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Yinhai Miao

PhD student of the Department of Public Management and Administration, Sumy National Agrarian University, Sumy, Ukraine;
ORCID: [0009-0000-3790-1919](https://orcid.org/0009-0000-3790-1919)

Tetiana Kharchenko

Candidate of Economy Sciences, Associate Professor of the Department of Public Management and Administration, Sumy National Agrarian University, Sumy, Ukraine;
e-mail: tetyana_22_82@ukr.net
ORCID: [0000-0002-3446-6533](https://orcid.org/0000-0002-3446-6533)
(Corresponding author)

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IMPROVING THE INNOVATIVE STRATEGY OF MANAGEMENT OF AGRICULTURAL ENTERPRISES IN THE CONDITIONS OF GLOBALIZATION

ABSTRACT

The purpose of the article is to study the peculiarities of the implementation of innovative strategies by Ukrainian farmers, to identify influencing factors, including the influence of global market factors on the effectiveness of the implementation of strategies, and to develop a mathematical approach to assessing the influence of uncertain factors. The methodological basis of the article is the methods and forms of scientific knowledge accepted in science, such as methods: of comparative and abstract-logical analysis, induction and deduction, abstraction, and mathematical formalization. A stratification of the factors of the negative impact of globalization, which slow down the implementation of the innovative strategy and create threats to the activity of agricultural enterprises, is carried out. It is indicated that the main directions of improvement of the innovation strategy should be assessment, consideration, and neutralization of the influence of globalization factors. It is also indicated that this leads to the heterogeneity of the implementation of the innovative management strategy of agricultural enterprises. Prospective directions for the implementation of innovative strategies in agricultural production are stratified. The stages of the implementation of the innovation strategy in the conditions of globalization and the tasks of management for the implementation of the innovation strategy in the global conditions are determined. Peculiarities of the implementation of innovative strategies in Ukraine are revealed. A mathematical model was developed to assess the influence of uncertain global factors, which will allow for reducing risks for the implementation of significant innovative strategies. It is indicated that significant innovative projects could lead to the transformation of agribusiness activities and the need for permanent implementation of innovative processes. It is indicated that thanks to the systemic innovation process, a synthesis of the resource and innovation model of enterprise development could be formed. Taking into account the specifics of innovative strategies and using the developed mathematical approach to assess the influence of uncertain global factors will allow reducing risks in the implementation of innovative strategies and improving their management.

Keywords: innovation strategy, agricultural enterprises, globalization, mathematical model

JEL Classification: Q16, O32

INTRODUCTION

Producers of agricultural products in Ukraine today are in extremely difficult conditions. Many agricultural enterprises are on the verge of survival. Therefore, the workers of these enterprises are forced to cultivate mined fields and work under artillery and mortar fire in order to support their existence. Due to military actions of significant intensity on the territory of Ukraine, the financial capacity of state institutions to support agricultural production is limited, and the possibilities of institutional support for the innovative activities of agricultural producers, in contrast to other countries in the European Union, where such practice is extremely common, are significantly reduced. This leads to a lack of working capital not only for the introduction of innovations but even for conducting usual economic activities.

At the beginning of intensive hostilities in 2022, Ukrainian agricultural producers received certain preferences on foreign markets, in particular, the market of the countries of the European Union. But already at present, there are signs of a reduction in preferential conditions for Ukrainian agricultural products on these markets. Obtaining the necessary amounts of financing for further production activities by Ukrainian farmers is possible only if they strengthen their positions on the global market of agricultural products and acquire permanent opportunities to sell their products in local markets.

The obvious way out of the situation in foreign markets is for Ukrainian farmers to acquire an appropriate level of competitiveness. For this, as numerous scientific studies show, it is necessary to introduce innovations. Significant obstacles on this path are a high level of wear and tear of agricultural machinery, and a lack of highly qualified personnel, especially in those areas that are necessary for the implementation of innovations, in particular in the field of information and communication technologies.

Innovative activity is a risky type of activity. It is known that only one out of seven innovative projects in Ukrainian conditions is successful. Unsuccessful projects are a direct loss to agricultural enterprises, which already have problems with a lack of working capital. Therefore, thought-out and balanced innovative strategies, which are based on mathematically relevant risk assessment, are extremely necessary nowadays for Ukrainian agricultural producers. Relevant risk assessment is a difficult task for Ukrainian farmers. Internal risks are well learned by manufacturers from the experience of practical activity. However, the risks of the global market are an area that most Ukrainian farmers have not even touched upon. Assessing risks by analogy with examples of successful implementation of agricultural innovation projects at neighboring enterprises is also not always possible, because the conditions, soils, production structure, and branch affiliation (plant breeding, cattle breeding, sheep breeding, etc.) form a motley nature of production activity, which narrows the possibilities of direct borrowing of experience.

The lack of information support for assessing global risks significantly deepens the problem. Finding and using sources of information, means of its processing, and evaluation often require special knowledge, which workers in the agricultural sector of Ukraine mostly do not have. And global risks, even with the availability of information sources and the availability of means of information processing and its analysis, are of an uncertain nature, which greatly complicates the relevant assessment of the consequences of their impact on the innovative activity of Ukrainian enterprises.

Accordingly, the above determines the need to study the peculiarities of the implementation of innovative strategies by Ukrainian farmers, the stratification of the factors influencing the global market on the effectiveness of the implementation of innovative strategies, and, most importantly, the development of a flexible, highly adaptive mathematical approach to assessing the impact of uncertain factors on the innovation process in all branches of agriculture.

LITERATURE REVIEW

Nowadays, as indicated by the research of Lunova et al. (2019), Halko et al. (2023), Cherevko et al. (2019), Horák et al. (2023), the Ukrainian agricultural industry, which for a long time relied predominantly on the unique natural and resource capabilities of Ukraine for the production of traditional products and the use of time-tested methods of conducting economic activity, approached the limit of extensive development of production activity. To further expand competitive agricultural production farmers, as it is indicated in the articles of Skrypyuk (2021) and Kravcakova et al. (2017), are forced to apply the foreign experience of implementing innovative strategies since only innovative strategies are able to ensure a significant intensification of production and sales activities. As an illustrative example, the article by Kravcakova et al. (2017) provides a comparison of the gross export of agricultural products by Dutch enterprises and the gross export of Ukrainian agricultural enterprises of Ukraine. The volume of export of agricultural products by Dutch producers under worse soil and weather conditions is much higher than in Ukraine. This is due to the much greater efficiency of agricultural production and much greater attention to the innovative development of the Netherlands. For example, the yield of wheat in the Netherlands is 9.6 t/ha, in Ukraine according to data for 2021 – 4.64 t/ha Kravcakova et al. (2017), the yield of potatoes in the Netherlands is 46.6 t/ha, in Ukraine according to data for 2021 – 16.6 t/ha. The costs of own funds of the agricultural enterprises of the Netherlands for scientific and research works amount to 335 million euros. This indicates the perspective of innovative activity in the agricultural sector of Ukraine and the presence of significant reserves of innovative development of agricultural enterprises. At the same time, this confirms the thesis about the need for significant financial resources to implement innovations and conduct scientific research in this area.

Under the conditions of significant threats - military, political, and economic, as it is stated in the works of Bondarchuk et al. (2022), Shamanska (2018), Lutsii, and others. (2022), only the effective implementation of innovative strategies that will ensure the appropriate competitive level of Ukrainian producers on the global market can guarantee the sustainable development of agricultural enterprises.

In the scientific works of Zakharchuk et al. (2022), Andrade et al. (2020), Ullah et al. (2021), and Parmová et al. (2022), it is indicated that there are two main models of reproductive economic activity: a resource model and an innovative one. According to Zilberman et al. (2022), Blakeney (2022), von Braun, and others (2022) ways of introducing an innovative model can be: mastering a new product/service (or providing a product/service of new quality), a new production method; access to new sales markets; deeper processing of raw materials; application of new methods of organizing production processes. At the same time, Yu et al. (2023) indicate that even the choice of an innovative development strategy does not always lead to the abolition of a resource-based approach to economic activity for agricultural production. The resource approach according to Mulyk et al. (2020), and Vernyuk et al. (2021), first of all, concerns product and process innovations common in Ukrainian conditions, the purpose of which is to increase the volume of output of types of products familiar to farms, increase production efficiency, and preserve the quality of these products. Research by Zoria (2018), Mazurenko et al. (2019), and Reznik et al. (2019), also confirm the predominant focus of innovative strategies in Ukrainian agricultural production on improving traditional methods and ways of management.

According to Cherevko et al. (2019), the effectiveness of the implementation of innovative strategies by agricultural enterprises is largely determined by the level of the appropriate infrastructure of the enterprise. Sus et al. (2022), single out financial infrastructure, Reznik et al. (2020)- organizational infrastructure, and Bahn et al. (2021) – information infrastructure. As is evidenced, in particular, by the work of Kuznyetsova, Tiutiunyk, Panimash, Zsolt, & Zsolt, (2022), researchers are often limited to these types of infrastructure. This needs clarification, because according to Yuan et al. (2022), who studied the peculiarities of organizational innovations in the agricultural sector, and Kotelenets (2021), who pointed out the need to harmonize social and economic interests in agricultural production, the social, psychological and motivational readiness of the team for the risks of innovative activity is significant for the successful implementation of the innovation strategy, the level of its solidarity to achieve the goal and the willingness to agree to a partial reduction in the level of social conditions provision.

As it is indicated by Stanco et al. (2020), Guo et al. (2020), Bjerкета et al. (2022) implementation of innovative strategies requires a much greater understanding and ability to assess the dynamic effects of external factors on the economic activity of farms than strategies aimed at manufacturing products to which management has already adapted. According to Naz et al. (2018), Perevozova et al. (2023), Bagum et al. (2021), Ammirato et al. (2021) this concerns not only meso-level factors but also global-level factors, the analysis of which agrarian management previously did not pay enough attention to. First of all, according to Thornton et al. (2018), this requires the development and implementation of strategies that should ensure access to foreign markets.

In general, as evidenced by the above review of literary sources, a significant number of scientific works are devoted to the problems of improving the innovative management strategy of agricultural enterprises. At the same time, the peculiarities of the implementation of innovative strategies by Ukrainian farmers, the identification of factors that slow down the implementation of innovative strategies, the study of external influences, including the influence of global market factors on the effectiveness of the implementation of these strategies, and the development of methods for assessing the impact of uncertain and undefined global factors require more in-depth study.

AIMS AND OBJECTIVES

The purpose of the article is to study the peculiarities of the implementation of innovative strategies by Ukrainian farmers, to identify influencing factors, including the influence of global market factors on the effectiveness of the implementation of strategies, and to develop a mathematical approach to assessing the influence of uncertain factors.

METHODS

The methodological basis of the article is the methods and forms of scientific knowledge accepted in science, such as the methods of comparative and abstract-logical analysis, the method of induction and deduction, and methods of abstraction. In addition, the method of mathematical formalization was used, since the use of this tool made it possible to develop a mathematical model for evaluating the effects of uncertain and unspecified factors.

RESULTS

Innovation in the given article is proposed to be considered not from a scientific point of view, i.e. in the presence of scientific novelty, but as the achievement of the desired result for the producer by using the latest methods, tools, approaches, etc. for a particular agricultural enterprise. Innovations should extend not only to the application of new equipment and technologies but also to other aspects of agricultural economic activity: land use, management, marketing, logistics, planning of external economic activity, etc. The implementation of innovative strategies is influenced by the peculiarities of their implementation in Ukraine.

According to data analysis (United Nations Conference on Trade and Development, 2022), the level of innovative development in the country is decreasing today. Thus, comparing the values of the Frontier technology readiness index of 2020 and 2016, the annual rate decreased by 1.13 times; the Research and Development index - 1.41 times; the Industry Activity index - 1.09 times; Access to Finance index – 1.14 times; the qualification level of employees (Skills) - 1.14 times. Only the value of the ICT implementation indicator improved - by 1.2 times. According to the Global Innovation Index (GII) (World Intellectual Property Organization) for 2021, the rank of Ukraine is 49, and the evaluation level is 35.6. That is, Ukraine is inferior to the Russian Federation (GII rank - 45), Greece (GII rank - 47), and Romania (GII rank - 48) according to the GII ranking. This indicates a certain threat to the innovative development of the economy, which accordingly increases the importance of introducing innovative strategies by the management of agricultural enterprises.

An indicator of the level of introduction of innovations in agricultural production can be, for example, the average annual (for the last ten years) labor productivity per employee at constant prices of 2016, which for 2021 is UAH 702,127 in crop production, UAH 549,809 in livestock production (State Statistics Service of Ukraine). However, the peculiarity of the introduction of innovations in Ukraine is not even in the insufficient level of absolute values of specific labor productivity, but in significant fluctuations of this indicator from year to year (Figure 1). These fluctuations, which are especially pronounced for the crop production, and their value in recent years as a percentage of the previous year (which for the most recent time period is less than 100%), indicate, firstly, a decrease in this indicator in recent years, secondly, a significant level of dependence on external influences, since the methods of management and agricultural management remain at a relatively stable level, which restrains the growth of labor productivity. The negative influence of the global factor - cross-border labor migration is also noticeable here. This also confirms the insufficient level of innovation implementation in the industry, as innovative strategies ensure the sustainability of economic activity.

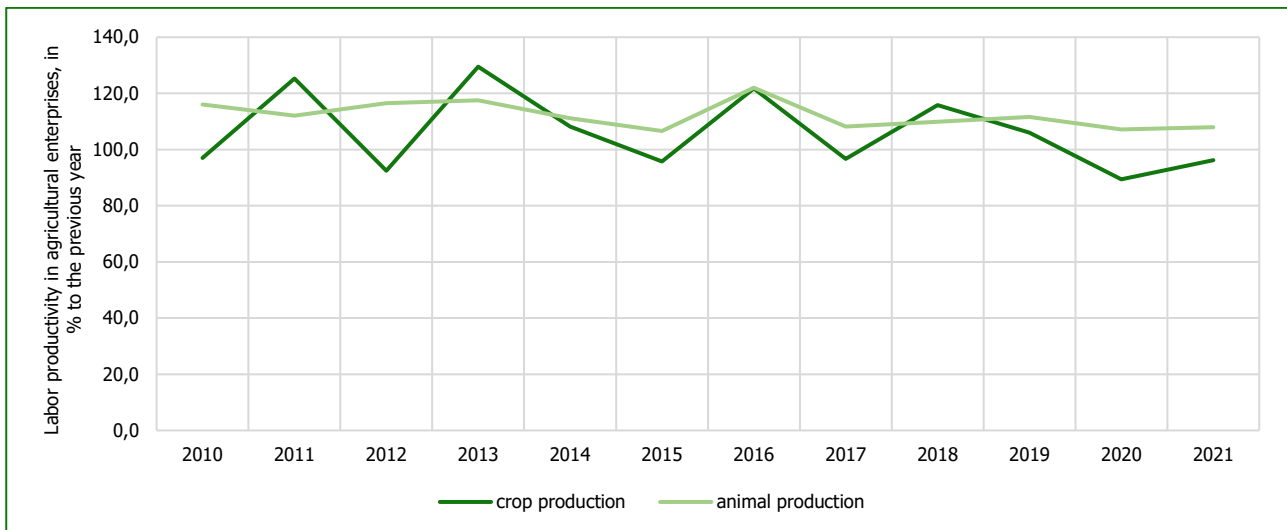


Figure 1. Labor productivity in agricultural enterprises per 1 employee on agricultural production, in % to the previous year. (Source: calculated by the authors based on State Statistics Service of Ukraine)

Another indicator of the level of innovation implementation can be the yield of agricultural crops. For example, for cereals and legumes (see Table 1), the yield for Ukraine is significantly inferior to the yield level of the leading European countries. At the same time, a significant indicator of the level of innovation implementation is the average yield deviation by region, the value of which can reach ~ 25% or more in comparison with the yield of grains and legumes in the country as a whole [43]. Also, a comparison of yields for agricultural enterprises and households indicates that, even with insufficient financing opportunities for households, the yield of agricultural crops in them may exceed the yield for enterprises. This also indicates

an insufficient level of implementation of not only product, and process, but also organizational innovations, since modern innovative technologies are able to stabilize production even under significant negative effects of external factors.

