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ЗМІСТ / CONTENTS

А. С. Полторак

Концептуальні основи біхевіористичного підходу до управління системою фінансово-економічної безпеки держави..... 9

A. Poltorak

Conceptual foundations of the behavioral approach to managing the system of financial and economic security of the state..... 9

С. Ю. Рубан, В. О. Даншин

Перспективи застосування геномної селекції для генетичного покращення молочної худоби в Україні.....20

S. Ruban, V. Danshin

Perspectives for the use of genomic selection for genetic improvement of dairy cattle in Ukraine.....20

О. К. Флоря, С. А. Нагорний, С. Ю. Косенко, О. І. Чалий, О. С. Чалай

Витрати часу на доїння кобил і їх етологічні показники30

O. Florya, S. Nahornyi, S. Kosenko, O. Chalyi, O. Chalaya

Time spent on milking mares and their ethological indicators.....30

Т. В. Качанова, Т. М. Манушкіна, О. І. Петрова, Н. П. Шевчук

Продуктивність високоолеїнового соняшнику при вирощуванні в умовах Південного Степу України41

T. