is a condition for the comprehensive success of post-global transformations. Thus, the selection and cultivation of productive organizational and managerial forms of integration and cooperation is included in the national "tree of goals" of preparation for the post-global era, the use of the logic of history and development trends.*

**Keywords:** *development, post-globality, efficiency, lifestyle, mode of production, humane, social-productive structure.*

## Introduction

**The scientific and theoretical base of the article** – the works of the founders of domestic schools and the organizational-managerial agrarian scientific tradition: E. Vorobyov, V. Kozlov, M. Makeenko, O. Mamaluy, M. Sazonov, I. Tkachenko, O.Chayanov, O. Yakuba. The industrial mode of life and social-economic structure (including

in the agrarian sector) brought the possibility and need for growth of personal and economic freedom, the scale of responsibility, innovation of decisions and approaches, preserving the proximity to nature, many features of rural life. In turn, increasing information saturation ensured the potential of global contacts. Accordingly, **the task of the work** is the allocation of critically important aspects in the organizational and managerial integration of the rural and urban way of life in the agro-industrial development of post-globality.

## Materials and Methods

Methodological validity is based on the syncretism of concrete-historical and abstract-logical approaches. Forecasting has accordingly increased and changed its tools, resource and methodological bases. The certainty of socio-economic structures is historical and changeable. As you know, the traditional culture of the agrarian society has implemented the main function of managing intellectual activity within the framework of the formula "do these because this was done before you". In an industrial society with the culture of Modern, the generalizing direction of management was "do, because it is rational". The post-industrial society is characterized by the approach "do, because it is effective". Moreover, the most diverse paradigms of the realizing of strategic partnership can be effective. The postmodern culture, inherent in the post-industrial society, is fundamentally open, deideologized, non-violent, based on the development of advantages, and not eliminating the shortcomings. This is its main difference from the characteristic of the previous eras, because this sign combines the entire successful management and stimulation system, especially relatively the immanent era of complex labour.

## Results and Discussion

The reproduction cycle presupposes the structure of relations of cooperation and competition (Chayanov, 1991; Kim & Shedyakov, 1991; Shedyakov, 2021). Optimization of the reaction of society and the corporation to call the transformation of the environment should combine intellectual efforts multiplied by the moral tension of employees. Therefore, in the realization of the selection of managerial decisions, the creation of their compositions, it is

advisable to take into account the variety of types of personality and its environment, life and working situations. So the rule, for example, representatives of the modernity of life are more striving for self-realization, therefore, in general, their values are rationalized, and they are more active and confident in themselves, while the agricultural population of traditional production is more focused on social environment, conformism and traditions. In organizational culture, either an aggressive approach (permission and prohibitions), or peaceful (instructions and commandments) prevails.

Forms and tools of social responsibility mutually resonate with the state and dynamics of social immunity, trends in the development of lifestyle and social consciousness (Kormyshkin & Halunets', 2017; Shedyakov, 2014, 2017; Tsaryk, 2011). These dominant approaches permeate the systems of worldviews, values and norms, beliefs and relations (myths, rituals), and, accordingly, the perception of the role of changes, the factor of time, differences on the grounds of gender, age, ethnic characteristics, etc., initiating dominance individualistic or collectivist culture (which visibly differ in the parameters of attitude to intervention in personal life, the degree of influence of the organization on the well-being of each, paternalism and calculation on support by the group, hierarchical advancement – exclusively within the familiar environment and, accordingly, in accordance with competence, distance or unity in social communications, the rule of "live to create" or "receive to consume", the desire to be the first or to be like everyone else, a craving for independence or solidarity, a social predisposition to successful or losers, the dominance of logic or intuition when making decisions, etc.). Accordingly, the frequency of expression of their disagreement for culture with a high level of distance from power is mainly low, while with a low level – a high, preferred management style in the first case – directive, in the second – democratic, perception of inequality – in the first case, mainly, mainly as people's inequalities, in the second, as inequalities of roles, the attitude of the office of the "they" or "we", the accessibility of the leadership, the ratio of law and tradition, the architectonics of social structures, the size of differentiation of income and conditions, the multiplicity of peripheral social groups are also radically changing, the degree of awareness of group members, the status of representatives of

different groups, behavioural features in connection with a high / low level of avoidance of uncertainty. And if the instrumental, relevant life values are secondary in relation to the hierarchies of needs, then the fundamental values themselves largely determine them.

Of course, the gap in the quality of life in the urban and rural areas significantly influenced the attitude to social space, the perception of the level of his justice. The possibilities of "finding yourself", develop their inclinations, selfrealize and so on in the city and village. The prerequisites for social tension were created between the urban and rural population, increasing the protest potential within society and violating the mutual understanding of the people. This became especially critical, leading to socio-political fault, when imposing a regional confrontation and supplementing religious, language, historical differences. Entropy is a measure of randomness, chaos, a measure of dissipation of the energy of systems, but in open systems the tendency to increase chaos is unhappy, there are mechanisms of phase transitions. In general, the increment of entropy is the result of energy exchange with the outside world ("flow of entropy") or internal processes ("production of entropy"). The second law of thermodynamics here remains with a change in entropy (when taking into account the change in the system). The unity of logical and random factors of development in the self-organization of systems leads to self-reproduction and self-confusion of social integrity.

Understanding of the value of life and creativity is inevitably growing, influencing the hierarchy of priorities (Schweitzer, 2020; Shedyakov, 2021; Thunberg, 2022). Post-globality expands the potential field of horizontal contacts. Moreover, this happens already on a global scale. But the nature of the "multi-storey" economy reduces different-quality (even-different-stroke) farms into organizational and technological chains. And the formation of various "agro-city" can bring together the features of life in the city and the village. Accordingly, the result of production depends on the skill of the leader: inside the team (stimulation, provision, command interaction), and outside it (providing a place in a promising organizational and technological chain). In the management subsystem of socio-economic relations, the significance of relations related to the complex tools of realization of the principles of social

partnership and production democracy becomes priority. Particular attention of society under the influence of ongoing changes is focused on scientists and scientific groups of a breakthrough level, with the activities of which the possibilities of launching "chain reactions" for a number of directions are associated. Accordingly, the decisions carried out in this regard, enhancing the position of a particular choice, not only the content of each of their elements of scientific and educational clusters, but also the quality of their relationship, ensuring the systematic interaction and cooperation experiences the transformation of the historical level. The main factor in success in the implementation of the breakthrough level technologies is flexibility, susceptibility, the ability to adapt to the logic of changes and to direct them properly.

The current disclosure in the levels of development of dominant and lagging behind such that the chances of the latter are reduced to obtaining the status of a service economy. At the same time, for some elements of the economic structure, the closeness is precisely the factor of fixing backwardness. The balance of "openness" and "closed", the capabilities of the (post)market mechanism and state influence provides for the forms of combining the energy of private labour and entrepreneurship with flexible state regulation. The result of participation in competition is often predetermined by self-discipline, readiness to work in its place with marginal dedication, on the verge and beyond the possible, as well as team coherence, consistency, coherence. The increasing fragmentation of most industries, an increase in the level of interconnection and interdependence, retaining formal independence of the general cycle links increase the range of capabilities for ecologically dirty and low-tech nodes and stages on world periphery. On the contrary, the migration of gifted, active, highly qualified personnel in the context of globalization can be supplemented by the use of intellectual activity living in the most distant corners of the world. The preservation of a high level of sex in a single process of material or spiritual production provides control in all key issues and on critical phases. In the formation of a multitier economy, the harshest processes of competition become the most stringent, unfolding within each of the floors of economy. The mechanism of strengthening cooperative relations is the strengthening of strategic

partnership of economic structures. Moreover, if the niches can be selected in the most accidental way (for example, in the certification of leading production) to ensure short-term prospects, then long – term trends require unconditional orientation to the leading trends of the international division of labour, in particular, to the growth of the global economy of the significance of the clusters of the knowledge society. All this acts in the direction of pull-up to the requirements of advanced enclaves, complicating the life of the survival strategy by saving on variable capital and additional costs. On the contrary, the sustainable realization of a model of economic growth and lifestyle based on endogenous technological progress involves the stimulation of both the formation of scientific and production and production complexes, and a wide involvement of complex labor, which suggests a constant inclusion in improving the level of their qualifications and competence.

Meanwhile, the objective need for the liberation of the creative abilities of a person of labour, intellectual activity is growing, however, in the conditions of the first time advanced advance to human rights. Moreover, these trends (including, for example, reduce social programs, increase the age of retirement, reduce the amount of payment and pension provision, free services to the population, mass dismissal, etc. during inflation), are noticeable even in the leading regions of the world. Moreover, they are drawn into the unprivileged regions that get ecologically harmful production, economically unprofitable cycles, deintellectualized operations, and socially flawed compensatory forms.

Transformation of agricultural biology and agribusiness is an integral part of global change (Shedyakov, 1992b; Shilov, 2013). In order to successfully carry out the next modernization and effectively use the mechanisms to stimulate the desired transformations in the network organization of the post-global society, it is necessary to cultivate mechanisms not to “oblige”, “force”, “administer”, but to “entice”, “interest”, “motivate”. Thus, ensuring the quality of life and the conditions for creativity comes to the forefront of management, appropriately transforming the current resource and methodological bases and redirecting them to increase the range of application of a deeply individual combination of the essential forces of each, for example, thanks to the mechanisms of social partnership and

industrial democracy.

The level of food security's increasing is directly related to resource conservation and environmental literacy (Shedyakov, 1992a, 2015). The organizational and managerial design of "breakthrough points" allows concentrating resources around strategic areas of development. An unconditional prerequisite for the long-term stability of reforms is the creation of a unified structure of state administration and local self-government, based on the traditions of both sovereign and domestic life, while at the same time capable of effective social innovation. Only this can protect the choice of a new general development model. Moreover, at the time of shifts in the paradigm level, when approaching the state of institutional uncertainty, one has to be guided not so much by the usual regulatory rules as to focus, on the one hand, on the value-semantic complexes of one's cultural and civilizational world (which, being realized in the forms of traditions, customs, and ensure the reproduction and development of the economy and society as a whole), on the other hand, on the general logic of the historical process and specific features: their own, their position and their goals. In particular, the adjustment of the economic mechanism in such a situation involves increasing attention in the implementation of organizational and managerial relations to the formed socio-cultural traditions, the development of cultural and civilizational worlds around them and on their basis.

Post-globality has an extensive (including organizational and managerial) potential to include the achievements of both Tradition and Modernity. The organic socio-cultural basis of the patriarchal way of life is the basic value-sense complexes (including those preserved by traditional religions). It is the moral cores through traditions, foundations, customs that create, organize and protect society and its economy. At the same time, if for most of the cultural and civilizational worlds their basic value-sense complexes have already been formed and are being tested for strength by complex post-modern processes, then for Ukraine they are being actively formed. It is extremely important that the difference between rural and urban perception of life be the basis for the growth of the creative, and not the destructive potential of the economy and society. Nowadays, the creation of organizational prerequisites for

successful transformations is complicated by the transitional nature of many socio-economic phenomena, the cardinality of the ongoing changes, and the movement from a social system to an unsystematic integrity. The directions of such changes are characterized as the penetration of postmodern culture into social relations with its inherent differences, which form their own advantages, dangers and limitations, in particular in the organizational sphere, and require appropriate prerequisites for development. The first of all, at the moment of shifts of the paradigm level, when approaching the state of institutional uncertainty, one has to be guided not so much by the usual regulatory rules as to focus, on the one hand, on the value-semantic complexes of one's cultural and civilizational world (which, being realized in the forms of traditions, customs, ways and ensure the reproduction and development of the economy and society as a whole), on the other hand, on the general logic of the historical process and specific features: one's own, one's position and the specifics of one's goals. Demands for the quality of information services for the management process are increasing: both at the fundamental level (timely isolation of knowledge important for a given area) and the current one (orientation in the economic situation). It is assumed that in the process of carrying out analysis, forecasting and constructive actions, and one mainly has to deal with a weakly structured multi-level environment, where completely different socio-economic logics and trends converge and diffuse. These grounds lead to the fixation of deliberately more mosaic, hybrid, conglomerate social communications, which are accentuated by an individual psychological (rather than socio-economic) beginning, therefore, instead of the usual hierarchies in the past, the equivalence of different things, poly-systematics, the impossibility of establishing in advance a rigid uniformity of socio-economic scales and canons (along with an increase in technical and technological standardization on a global scale).

The trinity of the system of social pedagogy, work and management can have a noticeable impact on the results of progress. Two ways to restore the controllability of the main processes of integrity compete on an enlarged scale: through a quasi-caste or socialized structure of society, each of which is associated with its own idea of a normative, fair and desirable way of life, directions of

individual and social change, the structure of production, distribution, exchange and consumption. Every cultural and civilizational world develops and develops in the process of history its own characteristics and ideas, in particular, fixed at the levels of diversity of language practices, socio-economic foundations, political institutions, etc. When realizing socio-political programming (including educational resources), it is obvious that scenarios for the exercise of power associated with the destruction of the cultural layer of civilization or with an attack on the rights and opportunities for creative self-realization of a person (especially his life) cannot be recognized as effective.

In many ways, the picture of the world is refracted in relation to co-creation and self-sacrifice in the name of realizing high ideals and values (at least self-restraint and self-discipline for the sake of achieving socially important results). And if the conditions of the High Modern "dissolved" a person in a common destiny, then the postmodern provides a much greater range for personal choice; "our universe is not a mechanism, and I, a human, participate in a continuous creative process, which is life. Yes, we are moving, changing in this living stream, whether we like it or not. But how we change – whether we improve or degrade, this largely, if not completely, depends on ourselves". Moreover, on the one hand, the degree of regularity of the phenomenon, as a rule, is opposite to its spirituality; on the other hand, the essence of the transformations experienced is also connected with the transition to the priority of the spiritual and mental principles of life activity. Spiritual (in particular, intellectual) creativity is the most productive, especially in the preparation and realization of the "next industrial revolution", which opens up prospects for combining the capabilities of man and artificial intelligence. But it is not the inclinations as such that become a factor in social life, but their identification, deployment and pro-social realizing; not labour potential or natural resources in themselves, but the measure of their use, the nature of involvement in the socio-economic turnover. And the tasks of raising the level of upbringing and education are among the most important requirements for ongoing socio-political programming.

Practice has convincingly demonstrated that often active interference in the internal affairs of other countries is associated not

so much with the tasks of stealing natural resources (today, primarily energy) or using fertile lands, but with the transfer of human potential (from valuable personnel with unique talents and experience to mass migration working and demographically active population). Here lies the realization of probable threats to socio-economic security. Concrete-universal forms of geostrategic positioning actively absorb the energy of various layers of the material and ideal level of realization of socio-economic processes. Attractiveness as a craving for abstract values makes it possible to combine the doctrines of "what should be" and "about what is", to resonate with the ideal and real worlds, creating a vector of change in social capital, and to translate spiritual energy into material accomplishments. The ideal is generally inherent in the material and their mutual resonation ensures the coherence of development; the content of ideas cannot be sought in the bowels of the individual consciousness or under the skull. On the contrary, it is the nature of the ideal as an objective reality that makes it possible for its social impact on processes. At the same time, by means of culture, an ideal representation of material reality is carried out, when the ideal is a sign of the true existence of the material. The cardinality of the ongoing transformations on a global scale demonstrates the limited practical truth of some previously developed abstractions and a number of research methods. At the same time, the insufficient depth of primary abstractions can lead to a narrowing of both theoretical and practical recommendations obtained in the process of ascent from the abstract to the concrete. The basis for regularly obtaining unforeseen (other than declared) results can be not only selfishness, the divergence of interests of indigenous people and elite groups, but also the inability to carry out strategic management based on the post-modern range of tools for future-diagnostics of socio-economic processes, which is converted into factors of economic power.

**Conclusions**

So, the effective integration (in particular, by organizational and managerial means) of the rural way of life into the new social order is a serious task of strengthening social security and a resource for the humanization of public life. Thus, the restoration of the dynamic equilibrium state of the planetary biosocial system implies, in

particular, the transition from being based on the expenditure of physical labour as the main part of the socially necessary to spiritual and intellectual activity as its defining component, from the prevalence of the material aspect of life to the virtual-mental sphere, from the orientation towards over-consumerism and the pursuit of pleasures to the values of morality and creation, from the uniformity of the pattern of life and development to their diversity based on the basic value-semantic complexes of cultural and civilizational worlds. Organic development is achieved by giving innovative forms to the natural value-sense complexes of the cultural and civilizational worlds. The elaborating of the comparative moments of historical experience and the using of tools of future-diagnostics convincingly testify about it.

Especially significant is the successful solution in the transition period, when in the long term the foundations for further political, economic and socio-cultural movement are being laid. In particular, on the one hand, it is necessary to mitigate, ecologization of living conditions, the perception of the best features of traditional values, on the other hand, one cannot pay by slipping into counter-modernity, decline and archaism. Improving food security is directly linked to resource conservation and environmental literacy. And education of ecological culture is a direction that is important not only for food security, but also for the formation of a new, more humane way of life. Careful attitude to man and the environment is necessary for the preservation of life and the development of mankind. It is required to increase the environmental standards of activities, the spread of social responsibility for their violation.

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# INNOVATION RECIPE ICE CREAM "GELATO" WITH INULIN

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**Abstract**
*The article presents an innovative technology for making "Gelato" ice cream using inulin. Ice cream is a popular food product on the food industry market and in restaurants. According to statistical data, ice cream is consumed by more than 70% of the population of Ukraine. In the modern world, the problem of obesity among adults and children is quite acute. Many factors lead to obesity, one of which is the consumption of poor-quality dairy products. That is why the development of low-calorie dairy products is an urgent direction. Inulin from chicory was chosen as a functional ingredient in the innovative ice cream recipe. Inulin is a polysaccharide consisting of fructose and glucose molecules, the sweetness of which is 10% of the sweetness of sucrose. This carbohydrate is often used in food products for diabetic purposes. Gelato is a frozen dessert made from cow's or vegetable milk,*

*cream and sugar with various additives. This dessert differs from other frozen desserts in its fat content (7% milk fat), has a richer taste, airy, rich creamy consistency. Raw materials necessary for the production of "Gelato" ice cream according to an innovative recipe: milk 2.5% fat, inulin from chicory, vanillin, strawberry puree. When studying the viscosity of the model system, it was established that at t -6°C, inulin when combined with milk exhibits the best viscosity and forms the most stable consistency. Studies of nutritional and energy value have shown that due to the introduction of inulin, it was possible to reduce the carbohydrate content by 3 times. The energy value of "Gelato" ice cream is 56.4 kcal/100 g, compared to 180 kcal/100 g for the control sample, which makes it possible to classify the developed ice cream as a low-calorie food product. During the analysis of the vitamin composition, an increase in group B vitamins was noted in comparison with the control sample. According to the results of the organoleptic assessment, an improvement in appearance, consistency and taste was noted. The introduction of this recipe into the menu of restaurants will allow to expand and diversify the range of low-calorie desserts.*

**Keywords:** *ice cream, inulin, low-calorie foods, "Gelato".*

## Introduction

The main task of the food industry and restaurant establishments is to provide the population with complete and high-quality food, because it plays a significant role in the formation and development of a healthy nation of the country. A fairly popular segment of the food market is sweet dishes and desserts, despite the fact that they do not belong to basic necessities (Kryskova, 2019).

Ice cream is in steady demand among consumers in the food industry and restaurants, especially in the summer. This is evidenced by the results of a study conducted by Research & Branding Group. According to the results of a statistical study, 73.9% of Ukrainians consume ice cream, in particular, in the summer they buy ice cream from 1 to 3 times a week, and 11.3% of consumers buy it every day. In general, consumers prefer plombir, milk and cream ice cream (in its natural form and with additives) in portioned waffle cups (Popova, 2019).

**Actuality of theme**

Modern production of ice cream in Ukraine is quite developed, but you can often find low-quality products that do not meet the requirements of regulatory documentation and have poor organoleptic properties. In order to increase profits due to the use of cheaper raw materials, manufacturers began to use vegetable fats, to simplify technological processes, which subsequently affects the quality and cost of the finished product (Floka *et al.*, 2021).

Consumption of low-quality food products, lack of fruits, vegetables and dairy products in the diet leads to obesity. According to FAO/WHO, more than 1 billion of the world's population have this disease. For example, in the USA, obesity is recorded in 65% of the adult population and 37% of children. In Ukraine, there are also problems of overweight among adults and children (Vlasenko et al., 2021). That is why Ukrainian manufacturers, including restaurants, face the urgent task of producing low-calorie food products.

Ice cream as a functional product should provide preserving the health of the population, to an important extent this concerns the elderly people and children, and therefore the gene pool of the nation. Modified fatty acid composition does not mean a deterioration in its quality at all. This is just another product, which will develop and take its place in the market of Ukraine.

Ice cream is a promising product for enrichment with functional ingredients, because the demand for it is quite high among all segments of the population. In addition, the creation of a high-quality product with the appropriate chemical composition will significantly increase the competitiveness of production or a restaurant establishment.

Scientific research, which has been conducted since the end of the 20th century, has revealed a lot healing properties of inulin for the prevention and treatment of a number of serious diseases that shorten the life of a modern person. This natural polysaccharide has no artificial analogues. Experimental studies have proven that regular use of inulin in food provides a number of health-improving effects in the human body.

Currently, the topic of studying technology is being actively researched production of products with the addition of organic vegetables, fruits or them derivatives Therefore, it would be

advisable to use organic fruits in recipe composition of such products as ice cream. Bioproducts (also organic products) agricultural and food products industry, made without (or with less use of) synthetics pesticides, synthetic mineral fertilizers, growth regulators, artificial food additives,

So, taking into account the above facts, the development of low-calorie ice cream using functional ingredients is an actual and promising direction. This will make it possible to expand the range of ice cream on the domestic market and in restaurants, as well as to partially solve the problems of the unbalanced diet of the population.

**The aim** there is a rationale for the innovative technology of frozen dessert – ice cream with the use of inulin of reduced energy value.

**Materials and methods**

Theoretical, computational-analytical, physico-chemical research methods were used during the work. The chemical composition of the developed ice cream was determined according to standard methods. The organoleptic evaluation of the quality of the samples was carried out by the method of profile analysis on a 5-point scale according to the main descriptors (appearance, color, consistency, smell, taste). Quality profiles were built using the MS Excel computer program. A control sample was prepared for the study, the main raw materials of which are: milk 2.5% fat, cream 33% fat, milk powder, white sugar, gelatin, vanillin. The research also used a developed product – ice cream "Gelato" with inulin.

**Results and discussions**

Inulin is a promising raw material for the production of low-calorie desserts. It is a sweet-tasting polymer in the form of powder or crystals, easily soluble in water (Zinchenko & Popova, 2020). The sweetness of inulin is 10% of the sweetness of sucrose. Today, inulin is one of the main functional ingredients used in the manufacture of various functional food products, because it is completely safe for the human body and has a wide list of technological properties. Inulin is also recommended for use in diabetic nutrition, as it does not significantly affect the increase in blood sugar (Perkovets, 2007).

For the selection of inulin, a comparative characterization of the

percentage content of inulin in different plants was carried out (Table 1.11) (Hrushetskyi, 2003).

The use of inulin-containing raw materials does not require significant changes in the technological process, the texture of the product is improved without harming the taste.

*Table 1.11*

**Inulin content in plants used in human nutrition**

| Source of receipt | Part of a plant | Dry matter content, % | Inulin content (% of fresh weight) | Inulin content (% of fresh weight) |
|---|---|---|---|---|
| Jerusalem artichoke, bulbous sunflower | Potatoes | 19-23 | 13-20 | 10-15 |
| Common chicory or wild chicory | Root | 20-25 | 15-20 | 5-10 |
| Barley | Grain | 5-7 | 0,5-1,5 | 0,5-1,5 |
| Garlic | Bulb | 40-45 | 9-16 | 3-6 |

According to the Table 1.11, inulin from common chicory was chosen for further use, the content indicator of which is the highest.

The solubility of inulins (Table 1.12) obtained from various plants was investigated theoretically (Hrushetskyi, 2003).

*Table 1.12*

**Solubility of inulins**

| The name of the plant | Solubility in water, t°C | |
|---|---|---|
| | 25 | 90 |
| Artichoke | Sparingly soluble | Easily soluble |
| Common chicory | Soluble | Very easily soluble |
| Barley | Sparingly soluble | Easily soluble |
| Garlic | Sparingly soluble | Easily soluble |

Having analyzed the solubility of inulins and the data presented in the Table 1.12, inulin from chicory was chosen for the development of innovative ice cream technology, as compared to other types of chicory it is soluble at t 25°C.

The advantages of using amorphous inulin powder for the production of ice cream are:

1. Providing the population with a complete and high-quality food product;

2. Expansion of the assortment;

3. Study of technological properties of a new type of raw material.

The main technological feature of inulin, which determines the expediency of its use in the production of ice cream, is the ability to form a white creamy gel with water, which is similar in texture to fat. Therefore, it can be used to partially replace fat, improve the texture, stability and taste properties of the product (Zinchenko & Popova, 2020).

Gelato is a popular Italian frozen dessert made of cow's or vegetable milk, cream and sugar with the addition of berries, nuts, chocolate, and fresh fruit. Gelato is generally lower in fat than other types of frozen desserts. Because it contains 70% less air and more flavor than other frozen desserts, it gives it a density and richness that sets it apart from other types of ice cream. This dessert contains only 7% milk fat. Its consistency resembles air-saturated cream (Udvorheli, 2015).

So, we substantiated the recipe composition and developed the technology of "Gelato" ice cream using amorphous inulin powder from chicory, the recipe of which is presented in Table 1.13.

*Table 1.13*

**Recipe for innovative ice cream "Gelato"**

| The name of the raw material | Mass, g, for 180 g of finished products | |
|---|---|---|
| | Gross | Net |
| Milk 2.5% | 130 | 130 |
| Inulin from chicory | 30 | 30 |
| Vanillin | 1 | 1 |
| Strawberry puree | 65 | 30 |
| Entrance | | 180 |

Inulin powder is mixed with other ingredients.

The production of "Gelato" ice cream involves the following stages: mashed strawberries are rubbed through a sieve to a homogeneous mass, vanillin is sifted. Milk is heated to a temperature of 40 °C, mixed with inulin and whipped to a lush foam. Add strawberry puree, vanilla and beat until a persistent lush foam is

formed. The resulting mass is cooled to -2°C and whipped again at a temperature of -6°C in the freezer. The duration of storage of ready-made ice cream in the freezer is 24 hours.

Organoleptic properties of the finished product are presented in Table 1.14.

*Table 1.14*

**Organoleptic properties of "Gelato" ice cream**

| Appearance | Color | Consistence | Taste | Scent |
|---|---|---|---|---|
| A uniform, airy mass of a light pink shade | Uniform, homogeneous, light pink, typical for this type of ice cream | Homogeneous with good whipping | Sweet, well-expressed milk with a strawberry taste | Milk, fruity |

In order to determine the optimal temperature for the preparation of "Gelato" ice cream, the viscosity of the model system under the influence of different temperatures was investigated. The results of the study are presented in Table 1.15.

*Table 1.15*

**Viscosity of the model system under the influence of different temperatures**

| Temperature, °C | Viscosity, Pa*s | Consistency characteristics |
|---|---|---|
| 0 | 1100 | The consistency remained liquid |
| –3°C | 1200 | The consistency is not uniform, slightly viscous |
| –6°C | 1720 | At this temperature, inulin in combination with milk showed the best viscosity and formed the most stable consistency |

Analyzing the data presented in table. Data table shows that the optimal temperature for making ice cream with inulin is –6°C.

It is known that inulins are very stable molecules at high temperatures, up to 140 °C. The most common commercial packaging consists of a whitish powder, the particles of which are quite "transparent" or "transparent" and usually have a neutral taste.

An important stage that allows you to assess the usefulness and quality of the developed chilled dessert is the analysis of the nutritional and energy value (Table 1.16).

*Table 1.16*

**Nutritional and energy value of "Gelato" ice cream compared to the control, g per 100 g**

| Composite | Control sample | Ice cream "Gelato" |
|---|---|---|
| Squirrels | 5,73 | 1,95 |
| Fats | 6,04 | 1,66 |
| Carbohydrates | 25,7 | 8,43 |
| Energy value, kcal | 180 | 56 |

From Table 1.16, it can be seen that there was a significant decrease in carbohydrates in the composition of the developed ice cream, which is explained by the complete exclusion of sugar from the recipe. In addition, the energy value of ice cream according to the latest recipe is 56.4 kcal/100 g, which is 3 times less compared to the control. So, the developed ice cream can be classified as a low-calorie food.

It is also important to preserve the vitamin composition when developing a new formulation. In Table 1.17 presents a comparative analysis of the vitamin composition of the developed ice cream and the control sample.

*Table 1.17*

**Vitamin composition of Gelato ice cream compared to the control**

| Vitamins | Content, mg/100 g | |
|---|---|---|
| | Control sample | Ice cream "Gelato" |
| Vitamins A | 0,14 | 0,15 |
| Vitamins $B_1$ | 0,03 | 0,11 |
| Vitamins $B_2$ | 0,45 | 0,66 |
| Vitamins PP | 0,16 | 0,42 |

From Table 1.17, it can be seen that the vitamin composition has increased, which is explained by the addition of strawberry puree to the recipe of "Gelato" ice cream.

During the organoleptic evaluation of quality, an improvement in the appearance, consistency and taste of "Gelato" ice cream was noted compared to the control sample. The obtained ice cream was characterized by a pleasant milky-strawberry taste and an airy consistency. The evaluation results are presented in the form of organoleptic quality profiles (Figure 1.2).

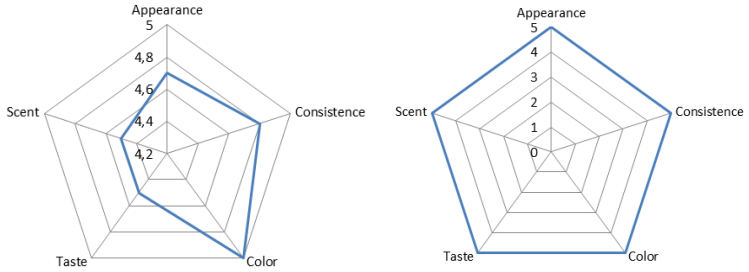


**Figure 1.2 Organoleptic quality profiles**
(a – control sample; b – "Gelato" ice cream)

## Conclusions

Based on a complex of theoretical and experimental studies, an innovative recipe for "Gelato" ice cream using inulin from chicory was developed. The use of inulin as a functional ingredient made it possible to reduce the energy value of the finished product and improve organoleptic properties. This recipe can be used in restaurants and food establishments in order to expand and diversify the range of low-calorie desserts.

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# Chapter 2 FINANCIAL-ECONOMIC AND ACCOUNTING-ANALYTICAL PROBLEMS FOR THE DEVELOPMENT OF AGRICULTURAL PRODUCTION

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## DIGITAL AUDIT OF COST OF GOODS SOLD AND BIOASSETS OF AGRICULTURAL COMPANIES

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**Abstract**
*The modern rate of development of information technologies in the agricultural sector is a significant driver of the increase in the amount of information that agricultural companies produce as a result of their activities. This leads to the complication of calculations of the cost of goods sold and the cost of bioassets, due to the increase in the depth of information detailing. At the same time, agricultural companies that most actively use advanced technologies for analyzing fields and cultivated crops are those that must perform an audit of financial statements and other types of audits. In this regard, the information pressure on auditors increases in accordance with the amount of information produced by the company.*
*This is the situation causes the problem of conducting an audit of the related lines of financial statements, in such a way as to obtain a result in an effective way. According to the conducted analysis, it is noted that audit companies should collect a complex of non-financial information with fragmentation at the level of each field and with sufficient*

*periodicity of accounting data, in order to form relevant expectations to account and conduct analytical procedures within the framework of digital audit. At the same time, conducting complex procedures requires the auditor to form additional data sets, such as price statistics, which in turn increases the amount of processed information.*
*Besides the increase in the amount of information, the public control over the operational activities of companies increases, which requires more and more disclosure of non-financial information, which may also become the subject of an audit over time.*
*That is why audit companies should start design approaches to the processing of already existing arrays of non-financial information of clients, within the framework of already existing procedures, in order to form effective practices for obtaining results in near future.*

**Keywords:** *agricultural, analysis, digital audit, big data, cost of sales, biological assets.*

## Introduction

In the 21st century, in the conditions of the digital economy, companies generate more and more information. The information can be used both for the preparation of management reports and for the formation of financial reporting, integrated reporting, iXBRL filling. At the same time, companies may need to undergo an audit, not only financial, but also non-financial (ecological, tax, etc.).

The rapid growth of the amount of information at the enterprise is a result of the scaling of operational activities, an increase in the pressure of the controlling authorities, the request of society for the availability of certain public information about the results of activities, such as emissions, carbon footprint, social policy, use of capital (natural, human, etc.), complication of accounting standards and other factors of various etymologies. In connection with the increase in the amount of information and the formation of big data arrays, audit companies are implementing digital audit, which aims at deep analysis, data visualization and big data processing.

It is believed that for large agricultural companies there is a significant problem of accounting of leased land from individuals. Although land is “excluded” from the scope of IFRS 16 “Leases”, it does not require complex discounting calculations, however, in the management accounting of these companies, the calculations related

to land are significant, as they include not only the financial component, namely the rental price, but also a large the number of non-financial indicators that the company must operate for its activities.

Non-financial indicators are:

• the area of private land shares grouped into a field;

• soil type;

• topographic restrictions (red lines) established by state or regional institutions;

• a list of one-time and systematic measures (investments) in improving of quality of soils;

• climate indicators of the area;

• normative and historical (actual) quantitative data on crop yields, etc.

Operating these indicators, which require periodic updating, leads to the production of a significant amount of information.

Depending on the specifics of the activity, agricultural companies, in addition to operating information about land, form the value of biological assets and have a complex calculation of the cost of cultivated crops, because this is a long-term and multifactorial process. The calculation process is complicated by the frequent inconsistency of reporting periods, as the most common reporting period, equal to the calendar year, does not coincide with the marketing agricultural year, which ends on June 30. Inconsistency of periods requires more detailed accounting, as information users require reporting for different periods. The combination of these factors also requires the formation and processing of significant sets of information.

Another driver of the complication of accounting, analytics and auditing is the active use of drones and the computerization of agricultural machinery, which leads to the accumulation of a significant amount of information.

The use of new information tools in agriculture helps in conducting various types of audits, namely the providing of additional information for financial audit procedures for various accounts ecological audits, cadastral audits, etc. However, at the same time, it leads to the complication of audit procedures, such as recalculation of cost of sales, preparation of expectations for expense

and income accounts, depreciation of agricultural machinery accounted for as inventory (for companies that sell agricultural machinery), etc.

Considering the abovementioned information, it can be noted that an urgent problem for agricultural companies in the field of accounting is the increase in the amount of data generated by the company and the increase in demand for public information, with limited resources for processing and auditing this data.

There were analyzed actual studies of Khirivskiy, R., Sodoma, R., Kleban, O., & Ustynovska, T. (2021), Kukel, G., Roleders, V., & Semchuk, I. (2020) regarding the prospects for the development of the agricultural sector in Ukraine; Zhukova, T., Iermolenko, K., & Plikus, I. (2020), Shapoval, L., & Kramarenko, K. (2022) regarding audit issues and Balaniuk, I., & Ivanyuk, T. (2022), Nezhyva, M., Zaremba, O., & Nehodenko, V. (2021) regarding the automation and digitization of audit.

In addition to profile works, relevant scientific articles in the field of application of the newest ways of processing land plots were analyzed. There are Tschand, A. (2023), Zamani-Noor, N., & Feistkorn, D. (2022), Liu, Y., He, X., Wang, W., Zhu, C., Jian, R., & Chen, J. (2022) and Di, Y., Gao, M., Feng, F., Li, Q., & Zhang, H. (2022). The articles of these scientists reveal the problems of working with agricultural drones, the impact of weather forecasting, the appropriate generation of information and its processing.

At the same time, the combination of audit of financial and non-financial information of agricultural companies that are actively implementing modern information collection systems for growing agricultural crops is not enough.

*The aim* of this article is to analyze the necessary combination of information of an agricultural company for conducting a digital audit.

*The object* is the process of generating and processing information produced by the enterprise as a result of its activities for reporting purposes.

## Materials and Methods

Scientific works of domestic and foreign scientists, open information of large agricultural companies and statistical data were

used for this article. In the process of achieving the aim, methods of comparison, induction and deduction, synthesis, generalization and graphic presentation of information were used.

**Results and Discussions**

In Ukraine, Kernell (363,000 ha as of 12/31/2022), Ukrlandfarming (~500,000 ha as of 12/31/2021), MHP (361,000 ha as of 12/31/2021) and others are considered to have the largest portfolio of cultivated land. They produce grain, as well as other agricultural products. If the process of buying and selling grain is a relatively easier process from the point of view of accounting for traders like the Nibulon company, then the formation of the cost of crops grown is a much more complicated process, as the cost is formed over a long time and includes a large number of factors.

Thus, the cost of growing winter crops, when reporting on December 31, will be included in the Balance Sheet. To recalculate costs, it will be necessary to recalculate the cost of grain, which has already been included in the Profit and Loss Statement, and the cost of bioassets that are still accounted for on the Balance Sheet.

In practice, different approaches are used for analytical calculation depending on the available input data from the company. However, in order to form analytics for the relevant class of accounts, the auditor must make an expectation, the result of which will not differ significantly from the actual amount. Significant deviations in expectation may indicate:

- significant changes during the reporting period;
- single events;
- the auditor's incorrect approach to forming an expectation.

In connection with the development of technologies for analyzing the conditions of sown crops and the conditions of fields, the formation of expectations should include as much as possible quantitative data from the companies and external data on the prices of the components that form the value of the bioasset or the cost of goods sold.

So, for the audit of the first year, or when the auditor changes, it is necessary to develop a expectation model that can be used for more than one year with an adjustment for single events in reporting period.

In order to understand a complete picture of events for the reporting period, it is necessary to obtain the following information from the agricultural company:

- technical characteristics of land plots:
  - size;
  - soil type;
- data taken from the equipment:
  - engine hours tied to the field;
  - normal level of fuel consumption;
- quantitative data of:
  - used seed material;
  - usage of fertilizers;
  - used chemicals (fungicides, pesticides, etc.);
  - used water (when using artificial irrigation);
- weather data:
  - amount of precipitation;
  - number of sunny days.

Partially abovementioned points to the request are included in audit requests, but are used for other purposes. Thus, auditors use the register of land plots to conduct an inventory of the actual plots and the presence or absence of crops sown on them and their compliance with the approved crop rotation plan. However, the technical characteristics of the soil are usually overlooked by auditors.

Obtaining a register of worked engine hours is rarely used, usually for the assessment of fixed assets by appraisers when applying the revaluation model of fixed assets at the enterprise. Also, engine hours are requested from the client when there is equipment that is accounted for as inventory for the Net realizable value test.

For example, for companies that sell agricultural machinery and have demonstration machinery that accrues engine hours and cannot be sold as new, however, for production agricultural enterprises, such cases may rather be an exception, for example, when the machinery is already written off and held for sale.

Quantitative data of usage and weather conditions are used sporadically to describe analytics, but not to generate expectations. For example, Ukraine had a long season of unfavorable weather for the harvesting of sunflower and corn in August-September 2022.

However, this information was used to explain the decrease in

revenue from sales of the respective crops when compared year-on-year, as well as fluctuations in revenue for companies that trade in original spare parts for agricultural machinery, as the harvest season shifted and the number of urgent orders also shifted to later dates. However, as a full-fledged observation of weather phenomena did not take place and their inclusion in the calculations did not take place.

Thus, to form an expectation, it is suggested to use the comprehensively summarized information given in Table 2.1.

*Table 2.1*

*A typical proforma for the analysis of the cost of production*

| Period | Field | Square | Type of soil | Normative yield | Fact harvesting | Motohours | Fuel usage (ths l) | Seeds (tons) | Type of fertilizer | Quantity of fertilizer (tons) | Type of chemicals | Quantity of chemicals (tons) | Water usage (m3) | Sunny days (J) | Rains quantity (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |

*Source: created by authors*

Depending on the availability of modern ways of information accounting at the enterprise, the periodicity may vary from quarters, months to days. The most detailed daily accounting will be based on which pivots can be built and loaded into Big Data processing programs for automated calculations and visualization.

Thus, a combination of internal quantitative factors and market information on prices can provide a preliminary picture of the cost of cultivation and the reasons of fluctuations at the level of each field for further usage in revenue expectations.

For further calculation and analysis procedures, each of the parameters provides the minimal necessary understanding of production processes and can help identify unusual items. Analysis of the number of used engine hours directly shows the degree of involvement of machinery in production and is a preliminary indicator of detecting fluctuations in fuel expenses.

Since agricultural companies use wholesale fuel purchases or coupons with wholesale discounts, to estimate the cost of used fuel from Table 2.1, it is necessary to use retail prices from open sources with correction for standard wholesale discounts or wholesale prices should be used if they are available in open statistics.

So, for the most detailed Table 2.1 – by days, fuel prices should be adjusted with a delay of the number of days that the fuel turns over according to the corresponding analysis of the financial line "Inventories" of the enterprise.

For Ukraine, a detailed analysis of fuel prices is mandatory because fuel price fluctuations are significant and the use of average prices can significantly distort expected or analytical data with large volumes of use. Thus, the diesel price graph in Figure 2.1 shows that the fluctuation for 2021 was UAH 5 per liter, after the stabilization of the fuel market after the start of the war, fluctuations were within UAH 54-57 per liter.