Table 1. Comparison of the yield of grain and leguminous crops for enterprises and households. (Source: calculated by the authors based on State Statistics Service of Ukraine)

Year	Productivity for enterprise, ts from 1 ha of harvested area	Productivity for households, ts from 1 ha of harvested area	The difference between productivity for enterprises and households	Average yield deviation for enterprises by regions, ts from 1 ha of harvested area	Average yield deviation for households by regions, ts from 1 ha of harvested area
1	2	3	4	5	6
2017	45.6	34.6	11.0	9.60	5.20
2018	52.2	34.4	17.8	14.48	6.76
2019	53.7	36.8	16.9	11.93	5.80
2020	46.4	31.9	14.5	12.65	5.18
2021	43.7	43.8	-0.1	4.91	5.17
2022	50.3	34.4	15.9	12.48	5.40

Since the average gross harvest of cereals and legumes for agricultural enterprises significantly exceeds this indicator for households, which may introduce a scale error, a comparison of yields was also made for vegetable crops, in particular, cabbage, the average gross harvest of which (see Table 2) for households significantly exceeds this indicator for agricultural enterprises. The study showed that the deviations from the average annual yield in various directions for agricultural enterprises reach 13%, and for households - only 3.6%. The maximum yield deviations by region from the average annual value for agricultural enterprises reach 29.4%, and for households - only 14.5%. These data confirm the presence of significant unevenness in the conditions of conducting economic activity by enterprises, by types of products, and, accordingly, the unevenness of the conditions for the implementation of innovative strategies.

Table 2. Comparison of the yield of white cabbage for enterprises and households. (Source: calculated by the authors based on State Statistics Service of Ukraine)

Year	Volume of production for enterprise (gross collection), thsd. centner	Productivity for enterprise, ts from 1 ha of harvested area	Volume of production for households (gross collection), thsd. centner	Productivity for households, ts from 1 ha of harvested area	The difference between productivity for enterprises and households	Average yield deviation for enterprises by regions, ts from 1 ha of harvested area	Average yield deviation for households by regions, ts from 1 ha of harvested area
2017	1466.7	375.8	15865.5	247.2	128.6	110.40	35.89
2018	1223.4	373.1	15496.6	255.4	117.7	63.46	34.19
2019	1445.2	391.1	16109.7	253.4	137.7	67.70	22.09
2020	1315.1	371.8	16478.8	245.9	125.9	51.10	24.00
2021	1112.2	370.7	16292.4	246.3	124.4	57.63	21.35
2022	752.2	342.4	14673.5	252.1	90.3	71.39	21.71

The methods of abstraction and mathematical formalization made it possible to develop an approach for evaluating the effects of uncertain and unspecified factors. For this, it is proposed to fragment the investment strategy into successive stages (or groups of stages that can be performed simultaneously), each of which must have a specific local goal, and the entire chain of stages must lead to the achievement of the general goal of the investment strategy. The specified chain forms an attractor on the response surface of the objective function (or a coordinated group of these functions) in the space of states from the influencing factors and indicators of the economy. The direction of implementation of each stage is indicated by the derivative (vector) of the objective function at the starting point of the stage on the response surface. The deviation of the vector from the given direction will be affected by the uncertainty and ambiguity of mainly external factors since the influence of internal factors is usually detected by management at the early stages of strategy implementation. When performing the stages, the effects of external factors must be identified and evaluated, and the direction of

the stage's implementation must be adjusted by clarifying the coordinates of the goal in the state space of each of the following stages. That is, for the operational management of the introduction of innovations at the first stage, it is not even necessary to identify an uncertain factor or a group of them. It is only necessary to assess their influence. This allows step-by-step detection of significant impacts of uncertain factors and adapting the strategy to them at the early stages of its implementation. The sensitivity of investment strategy implementation to this form of feedback should be maximum. Using the method of mathematical formalization, the proposed approach can be presented as follows:

$$\vec{\varphi} = \bigcup_{i=1}^n \vec{\varphi}_i \oplus \vec{f}_i \quad (1)$$

where $\vec{\varphi}$ is the objective function of the investment strategy; $\vec{\varphi}_i$ is the objective function of the stage, $i = 1 \dots n$ is the stage index; \vec{f}_i is a vector of management actions.

$$\frac{\partial \varphi_{ij}}{\partial x_j} \Delta \neq 0 \rightarrow \text{Info}(S) \sim \vec{f}_{ij} \quad (2)$$

$$\text{Info}(S) = - \sum_{k=1}^h \frac{J(C_k, S_k)}{J(S) - U} \log \log \frac{B(C_k, S)}{B(S) - U} \quad (3)$$

where Δ is the deviation of the objective function from the given value (which is equal to the difference of these indicators at the time of the study); φ_{ij} is the objective function of the i -th stage, which depends on the j -th parameter x_j ; \vec{f}_{ij} is the vector of management actions due to the deviation of the derivative $\frac{\partial \varphi_{ij}}{\partial x_j}$ from the predicted direction; $\text{Info}(S)$ is an information entropy indicator, which is defined as the ratio of the predicted slope ratio of the objective function to the tangent of its real angle; J is an array of derivatives; C_k is an array of derivatives, the impact of which is predicted to be compensated by management actions; S_k is an entropy from C_k derivatives; S is the integral entropy of the investment strategy; U is an array of derivatives that lead to deviation Δ ; $k = 1 \dots h$ is the index of the derivative in the array of derivatives.

In case the deviation Δ acquires an unacceptable value $\Delta \geq \Delta_{unacceptable}$, the implementation of the innovative strategy should be stopped.

Among the factors that slow down the implementation of the innovative strategy of Ukrainian agricultural enterprises, the following groups can be singled out:

- the financial group, which includes: limiting access to cheap financial resources (see p. 12, Table 3), necessary for the implementation of long-term innovations; reluctance of financial institutions to allocate loans for innovative projects that are considered too risky; management's irrational assessment of the prospects of an innovative strategy due to the focus on solving tactical problems; the frequent need to implement urgent organizational measures to compensate for the lack of working capital associated with the impact of external, in particular, weather risks, which limits the possibility of financing innovative strategies, etc.;
- the technical and technological group, which includes: significant wear and tear of technical and technological means, their significant moral obsolescence, which is characteristic of Ukrainian agricultural production; improper access of manufacturers to modern technologies (see p. 11, Table 3), etc.;
- the institutional group, which includes: permanent political and economic crises, including global crises (see p. 3, Table 3); inconsistencies in regulatory support for innovative activities; instability of the tax policy, which leads to insufficient volumes of investment in the industry, etc.;
- the market group, which includes: significant dynamic changes in production and consumption trends on commodity exchanges by types of agricultural products (see p. 2 Table 3); global imbalances between local markets for agricultural products and means of agricultural production (see p. 4, Table 3); restrictions for Ukrainian agricultural producers on local markets (see p. 8, Table 3); dynamics of changes in demand on local markets (see p. 13, Table 3), etc.;
- the organizational group, which, first of all, can include: insufficient awareness of the benefits of innovative strategies; lack of labor resources, first of all, highly qualified workers; lack of cooperation with research structures, etc.;

- a psychological group, which, first of all, can be attributed to a significant inclination of the management of agricultural enterprises to traditional forms and methods of conducting economic activity; the authoritarian nature of management which is characteristic of Ukrainian agrarian management, etc.

Factors that slow down the implementation of an innovative strategy can also include the considerable duration of the production cycle inherent in agricultural production, both in crop and livestock production. For crop production - due to its seasonal nature, for livestock production, in particular, due to the length of breeding work as a component of the innovation process.

Significant disparities between the elements of value chains, which were pointed out by Koval et al. (2023), during the sale of agricultural products and, most of all, during their export (see item 6, Table 3) are also a significant influence factor for the implementation of an innovative strategy, in particular with regard to the level of expected profit.

The given stratification of the factors that slow down the implementation of the innovative strategy of Ukrainian agricultural enterprises allows for a more relevant assessment of direct and indirect global influences on the formation of the innovative strategy of agricultural enterprises. Significant globalization factors and the level of their influence on the formation of an innovative strategy are shown in Table 3.

Table 3. Globalization factors and the level of their influence on the formation of the innovative strategy of agricultural enterprises of Ukraine.

N	Globalization factors	Level of influence
1	Geopolitical influences on the redistribution of flows of agricultural products and means of agricultural production between local markets	Considerable
2	Trends in changes in the ratio of production and consumption volumes on commodity exchanges by types of agricultural products	Considerable
3	Economic crises and uneven demand for agricultural products caused by them	Considerable
4	Global imbalances between local markets for agricultural products and means of agricultural production	Considerable
5	Labor migration	Significant for the category of highly qualified workers and average for other categories
6	Creation of cross-border value chains	Significant for a special period, average for peacetime
7	Specialization of national economies in the production of certain types of products for the global market	Average
8	The level of quotas and restrictions for Ukrainian agricultural producers on local markets	Average
9	Global impact on the uneven profitability of certain sectors of agricultural production and, as a result, the uneven demand for innovations in these sectors	Average
10	Uneven access of national producers to the resources of the global financial market	Significant for a special period, average for peacetime
11	Uneven access of national manufacturers to modern technologies	Average
12	The level of competitiveness of national producers on the world market and potential local markets of Ukrainian agricultural products	Average
13	Dynamics of changes in demand in local markets	Minor

Factors that slow down the implementation of innovative strategies and factors of negative globalization may be considered as factors of threats to the activity of Ukrainian agricultural enterprises. Therefore, one of the main directions for improving the innovation strategy is the relevant assessment, consideration, and, if possible, neutralization of these risks.

Different economic efficiency of certain directions and branches of agricultural production leads to variability in the level of motivation of their management. This, in turn, leads to the inhomogeneity of the level of implementation of the innovative management strategy of agricultural enterprises to improve innovative development both at the level of individual enterprises and at the level of industries. This is confirmed by the data shown in Figure 1, Table 1, and Table 2. The non-homogeneity of the level of implementation of innovative strategies is also due to the significant difference of farms in terms of size, resource provision, etc.

An assessment of the importance of non-main factors of global influence on Ukrainian agricultural production also needs attention. An example of such a factor is changes in freight rates for the transportation of dry cargo by sea. Since the peculiarity of Ukrainian agribusiness is that in peacetime sea transport occupied a prominent place in export deliveries of agricultural products, it is appropriate to compare the influence of freight rates and the exchange value of grain on the prices of consumer products on local markets (Figure 2). Data shown in Figure 2 indicate that freight rates are more important for some markets than the exchange value of grain. This confirms the need to introduce organizational innovation strategies in view of the need both to preserve one's position in local markets and to achieve the necessary level of profitability of agricultural production.