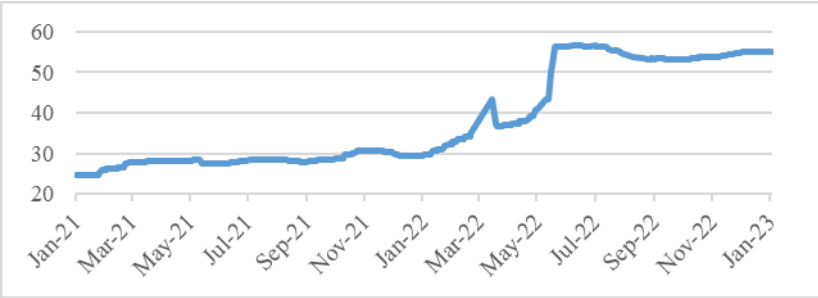


**Figure 2.1 Diesel price in Ukraine, UAH per liter**

*Source: created by authors based on Ministry of Finance of Ukraine (2023)*

The cost of used chemicals, fertilizers and water may be assessed by analogy with fuel. However, in the case of absence of open centralized data, auditors may use trading platforms such as Epicenter, Rozetka, OLX with an adjustment for a wholesale discount.

According to the authors view, the use of weather conditions, namely the number of sunny days (for the formation of the quantity of joules perceived by plants) and millimeters of precipitation is an important component for understanding the number of fertilizers

used and the timing of harvesting.

Formation of all the described data on a daily basis is possible only with the use of high-tech technologies of analysis and monitoring of the conditions of the fields.

Thus, there are separate specialized companies that provide services for forming a map of nitrogen application, herbicides, potential yield, trichogram, NDVI monitoring, etc. Depending on the available resources, large agricultural companies may have their own departments for the application of advanced technologies or use the services of intermediaries such as DroneUA, A-Drones, SmartFarming, etc. Therefore, with high-tech agricultural production, obtaining such data is not a problem. Thus, to create a general picture of production, external data of prices and weather, internal quantitative data should be processed, while they can be summarized or disaggregated by locations (fields) and periods (months, days).

With the most detailed format of accounting or data collection, a large array of data is formed, which can be processed either manually by involving a lot of resources (time or employees) or through the creation of algorithms in declarative languages such as MySQL in the presence of auditors with relevant knowledge or programs that visualize algorithms of declarative languages as Alteryx, which can be used by auditors who do not have sufficient IT knowledge.

After an analysis of data in Table 2.1 with tie to market prices, it remains to allocate costs to those related to the goods sold and include them in the Cost of goods sold in the reporting period or leave them on the balance sheet as of the reporting date for expectation.

Thus, the formation of a base for expectation and for the following calculation and analysis procedures turns into a complex process that forms a large array of data and forces auditors to plan the use of Big Data processing resources.

The development of algorithms for auditing not only financial, but also other data requires the collection and processing of data in a such way that obtaining the result is relevant from the point of view of labor costs. The designing of approaches to the analysis of non-financial data in current conditions is becoming a necessity, as other reports (management report, integrated reporting etc.), that disclose

non-financial data such as the number of emissions, investments in capital formation, the impact on water or land resources and accompanying financial statements, are gaining popularity. As with financial reporting, when the request for its preparation came with a request for its audit, so with other reports, over time, a public order for the audit of non-financial reports will come and the audit companies will already have the practice of recalculating non-financial indicators.

**Conclusions**

Summarizing the results of the analysis, it can be stated that with the development of reporting, companies should disclose more and more data (both for internal and external use), must process a large array of information. As a result, a clear dependence is observed: the company is not only a producer of goods or services, but also of information; and the greater the scale of production and public demand for information, the more it must be produced and processed. As a result, a larger array of information is subject to audit; and with increasing of the complexity of businesses and standards, the auditors should involve more external (market) information to issue an audit opinion.

The analysis of the economic activity of agricultural companies, namely accounting financial data and non-financial information, indicates that auditors need to have a comprehensive model for the analysis of quantitative indicators in order to design the correct expectation for analytics, conducting proper analytical procedures and identifying unusual events during the reporting period.

Developing of the practice of analysis of quantitative indicators of agricultural companies by auditors is relevant in connection with the necessity of search of effective approaches for the analysis of such indicators to meet the future demand of reports users.

Depending on the existing portfolio of agricultural clients in audit companies, different approaches can be developed and tested, since agricultural producers themselves have different degrees of integration of the latest systems for analyzing fields, crops, etc., and there is no commonly used accounting system for data obtained from agrodrones or other systems. For example, SAP and Oracle are included in accounting, Microsoft Excel and Google Sheets are used

for processing tables, and since the use of agrodrones is based on startups, the results of information processing can be produced by programs written for specific tasks that means that recording data in their unique system, storage or sending to cloud environments may occurs in specific formats. This situation leads to necessity of converting of specific information in the forms that more common for accountants and auditors.

So, with the development of agrarian technologies of information collection and increasing public demand for information, accounting at agricultural enterprises becomes more complicated, scaled and requires deeper analysis by both employees of such companies and auditors.

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# MANAGEMENT REPORTING IN THE COMPANY'S ACCOUNTING-INFORMATION SYSTEM AND THE PRINCIPLES OF ITS FORMATION

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**Abstract**
*For the effective development of an enterprise, a complete information environment must be created. Financial accounting and reporting provide information about the facts of economic activities that cannot be influenced. The information base for enterprise management is not limited to financial statements, which has led to the emergence of a new concept – management reporting. There is still no conceptual framework for its preparation. Management reporting contains accounting and calculation indicators that are calculated using methods that are not only related to accounting (methods of planning, analysis, control). It allows the company's managers to set their own requirements for the content, structure, detail, presentation, etc.*

**Keywords:** *reporting, financial reporting, management reporting, internal reporting, accounting method, accounting-information system, principles of formation.*

## Problem statement

Information is the result produced by an accounting system in the process of identifying, measuring, recording, accumulating, summarising and processing data on events and facts of an entity's life. It is summarised and presented to users in the course of reporting. Financial accounting and reporting have a significant drawback – they produce information about the facts of economic activity that users cannot influence. Enterprises face problems related to the lack of accounting information and analytical breakdown of indicators on the basis of which they make forecasts and plans for further activities of the enterprise, its future development or

management decision-making in the operating cycle. The scientific literature suggests that the information base for enterprise management cannot be limited to financial statements alone. This led to the emergence of such a concept as management reporting. The structure of management reporting depends on the organisational and structural features, specifics of functioning and nature of the enterprise's activity, which makes the issue of methodology and allocation of features of management reporting formation at domestic enterprises relevant.

**Literature review**

Both domestic and foreign scholars, in particular, M Bilukha, O. Borodkin, O. Vakulchyk, M. Zavorotnyi, L. Napadovska, P. Khomyn, I. Yaremko, B. Needles, J. Foster, D. Bittle, etc. have studied the issues of using information for enterprise management, decision-making and peculiarities of forming this type of reporting. However, there are theoretical and practical problems in defining the essence and place of management reporting in the enterprise information system, its links with other types of reporting, substantiation of the principles, methodology and algorithm of its formation, which determines the relevance of the study.

**The purpose of the study**

Disclosure of the peculiarities of formation of management reporting, determination of its role and place in modern management systems at domestic enterprises, basic principles of its preparation.

**Research results**

Despite the fact that in the works of domestic and foreign scholars have studied the essence, classification, and principles of management reporting, the peculiarities of its formation at enterprises in specific industries remain poorly understood, and the forms of reports and the system of indicators included in them, the methodology for generating reports, etc. have not been developed. This leads not only to a decrease in the quality of management reporting, but also to an increase in the costs of its develop and implementation. With minimal labour and time costs, the information should reveal the possibilities of using the company's resources, the consequences of economic, technical and technological business

processes and be summarised in the form of reports (including internal ones). This led to the emergence of a specific product – "management reporting".

Domestic and foreign scholars identify two interconnected subsystems of financial and management accounting, which generate information that is summarised in financial and management reports, respectively. D. Rybalchenko, Partner and CFO of Nota Group, identifies six reasons for implementing management accounting at an enterprise: loss of management intuitiveness due to scale; attracting investors and the need for a transparent accounting and reporting system for all participants; complication of the company's business processes; quick answer to the question: "Where's the money?"; the need to segment products and customers; the need to account for current finances: how much is on the balance sheet, how much is owed and to whom, etc. (Rybalchenko, 2020).

According to O. Vakulchyk, the economic crisis of the 30s of the twentieth century exposed the shortcomings of the traditional system of production costing, which did not provide management with the necessary information for management decision-making, which became a prerequisite for the powerful development of management accounting and reporting (Vakulchyk, 2010).

The diversity of scholars' views on management reporting can be attributed to the emergence and change in the composition of users of accounting information. At the time when the owner was not separated from management, the accounting statements of that time, with a certain assumption, can be called management accounting. As a result of the separation of ownership and management functions, there was a need to improve the theory and practice of management accounting. There are many definitions of management reporting in the scientific literature. However, it should be remembered that the accuracy and conciseness of any term is essential for its correct use. The vast majority of definitions of "management reporting" contain references to the purpose or reason for preparing reports (information ensure for the activities of the company's managers and its structural units) and the content of information to be reflected in management reports (disclosure of the results of the implementation of the managers' decisions or the performance of the company and its individual units).

In the specialised literature, scholars use different terms to refer to this type of reporting: “internal accounting reporting”, “internal reporting”, “internal economic reporting”, “accounting management reporting”, “management reporting”, “operational reporting”. In addition, some scholars equate such concepts as “internal” and “intra-economic”; “internal”, “internal management” and “management” reporting. In our opinion, this issue is debatable. Thus, if there is internal management reporting, then there should be external management reporting. In our opinion, the name “management reporting” emphasises its purpose to a greater extent – meeting the information needs of exclusively internal users at all levels of enterprise management.

In order to understand the essence of the concept of “management reporting”, let us focus on the analysis of such a category as “reporting”. This category has been interpreted in the following ways: as an element of the accounting method, as a source of information and as a form of observation (Ivanenko, 2011). In the scientific and specialised literature, the category of “reporting” has substantially similar, but with some differences, definitions. Thus, describing reporting as an element of the accounting method, V. Shvets notes that it is the final generalisation of information and obtaining the final indicators that characterise the activities of the enterprise (Shvets, 2008).

For a long time, it was believed that all types of reporting are formed based on a single information base created in the accounting system. However, some researchers believe that management accounting is the basis for the preparation of any reporting. It is worth noting that the main types of reporting have their own peculiarities both in terms of the content and level of detail of information, as well as in terms of the frequency of preparation, presentation, measures, indicators, users, purpose, etc. Management decision-making may require information that is generated outside of accounting (e.g., about the external environment in which the company operates; not only quantitative but also other indicators, etc.) The main difference between management reporting and financial reporting is that financial reporting contains mainly accounting indicators that reflect the state of the accounting object, while management reporting contains accounting and settlement

indicators. The latter are calculated using methods that are not related to accounting (methods of planning, analysis, control, etc.).

The current legislation of Ukraine establishes restrictions on the detail of information in financial, statistical and tax reports. As a result, the needs of internal users of such reports are not always met in full. Management reporting allows the company's managers to set their own requirements in terms of content and structure, level of detail, presentation, qualitative and quantitative characteristics, etc. It can be said that management reporting is prepared based on requests from internal users. It is able to minimise, if not eliminate, the information gaps that arise when using the above-mentioned types of reporting.

Management accounting and reporting have been left out of the attention of legislators. The study conducted by M. Shmygun and V. Ivanenko allowed to conclude that management reporting is an independent system of providing data necessary for information ensure of management (Shmygun & Ivanenko, 2008). According to domestic scholars, management reporting should be understood as all types of reporting (financial, internal economic, tax, statistical, non-financial, integrated) that can be used for management decision-making. This statement expands the range of its use not only by internal users, but also by external ones (Zavorotnyi, 2020).

Instead, S. Korol believes that equating management reporting with internal economic, operational or other reporting does not meet modern practice and requirements for information ensure of enterprise management and does not take into account the possibilities of accounting automation that exist today. In his opinion, the main types of reporting differ not only in purpose, but also have their own characteristics in terms of their content, level of detail of information, frequency of generalisation and presentation, structure of indicators and measures (Korol, 2014).

When forming a management reporting system, S. Kuznetsova suggests determining the form, deadline for submitting reports and those responsible for their preparation; drawing up a scheme for the formation of management reports; identifying the owners of the source information; the responsible coordinator; users of information and the form in which it will be provided to them (Kuznetsova, 2014).

There is also no consensus on the interpretation of the management accounting method (preparation of management reporting). It includes elements of planning, control, and analysis. L. Napadovska understands the method of management accounting as a set of traditional methods of planning, control, accounting, analysis, rationing, and management decision-making that facilitate the study of the "behavior" of costs and income in order to manage them (Napadovska, 2004). M. Pushkar distinguishes the following groups of management accounting methods: general methodological methods of research of the object – observation, comparison, analysis and synthesis; general scientific methods of accounting – general methods inherent in accounting, such as double entry, documentation, inventory, evaluation and calculation, accounts, double entry; specific methods of accounting – grouping and regrouping of production costs, normative method of accounting and calculation, mathematical methods of cost and profitability research. This position reflects a general scientific approach to the methodology of any science, but does not streamline the methodological framework for specific methods of management accounting (Pushkar, 1999).

Management reporting is gaining importance due to the need to ensure high competitiveness of the enterprise and to include data on the external environment in which the enterprise operates. The centre of gravity in management work has shifted from the accounting stage to the risk forecasting stage. This led to the fact that management accounting and reporting went beyond traditional accounting: not only the traditional components of the accounting method, but also those inherent in management accounting were used in the preparation of management reports. The emergence of the latest information technologies and their implementation in the accounting and information system of the enterprise created conditions for eliminating the above-mentioned shortcomings of management reporting.

In today's business environment, an enterprise is forced to look for forms of adaptation, including accounting, to the conditions of a constantly changing external environment. This cannot but affect management reporting, which becomes more dynamic and open in responding to both the problems that arise in the company's activities

and in responding to various user requests. One should not neglect such a factor as the professional level of users of management reporting, which is expressed in the ability to correctly request the necessary information, and the accountants who fulfil the received information request.

The managers of an enterprise and its structural units, setting requirements for the composition of information necessary for decision-making, determine the form, structure of indicators, frequency, etc. of management reporting. The accounting information should be as close as possible to the structure of the company's reporting in order to spend less effort (time) on regrouping (selecting) them in the process of preparing the relevant reports.

The statement of the purpose of financial statements can be divided into two parts: 1) a list of qualitative and 2) content characteristics. When formulating the purpose of management reporting, it should be borne in mind that the characteristics of the information provided to its users will be situational: depending on the timeframe, tasks of structural units, etc., preference will be given to one or other qualitative characteristics of management reporting.

Thus, the purpose of preparing management reporting is to provide internal users with information necessary for management decision-making and effectively performing their functional duties to solve both current and strategic tasks in the course of the entity's activities.

When defining the objectives of management reporting, K. Nahirska suggests taking into account the following areas:

1) to inform evaluation and analysis – to present indicators in dynamics; in comparison with other equivalent structural units; in comparison with industry averages; in terms of the impact of the most dependent factors; monitoring the feasibility and significance of individual analytical indicators;

2) for information ensure of control – bringing the content of reporting formats in line with the budget tables; ensuring comparability of reporting and budget indicators and methods of their calculation; compliance with the frequency of submission of reporting forms (especially in case of control over the activities of heads of structural units);

3) information support for management decision-making – provision of alternative options for each individual decision; availability of quantitative and qualitative indicators with a brief description by the relevant specialist; presentation of additional indicators on the impact on social development of the enterprise or region and ensuring economic security (Nahirska, 2012).

The issue of forming the optimal number of statements for information users depends on the number of features and criteria. The list of analytics that will be displayed and the approaches to selecting features in the statement should be taken into account. On the one hand, a one-dimensional statement makes it possible to reduce the number of attributes to a minimum (one attribute) and, on the other hand, to increase the total number of attributes, while a multidimensional statement displays many attributes (limited by the number of graphs) in one large statement. It is worth noting that each specific situation requires an appropriate decision on the methodology of forming a reporting table. Thus, to prepare information in an operational mode to meet the information needs of a lower level of management, single-level reports are more often used, while for a higher level of management it is recommended to use multilevel statements that allow comparing several criteria.

To meet the needs of different levels of management, an internal reporting system should be established for each responsibility centre, the indicators of which should be able to be summarised by structural units of the enterprise.

An effective system the formation of internal reporting is possible when, on the one hand, the heads of responsibility centres are held accountable for its reliability, and, on the other hand, the enterprise should systematically monitor the process of submitting internal reports and the performance of their functions by responsible persons. The internal regulations on management reporting should define the following: deadlines for preparation; formats of internal accounting management reports; areas of presentation; segmentation criteria (e.g., geographic, organisational segment, etc.).

Accounting and reporting principles are regulated by the laws of a particular country and international financial reporting standards. The category “principle” first appeared in the 1930s in the United States. At that time, two main principles were identified:

conservatism and immutability. Foreign researchers R. Enthony and J. Rees note that accounting principles are developed by people, and unlike the laws of physics or chemistry are not "eternal truths"... rules and agreed concepts of accounting are usually called principles (Enthony & Rees, 1998). The principles of accounting (financial) reporting are considered by foreign scholars from the perspective of accounting. In particular, B. Needles, H. Andersen, & D. Conduell (2003), R. Enthony, & J. Rees (1998) and some others believe that basic accounting principles form the basis for regulating the accounting information system and are aimed at the formation and presentation of reports. The basic accounting principles are: reporting period, monetary (kopeck) measurement, property separation, cost accounting, going concern, duality, prudence, realisation and accrual basis.

The interpretation of the principles forming of management reporting remains an unexplored issue. M. Demianenko proposed the principles that should be taken into account when forming management reporting and its presentation to interested users: reliability; flexibility (modular principle), efficiency (timeliness); separation; systematicity; aggregation (collapse) of information; hierarchy; comparability of indicators; top-down design; cost controllability. He also proposed the main requirements for information: efficiency (rationality), effectiveness, reliability (accuracy), specificity (targeting), confidentiality, accessibility, open architecture, integrity (completeness) (Demianenko, 2012).

Given that the interests of different user groups differ, the requirements for information and its presentation in management reporting and accounts prepared in accordance with IFRS also differ. The higher the level of management, the more the interests and set of decisions made by the manager are closer to those of external users. Management reports should contain similar information to financial statements, but in a more detailed manner (data in natural units of measurement, by different types of activities or centres of responsibility, etc.)

In the formation of management reporting, the most progressive form of its organisation is the model by responsibility centres. P. Khomyn believes that cost centres are the divisions of enterprise where the primary reflection of costs takes place. They are not

complete in the production cycle, unlike responsibility centres, where such a cycle ends with the production of finished products (works, services) and their calculating. Therefore, there is an intermediate reflection of costs with their subsequent transfer to responsibility centres. In his opinion, a responsibility centre is an organisationally separate structural unit managed by a separate manager. A cost budget is prepared for such a unit. Cost deviations and their causes are analysed by the manager of the responsibility centre (promptly based on management accounting registers) and by top-level managers (based on reports on the implementation of cost budgets submitted by responsibility centres) (Khomyn, 2004).

We consider cost centres to be production and service units that have homogeneous functions and operations. A cost centre is a set of cost centres that are considered as a production unit. A cost centre may overlap with cost centres if they have similar production, organisational and accounting characteristics. A responsibility centre contains several cost centres and covers not only production costs but also all economic activities of the enterprise.

Recently, the attention of scientists and practitioners has been focused on the principles of develop and formation of management reporting. N. Kulikova identifies the following principles that should be taken into account when preparing management reporting: 1) principles that determine the theoretical basis for the formation of management reporting: systematicity, scientificity, accounting for the time value of money, prudence, accrual accounting, the principle of mutual complementarity of related sciences; 2) principles that determine the composition and structure of management reporting: usefulness, qualitative materiality, sufficiency, brevity, targeting, individuality, rationality, clarity, visibility and analyticality, technologically and analyticality, technological efficiency, unity and formal distinction between accounting and settlement indicators, linking indicators; 3) principles that determine the procedure for preparing management reporting: reliability, independence, the principle of consistent application of accounting policies, mandatory automation, integrated information base, use of professional judgement, confidentiality, efficiency; 4) principles that ensure the effective use of information technology: principles of interactivity and hierarchical presentation of information, openness

(development); 5) principles of information modelling: information sufficiency, feasibility of the model and forecasts based on it, multiplicity of models, aggregation, parameterisation; 6) principles caused by the need to apply professional judgement: validity, consistency, unambiguity, technical feasibility; 7) principles that lose their role in the conditions of using decision support systems: accounting equality, quantitative assessment, priority of economic content over legal form, documentation, single monetary measure, periodicity (Kulikova, 2015).

According to L. Shatkovska, such principles should include expediency, targeting, clarity, efficiency (timeliness), objectivity, optimality, accuracy, reliability, comparison with plans, estimates, and the ability to use internal reporting indicators for internal control (Shatkovska, 2011).

The approaches discussed above to the selection of principles to be taken into account when preparing internal management reporting give grounds to conclude that there is no generally accepted classification of them. In our opinion, this can be explained by the fact that the system of principles of internal management reporting includes general principles of account reporting. In view of this, there are proposals to distinguish two main groups of principles of management reporting when building a general classification of principles of management reporting: 1) general, which must be observed in the preparation of any accounting statements and 2) special, which are taken into account only in the preparation of internal management reporting (Koryagin & Kutsyk, 2016). The set of principles to be used at the enterprise should be enshrined in the administrative document regulating the management accounting policy (order on accounting policy or separate provision on management accounting policy).