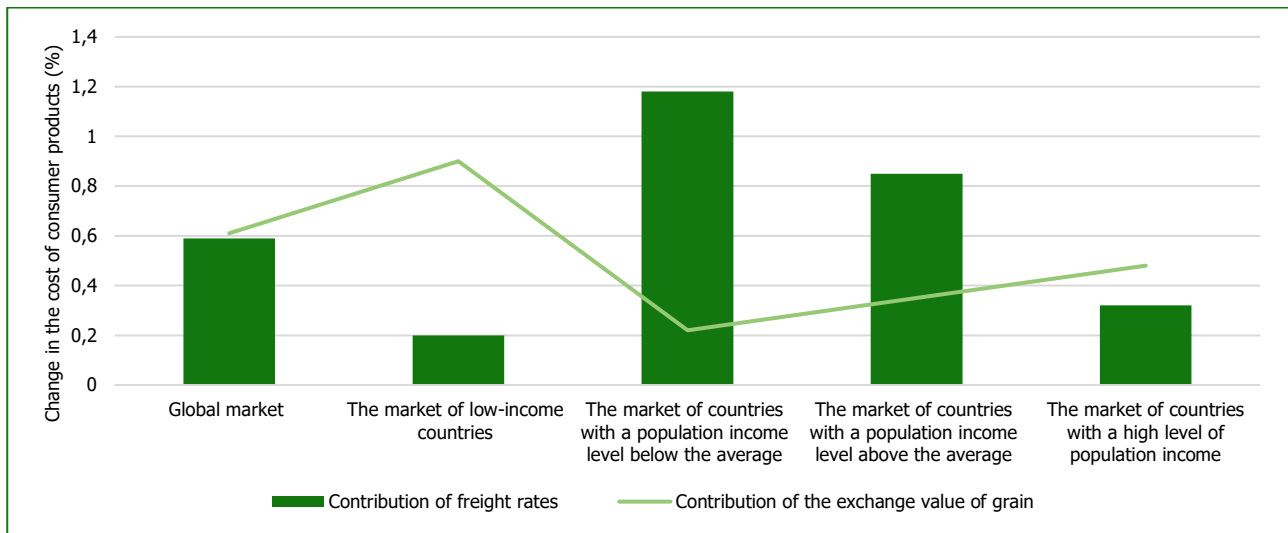


Figure 2. Comparison of the impact of the increase in freight rates for the transportation of dry cargo by sea and the exchange value of grain on the prices of consumer products in local markets, change in %. (Source: calculated by the authors based on State Statistics Service of Ukraine)

The production of organic products is an example of an innovative line of activity that is gaining popularity in the world market. There are prospects for the sale of such products, which leads to the positive influence of factors 12 and 13 of Table. 3 and stimulates the implementation of these innovations in Ukraine. Thus, the number of Ukrainian producers of organic products increased by 2.56 times from 2012 to 2020, and the area of agricultural land for growing organic plant products increased 1.69 times during the same period. At the same time, the value of not relative, but absolute indicators is the indicator of the level of implementation of organic innovation strategies. For example, the area of agricultural land for growing organic crop products is only ~1% of the total plowed area of agricultural land. Also, an indicator of the introduction of organic innovative strategies is the rate and direction of changes in organic crop cultivation in shorter time intervals. For example, in 2020, the number of producers of organic plant products decreased by 11% compared to 2019 (Kyrylenko et al., 2022; Zayed, et al., 2022; Semenets-Orlova, et al., 2022; Gaman, et al., 2022; Mironova et al., 2022; Yuldashev, et al., 2022; Kulikov, et al., 2022). This indicates the possibility of different directions of influence of global factors and national and micro-level factors on the implementation of innovative strategies in agricultural production, which is also a certain peculiarity of the innovation process in Ukraine.

The promising directions for the implementation of innovative strategies in agricultural production to acquire the necessary level of competitiveness on the world market and to level negative global impacts with the stratification of these strategies are also (Kuznyetsova, et al., 2022; Mulska, et al., 2022; Sytnyk, et al., 2022; Dvigun, et al., 2022; Sumets, et al., 2022)[53-58]:

- technical and technological: implementation of technologies for increasing the yield of agricultural products; introduction of energy-, resource- and moisture-saving, No-till and Mini-till technologies; adaptation of breeding varieties to the conditions of one's own farm; use of secondary resources of agricultural production; the use of technologies for maintaining the quality of products during their storage; application of biotechnological innovations, etc.;
- marketing, regarding the application of information and communication technologies; innovative advertising techniques; the latest tools for stimulating sales of own products, etc.;

- organizational: application of innovative land use strategies and preservation of soil fertility; introduction of innovative methods of keeping and feeding animals, increasing their productivity and increasing the quality of livestock products; improvement of the breed composition of groups of domestic animals, adaptation of breeding animals to the conditions of a specific farm; reduction of specific costs for the production of own products due to the intensification of production; implementation of quality control mechanisms; certification of products at the level of international standards; promotion of mutually beneficial interaction of all parties in the value chain from production to sale of own products; use of information and advisory systems when implementing innovative strategies; expanding the use of cooperation mechanisms; the spread of activity not only in the field of production and sales, but also in the field of service provision, for example, regarding the maintenance of agricultural machinery, the organization of providing resources for agricultural production of other enterprises, etc.

The peculiarity here is that the implementation of innovative strategies is more characteristic of the field of crop production, and the first concerns the implementation of process innovations. The most common process innovation strategies relate to the technological improvement of production processes and processes of maintaining the appropriate level of product quality during its storage. Product innovation strategies are also more characteristic of the field of crop production than animal production. Since the management of agricultural enterprises understands the risks of adapting varieties to the conditions of a particular farm, these strategies often involve the development at once of several plant species new to the farm. Organizational and marketing innovation strategies are differentiated by types of innovation and are mainly aimed at increasing production volumes, quality, or consumer properties of own products.

In order to increase the effectiveness of the innovation strategy in the conditions of external influences on the management of agricultural enterprises, it is necessary to implement effective methods of planning and management of innovative activities; a clear understanding of the goals and tasks of the specified activity; the application of methods for evaluating factors of external and internal influence on this activity, in particular, for their dynamic changes; assessment of the necessary resources, primarily financial, for the implementation of innovations and provision of sources of investment in innovative activities; development of ways of operational improvement of innovative activity.

The implementation of an innovative strategy by agricultural enterprises in the conditions of globalization should include the following stages: determination of the goal; identification of risks for the implementation of an innovative strategy; assessment of resource possibilities for its implementation; development of a strategic plan and determination of the stages of implementation of the innovation strategy; formation of organizational measures and a set of management actions for effective implementation of the innovative strategy; planning stages of resource allocation and organizing control over its storage and spending; formation of organizational mechanisms for ongoing coordination of operational and strategic plans; prompt adjustment of organizational measures and a set of management actions to identify the unexpected impact of external and internal factors.

The tasks of management in the implementation of an innovative strategy in the conditions of globalization are: not only establishing the goal of innovative activity, but also improving the permanent coordination of operational and strategic tools for its achievement in the dynamic conditions of globalization challenges; adjustment of the conceptual foundations of the company's strategy in case of changes in the factors of global influence for the use of innovative advantages; organization of receiving appropriate and timely information about changes in the competitive environment and introduction of a method of its effective analysis and evaluation; operational optimization of a set of strategic management tools; effective adjustment of plans to achieve intermediate goals depending on changes in factors of global influence; expansion of production to cover most of the chain of production, its preservation and processing, direct sale to the wholesale consumer; effective motivation of workers who contribute to the introduction of innovations.

A peculiarity of the implementation of innovative strategies in agricultural production is also that the management of agricultural enterprises understands well and is able to assess in a relevant manner those risks of innovative strategies that directly affect economic activity. For example, it may be the lack of financial resources for the introduction of the latest technologies, the lack of employees with the necessary qualifications for the effective implementation of innovative strategies, etc. Risks due to lack of awareness: regarding the specifics of innovative production, regarding changes in demand for innovative products in promising markets are often neglected. The effects of national-level risks, for example, regarding the forecasting of changes in the regulatory measures of state institutions and the specifics of regulatory and legal regulation of innovative activity, not to mention the effects of global factors, are mostly left out of the attention of practitioners. That is why the most common innovative strategies of Ukrainian agrarian management are strategies for step-by-step improvement of enterprise activity. This refers, first of all, to product and process innovations with the aim of increasing the output of traditional types of products and increasing the efficiency of traditional methods of production. This significantly reduces the level of risks, since the production of types of products familiar to the enterprise in previous periods made it possible to adapt to external influences by the "trial and error" method. However, significant innovative

projects with a relevant assessment of their risks are able to have a much greater economic effect. Large associations, mainly holdings, which have a powerful material and technical infrastructure and are provided with financial resources are capable of the implementation of such innovative strategies in Ukraine.

In the case of the importance of an innovative strategy, which almost always leads to the transformation of agribusiness activities, it is necessary to take into account the need for simultaneous organizational changes, for example, with technological changes, and even the introduction of new economic models of activity. This, in general, can lead to the permanent and integral nature of the innovation process. This integral nature of the innovation process refutes the classic division of models of economic activity into resource and innovation models. Due to the integral, systemic nature of the innovation process, a synthesis of resource and innovation models is formed, which emergently affects the entire activity of the enterprise.

At the same time, with a significant level of negative external influences, it is necessary to provide resources to return to established technologies, methods of organization, etc., to stabilize economic activity.

DISCUSSION

In the works of scientists, in particular, Zakharchuk et al. (2023), Andrade et al. (2020), Ullah et al. (2021), Parmová et al. (2022), the thesis is spread that there are two models of reproductive economic activity: resource-based and innovative. In the opinion of the authors, it is extremely difficult to separate the "pure" innovation component from the resource component for agricultural activity. Agricultural production by its very nature relies on the use of resources. Even the transportation of products can be considered as the use of logistics system resources. In addition, according to the authors, due to the integral, systemic nature of the innovation process, a synthesis of resource and innovation models is formed, which emergently affects the entire activity of the enterprise. This confirms the conclusion of the authors that for significant innovative strategies, which almost always lead to the need to transform agribusiness activities, it is necessary to take into account the possibility of introducing new economic models of activity that go beyond resource and innovative approaches.

According to Cherevko et al. (2019), the effectiveness of the implementation of innovative strategies by agricultural enterprises is largely determined by the level of the appropriate infrastructure of the enterprise. Sus et al. (2022), single out financial infrastructure, Reznik et al. (2020), highlight the organizational infrastructure, Bahn et al. (2021), highlight the information infrastructure. In the opinion of the authors, for Ukrainian agricultural production, a significant factor for the successful implementation of the innovative strategy is the social infrastructure, which increases the motivational readiness of the team to implement the innovative strategy, even with a certain reduction in the social expenses of the enterprise during the period of innovation implementation.

In the scientific works of Bondarchuk et al. (2022), Shamanska (2028), and other scientists rightly point out the insufficient level of implementation of innovative strategies in Ukrainian agribusiness, and the reasons given by the authors for this are, for the most part, quite significant. However, the most significant problem for the spread of the innovative process in agricultural production, according to the authors, is the high degree of risk of introducing innovations. Moreover, even examples of effective implementation of this process in individual farms do not inspire other farms to innovate, since agricultural management understands the non-identity of conditions and resources of farms, significant dynamism of influencing factors, and therefore prefers not to take risks than to take risks and lose. Therefore, the hope for the effectiveness of the spread of innovations due to the mechanism of "diffusion" - that is, the natural introduction of their use due to the visual demonstration of effectiveness, according to the authors, is exaggerated.

A problem in the introduction of innovative strategies in agricultural production is also the fact that the management of agricultural enterprises understands and evaluates the risks of innovative strategies that directly affect their economic activity quite well. The effects of national or global risks are uncertain for most managers. That is why, in contrast to the views of Shamanska (2018), Lutsii et al. (2022) the most widespread innovative strategies of Ukrainian agricultural management are strategies for step-by-step improvement of enterprise activity. This refers, first of all, to product and process innovations with the aim of increasing the output of traditional types of products and production efficiency. This significantly reduces the level of risks, since the production of types of products familiar to the enterprise in previous periods made it possible to adapt to external influences by the "trial and error" method. However, significant innovative projects with a relevant assessment of their risks have a much greater economic effect. That is why tools and methods for identifying and evaluating external influences are needed.