The principles formation of reporting are of interest not only to scientists but also to international organisations, in particular the International Federation of Accountants, which in 2013 issued a special report “Principles for Effective Business Reporting Processes”. Its purpose is to help enterprises improve the quality of the reporting process. Thus, they include 11 principles that are recommended for use by all enterprises, regardless of their size, structure, form of ownership, etc.:

1) senior management should assume leadership for high-quality reports through effective reporting processes;

2) the enterprise should determine the various roles, responsibilities, and consequential capabilities in the reporting process, appoint the appropriate personnel, and coordinate collaboration among those involved in the reporting process;

3) the enterprise should develop and implement an effective planning and control cycle for its reporting processes in the context of, and in alignment with, its wider planning and control cycles;

4) to ensure the provision of high-quality information, the enterprise should regularly engage with its internal and external stakeholders and understand their information needs with regard to past, present, and future activities and results of the enterprise;

5) based on the outcomes of its stakeholder engagement, and taking cost-benefit considerations into account, the enterprise should define the content to be included in its reports and also decide on the audience, layout, and timing of its reports;

6) the enterprise should have a process in place to ensure that the most appropriate reporting frameworks and standards are selected and that the requirements of those frameworks and standards are aligned with stakeholder information needs;

7) the enterprise should determine what information needs to be captured, processed, analyzed, and reported, and how to organize the information processes and related systems for effective reporting;

8) the enterprise should identify, analyze, and select appropriate communications tools and decide how to optimize distribution of the enterprise's reporting information via the various communications channels;

9) the enterprise should ensure that reported information is sufficiently analyzed and interpreted before it is provided to internal and external stakeholders;

10) when obtaining internal or external assurance is not a matter of compliance, the enterprise should consider voluntary internal or external assurance on its reports and reporting processes;

11) the enterprise should regularly evaluate its reporting processes and systems in order to identify and carry out further improvements required for maintaining reporting effectiveness (International Federation of Accountants, 2013).

**Conclusions**

The study suggests the following that management reporting today is one of the key tools for making informed management decisions and forming plans that will allow an enterprise to development in the current conditions of market competition. The growing popularity of management reporting is due to the fact that nowadays the senior management of progressive Ukrainian firms does not limit itself to accounting or financial information, but increasingly pays attention to information of a non-financial nature.

Management reporting can be viewed as a separate component or subsystem in the management and control systems of an enterprise. In these systems, management reporting connects management personnel with performers and production, as it reflects information about the overall activities of the institution. In addition, it has been determined that management reporting is qualitatively better than accounting, financial and tax reporting, as it can reflect specific indicators that are not reflected in other reports. Each individual management report is useful only if the management needs this or that specific information, otherwise it is not only useless, but also to some extent harmful, since it requires resources for its formation.

To effective implementation of the proposed system of principles in the practical activities of a particular enterprise, more detailed recommendations for their practical application should be developed. Further research in the field of management reporting will allow for a better selection of tools for the formation of specific information and analytical reports, which in turn will allow for more relevant information necessary for the smooth functioning of planning and management systems, with the least time and financial costs.

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# LENDING OF AGRICULTURAL PRODUCERS IN UKRAINE: ECONOMIC AND STATISTICAL ANALYSIS OF DATA PANEL

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**Abstract**
*The purpose of the article is to analyse and develop a methodology for a comprehensive statistical study of lending to agricultural producers as a source of their investment. The analysis of the agricultural loan market for 2008-2022 was carried out on the basis of statistical data of the National Bank of Ukraine and on this basis conclusions were drawn about the level and features of agricultural lending in Ukraine. The methodological basis of the article is general scientific methods and techniques: a systematic approach to the object and subject of research, dialectical logic, analysis and synthesis, comparison and generalization, grouping, the method of scientific abstraction, modelling, which ensures the integrity, comprehensiveness and reliability of the article. The size, dynamics and structure of bank lending to agricultural producers are statistically estimated. The main problems faced by agricultural producers in the process of development of borrowed credit resources are identified. The need to increase the credit availability of agricultural enterprises is analytically substantiated. The features of development and the current practice of lending to agricultural enterprises in Ukraine are disclosed. The main directions of the state policy to stimulate the attraction of loans by agricultural enterprises are substantiated. The ways of development of bank lending to strengthen the resource base of agricultural enterprises are proposed.*

**Keywords:** *agriculture, banks, credit, growth rates, specific weight.*

## Introduction

Agro-industrial production is a strategically important sector of the economy, on which the level of food and national security of the country depends, and support for its lending in times of war is objectively necessary. Stimulation of lending is a key tool in solving the problem of the Ukrainian economy entering the trajectory of dynamic development. Increasing the availability of credit resources is one of the main conditions for the sustainable development of agriculture, which is determined by the need to prepare for the sowing campaign in crop production, the procurement of fodder stocks when fattening livestock in animal husbandry.

Taking into account the duration of the production and financial cycles in agriculture, there is a higher need for short-term loans compared to other sectors to finance current assets for a period of several months to 1-2 years. At the same time, the risks of lending to the industry are high, which is associated with significant fluctuations in prices for agricultural products and instability of natural and climatic conditions in the main territory of Ukraine, as well as the problem of information asymmetry due to the poor quality of financial accounting for most farmers and personal subsidiary plots. In addition, the territorial dispersal of agricultural producers leads to an increase in the transaction costs of lending and other financial services to such clients. To overcome these problems, lenders may demand substantial collateral from potential borrowers, charge higher interest rates, or deny loans to borrowers who do not meet more stringent underwriting standards.

The high importance of agriculture in the period of post-war renewal indicates the need for a detailed analysis of the features of organizing bank lending to agricultural producers and the formation of a mechanism that ensures their access to credit resources, which determines the relevance of the article.

## Literature Review

The issues of financial support and lending to agricultural enterprises are widely considered in the works of domestic scientists in the field of finance and enterprise finance (Andros *et al.,* 2019a; Andros *et al.,* 2019b). In the conditions of war, the problems of state regulation and support of agro-industrial production are reflected in

the collective monograph (Andros & Gerasymchuk, 2022). In foreign science, the specifics of agricultural credit and the problems associated with financial support for the activities of agricultural enterprises are reflected in the works Hubbs & Kuethe, 2017; Chandio *et al.*, 2018; Agbodji & Johnson, 2021; Kuethe *et al.*, 2022). The problems of improving the lending system, the investment activity of enterprises, the mechanism of lending and state regulation in the field of agriculture were covered in the works of scientists and practitioners: Kremp & Sevestre 2013; Cosci *et al.*, 2016; Sidek *et al.*, 2016; Ferri *et al.*, 2019; Kambali *et al.*, 2022. In foreign economic literature, the main attention is paid to the forms of state support for agricultural producers, the assessment of the impact of subsidies in terms of the efficiency of the use of public funds and the functioning of agricultural banks, however, at the level of microfinance. These problems are reflected in the works: Behr *et al.*, 2011; Anang *et al.*, 2015; Fecke *et al.*, 2016; Silong & Gadanakis, 2019.

In the methods developed by economists, the assessment of the effectiveness of the lending process for enterprises was associated with the study of the dynamics of the gross social product, the turnover of loan investments, the share of loans in working capital, the percentage of use of the country's potential resources by the credit system, satisfaction of loan needs (Baas & Schrooten, 2006; Bartoli *et al.*, 2013; Kiplimo *et al.*, 2015).

The methodological approaches proposed by scientists did not very clearly derive and link the efficiency of the national economy with the efficiency of lending and practically did not determine the problematic elements in the credit mechanism. Researchers of theoretical issues of evaluating the effectiveness of lending in the last decade have also not been successful in this matter and were mainly based on indicators that characterize individual moments of the lending process: the share of overdue debt, the share of credit resources directed to the manufacturing sector, the share of long-term loans in the total loan amount. The authors' research confirms the importance of further developments in assessing the volume, dynamics and structure of bank lending to agricultural producers, the activities of a commercial bank in the credit market and the activation of effective sales of bank agricultural products.

Thus, the study of the issues of assessing the effectiveness of the credit mechanism and, in particular, the process of lending to agricultural enterprises, the search for perfect relationships between the lender and the borrower, the development of practical recommendations in the field of improving the process of financing business entities, taking into account the features of the current stage of the functioning of agricultural production, is not well understood.

The foregoing gives grounds for asserting that the improvement of the system of crediting agricultural producers is one of the urgent and insufficiently studied problems in economic science.

**Methodology**

The methodological base of the study is a systematic analysis of the process of lending to agricultural producers, a structural analysis of the organization of financial support for agricultural producers, a logical analysis of trends in the development of the process of lending to the agricultural sector against the backdrop of solving the problem of the post-war restoration of the Ukrainian economy. The decomposition of the tasks of the process of agricultural lending, solved in the credit sector, is carried out. Methods of induction and deduction were used in the analysis of agricultural lending in Ukraine. The generalization method was used in the analysis of the agricultural loan market for 2008-2022 based on the statistical data of the National Bank of Ukraine. The method of mathematical modelling was used in compiling a dynamic equilibrium model for analysing the development of the agricultural lending process.

**Results and Discussion**

Under the conditions of war, it is difficult for agricultural producers to obtain a loan from commercial banks, since they are aimed at working with borrowers who are able to ensure the return of credit resources at a high interest rate in a short period. The market for credit resources in the agricultural sector is monopolistic in nature on the part of individual credit institutions, and agricultural producers show low activity.

The finances of agricultural enterprises are characterized by certain specifics and require a constant inflow of loan capital. Due to the length of the production cycle, the seasonality of production and the associated nature of the formation of costs and stocks,

agricultural enterprises do not have sources for continuous financing. The use of loan capital makes it possible to significantly expand the volume of economic activity of enterprises, ensure more efficient use of own funds, and accelerate the renewal of fixed assets. In this regard, the attraction and use of borrowed financial resources is an important aspect of the financial activity of the enterprise, aimed at achieving high end results of management.

To assess the state of bank lending in Ukraine in recent years, consider the main trends in the functioning of the banking sector.

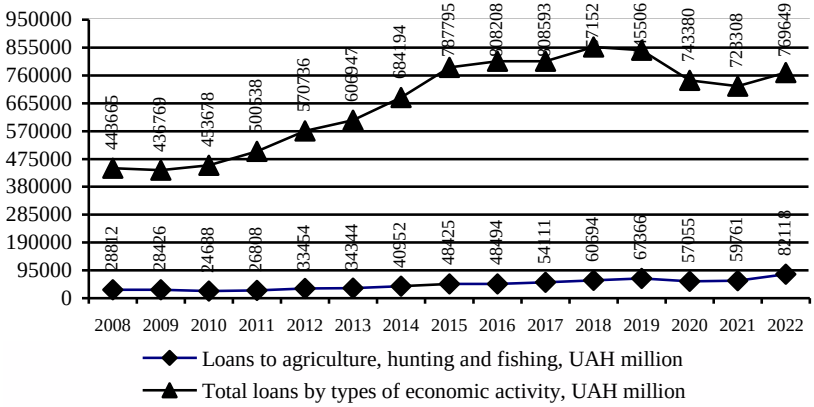


**Figure 2.2 Loans provided to agriculture, hunting and fisheries in the period 2008-2022, UAH million**

*Note: compiled by the authors based on data from the National Bank of Ukraine*

Analysing the current situation with bank lending to agriculture, we can say that the lending activity of banks began to grow, the volume of bank lending to the agricultural sector increased. As can be seen in Figure 2.2, the volume of bank lending to agriculture in Ukraine is UAH 82.118 billion in 2022, against UAH 28.812 billion in 2008 (an increase of 3.4 times – by UAH 24.494 billion over 15 years). At the same time, we note that the share of agriculture in lending to the economy increased from 5.36% in 2011 to 10.67% in 2022 (Figure 2.3).

An analysis of the participation of banks in the financing of production leads to the thesis that, against the backdrop of high growth rates in the banking sector compared to the economy as a

whole, there is a tendency for banks to intensify their performance of financial intermediation. There is a significant relationship between finance and credit. One of the main areas of bank lending is the financing of seasonal field work. A timely loan on terms acceptable to a rural commodity producer and the same operational financial resource, without which it is impossible to open the season of spring work, start and finish the collection and sale of agricultural products on time.

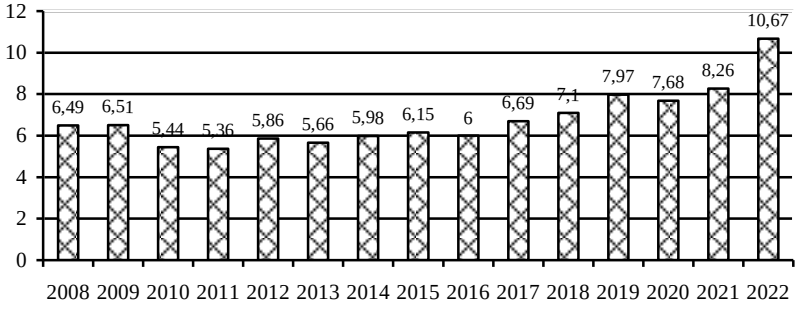


**Figure 2.3 Dynamics of the share of agriculture, hunting and forestry in the total volume of lending to the economy for the period 2008-2022, %**

*Note: compiled by the authors based on data from the National Bank of Ukraine*

Figure 2.3 shows that the share of loans to agriculture in the total volume of loans is more than 7% in the period 2018-2020, in some years reaching values of more than 8% and 10% (as of 2021 and 2022, respectively). The share of agriculture in the loan portfolio of banks for 2021 is 8.26%, while it increased by only 1.57% compared to 2017 (6.69%). In 2008, the share of agriculture in the loan portfolio of banks amounted to 6.49%, and in 2016, it decreased by 0.49% and amounted to only 6%.

Given the above, we note that the limiting factors for the participation of credit in this process are: low profitability in agriculture, high risks of production, there is a disparity in prices for manufactured products and raw materials and materials consumed by agricultural enterprises. These and other factors have a satisfactory

effect on the financial stability of agricultural producers, preventing them from meeting the requirements set by banks. At the same time, additional sources of loan repayment are, as a rule, insufficient or non-existent.

As can be seen in Table 2.2, the volume of loans issued to agriculture showed a positive trend and rose to the level of UAH 59.761 billion in 2021, against UAH 57.055 billion in 2020.

*Table 2.2*

**The share of loans provided to agriculture, hunting and forestry in the period 2008-2022, UAH million**

| Year | Total loans by types of economic activity, UAH million | Agriculture, hunting and forestry, UAH million | The share of agriculture in the portfolio, % | Growth rates, total loans, % | Growth rate of agricultural loans % |
|---|---|---|---|---|---|
| 2008 | 443 665 | 28 812 | 6,49 | -1,55 | -1,34 |
| 2009 | 436 769 | 28 426 | 6,51 | 3,87 | -13,15 |
| 2010 | 453 678 | 24 688 | 5,44 | 10,32 | 8,59 |
| 2011 | 500 538 | 26 808 | **5,36** | 14,02 | ***24,79*** |
| 2012 | 570 736 | 33 454 | 5,86 | 6,34 | 2,66 |
| 2013 | 606 947 | 34 344 | 5,66 | 12,73 | 19,24 |
| 2014 | 684 194 | 40 952 | 5,98 | 15,14 | 18,25 |
| 2015 | 787 795 | 48 425 | 6,15 | 2,59 | 0,14 |
| 2016 | 808 208 | 48 494 | 6,0 | 0,048 | 11,58 |
| 2017 | 808 593 | 54 111 | 6,69 | 6,0 | 12,17 |
| 2018 | 857 152 | 60 694 | 7,1 | -1,36 | 10,99 |
| 2019 | 845 506 | 67 366 | 7,97 | -12,08 | *-15,31* |
| 2020 | 743 380 | 57 055 | 7,68 | -2,7 | 4,7 |
| 2021 | 723 308 | 59 761 | 8,26 | 6,41 | ***37,41*** |
| 2022 | 769 649 | 82 118 | **10,67** | - | - |

*Note: compiled and calculated by the authors based on data from the National Bank of Ukraine*

The dynamics of bank agricultural lending during the period under review was average, although in general, high growth rates were observed at the end of 2021. Lending to agriculture decreased significantly (-15.31% in 2019), which was the worst result in recent years. In general, the growth rate of agricultural loans in 2021 amounted to 37.41%. For comparison, the last time higher growth rates in general for the year were in 2011 (+24.79%). It is worth noting that the result of 2011 was atypical due to the anomalous

dynamics of assets in 2009 (-13.15%), when against the backdrop of unprecedented turbulence, assets rose immediately by 8.59% in 2010. Thus, aside from the not-quite-routine 2011 result, asset performance in 2021 was actually better than in 2013 (+19.24%).

The growth rate of the loan portfolio of agricultural entities during 2010-2022 (with the exception of 2019) remain at a level sufficient for this sector. This indicates both the growing need of agricultural entities for borrowed funds, and the expansion of the supply of agricultural loans from banks. Government programs and regulatory easing, aimed, in particular, at restructuring loans in the context of a pandemic and war (Figure 2.4), support the growing need for agriculture in borrowed funds.

In the end, all these efforts contributed to the revitalization of the agricultural sector.

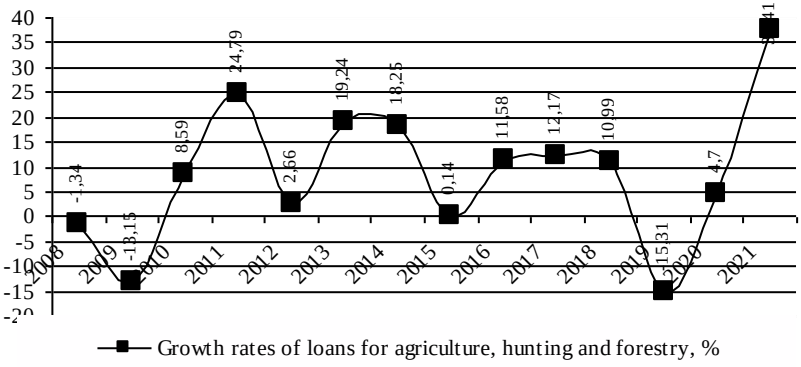


**Figure 2.4 Growth rates of loans for agriculture, hunting and forestry in the period 2008-2022, %**

*Note: compiled by the authors based on data from the National Bank of Ukraine*

We attribute the rather high result in terms of the growth rate of agricultural lending in real terms in 2021 to the loose monetary policy of the National Bank of Ukraine and support for the economy through the pandemic. Measures taken at the state level in 2022 led to a revival of lending in the agricultural sector. Against the background of the consequences of the pandemic and the war, there has been an increase in the volume of lending to the agricultural business, an increase in the availability of loans and, consequently,

an increase in the business activity of Ukrainian agribusiness. The revival of lending to the agricultural sector and the mitigation of the consequences of the pandemic were largely facilitated by the financial support provided at the state level to agricultural producers.

In 2023, with a high probability, the dynamics of assets will be weaker. First, the easing introduced due to the pandemic and the war can be revised or cancelled. Secondly, the economy is experiencing an increase in interest rates; as a result, agricultural lending may slow down.

As seen in Figure 2.5, during 2008-2022 the volume of mortgage lending to households decreased by almost 5.5 times. If in 2008 the volume of mortgage lending amounted to UAH 143.416 billion, then in 2022 this figure was only UAH 26.305 billion. The reasons for such a low share of mortgage lending include: the lack of solvent borrowers with officially confirmed income; insecurity of households investing in housing in the primary market; slow decline in interest rates on mortgages, in particular, in 2021, the average mortgage loan rate depending on the type of real estate: a new building or a finished building fluctuated between 14-24%.

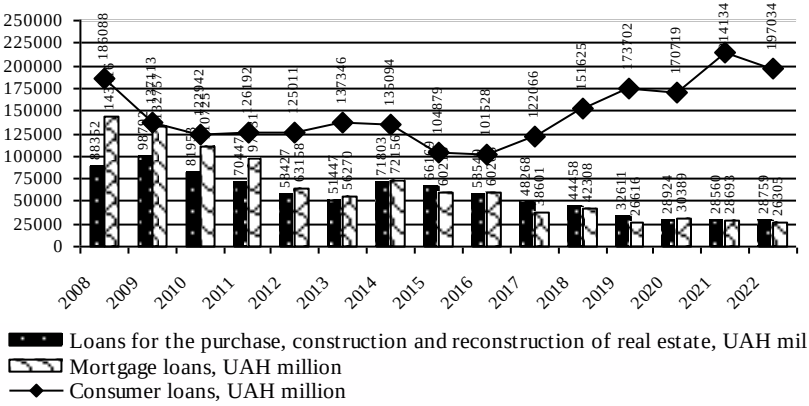


**Figure 2.5 Loans provided to households by target area in 2008-2022 (balances at the end of the period), UAH million**

*Note: compiled by the authors based on data from the National Bank of Ukraine*

Regarding loans for the purchase, construction and reconstruction of real estate, it should be noted that in the period 2009-2022 there is

also a trend towards a decrease in household lending in this area. If in 2009 the volume of lending in this direction amounted to UAH 98.792 billion, then in 2022 this figure was already UAH 28.759 billion (an almost 3.4-fold decrease in lending). At the same time, in the sphere of consumer lending to households, a moderate growth dynamics was noted over the period under review: from UAH 137.113 billion in 2009 to UAH 197.034 billion in 2022. In 2021, household consumer lending reached a maximum value of UAH 214.134. If in 2021 to compare with 2008, then there was an increase of almost 1.6 times during this period. In the context of the structure of bank loans provided to business entities by types of economic activity, the following can be stated (Table 2.3).

*Table 2.3*

**Structure of loans by types of economic activity as of the end of January 2022 (fund balances at the end of the period), UAH million**

| Type of economic activity | Loans are provided by industry | Specific weight, % |
|---|---|---|
| *Agriculture, forestry and fisheries* | 82 118 | *10,67* |
| Mining and quarrying | 11 697 | 1,52 |
| *Processing industry* | 155 514 | *20,21* |
| Supply of electricity, gas, steam and air conditioning | 64 592 | 8,4 |
| Water supply; sewerage, waste management | 690 | 0,089 |
| Construction | 23 536 | 3,06 |
| *Wholesale and retail trade; repair of motor vehicles and motorcycles* | 290 245 | *37,71* |
| Transport, warehousing, postal and courier activities | 33 730 | 4,38 |
| Temporary accommodation and catering | 4 716 | 0,61 |
| Information and telecommunications | 13 543 | 1,76 |
| Financial and insurance activities | 6 593 | 0,86 |
| Real estate transactions | 56 913 | 7,39 |
| Professional, scientific and technical activity | 8 533 | 1,11 |
| Activities in the field of administrative and auxiliary services | 12 768 | 1,66 |
| Education | 197 | 0,026 |
| Health care and provision of social assistance | 3 163 | 0,41 |
| Arts, sports, entertainment and recreation | 764 | 0,099 |
| Provision of other types of services | 338 | 0,044 |
| Total loans by types of economic activity | 769 649 | 100 |

*Note: compiled and calculated by the authors based on data from the National Bank of Ukraine*

Agriculture, being an industry with a high degree of risk, is always the object of close attention from commercial banks. In 2022, agriculture, forestry and fisheries accounted for 10.67% of all loans or UAH 82.118 billion. In 2022, the largest volume of credit funds was concentrated in the wholesale and retail trade – UAH 290.245 billion (37.71% of all loans provided to business entities); 20.21% of all loans (UAH 155.514 billion) provided to legal entities are concentrated in the processing industry.

*Table 2.4*

**Structure of bank lending to agriculture by terms of lending, 2022, UAH million**

| Types of economic activity | That's all | including | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | in the national currency | | | | in foreign currency | | | |
| | | that's all | including by terms | | | that's all | including by terms | | |
| | | | up to 1 year | from 1 year to 5 years | more than 5 years | | up to 1 year | from 1 year to 5 years | more than 5 years |
| Total, UAH million | **777 369** | **514 144** | 334 136 | 141 822 | 38 186 | **263 225** | 95 646 | 104 199 | 63 380 |
| Agriculture, forestry and fisheries | **121 742** | **91 601** | 51 176 | 37 849 | 2 575 | **30 141** | 16 475 | 10 970 | 2 696 |
| Share of agriculture, forestry and fisheries, % | **15,66** | **17,82** | 15,32 | *26,69* | 6,74 | **11,45** | 17,22 | 10,5 | 4,25 |

*Note: compiled and calculated by the authors based on data from the National Bank of Ukraine*

The data in Table 2.4 show that in the structure of bank agricultural lending in terms of lending terms in the national currency, the largest share in 2022 is occupied by loans from 1 to 5 years (26.69%). The share of short-term loans issued to agriculture in the national currency in 2022 is 15.32% against 6.74% of long-term loans.

In the structure of bank agricultural lending in terms of terms of lending in foreign currency, the largest share in 2022 is occupied by short-term loans (17.22%). The share of medium- and long-term loans is 10.5% and 4.25%, respectively.

More loans to agriculture are provided in the national currency – UAH 91.601 billion, and in foreign currency – UAH 30.141 billion, respectively. The share of loans in agriculture in the national currency reaches 75.24% in 2022.

The confidence of the banking system in agriculture determines the nature of the allocated loans. As a rule, commercial banks practice issuing credit resources for a short period, but today the largest number of 26.69% of the issued credit funds in the national currency falls on medium-term loans for a period of 1-5 years. The share of long-term bank loans of 5 years and older is 6.74% of the total loan portfolio of commercial banks. The low share of loans in agriculture is determined by several reasons. First of all, this is due to the peculiarities of the flow of agricultural production. A long production cycle, great dependence on natural and climatic conditions, dispersion of borrowers, high costs and expenses of agricultural production cause insufficient attractiveness of this industry on the part of commercial banks.

In addition, the insufficient interest of commercial banks in agriculture is due to a number of other reasons, such as the high costs of maintaining branches in rural areas; lack of enthusiasm of large banks to work with small and medium-sized borrowers; isolation of settlements and poor communication; the presence of an overwhelming number of poor people in rural areas; high level of expectation of irreversibility of issued loans; lack of liquid collateral from agricultural producers to obtain a loan; existing mistrust of the population in the banking system.

**Conclusions**

The specificity of agricultural credit implies the availability of seasonal credit to agricultural enterprises, the use of a system of preferential and subsidized lending, the development of a mortgage form of credit, as well as the formation of a system of financial institutions of additional sources of credit resources for the industry.

The crisis financial condition of agricultural producers in the conditions of war, the underdevelopment of the financial and credit infrastructure of the agro-industrial complex form a small capacity of the credit market in the agrarian sector of Ukraine. The solution of these problems is the primary task of increasing the efficiency of agricultural production.

Proposed measures to stimulate lending to agriculture and the economy as a whole: simplification of the procedure for considering applications for concessional financing; the number of documents to

put depending on the amount of the loan; reduce the time for approval of the application; given the higher transaction costs of lending, increase incentives for banks to lend to small agricultural enterprises; expansion of the list of authorized banks participating in the implementation of the preferential lending mechanism so that a larger number of regional banks, well aware of local specifics, participate in preferential lending to agricultural producers.

The results of the analysis showed that the formation of an integral system of agricultural credit, which combines the participation of the state, commercial banks, credit cooperatives, is a necessary link that can provide agricultural enterprises with financial resources. Despite the strengthening of self-financing and changes in the scale of state assistance in the agricultural sector, the policy of concessional lending to agriculture remains unchanged, the main principle of which is partial compensation of the current interest rate from budget funds.

The multistructural nature of the agrarian economy means that when forming a credit system, equal access to credit resources should be ensured for different social types of farms. Stable and profitable agricultural companies can take advantage of loans from commercial banks. High operating costs, remoteness of rural settlements, and a poorly developed insurance system make it unacceptable for commercial banks to interact with small rural entrepreneurs. The way out is the creation of multi-level rural credit cooperation: the first – at the district level, the second – at the regional level, the third – at the state level. With a significant share in the gross agricultural production and the social significance of personal subsidiary plots, it is necessary to develop the non-bank lending sector, which can be represented by various microcredit institutions.

The theoretical and practical developments proposed in the article on methodological issues of statistical research of bank lending to rural producers can be used by investors, banking structures to make decisions on issuing loans, timely identification of problem loans, as well as the development of management decisions by government agencies to find the most effective ways to develop agriculture and in line with improving Ukraine’s food security.

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# FINANCIAL FOOD SECURITY: UKRAINE'S PRACTICE UNDER MILITARY STATE

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**Abstract**
*The article explores the needs of financial support for Ukraine's food security in order to determine its sources under martial law. The positions of Ukraine and individual countries on the GFSI Global Food Security Index, as well as the assessment of food security using domestic methods, were considered. The dynamics and trends of individual indicators of financial resources of the overall potential of the agricultural sector of Ukraine in 2018-2022 are analyzed. compared to the sector's performance in terms of gross domestic product. Measures of the Government on financial provision of food security of Ukraine are outlined. It has been determined that the development of food security financing should include, in addition to compensation for the damage caused by the war, also the improvement of legislation in order to generate additional financial resources by optimizing tax, budgetary and investment regulation, simplifying the requirements for doing agricultural business, resolving problems with logistics and export of*

*agro-industrial products, mitigating the impact of inflation and monetary pressure. The volume of financial resources for the reproduction of the pre-war level of GDP production should significantly exceed it.*

**Keywords:** *agricultural sector, finance, budget support, food bakery.*

## Introduction

International law in the Rome Declaration on World Food Security (Rome Declaration, 1996) defines it as a state in which people have constant access to food for an active life. The Declaration positions the need for countries to adopt policies that will promote investment in human resource development, research and infrastructure to achieve food security, encourage job creation and profitable production, and ensure equal access of producers to productive and financial resources.

The policy of the Government of Ukraine according to the Plan of Measures for Ensuring Food Security under Martial Law (Resolution 327-r), refers it to the priority issues of national security and is defined as a set of actions that provides for monitoring the state of food security and agricultural infrastructure in general; providing support to food producers; providing targeted assistance to socially vulnerable categories of the population; centralized control of product prices.

Stabilization of the state and restoration of the potential of the agricultural sector of Ukraine as the main guarantor of food security provides for the implementation of measures, primarily state protectionism through direct financial support, as well as assistance in attracting international assistance, which is the subject of scientific research.

## Materials and methods

To achieve the goals of assessing the needs of financial support for ensuring the food security of Ukraine for the period of the legal regime of martial law and post-war reconstruction, the work used: a monographic method to describe the legal framework, analysis and synthesis to assess indicators of the state of the agricultural sector and the need for financial resources, a graphical method for reflecting the dynamics of macroeconomic indicators of the economy

of the agricultural sector, logical for theoretical generalizations and conclusions.

The study used indicators of the Global Food Security Index GFSI (Global Food Security Index, 2022) according to the FAO methodology for Ukraine and a number of other states. Also involved is the methodology for calculating food security indicators of the Methodological recommendations for calculating the level of economic security of Ukraine (Methodological recommendations 1277, 2013).

Also taken into account is the approach of researchers (Lagodiienko *& et al.,* 2022) on the impact of a system of internal and external factors on the food security of Ukraine using the Pearson correlation coefficient, where the availability of products, quality and safety, sustainability and adaptation of production are recognized as factors of internal influence. Factors of external influence are the inflation index, incomes of the population, the minimum wage, GDP per capita. The KSE study (KSE Agrocenter, 2023) is taken into account, which determined that as of October 2022, due to rising consumer prices and unemployment, the availability of food products in Ukraine decreased by 15-43%, as well as the forecast of the relevant Ministry of GDP decline during war by 30% (Ministry of Agricultural Policy, 2023).

**Results and discussion**

The food security of Ukraine according to the international rating (Global Food Security Index, 2022) since 2018 as a result of the war has decreased in the rating from 63 positions to 71. At the same time, the integral indicator increased from 54.1 to 57.9; economic affordability – from 55.7 to 66.6; however, physical accessibility decreased from 50.2 to 48.1; food quality and safety increased from 61.0 to 71.3. The financial resources deployed to achieve this level of food security were accumulated for the sector in a relatively stable and profitable 2021.

Under the conditions of the introduction of the legal regime of martial law, the volumes and structure of financing of the agricultural sector have undergone significant changes. According to the State Statistics Service, in 2021 the agricultural sector received UAH 239.98 billion ($8.8 billion) of profit, with 88.3% of

enterprises being profitable, incl. UAH 593.3 million ($21.8 million) of profit for January-September, and in 2022 the financial result (balance) before tax in the agriculture, forestry and fisheries industry for January-September amounted to UAH 344.9 million ($12,7 million at the rate of 2021 and 9.3 at the rate of 2022) loss and only 44% of enterprises were profitable, while in the economy as a whole – 60%.

The drop in the level of profitability is caused by the conduct of hostilities in the country and the introduction of martial law. The International Monetary Fund (IMF, 2023) predicted a 35% decline in the Ukrainian economy in 2022. As for the agricultural sector, the risks are even greater, in particular, the level of food security, according to the analysis of the food affordability index, has already decreased by almost 50% (KSE Agrocenter). The losses of the industry over the six months amounted to $4.29 billion, or almost 7.8% of the volume of financial resources for the period of 2021. The impact of the war on the finances of the agricultural sector according to the results of operations is given in Table 2.5.

*Table 2.5*

**Change in the financial resources of the agricultural sector of Ukraine in 2022-2021, mln. UAH**

| | Financial result (balance) before taxation, mln.UAH | | 2022, % | | 2022 % 2021 |
|---|---|---|---|---|---|
| | 2022 | 2021 | Profitable enterprises | Loss-making enterprises | |
| Total | 56695,9 | 587000,6 | 59,5 | 40,5 | 9,66 |
| *agriculture, forestry and fishing* | -344,9 | 593,3 | 44,0 | 56,0 | -58,13 |
| *industry* | -117968,0 | 392697,5 | 56,5 | 43,5 | -30,04 |

*Source: (State Statistics Service of Ukraine, https://www.ukrstat.gov.ua)*

According to various estimates, the direct losses of the agricultural sector exceed $6 billion, additional economic losses up to $22 billion, and from a decrease in income along the agro-industrial complex chain up to $30 billion, the volume of which is increasing with the conduct of hostilities (Ukraine: Request for

Purchase, 2023). In total, the losses amount to $58 billion or UAH 2,300 billion. For comparison, the entire agricultural output in terms of the balance of production accounts and income generation (in actual prices) in 2021 amounted to UAH 1,366 billion, or 59% of the industry's losses, and the average annual output for 2014-2020 – 70%. The volume of financial resources of agricultural corporations (according to the financial balance sheet) in 2020 amounted to UAH 1,130 billion, or 49% of losses, and the average annual level of financial resources for 2013-2020 – 38% of the losses incurred from military aggression. In order to reduce the decline in production indicators, the level of income of agricultural corporations, and equalize food security in terms of availability and affordability of food, adequate compensation mechanisms are needed, primarily financial instruments (Tulush & Radchenko, 2022).

The decline in production during the war, in addition to direct damage from the conduct of hostilities, is assessed by agricultural producers even more pessimistically, the achievement of at least breakeven is already considered a success. The results of the assessment and forecasts of the expectations of commodity producers according to the State Statistics Service are shown in Figure 2.6. Other factors came to the fore in the war, namely the destructive effect, as well as weather conditions.

At the same time, the financing of the agricultural sector of Ukraine and the results of its activities until 2022, according to studies (Tulush & Radchenko, 2022), demonstrated a steady trend. The financial potential in terms of the volume of financial market resources, budgetary and credit support, investments and own resources of economic entities, according to various estimates, reached UAH 1.65 trillion ($60.66 billion), of which the share of own resources was 80-82% (Figure 2.7).

In the theory of financial management (Michalski, 2008), the ratio between sources of industry financing from equity and debt capital, depending on economic cycles, can be as follows: 30-40% / 70-60% – active development; 50%/50% – steady growth; 60-70/40-30% – a crisis state. For the conditions of war and restoration, the proportions of the crisis state may vary depending on the chosen general economic strategy.

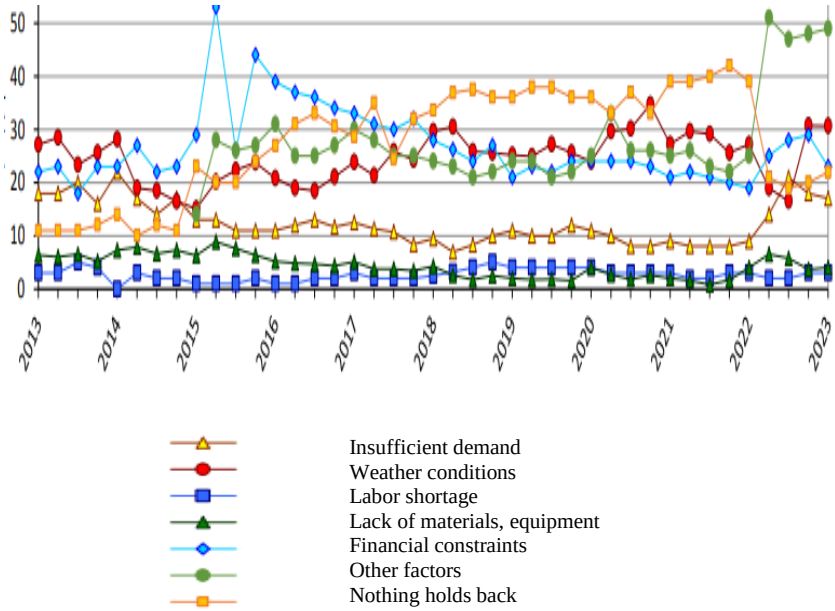


**Figure 2.6 Dynamics of expectations of agro enterprises in Ukraine regarding the prospects for the development of their business activity in 2013-2023**

*Sources: (State Statistics Service of Ukraine, https://www.ukrstat.gov.ua)*

Forecast scenarios of financial resources to ensure the food security of Ukraine in the context of post-war recovery (Table 2.6).

To ensure the level of food security, the financial resources of producers should have a reserve of potential, the value of which depends on possible scenarios for the maneuver of financial flows (primarily through logistics, attracted credit resources, increased consumption, etc.). The equation of trends in indicators of the financial potential of the agricultural sector is given in Table 2.7. Information for evaluating such scenarios is indicators of costs, revenues, prime cost against the background of inflation indices, consumer and selling prices.

Probably, due to the trend of indicators since 2018, the annual increase in airborne forces will be UAH 126 billion, budget support will be reduced by UAH 1.9 billion, lending will increase by UAH

13 billion, price regulation will decrease by UAH 1.07 billion, investments will decrease UAH 8 billion, capital accumulation will grow by UAH 6.4 billion annually. The most expected forecast is for investments, with a probability of 90%.

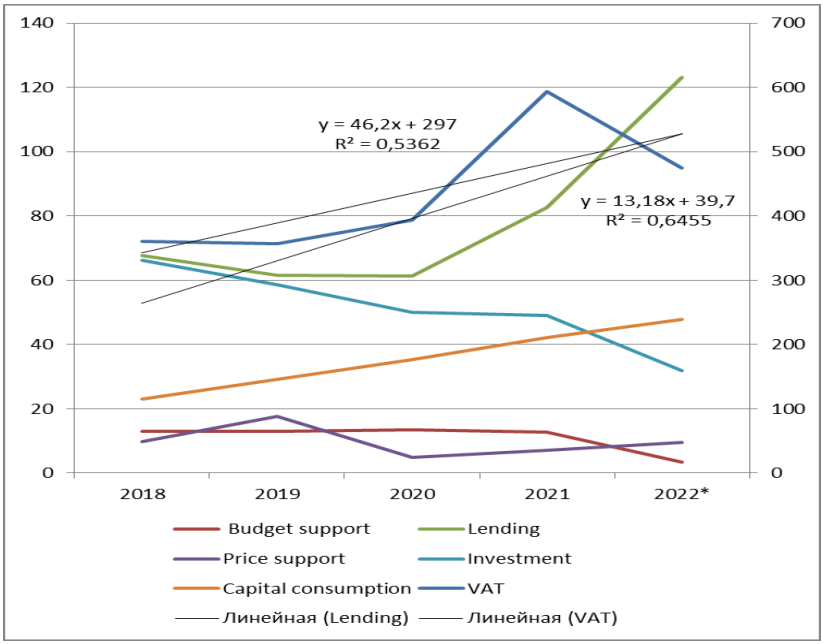


**Figure 2.7 Dynamics of financial resources and GDP of agriculture in Ukraine for the period 2018-2022, UAH billion**

*Sources: (State Statistics Service of Ukraine, https://www.ukrstat.gov.ua)*

At present, the recovery forecast (Project of the Recovery Plan of Ukraine) provides that among the priority tasks of financing the recovery of the Ukrainian agricultural sector are the restoration of logistics infrastructure, the introduction of new ICT technologies, the development of agro-processing and organic agriculture sectors (Table 2.8).

It is envisaged (Principles of a green) priority in the development of sustainable and environmentally friendly practices in agriculture, which include: precision farming, the use of crop rotations and a biodiverse multicultural approach in crop production; small-scale

livestock production with high animal welfare standards; application of technologies and practices to reduce greenhouse gas emissions, reduce and recycle agricultural and food waste; organic farming; non-waste and recovery production of a full cycle, etc.