CONCLUSIONS

The factors that slow down the implementation of the innovative strategy of Ukrainian agricultural enterprises are stratified. These factors and factors of negative globalization influence are proposed to be considered as threats to the activity of Ukrainian agricultural enterprises, therefore the main directions of improvement of the innovation strategy should be the assessment, consideration, and, if possible, neutralization of these risks. It is noted that this leads to the inhomogeneity of the level of implementation of the innovative management strategy of agricultural enterprises to improve innovative development both at the level of individual agricultural enterprises and at the level of industries. Prospective directions for the implementation of innovative strategies in agricultural production are also stratified. The stages of the implementation of the innovation strategy in the conditions of globalization are specified and the tasks of management in the implementation of the innovation strategy in the specified conditions are named.

The peculiarities of the implementation of innovative strategies by Ukrainian farmers have been revealed, in particular: the insufficiency of the diffusion mechanism for the spread of innovations; significant variability in the level of motivation of the management of various agricultural industries and areas of activity to implement innovative strategies due to a significant difference in their economic efficiency; the possibility of different directions of influence of global factors and factors of other levels on the implementation of innovative strategies; the importance of minor factors of the global impact on Ukrainian agricultural production, for example, changes in freight rates for the transportation of dry cargo by sea, which, due to the predominant share of sea transport in export deliveries of agricultural products, necessitates the introduction of organizational innovation strategies to maintain a position in local markets and to achieve the necessary level of profitability of agricultural production; insufficient attention of managers to the influence of global factors; the spread of risk reduction strategies in Ukrainian agricultural production, which leads to an increase in the share of those innovations that contribute to increasing the output of traditional types of products and increasing the efficiency of those production methods to which management has already adapted. The last feature significantly reduces the level of risks, since the production of types of products familiar to the enterprise in previous periods made it possible to adapt to external influences by the "trial and error" method, but significant innovative projects with a relevant assessment of their risks are able to give a much greater economic effect.

For the possibility of implementing projects in the conditions of uncertainty and uncertainty of global impacts, an approach to assessing these impacts using methods of abstraction and mathematical formalization has been developed. It is indicated that the implementation of such innovative strategies in Ukraine is possible for large associations, predominantly holdings, which have a powerful material and technical infrastructure and are provided with financial resources.

It is noted that significant innovative projects often lead to the transformation of agribusiness activities, the need for organizational changes, and the introduction of new economic models of activity. This, in general, can lead to the permanent and integral nature of innovation processes. The integral nature of the innovation strategy refutes the classic division of models of reproductive economic activity into resource and innovation models.

It is indicated that due to the integral, systemic nature of the innovation process, a synthesis of the resource and innovation model is formed, which emergently affects the entire activity of the enterprise.

Limitations of research. Statistical studies are limited to the time before the start of full-scale hostilities in Ukraine, as this led to the distortion of the identified trends in an unpredictable way.

Prospects for further research. The authors see the further prospect of research in the development of a software module on the basis of the proposed mathematical approach, its implementation in the practice of Ukrainian management, and, by summarizing the experience of its use, offering effective approaches to improving innovative strategies.

ADDITIONAL INFORMATION

AUTHOR CONTRIBUTIONS

All authors have contributed equally

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Мяо І., Харченко Т.

УДОСКОНАЛЕННЯ ІННОВАЦІЙНОЇ СТРАТЕГІЇ УПРАВЛІННЯ СІЛЬСЬКОГОСПОДАРСЬКИМИ ПІДПРИЄМСТВАМИ В УМОВАХ ГЛОБАЛІЗАЦІЇ

Метою роботи є дослідження особливостей упровадження інноваційних стратегій українськими аграріями, виявлення чинників впливу, у тому числі впливу факторів глобального ринку на ефективність реалізації стратегій, та розроблення математичного підходу до оцінювання впливу невизначених факторів. Методологічною основою дослідження є прийняті в науці методи й форми наукового пізнання, такі як методи порівняльного й абстрактно-логічного аналізу, метод індукції та дедукції, методи абстрагування й математичної формалізації.

Проведено стратифікацію факторів негативного впливу глобалізації, які вповільнюють реалізацію інноваційної стратегії та створюють загрози для діяльності українських сільськогосподарських підприємств. Указано, що основними напрямками вдосконалення інноваційної стратегії мають бути оцінка, урахування та нейтралізація впливу глобалізаційних факторів. Підкреслено, що це призводить до неоднорідності впровадження інноваційної стратегії управління сільськогосподарськими підприємствами. Стратифіковано перспективні напрями реалізації інноваційних стратегій у сільськогосподарському виробництві. Визначено етапи реалізації інноваційної стратегії в умовах глобалізації та завдання менеджменту для реалізації інноваційної стратегії в глобальних умовах. Виявлено особливості реалізації інноваційних стратегій в Україні. Розроблено математичну модель для оцінки впливу невизначених глобальних факторів, що дозволить зменшити ризики для впровадження значущих інноваційних стратегій. Указано, що значущі інноваційні проекти можуть призвести до трансформації діяльності агробізнесу та необхідності перманентного впровадження інноваційних процесів. Відзначено, що завдяки системному інноваційному процесові може сформуватися синтез ресурсної та інноваційної моделі розвитку підприємства. Урахування особливостей інноваційних стратегій та використання розробленого математичного підходу для оцінки впливу невизначених глобальних факторів дозволять знизити ризики при реалізації інноваційних стратегій і покращити управління ними.

Ключові слова: інноваційна стратегія, сільськогосподарські підприємства, глобалізація, математична модель

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