*Table 2.6*

**Forecast scenarios for the need for financial resources to ensure food security in Ukraine**

| Indicators | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|
| VAT | 361 | 357 | 393 | 593 | 474 | 599 | 757 | 856 |
| Budget support | 13 | 13 | 13,5 | 12,8 | 3,5 | 1,58 | 0,34 | 0,11 |
| Lending | 67,6 | 61,6 | 61,4 | 82,6 | 123 | 136 | 149 | 163 |
| Price support | 9,7 | 17,6 | 4,9 | 7,1 | 9,6 | 8,5 | 7,4 | 6,4 |
| Investment | 66,1 | 58,5 | 50,1 | 49,1 | 31,8 | 24,1 | 16,3 | 8,4 |
| Capital consumption | 23,1 | 29,3 | 35,3 | 42,3 | 47,8 | 54 | 60,3 | 66,5 |

*Sources: (Project of the Recovery Plan of Ukraine)*

Maintaining the economy and post-war reconstruction requires the involvement of all resources, but the most important and decisive are public finances and / or generated with the participation of the state. Therefore, the share of the state in the economy of wartime and post-war renewal is growing. Regarding the support of production and the post-war recovery of the agricultural sector, hope is placed on international donor support. As a country that has received the status of a candidate for EU membership, Ukraine has the opportunity to receive financial assistance under the Instruments for Pre-Admission, IPA through grants, investments, technical assistance, participation in EU programs and initiatives.

*Table 2.7*

**Equation of trends in indicators of the financial potential of the agricultural sector of Ukraine**

| Indicators | y | $R^2$ |
|---|---|---|
| VAT | y=126,38x + 3 | $R^2$=-1,438 |
| Budget support | y=-1,92x + 16,93 | $R^2$=0,5008 |
| Lending | y=13,18x + 39,7 | $R^2$=0,6455 |
| Price support | y=-1,07x + 12,99 | $R^2$=0,1242 |
| Investment | y=-7,8x + 74,53 | $R^2$=0,9257 |
| Capital consumption | y=6,24x + 16,84 | $R^2$=0,999 |

*Table 2.8*

**Priority tasks for the restoration of the agricultural sector**

| Direction | Task |
|---|---|
| ICT technologies | The technological solution lies in the development and implementation of precision farming tools that will help reduce the use of water and pesticides in line with the EU strategy "From lan to table" aimed at 50% reduction in the use of pesticides. The most promising precision farming technologies are Variable Rate Fertilization (VRNT), Machine Control (MG), Variable Rate Irrigation (VRI), and Controlled Field Movement Technology (CTF) |
| Agro processing | The recovery plan includes a significant amount of investment aimed at the development of the agro-processing industry in Ukraine (for example, $ 10.2 billion is allocated exclusively for the development of agro-processing) |
| Agro organic farming | The war of russia against Ukraine had a devastating effect on the activities of the Ukrainian organic sector. In 2020, according to the Organic Initiative, there were 445,000 km2 of organic agricultural land in Ukraine. However, almost 20% of these lands are located in combat areas |

*Sources: (Project of the Recovery Plan of Ukraine)*

PU "All-Ukrainian Agrarian Council" and the USAID Program (USAID Program, 2023) for Agrarian and Rural Development (AGRO, 2023), launched a joint project to support the economic recovery of the agricultural sector of Ukraine, which suffered as a result of russia's military aggression against Ukraine. It was announced that the program is focused exclusively on small and small agricultural producers as the most vulnerable production segment in the agricultural sector. The project introduces the best international practices for fixing war crimes and calculating the losses caused by them. Based on the information collected, an evidence database is being created to confirm the crimes committed by the russian federation against Ukraine.

**Conclusions**

A study of the financing of the agricultural sector under martial law and post-war reconstruction made it possible to determine that enterprises do not have enough financial resources, but the State budget does not have them either. Sources of increased financial

support for food security in a state of martial law are the resources of the global financial market, international borrowing and donor funds. At the same time, the Government should promote an appropriate level of support for food security throughout the food chain and stimulate producers by compensating for the damage caused by the war, building infrastructure, balanced exports, taking into account Ukraine's international obligations, domestic processing needs, correlation of food prices and household incomes the like. It is important to formulate a strategy that would include the proportions of financial resources to support the food security of the primary production link in the established proportion of own and borrowed funds and the norms for financing fixed capital.

Such a financing development system should provide for the improvement of legislation to generate additional financial resources by optimizing tax, budgetary and investment regulation, simplifying the requirements for doing agricultural business, resolving problems with logistics and export of agro-industrial products, and mitigating the impact of inflation and foreign exchange pressure.

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**Chapter 3**

# MARKETING AND LOGISTICS OF AGRICULTURAL PRODUCTS

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## COMPREHENSIVE MARKETING SYSTEM AS A BASIS FOR INCREASING THE COMPETITIVENESS OF TRADE ENTERPRISES IN MODERN CONDITIONS OF DOING BUSINESS

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**Abstract**
*The purpose of our research is to generalize theoretical and methodological approaches to the formation of a complex marketing system, to develop recommendations for the implementation of the main elements of this system in the practical activities of enterprises in modern conditions and to allocate marketing reserves aimed at increasing the competitiveness of trading enterprises in modern business conditions. It is proved that the formation and functioning of the enterprise marketing system should be carried out on the basis of a*

*systematic approach and synergistic combination of marketing tools, taking into account the characteristics of products, market, behavior and consumer needs, with the marketing management system, on which the successful activity of the enterprise in the market environment depends. Each enterprise, forming a complex marketing system, should focus its activities on the achievement of marketing goals and set up dynamic interrelationships between the factors of the external and internal environment by building key subsystems of the enterprise: strategic and corporate management, information-analytical, control-adaptive, potential management. Thanks to the existence of such a system, each enterprise, based on its own business conditions and socio-economic interests, can adapt it for itself.*
*The main components of the integrated marketing system are defined and proposals for the implementation of this system in the activities of trading enterprises are provided.*

**Keywords:** *integrated marketing system, marketing complex, marketing management, competition, enterprise competitiveness, marketing tools, marketing department.*

## Introduction

In the period of reform and modern development of the economy of Ukraine, it is extremely important to adapt domestic enterprises to the conditions of a dynamic external environment, where the conditions of doing business on the domestic and foreign markets, the competitive environment, the processes of innovative development and organizational transformations become especially cruel. The effective operation of modern enterprises is influenced by a large number of factors, both external and internal.

Modern trends in the domestic market economy are characterized by the intensification of the processes of globalization and integration into the world market, the consequences of which are increased competition in the domestic and foreign markets.

At the same time, domestic enterprises currently operate in very difficult conditions of the global economic crisis, which is caused by the pandemic and endangers the possibility of effective business operations. It is important for enterprises to survive in crisis conditions, adapt to them and minimize threats from the external environment. This is possible with a high level of competitiveness of

the enterprise, with existing competitive advantages, potential opportunities and reserves for their improvement. In the conditions of fierce competition on the market, there is a competitive struggle between product manufacturers for favorable conditions of production, sale of products, attracting consumers, quality indicators, profit indicators and other competitive advantages.

## Materials and Methods

The **methodology** basis of the study was a synthesis of the results of applied research in economics, scientific works of domestic and foreign scientists, which highlighted the fundamental theories of competitive advantage, competitiveness and marketing management.

## Results and Discussion

For most enterprises, the activation of marketing can be considered a tool that can increase competitiveness, ensure effective industrial, economic and social relations, which will allow the realization of economic interests as employees, business owners and consumers. The consumer and his constantly growing needs are especially important in modern business conditions. The knowledge, understanding and adaptation to the needs of consumers is a key element of a complex marketing system. A complex marketing system based on knowledge of consumer needs and product production technologies that satisfy them is the only opportunity for enterprises to achieve a high level of performance indicators: profit, sales volume, expansion of sales markets, coverage of a wide range of consumers.

In modern conditions, the turbulence of the external environment and the high level of competition forces us to reassess the principles and characteristics of conducting modern business and radically change the approaches to the enterprise management system.

It is known that the main condition of the economic development of the enterprise is its active activity on the market. At the same time, commercial success is ensured by such important factors as knowledge of the wishes and needs of consumers, quick and flexible response to all their requirements. This is ensured by studying the possibilities and effective use of various methods, forms and ways of selling goods and services, forming the demand of existing and

potential consumers, i.e. under the conditions of a marketing approach in the organization of sales activities of enterprises (Mordvinceva, 2006). Marketing should be the basis of the functioning of business entities of any sphere of activity, and marketing activity has a decisive influence on the formation of the system of economic relations of specific producers with consumers in the direction of effective positioning of the product on the market and ensuring its sale.

The specific features of marketing in Ukraine include: lack of consumer information and low purchasing power; lack of perfect competition on the market, which reduces the impact of marketing measures; a high level of dependence of product manufacturers on distribution structures, which leads to low prices for enterprises; lack of qualified marketing specialists; consumer distrust of advertising and sales promotion; lack of balanced regulatory and legal regulation of the market; protection against unfair competition.

The company's marketing system includes three main elements (Figure 3.1).

In addition, wholesale and retail trade enterprises face a number of problems: changes in demand volumes, price fluctuations, high impact of business risk factors, imperfect organizational structure of enterprises, adoption of strategically important decisions without deep marketing justification and analysis. The consequence of these processes is that the sales policy in most trade enterprises remains unformed and, accordingly, they have a low level of organization of sales activities, development of the product sales system, instability of work and unprofitable activity (Bahorka, 2020).

The concept of marketing originates from the era of commodity production to the era of human relations, which is evidence that in modern conditions of rapid changes, in addition to thorough market research, strategic and operational marketing planning, sales promotion, the function of any enterprise comes first interaction with the consumer within the entire marketing complex. This involves focusing the company's marketing activities on establishing long-term, constructive, privileged relations with potential customers and supplementing the classic "4R" complex with tools that take into account the individual characteristics of the consumer.

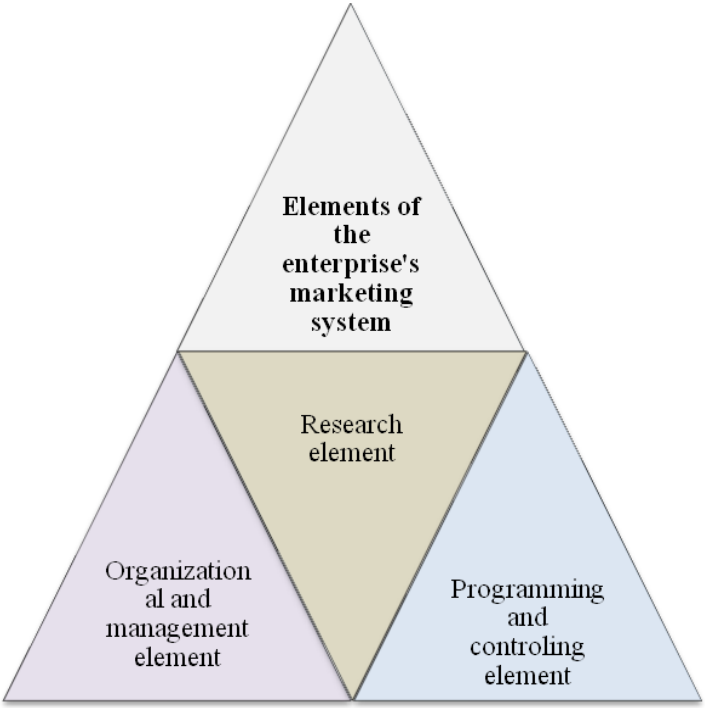


**Figure 3.1 Elements of the marketing system at the enterprise**
*Source: summarized by the authors*

In modern conditions, marketing is one of the necessary determining tools for the organization of the rational implementation of the product and sales policy of conducting business in the conditions of increased competition and openness of markets.

In our opinion, it is important that the formation and functioning of marketing activities at enterprises be based on a systemic approach, which is an organizational and functional integrity, all the components of which are harmoniously interconnected and on which the successful operation of the enterprise in the market environment depends.

The complex marketing system of the enterprise is an internally organized set of interrelated components (economic, social, organizational, technical and technological) in relation to the external environment, the integral unity of which ensures, on the one hand,

the satisfaction of consumer needs, and on the other hand, the achievement of economic sub object of the set goals (Bahorka &Yurchenko, 2020). This is real under the condition of purposeful and effective functioning of such subsystems as marketing information, marketing complex, marketing management.

A complex marketing system is gaining particular importance in the work of enterprises, where it is extremely important to focus on more complete satisfaction of consumer needs, increase sales and profits by eliminating intermediaries and ensuring closer contact with customers, including information provision and analytical support. In this context, a properly planned and organized complex marketing system will allow to optimize and clearly plan measures to achieve the mission of the enterprise placed on the market and ensure efficient, stable and profitable operation of the enterprise.

We are convinced that a complex marketing system is a combination of a marketing complex with a marketing management system (Figure 3.2).


**Figure 3.2 Components of the complex system of agrarian marketing of the enterprise**

*Source: generated by the authors*

The essence of the integrated marketing system is the combination of elements of the Marketing-mix complex and the marketing management system in order to respond quickly to changes in the market environment. We are sure that the expected results can be achieved only in the interaction of these components of the marketing system, the use of individual elements, in our opinion, will not give a full-fledged result.

Of course, the following components must be taken into account when forming a comprehensive marketing system at the enterprise:

1) analytical and strategic (market research, analysis and assessment of the enterprise's marketing capabilities, market segmentation and selection of target segments);

2) development of the marketing complex (product policy, pricing, sales methods, marketing communications);

3) organization and management of marketing (creation of a marketing service, functioning of a marketing information system, management of marketing activities).

The main task of researching the enterprise environment is to analyze the factors of the macro- and microenvironment of the enterprise, in order to identify the strengths and weaknesses of the enterprise, opportunities and threats of the market, in which the results of the analysis of all aspects of production, finance, sales and strategy of the enterprise are concentrated, conclusions are formulated regarding possible ways resistance to the negative influence of factors. The process of adaptation of the enterprise to changes in the environment and, above all, to the action of uncontrollable factors is important. The results of the study of the enterprise environment will allow the correct use of the internal and external (uncontrolled) environment in order to achieve success with consumers and ensure the stable functioning of the enterprise in modern conditions.

The effectiveness of the marketing system is possible if the following requirements are met:

– upgrading the qualifications of the company's employees, who are responsible for the organization and implementation of the company's marketing and sales activities, and in their absence at the company, the training of new specialists from among full-time employees or external employees;

– involvement of third-party specialists in marketing activities on the basis of outsourcing;

– optimization of the organizational structure through the creation of a marketing department or the establishment of the position of a marketer;

– informational and innovative material support for the functioning of the enterprise's marketing service;

– development of measures to stimulate the company's employees to switch to marketing-oriented activities.

In our opinion, increasing the competitiveness of an enterprise depends mainly on three factors: correctly formed marketing tools, elements of the organizational structure and its management system. In this context, the organizational structure of marketing activity at the enterprise can be defined as the basic component of the organization, on the basis of which marketing management will be carried out, that is, it is a set of services, departments, units, which include employees engaged in various areas of marketing activity. One of the main principles of the organization of marketing management is to bring the places of marketing decisions as close as possible to the divisions that dealing with practical marketing. In order to the management system to be able to adapt to consumer requests, innovations, market conditions, it is necessary to create a marketing service at the enterprise. Any marketing organizational structure should be built on the basis of the following components and their interaction: functional features, location, goods and consumer markets. We consider it necessary to pay attention to the fact that the extreme shortage of reliable market information leads to high uncertainty when making management decisions, and primary information is not collected and systematized.

The attractiveness of the product does not provide sufficient guarantees regarding its sale. For this, it is necessary to inform consumers about its existence, to convince them of its good quality and to incline them to purchase the product (Kovalenko, 2013). That is, consumers need complete information in order to understand the advantages of the company's product. It is from this point that we want to draw attention to the importance of creating a CRM system – customer relationship management as one of the main components of the marketing communications complex.

At the same time, we understand that when focusing only on the CRM system, the company will lose a lot of market opportunities related to entering other consumer markets. Tools that support such analysis should exist in programs that provide marketing planning, along with analytical CRM tools.

We offer active use of the marketing communications system in a comprehensive marketing system. We insist that in modern conditions, special attention should be paid to the full use of the Internet resource. We are sure that in this way the sales of products will be stimulated, a positive image of the enterprise will be formed and feedback from consumers to producers will be ensured. In addition, Internet communications will help establish direct contacts with buyers of products, bringing relations with them to a new level, which will allow receiving operational information about the market situation and changes in the structure of consumer demand.

We have proposed marketing reserves that will contribute to increasing the competitiveness of the enterprise (Table 3.1).

The measures proposed by us will contribute to the effective use of marketing reserves in the company's activities.

So, we must state that marketing reserves are a tool with which the company can increase its competitiveness. Unused marketing reserves for increasing competitiveness, for most trade enterprises, remain the comprehensive use of all marketing tools (elements), the introduction of new forms of trade, and the use of modern business methods.

**Conclusions and recommendations for further research**

So, from the above, it can be noted that the basis of a complex marketing system is the mechanisms of its implementation, which ensure the stability of the system, its purposefulness, interconnectedness, interdependence and complexity of its elements determine the integrity of the system; all tasks performed by individual elements of the system are interconnected; elements of the system and actions related to them have a certain subordination, which builds a hierarchy; the system changes under the influence of specific factors, which determines its dynamism; the system's ability to adapt to the external environment without losing its individuality.

*Table 3.1*

**Suggestions for more effective use of marketing reserves**

| Measures | Characteristics |
|---|---|
| Creation of a marketing organizational structure | In order to strengthen analytical work, strategic planning and stimulation of product sales. |
| The formation of a constantly operating marketing and information system | It will help the enterprise to avoid strategic surprises, to receive timely, complete and reliable information about the state of the external environment, to form a positive reputation, to contribute to a more successful promotion of products to the market and an increase in their sales, the created strategic planning department will include monitoring services and audit, public relations. |
| Review contracts and implement a system of discounts | Refuse unprofitable deliveries and sales; implement a system of discounts for regular customers. |
| Increasing employee interest in product sales | Motivation and incentive system for employees (bonuses, salary increase, interest on sales). |
| Active use of the marketing communications system | Carry out a number of measures to intensify work on promotion on the Internet, reconstruction of the site, distribution of the site in search engines and other works. |

*Source: suggested by the authors*

In order to increase the competitiveness of commercial enterprises, we offer:

– to carry out a purposeful assortment policy that will help the enterprise to determine the competitiveness of goods in this market segment, will allow to avoid significant financial, entrepreneurial and organizational and commercial risks. For this, the company's specialists need to form an assortment policy so that each type of product gets the maximum effect both in terms of money and in terms of meeting the needs of its customers;

– maintain constant contact with potential consumers. Implementing this direction, the management staff of the enterprise must develop and apply a system of constant monitoring of the external and internal environment with the formation of an information base;

– to expand the search for possible sources of purchase of goods, to create additional sources for replenishing commodity resources. For this purpose, the enterprise should rent out free space in warehouses, provide consulting and transport services to legal entities and individuals; to activate the communication policy aimed at obtaining information about potential buyers, implementation of the CRM system, B2B and B2C systems, full use of Internet communications;

– use progressive forms and methods of studying demand and product promotion: participation in exhibitions, fairs, product testing, customer surveys to familiarize customers with new products of the enterprise, analysis of the value of products for potential buyers;

– improve the organizational structure of the enterprise and strengthen the analytical work of employees, introducing the latest methods of collecting and processing information, with the aim of reducing costs and increasing turnover.

The importance of the implementation of a complex marketing system lies in the combination of elements of the Marketing-mix complex and the marketing management system, with the aim of prompt response to changes in the market environment. We are sure that the expected results can be achieved only in the interaction of these components of the marketing system, the use of individual elements, in our opinion, will not give a full-fledged result.

The main areas of search for reserves to increase competitiveness are: resource, organizational, technological and marketing potential – the degree of consumer satisfaction with products, strengthening of personnel potential, focus on innovation, the competitive potential of the enterprise and the effectiveness of the strategy for a certain market segment.

Each enterprise, forming a complex marketing system, should focus its activities on the achievement of marketing goals and set up dynamic interrelationships between the factors of the external and internal environment by building key subsystems of the enterprise: strategic and corporate management, information-analytical, control-adaptive, potential management. Thanks to the existence of such a system, each enterprise, based on its own business conditions and socio-economic interests, can adapt it for itself.

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# A COMPREHENSIVE APPROACH TO RISK MANAGEMENT OF LOGISTICS ACTIVITIES OF AGRARIAN ENTERPRISES IN THE CONDITIONS OF CRISIS PHENOMENA

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**Abstract**
*The risks of the logistics activity of agricultural enterprises have been identified, which are conditionally systematized into 2 groups: exogenous (political, foreign economic, institutional, market, insurance, financial, environmental) and endogenous (related to the processes of material and technical support, stock formation, economic, transport, sales, information). The expediency of applying a comprehensive approach to risk management of logistics activities of enterprises in the agrarian sector is substantiated. A set of measures for leveling the risks of logistics activities in the logistics management system of agricultural enterprises in conditions of instability and crisis phenomena is proposed.*

**Keywords:** *agricultural enterprise, logistics activity, risk, types of risks, risk management, comprehensive approach, instability, variability, crisis situations, risk mitigation, insurance.*

## Introduction

The changing, dynamic and unpredictable development of the external institutional environment, crisis phenomena are one of the causes of various types of risks in economic activity, including logistics. Therefore, in modern conditions of economic instability

and uncertainty, it is expedient to comprehensively manage the risks of logistics activities in the risk management system of agricultural enterprises.

In this regard, the issue of forming a risk management system is currently being updated with the aim of finding fundamentally new tools and methods for assessing the risks of logistics activities of enterprises in the agrarian sector, management approaches to their levelling and minimization. All this requires an in-depth analysis of the essence and content of risk management in order to understand the dynamic patterns of managing the logistics activities of enterprises of various branches, including the agro-industrial complex.

**Materials and Methods**

A significant number of scientific works by leading foreign (Dźwigoł, 2008, 2016; Damodaran, 2008; Fuchs & Wohinz, 2009; Andersen & Schreder, 2010; Karbownik *et al.*, 2012; Crouhy *et al.*, 2012) and domestic scientists (Mamchyn & Rusanovska, 2011; Kondratenko & Lobashov, 2012; Shpachuk & Sanko, 2012; Khromykh *et al.*, 2013; Vitlinskyi & Skitsko, 2013; Volosovych, 2013; Krykavskyi *et al.*, 2014; Korotkyi, 2014; Kulyk, 2015; Hryshko & Hunchenko, 2016; Ilchenko, 2016; Yevtushenko *et al.*, 2016) are devoted to the problematic issue of risk management in the process of organizing logistics activities.

Scientists and specialists pay a lot of attention to the development of logistics risk classifications; justification of the methodical approach and practical tools for determining the logistics risk of the enterprise in conditions of uncertainty; study of foreign experience in the field of enterprise risk management; substantiation of the expediency of applying risk management in the management of logistics systems of enterprises in order to optimize the process of making rational decisions; development of a model of risk management of logistics systems detailing stages and main components; determination of directions for improvement of system risk analysis in logistics activities of enterprises, etc.

At the same time, despite such close attention to the outlined problem on the part of scientists, it remains relevant to conduct scientific research in the direction of improving risk management of

logistics activities of agrarian enterprises using an integrated approach.

**The purpose of this paper** is to generalize and systematize existing approaches to defining the essence and content of the concept of "risk management"; the author's interpretation of this economic category from the perspective of the transformation of logistics management and increasing the level of economic security of business entities in the field of agricultural production; substantiating the expediency of applying a comprehensive approach to managing the risks of logistics activities of agrarian enterprises in the conditions of crisis phenomena.

**Results and Discussion**

A critical analysis of scientific sources shows that today there is no single theoretical approach to defining the essence of risk management. This is due to the fact that scientists are representatives of various economic theories and schools with their own scientific approaches and features, as well as the ambiguity and multifaceted nature of this concept. After all, the term "risk management" is considered as an object of research from the standpoint of public administration, economic and financial security, insurance, investment, financial, strategic, marketing, and logistics management.

For the most part, researchers understand the concept of "risk management" as science; methodology; art; process; system; structural components of the system; factor; managerial paradigm; a specific branch of management; a set of methods, techniques and measures, etc.

Thus, in the scientific literature, this economic category is interpreted as:

– an important component of the innovative activity of the enterprise;

– modern risk management system of business structures;

– a system of an organizational and financial nature, which is united by a common idea and is aimed at minimizing the costs associated with the management of a certain object;

– the factor of ensuring the economic security of enterprises;

– a synthetic scientific discipline that studies the impact on various spheres of human activity of random events that cause physical and material damage;

– a methodology that has its own set of terms, classification, a single approach to the analysis of various risks;

– the art and science of ensuring the conditions for the successful functioning of any production and economic unit in conditions of risk;

– the process of developing and implementing a program to reduce any incidental losses;

– a set of methods, techniques and measures that allow to predict to a certain extent the occurrence of risk events and take measures to exclude or reduce the negative consequences of the occurrence of such events;

– a system of risk assessment, risk management and economic (more precisely, financial) relations arising in the process of this management, and includes the strategy and tactics of management actions;

– a specific branch of management that requires knowledge of the subject activity of the firm, insurance company, analysis of the economic activity of the enterprise, mathematical methods of optimization of economic tasks;

– management of the organization as a whole or its individual divisions taking into account risk factors (i.e. random events affecting the organization) based on a special procedure for their detection and assessment, as well as the selection and use of methods for neutralizing the consequences of these events, exchanging information about risks and monitoring the results of application these methods;

– a component of the financial security management system at the enterprise;

– a system that includes identification, risk analysis, management;

– modeling the possibility of deviation with some limitation of a managerial, competent, motivational, psychological nature;

– the system of risk management and economic (financial) relations arising in the process of this management, including the strategy and tactics of risk management;

– purposeful search and organization of work to reduce the degree

of risk, the art of obtaining and increasing income (profit, profit) in an uncertain economic situation.

I. Verbitska (2013) emphasizes that within the framework of the concept of risk as a danger or threat, risk management means the technique of reducing the probability of occurrence of negative events and their consequences by means of measures that require reasonable costs. Within the framework of the concept of risk as an opportunity under risk management, the degree of use of the technique of maximizing income while simultaneously limiting or minimizing losses is considered.

At the same time V. Vitlinskyi *et al.* (2000) adhere to a modern point of view based on the "neoclassical" theory, noting that risk management is designed to ensure the optimal ratio of profit (increase in market value) and risk for the enterprise, its acceptable (allowable) level.

In the monograph "Riskology in economics and entrepreneurship" V. Vitlinskyi & H. Velykoivanenko (2004) emphasize the need to use various approaches, processes, and measures in management activities that allow to a certain extent (to the extent possible) to predict the possibility of the occurrence of risky events and to seek reducing the degree of risk to acceptable limits.

According to A. Kaminskyi (2017), two parts can be distinguished in the modern problem of risk management. The first part is caused by problems arising from inadequate, insufficient implementation of a certain structural component of risk management processes. The second part is the problems caused by the functioning of risk management as a whole system in a financial institution. Therefore, it is logical for the analysis of the researched problem to present the structure of the risk management process.

The genesis of risk management is characterized by the transformation of ideas about risk, the problem of risk measurement, and especially the attitude to situations with risk. At the same time, risk management is not static, it is dynamic, and its dynamics are generated precisely by the issue of risk (Bernstein, 1998).

As a result of the research, it was established that a number of scientists equate the concept of "risk management" with risk management. Thus, A. De Marco, M. J. Thaheem (2014) formulate

risk management as a process of identification, assessment and prioritization of risks with subsequent coordinated and economical use of resources to minimize, monitor and control the probability or impact of adverse events, or to maximize the realization of opportunities.

The majority of foreign scientists pay considerable attention to the issues of risk management, understanding by this definition:

– a method aimed at organizing, identifying and responding to risk factors to achieve project goals;

– planning, monitoring and implementation of measures necessary to prevent exposure to risk;

– a systematic method of identifying, analysing, processing and monitoring risks that are all involved in any activity/process;

– a systematic method that minimizes risks that can be an obstacle to achieving the goal;

– a set of measures aimed at working with risks to maintain control over the project;

– a means of dealing with uncertainty (identifying the sources of uncertainty and associated risks and then managing those risks in such a way as to minimize (or avoid altogether) negative outcomes and benefit from any positive outcomes);

– a planned and structured process that allows the project team to make the right decisions at the right time by identifying, classifying and quantifying risks and then managing and controlling them;

– a systematic way of looking at areas of risk and knowing how to deal with each of them;

– a management tool aimed at identifying sources of risk and uncertainty, determining their impact and developing appropriate measures in response to management;

– the process of identifying, evaluating and controlling financial, legal, strategic and security risks for the organization's capital and income; these threats or risks may arise from various sources, including financial uncertainty, legal obligations, strategic management errors, accidents and natural disasters;

– the process of identifying, assessing, and prioritizing risks, followed by the integrated and cost-effective use of resources to reduce, monitor, and control the likelihood or impact of adverse events, or to maximize opportunities.

It is worth noting that risk management refers to the practice of early identification of potential risks, their analysis and the adoption of preventive measures to reduce/contain risk. Risk management includes identification, analysis and response to risk factors that are an integral part of business. Effective risk management means trying to control future outcomes as much as possible by acting pre-emptively rather than reactively. Thus, effective risk management allows reducing both the possibility of risk occurrence and its potential impact.

The generalization of special literature shows the existence of various scientific approaches to the classification of logistics risks of enterprises of various branches (Table 3.2).

*Table 3.2*

**Logistic risks according to different scientific concepts**

| List of risks | Sources | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | *1* | *2* | *3* | *4* | *5* | *6* | *7* | *8* |
| Inventory management risk | + | + | + | | | | + | |
| The risk of logistics operations of transportation | + | | | | + | | + | |
| The risk of carrying out logistics warehousing operations | + | | | | + | | + | |
| Risk of logistics management (administration) | + | | | | | + | + | |
| The risk of carrying out logistics operations of cargo processing | + | | | | | | + | |
| The risk of unsatisfactory performance of contractual obligations | | | + | | | + | | |
| Purchase and sale risk | | | | | + | + | | |
| The risk of a long period of customs clearance | | | + | | | | | |
| The risk of an insufficient level of qualification of logistics personnel | | | + | | | | | |
| Commercial risk (disruption of deliveries or short deliveries of products, violation of delivery terms, non-fulfillment of financial obligations) | | | | + | | | | + |
| Natural risk (loss of property in logistics processes) | | | | + | | | | |

| List of risks | Sources | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | *1* | *2* | *3* | *4* | *5* | *6* | *7* | *8* |
| The risk caused by the theft of goods and material values | | | | + | | | | |
| Environmental risk | | | | + | | | | |
| The risk of civil liability for damages | | | | + | | | | |
| Technical risk (inefficient use of logistics infrastructure) | | | | + | | | | |
| Currency risk during logistics processes | | | | + | | | | |
| Payment risk (use of unreliable payment forms) | | | | + | | | | |
| Production risk | | | | | + | | | + |
| Information flow management risk | | | | | | + | | |
| The risk of managing material resources | | | | | | + | | |
| The risk of an incorrectly chosen logistics strategy of the enterprise | | | | | | + | | |
| The risk of inconsistency of interaction between units regarding the analysis and expenditure of resources | | | | | | + | | |
| The risk of insufficient control over all stages of business process management | | | | | | + | | |
| The risk of breaking ties with logistics partners | | | | | | + | | |
| Financial risk | | | | | | | | + |
| Insurance risk | | | | | | | | + |

*Source: (Mamchyn & Rusanovska, 2011 (1); Shpachuk & Sanko, 2012 (2); Khromykh et al., 2013 (3); Krykavskyi et al., 2014 (4); Kulyk, 2015 (5); Ilchenko, 2016 (6); Hryshko & Hunchenko, 2016 (7); Yevtushenko et al., 2016 (8))*

As can be seen from the Table 3.2, the main types of risks that affect the results of the logistics activities of enterprises (including agricultural ones) and need to be taken into account when making relevant management decisions, most scientists include risks associated with the management of material resources and stocks, logistics management, organization of the processes of transportation, cargo processing, storage, sales of products,

contractual work.

It has been established that, as a rule, 40% of operational risks, 25% of functional risks, 25% of macro-environmental risks, and 10% of extended value-added chain risks arise in trade enterprises (Ilchenko, 2016).

Surveys by Deloitte made it possible to identify the following risks: strategic and reputational, financial, operational, compliance risks, and cyber risks.

So, as research shows (Bezpartochna & Trushkina, 2021; Bezpartochna *et al.*, 2022; Bezpartochnyi, 2021; Bezpartochnyi *et al.*, 2022; Demianchuk & Bezpartochna, 2023; Kwilinski *et al.*, 2022; Trushkina, 2019a, 2019b; Trushkina *et al.*, 2020a, 2020b), when managing the logistics activities of agricultural enterprises in the context of crisis phenomena, it is advisable to take into account a set of risks, which can be conditionally systematized into 2 groups: exogenous and endogenous risks (Table 3.3).

*Table 3.3*

**Systematization of the risks of logistics activities of agricultural enterprises in the conditions of crisis phenomena**

| The name of the risks | | Content of risks |
|---|---|---|
| Exogenous | Political | Unstable political situation |
| | Insurance | Loss of expected economic (financial) benefits or direct losses as a result of a full-scale invasion of russia on the territory of Ukraine |
| | Institutional | Insufficiently effective action of legislative and regulatory documents regulating the processes of procurement, sales, commercial, transport activities |
| | Market | The unpredictability of the market situation; inflexibility of the existing logistics systems of enterprises in the agricultural sector to constant fluctuations in consumer demand, changes and risks of the market environment |
| | Foreign and economic | Decrease in the volume of export deliveries of agricultural products due to blocking of seaports; disruption of food supply chains; improper fulfilment of terms of foreign economic contracts |
| | Financial | Constant changes in exchange rate fluctuations; increase in debt for sold products; difficulties in attracting credit resources due to |

| | | |
|---|---|---|
| | | financial and economic instability;<br>limited amount of financial funds of enterprises |
| | Ecological | Negative impact on the environment due to violation of conditions of transportation and storage of products;<br>lack of a concept of agricultural production waste management based on circular economy |
| Endogenous | Economic | Reduction of the level of profitability from the operational activities of agrarian enterprises;<br>lack of sufficient organizational and economic support for the provision of quality logistics services |
| | Technological | Insufficient application of innovative technologies at agricultural enterprises |
| | Related to material and technical supply | A limited amount of consideration of a set of factors when calculating the optimal batch of supply of material resources;<br>non-rhythmic work of suppliers;<br>inability of the enterprise to effectively plan orders;<br>impossibility of fulfilling the terms of the contract for the supply of material resources |
| | Related to the formation of reserves | Increase in the volume of production and commodity stocks;<br>ineffective inventory management |
| | Transportation | Untimely delivery of cargo due to breakdown or unforeseen downtime of vehicles;<br>cargo not being ready at the required time;<br>cargo loss due to adverse transportation conditions |
| | Sales | Insufficient consideration of the specifics of serving different categories of consumers in the context of the concept of relationship marketing;<br>an imperfect system of contractual relations between enterprises and consumers;<br>late payments by consumers |
| | Informational | Insufficient use of modern information and communication technologies and electronic platforms as information support tools for the organization of logistics activities and management of relationships with consumers |
| | Ecological | Insufficient use of environmentally friendly technologies in agricultural production |

*Source: authors' development*

In order to avoid logistical risks of enterprises, scientists suggested implementing the concept of adaptive risk management and tools of process, anti-crisis and innovative risk management (Ilchenko, 2016), as well as using such tools as insurance, limiting, hedging, diversification, risk distribution, reserving funds to cover unforeseen expenses (Yevtushenko *et al.*, 2016).

As a result of research (Tryfonova & Trushkina, 2018; Zaloznova *et al.*, 2018; Zaloznova & Trushkina, 2019), it was established that the risk management algorithm of logistics activities of agricultural enterprises should include the following stages:

1) SWOT-analysis of risks – identification of risks, their specificity and features, research of factors affecting the occurrence of risks, analysis of the amount of losses;

2) identification of the most significant risks by the expert method – ranking of risks by the level of their impact;

3) rating risk assessment using a risk assessment scale;

4) selection of effective tools for minimizing the risks of logistics activities, which can include:

– improvement of approaches to the identification of logistical risks, which consists in determining the factors and sources of risks, risk events, effects and consequences of the occurrence of risk situations;

– elimination of risks – refusal of certain types of activities associated with a high level of risks;

– transfer of risks when entering into supply, storage, transportation, sales contracts;

– diversification;

– redistribution of risks;

– reserving funds to cover unforeseen expenses;

– liability insurance of freight forwarders when transporting products;

– cargo insurance.

To improve the organization of logistics activities of agricultural sector enterprises, taking into account the impact of possible risks, it is advisable to use a comprehensive approach based on a combination of system, process and functional approaches. The main purpose of the integrated approach is to optimize the risk management system through the implementation of principles

(integrity, hierarchical construction, structuring, multiplicity, integration), methods, tools and the entire list of management functions (forecasting, planning, organization, accounting, control, analysis and regulation) a complex of consistently implemented processes of logistic activity of business entities in the field of agricultural production.

**Conclusions**

Taking into account the above, it can be stated that there are many risks that must be taken into account when organizing the logistics activities of agricultural enterprises. At the same time, it is necessary to carry out constant monitoring, systematic analysis of the risks of logistics activities of enterprises of the agro-industrial complex. And on this basis, comprehensively manage risks with the help of a set of methods and tools that make it possible to predict the occurrence of risk events to a certain extent and take measures to minimize and level them in a timely manner. Such measures include the development and adoption of strategic decisions regarding logistics risk management; development and implementation of a strategy for effective management of contractual relations with suppliers, transport organizations, consumers using risk-oriented tools; implementation of integrated concepts and the organizational and economic mechanism of risk management.

So, based on the generalization of conceptual provisions regarding this problem, the term "risk management" is proposed to be considered from three positions, namely as:

1) an important factor in increasing the level of economic security of business entities in the field of agricultural production;

2) modern paradigm of logistics management;

3) a comprehensive approach to the formation of a risk management system of the logistics activities of agricultural enterprises in the conditions of crisis phenomena.

In our opinion, the most meaningful is such a generalized interpretation of the economic category "risk management" as a complex of managerial actions, economic relations and measures of influence on processes and phenomena in conditions of uncertainty and lack of quality information, which are of a systemic and complex nature, aimed at ensuring the most favourable conditions for

functioning and obtaining results, through timely detection, assessment and neutralization of the manifestation of negative consequences of unforeseen events.

Risk management consists in a comprehensive analysis of political, foreign economic, financial and economic, investment, social, production, innovation, information, technological, market, marketing factors that affect the logistics activity of agricultural enterprises.

For the effective functioning and sustainable development of agricultural enterprises in conditions of instability and uncertainty, it is necessary to apply a comprehensive approach to risk management of logistics activities.

This will make it possible to identify reserves for improving the efficiency of business process management and to scientifically develop a plan of measures aimed at optimizing time, minimizing costs for the organization of logistics activities, rational use of resources, ensuring quality requirements for the provision of logistics services in the product supply chain, transformation of partner relationships, flexible response to changes in the external environment.

Prospects for further research are the development of a mechanism for anti-crisis risk management of logistics activities of agrarian enterprises and a marketing strategy in the field of insurance services in the conditions of digitalization.

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# A STUDY OF DIVERSIFICATION OF UKRAINIAN AGRICULTURAL EXPORTS TO THE EU COUNTRIES AND ENSURING FOOD SECURITY

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**Abstract**
*The article studies the implementation of the European Commission's "Solidarity Lanes" initiative to promote Ukrainian agricultural exports. Stakeholders of the "Solidarity Lanes" and logistics platforms for promoting Ukrainian agricultural exports are identified. The ways to diversify Ukrainian agricultural exports using road, rail and sea transport are analysed. Measures to accelerate the implementation of the "Solidarity Lanes" initiative to increase the volume of Ukrainian agricultural exports within diversified routes are proposed.*

**Keywords:** *Solidarity Lanes, food security, logistics, exports, agricultural products, diversification.*

## Introduction

Russia's full-scale military aggression in Ukraine has caused the destruction of the agricultural sector through damage and replacement of agricultural land, destruction of assets, blocking of

seaports, and complications in export logistics. As a result, there is a need to diversify Ukrainian agricultural exports through the EU and supply products to third countries to ensure food security. Thanks to the coordinated work of rail and road transport, Ukraine's agricultural exports were diversified, but the volume of supplies remained low. The coordination of efforts between the Government of Ukraine and foreign partners allowed the introduction of the so-called "Solidarity Lanes" and the removal of customs barriers to the export of agricultural products abroad (European Commission, 2022). Thus, sanitary and phytosanitary requirements for agricultural exports were cancelled. The signing of an Agreement by Ukraine, Turkey, and the United Nations to unblock Ukrainian ports contributed to the growth of grain exports abroad (United Nations, 2022).

Massive protests by European farmers against imports of Ukrainian grain to the EU led to a ban on the supply of products until the market stabilises.

We have studied the financial losses of Ukraine's agricultural exports under martial law (Bezpartochnyi, Britchenko, & Bezpartochna, 2022), the export logistics of Ukrainian agricultural products in the context of ensuring food security under martial law (Bezpartochnyi & Britchenko, 2022; Bezpartochnyi, Britchenko, & Prylutska, 2023). The literature includes studies on the intensification of agricultural production and export growth (Pasichnyk, 2020); the need for state support and export promotion (Stukan, 2018; Tytarchuk, & Bieliaieva, 2021); the Deep and Comprehensive Free Trade Area (DCFTA) Agreement between Ukraine and the EU (Yatsenko *et al.*, 2017; Pugachov, 2019); and the development of Ukraine's commodity export diversification (Ivanov, 2022). However, the issues of ensuring further diversification of Ukrainian agricultural exports during martial law due to changes in the economic situation in the EU and ensuring food security in third countries remain poorly understood.

The aim of the study is to examine the implementation of the "Solidarity Lanes" initiative to promote Ukrainian agricultural exports and ensure food security. The main objectives of the study are: to identify the stakeholders of the "Solidarity Lanes"; to use diversified logistics routes – road, rail and sea transport.

## Materials and Methods

The methodological basis of the study is the general economic principles and methods of a systematic approach to studying the process of export logistics of agricultural products from Ukraine during martial law and ensuring food security. The methods of analysis and synthesis were applied, which allowed to identify the problems of implementing the "Solidarity Lanes" initiative and to determine the directions of diversified routes development of Ukrainian agricultural exports under martial law. The sources of statistical information on the agricultural sector of Ukraine were used. The abstract-logical method is used to diversifying the export logistics of agricultural products from Ukraine and ensuring food security.

## Results and Discussion

Before russia's large-scale war against Ukraine, an average of 75% of Ukrainian grain was exported to Europe, Asia and North Africa, which provided foreign exchange earnings of 20% of annual export revenues. At the same time, seaports exported 90% of grains and oilseeds (Ministry of Agrarian Policy..., 2022). The complication of exporting Ukrainian agricultural products abroad due to the blockade of seaports has threatened global food security. Therefore, as part of the EU's solidarity with Ukraine and in order to create alternative logistics routes for the export of Ukrainian agricultural products, the European Commission presented the "Solidarity Lanes" initiative on 12 May 2022 (European Commission, 2022).

According to the President of the European Commission, Ursula von der Leyen, thanks to its implementation, Ukraine exported 10 million tonnes of grain and sunflower seeds to the EU, while the quarterly export volume of the first component alone was planned by the European Commission to be 20 million tonnes[1].

Stakeholders were involved in the implementation of the "Solidarity Lanes" activities and in promoting the initiative (Table 3.4).

[1] *Ursula von der Leyen: 10 million tons of cereals and oilseeds have now been transported out of Ukraine*
*https://twitter.com/vonderleyen/status/1560288712768069633*

*Table 3.4*

**Stakeholders of the "Solidarity Lanes" initiative**

| EU | Ukraine | Ukraine/ EU member states | Other countries |
|---|---|---|---|
| Directorate-Generals of the European Commission: MOVE, AGRI, SANTE, TAXUD, NEAR | Coordinating Council for Logistics in Agriculture: Ministry of Agrarian Policy and Food of Ukraine, Ministry of Infrastructure of Ukraine, Secretariat of Cabinet of Ministers of Ukraine, State Border Guard Service of Ukraine, Committee of Verkhovna Rada of Ukraine on Agricultural and Land Policy, State Service of Ukraine on Food. Safety and Consumer Protection, State Customs Service, Ministry of Economy of Ukraine, Ministry of Foreign Affairs of Ukraine, Ministry of Finance of Ukraine, Ukrzaliznytsia, Ukrainian Sea Ports Authority | Infrastructure managers | U.S. Embassy in Ukraine |
| European External Action Service (EEAS) | | Owners of vehicles | Managers of infrastructure U.S. |
| Delegation of the European Union to Ukraine (EUDEL) | Mission of Ukraine to the European Union, Central executive bodies of Ukraine | Suppliers of transport and logistics services | International buyers and distributors, International suppliers transport and logistics services |
| Producers of goods of critical imports | Agricultural producers | | International financial institutions |

| | | | |
|---|---|---|---|
| Facilitators: European Union Advisory Mission (EUAM), European Union Border Assistance Mission to Moldova and Ukraine (EUBAM UA-MD), EU Support to Strengthening Integrated Border Management in Ukraine (EU4IBM), European Border and Coast Guard Agency (Frontex), Customs working group Ukraine-Romania (EUAM, EUDEL, CELBET, EUBAM UA-MD, DG TAXUD, DG NEAR, FRONTEX) | Facilitator: Export Support Centre UCCI | Control bodies of Ukraine and neighbouring EU member states: border and customs services, authorities phytosanitary and veterinary control | Facilitator: International Organization for Migration (IOM) |

*Source: European Commission*

At the beginning of the European Commission initiative called on EU market participants urgently provide additional transport for the delivery of goods to and from Ukraine. To coordinate requests and establish relevant contacts, the European Commission announced the creation of a logistics platform involving representatives of the European Commission, EU Member States, Ukraine and business to coordinate actions between participants in the logistics chain and optimise cargo flows. The event also envisaged the creation of special contact points of EU member states to implement the initiative (based on the "single window" principle), which would allow stakeholders to report problems along the logistics chain.

In early June 2022, the European Commission developed three tools to match supply and demand, establish business contacts between producers, traders, logistics representatives and buyers:

- logistics platform EU-Ukraine business matchmaking platform[2];
- logistics platform to optimise Ukrainian grain exports

[2] *Keeping Ukrainian goods moving: EU-Ukraine Business Matchmaking Platform https://eu-ua-solidarity-lanes.seu.b2match.io/*

Grainlanes[3];

- business help line for individual consultations (eu-ukraine-solidaritylanes@ec.europa.eu).

To further facilitate the search for partners for the transport and sale of agricultural products the European Commission is also working on the development of an application to display the movement of products by rail based on the Transportation Management Platform "Transporeon"[4].

The EU-Ukraine Business Matchmaking Platform was launched on 7 June 2022 and complements two other EU matchmaking platforms: the EEN Supply Chain Resilience Platform and EU Clusters Support Ukraine.

The Grainlanes logistics platform was established on 13 June 2022 by the European Commission together with V_labs and Rail Cargo Group to optimise the export of exclusively Ukrainian grain to EU member states by land transport and brings together EU logistics companies and traders and farmers from Ukraine. Like the previous platform, this one is designed to speed up the process of matching supply and demand. The platform's special feature is that it simultaneously places both trade and transport requests, which should facilitate the process of organising export deliveries. If the platform is successful, it is planned to add new functionality (border crossing specifications or a database of short-term logistics demand).

Companies from the EU and Ukraine can send their individual requests for advice to the help line eu-ukrainesolidarity-lanes@ec.europa.eu.

According to the initiative's facilitators, despite the widespread use by stakeholders of the tools developed by the European Commission to facilitate the process of providing additional transport for Ukrainian export products, the problem of a shortage of specific grain wagons, including carrying capacity, and a limited number of trucks and drivers for the transporting of agricultural goods remains acute.

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*[3] https://minagro.gov.ua/news/yevrokomisiya-zapustila-platformu-dlya-optimizaciyi-eksportu-ukrayinskogo-zerna-do-yes-grainlane*

*[4] Transporeon: Transporeon is the Transportation Management Platform for shippers, forwarders, carriers and retailers to move, manage and monitor freight in a world in motion https://www.transporeon.com/en*

In May 2022 the European Commission called on all participants in the initiative to direct export shipments of Ukrainian agricultural products towards freight corridors with the best available capacity. With the involvement of industry representatives the European Commission was to identify key transshipment and track change centres on the borders with the EU and outside Ukraine. The European Commission also asked market participants to urgently transfer mobile grain loaders to border terminals to speed up transshipment, while also assuring the supporting and coordination of the authorities and businesses concerned with the manufacturers of such equipment.

In order to eliminate delays in the delivery of goods the European Commission called on the infrastructure managers of EU member states to provide time slots in railway schedules for the unimpeded passage of cargoes between transshipment centres and EU ports and announced the signing of the Road Transport Agreement with Ukraine as soon as possible.

In order to encourage transport operators in the EU to send vehicles to Ukraine, the European Commission also committed to investigate the need for additional financial guarantees and was to consider cooperation with national export credit agencies of EU member states and international financial institutions to insure the risks of rail freight carriers, inland waterway transport companies, wagon and truck owners.

On 29 June 2022 Ukraine and the EU signed the Agreement on Carriage of Freight by Road[5], which cancelled the need for Ukrainian carriers to obtain permits for bilateral and transit transport to the EU country and avoided stopping the export of Ukrainian products through road checkpoints. Thus, Ukrainian trucks were finally able to cross the border without additional restrictions on the number of entries and the length of stay (previously, the problem of lack of permits was very acute with some EU countries, primarily Poland).

Regarding the liberalisation of rail and inland waterway transport, at the end of August 2022, Director-General MOVE Henrik Hololei stated that the Directorate was ready to work closely with the relevant central executive authorities of Ukraine to discuss aspects of

[5] *https://transport.ec.europa.eu/system/files/2022-06/Agreement_EU_Ukraine_carriage_of_freight_by_road.pdf*

possible liberalisation and find a solution acceptable to both parties. The European Union Agency for Railways (ERA), in turn, expressed its readiness to cooperate with the Ministry of Infrastructure of Ukraine and Ukrzaliznytsia in the area of transport safety and approximation to EU standards. In particular, the priority of Ukraine's adaptation of EU legislation in the field of rail transport, as provided for in the Association Agreement, was noted.

Starting from 1 October 2022 Ukraine will also join the international customs information exchange system NCTS (a joint transit system with 35 countries in the European region) and receive a "customs visa-free regime", which will significantly speed up the time for trucks to cross the border due to simplified declaration of goods and the corresponding acceleration of their customs clearance[6].

In addition to the urgent search for alternative routes for grain exports the European Commission has outlined medium- and long-term measures to increase the capacity of new export corridors.

To this end the European Commission planned to provide all stakeholders with recommendations on available funding, in particular from the Cohesion Fund (CF) and the European Regional Development Fund (ERDF) (under the Interreg 2021-2027 programme) in combination with EU external financing instruments, and the most appropriate procurement procedures that could be used in areas where rapid intervention could deliver results. The European Commission has identified the urgent rehabilitation of dual-track border crossing points that have not been used for a long time or have low throughput, the expansion of the capacity of existing railcar track change facilities and the capacity of transport infrastructure at border crossing points as one of these areas.

At the end of July 2022, as part of its policy to extend TEN-T to neighbouring countries the European Commission amended the indicative maps of the Trans-European Transport Network to include Ukrainian logistics routes. The changes concern the following routes that will intersect in Lviv:

- The North Baltic Corridor was extended through Lviv and

[6] *https://taxation-customs.ec.europa.eu/news/customs-ukraine-join-common-transit-convention-and-convention-simplification-formalities-trade-goods-2022-09-05_en*

Kyiv to Mariupol;

- The Baltic-Black Sea-Aegean corridor was extended through Lviv, Chernivtsi (Romania and Moldova) to Odesa;
- The Baltic Sea-Adriatic Sea and Rhine-Danube corridors will pass through Lviv.

Diversified logistics routes for the export of Ukrainian agricultural products to European seaports are shown in Figure 3.3.

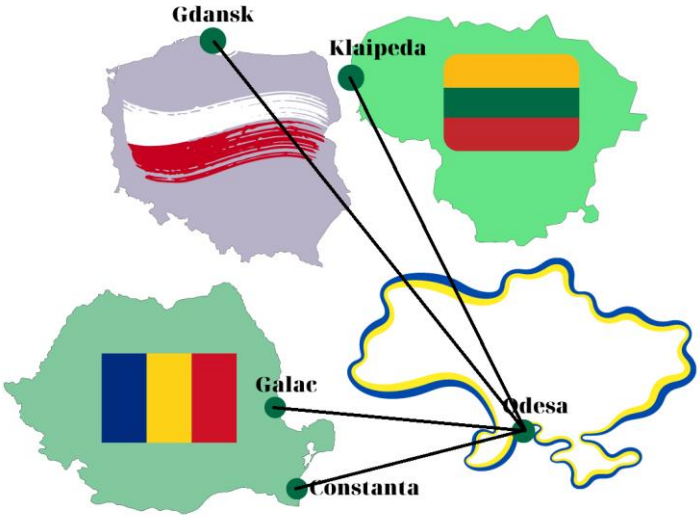


**Figure 3.3 Diversified logistics routes for exporting Ukrainian agricultural products to European seaports**

*Source: authors' development*

The European Commission is also working with EU member states to implement the Adriatic transport routes, including Odesa via Slovakia (motorway) – Trieste (Italy) / Rijeka (Croatia; there is a free grain storage capacity of 1 million tonnes), as well as exports through seaports in Poland, Lithuania, Germany, the Netherlands, and Belgium.

In early July 2022, Romania resumed railway communication between the Galac river port on the Danube and Ukraine to accelerate the export of Ukrainian grain. At the end of August 2022, Ukrzaliznytsia reopened two railway connections to the Romanian

border: on the Rakhiv-Berlebash-state border and Teresva-state border sections in Zakarpattia region. After the repair of the relevant tracks on the territory of Romania, the Berlebasi-Valea-Viseului border crossing point will be opened, which will allow unloading the existing Vadul-Siret-Dornesti and Dyakovo-Halmeu railway checkpoints.

According to the Mission of Ukraine to the EU, as part of the search for additional financial opportunities, the European Commission's DG MOVE has announced the possibility of providing operational support to finance targeted small-scale projects of Ukraine at the border and ports that can be implemented quickly (e.g. port development, construction of access roads/buffer parking areas, etc.) To the same end the European Commission, with the involvement of EUAM, together with EUDEL, IOM and EU4IBM, has ensured that a feasibility study is carried out on the EU-funded reconstruction and modernisation of the Krasnoilsk-Vicovu de Sus and Dyakivtsi-Racovat checkpoints on the Romanian border to increase their capacity and open up cargo routes. The construction of additional checkpoints may also be financed in the future.

As part of Ukraine's recovery and the logistics infrastructure development for agricultural exports and ensure food security need to be establishing new infrastructure links what focus on:

- modernisation of cross-border connectivity (road-road, road-rail, rail-rail) between the EU and Ukraine and optimisation of traffic flows in terms of capacity, interoperability and efficiency of border crossing services. The Connecting Europe Facility (CEF) programme can support the necessary investments;
- development of new Trans-European Transport Network (TEN-T) connecting the EU with Ukraine and Moldova;
- improving connectivity and navigability on the Rhine-Danube corridor to ensure more efficient traffic through enhanced coordination between ports and river authorities in the EU, Ukraine and Moldova.

**Conclusions**

Launched by the European Commission the "Solidarity Lanes" initiative was designed to cover an extraordinary period for Ukrainian agricultural exports. To implement the action plan the

European Commission is working with Member States, Ukrainian authorities, EU and Ukrainian transport operators, infrastructure managers, owners of rolling stock, vessel and vehicle, international financial institutions and other stakeholders around the world.

Despite some successes in implementing the initiative the main challenges to establishing new logistics routes in the context of the blockade of Ukraine's seaports remain infrastructure issues and ensuring effective diversification of logistics routes and vehicles for exporting goods outside seaports.

The land and river infrastructure, particularly on the borders with the EU, which has been neglected for years, cannot be restored and built in such a short period since the initiative was launched, and cannot meet all current wartime needs. The following issues remain relevant today:

- lack of proper communication at the national level in terms of coordination of the initiative and at the interstate level in terms of prompt resolution of problems at the border;
- lack of rolling stock from the EU;
- insurance of barges/ships and rolling stock;
- the need to increase transshipment capacity in ports;
- reducing the time for transshipment of agricultural products at checkpoints;
- the need to simplify customs, veterinary and phytosanitary control at the border;
- the critical need for warehouses for temporary storage of agricultural products from Ukraine, etc.

The following measures are proposed to accelerate the implementation of the initiative and increase of Ukrainian agricultural exports via diversified routes:

- establishing a Ukrainian national coordinating body at a high political level to address the above issues, which would include representatives of all relevant government agencies and would have clear tasks, responsibilities and a mechanism for coordination between participants in the implementation of the "Solidarity Lanes" initiative;
- establishing of an interstate customs working group "Solidarity Lanes" with representatives of Ukrainian, Romanian, Slovak and Polish customs authorities (with the assistance of

EUAM);

- establishing "priority lines" at checkpoints for agricultural products, with appropriate signage along the main roads to inform drivers in advance of the specific queue corresponding to a particular type of cargo;
- construction/arrangement of additional railway tracks and sidings near the border for train stopping;
- purchase/rental/donation of specialised grain wagons for the transportation of Ukrainian grain from EU member states and stimulation of their production;
- building up a network of temporary storage facilities for Ukrainian agricultural products in the EU, including Poland, Slovakia and Romania;
- strategic solution to the issue of gauge mismatch between Ukraine and the EU;
- increasing vessel capacity through proper maintenance of the Danube River channel;
- increasing the capacity of roads and infrastructure at checkpoints and within the country;
- establishing joint checkpoints on the border with the EU, etc.

The above measures will contribute to the development of diversified of Ukrainian agricultural exports and ensure food security.

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# CONCLUSION

The food security of the state is one of the elements of economic policy aimed at ensuring stable food production, accessibility of food and its consumption by the population through domestic production and imports. Ensuring food security in each country is characterised by natural and climatic conditions of agricultural production, availability of agricultural enterprises of various organisational-legal forms of ownership, resource potential and production factors, various actors in the foreign economic activity infrastructure, etc. In the absence of conditions to ensure domestic production of agricultural products, countries import them.

The food problem is a global one as it cannot be solved by the efforts of individual states alone, but requires well-established cooperation of the global community, regardless of social-economic development.

Ensuring food security involves a set of state measures aimed at preventing food crises, hunger, and the introduction of adequate nutrition for the population, with the governments of the respective countries being responsible for ensuring food security.

Russia's full-scale invasion of Ukraine has strengthened Ukraine's role in ensuring global food security. The blocking of shipments from seaports and the jeopardised sowing campaign have led to a sharp rise in prices on the global market, creating not only risks of undermining the country's agricultural sector and the national economy as a whole, but also the food supply of third countries.

The results of the authors' research in the scientific monograph are devoted to solving problems of ensuring food security during martial law, using financial and accounting instruments to managing the activities of agricultural enterprises, managing marketing and logistics of agricultural products, state regulation of agricultural exports, forming new logistics lines for export and cooperation with EU countries, and solving environmental problems of food security.

The research results presented in the scientific monograph reflect the theoretical, methodological and practical aspects of ensuring food security during martial law through the formation of mechanisms to support agricultural production, export of agricultural products,

solving environmental problems, managing logistics supply channels, using a marketing complex, and models of financial security of agricultural enterprises.

The study of the consequences of russia's full-scale aggression on the territory of Ukraine revealed that the aggressor caused significant damage to the ecological system and environmental pollution. It is concluded that the environmental pollution that is currently being inflicted on the environment throughout Ukraine will continue to affect the ecology and health of the Ukrainian population for many years to come. Restoration of soil cover and territories will take decades depending on the degree of damage and will require significant labour and financial resources.

The growing role of the green economy requires the introduction of innovations and organizational-technological chains in production and cooperation. The authors conclude that the effective integration of the rural way of life into the new social order is a serious task of strengthening social security and a resource for the humanisation of social life. There is a need to move from being based on the costs of physical labour to spiritual-intellectual activity as its defining component, from the predominance of the material aspect of life to the virtual-mental sphere, from an orientation towards excessive consumption and the pursuit of pleasure to the values of morality and creation, from the uniformity of models of life and development to their diversity based on the basic value-meaning complexes of cultural-civilisational worlds.

The use of information technology in the agricultural sector is a significant driver of the increase in the amount of information that agricultural enterprises produce as a result of their activities. In this regard, there is a need to audit related financial statement items. It is necessary to collect a set of non-financial information and to form price statistics data sets. The information base for management reporting also needs to be improved, allowing the management system of agricultural enterprises to set its own requirements for content, structure, detail, presentation, etc.

In order to ensure the efficiency of agricultural enterprises, lending to agricultural production is becoming increasingly important. The authors have identified problems with the credit availability of agricultural enterprises. The main directions of the

state policy to stimulate the attraction of loans by agricultural enterprises and directions of development of bank lending to strengthen the resource base of agricultural enterprises are proposed. Considerable attention is paid to the problem of financing food security, in particular, compensation for losses caused by the war, as well as improving legislation to generate additional financial resources by optimising tax, budget and investment regulation, simplifying requirements for doing agricultural business, solving problems with logistics and export of agricultural products, mitigating the impact of inflation and monetary pressure.

In the scientific monograph, the authors emphasise the need to form a complex marketing system, develop recommendations for implementing the main elements of this system in the practical activities of enterprises during martial law and allocate marketing reserves aimed at increasing the competitiveness of economic entities. It has been determined that the formation and functioning of the enterprise's marketing system should be carried out on the basis of a systematic approach and synergistic combination of marketing instruments, taking into account the characteristics of products, market, behaviour and needs of consumers with the marketing management system.

The authors substantiate expediency of application of an integrated approach to risk management of logistics activities of agrarian enterprises. A set of measures to mitigate the risks of logistics activities in the system of logistics management of agricultural enterprises in the context of instability and crisis phenomena is proposed. Within the framework of the European Commission's "Solidarity Lanes" initiative to promote Ukrainian agricultural exports, the ways of diversification of Ukrainian agricultural exports using road, rail and sea transport are analysed. Measures to accelerate the implementation of the "Solidarity Lanes" initiative in order to increase the volume of Ukrainian agricultural exports within the framework of diversified routes are proposed.

The study has shown that there are barriers that impede the effective organisation of international logistics activities of agricultural enterprises during martial law. In this regard, the authors propose priority areas of infrastructure ensure for the managing of international logistics activities of agricultural enterprises, which

include intensification of networking and partnerships through the creation of cross-border agro-cluster structures; uniting small farms, joint activities in the agricultural sector of two or more companies and various groups of stakeholders to achieve a common goal and synergistic effect.

In general, the authors of the scientific monograph are convinced that during martial law, ensuring food security is achieved by accumulating the available resource potential, using instruments of state and international support for agricultural producers and traders, developing and implementing an action plan for the post-war recovery of Ukraine's economy.

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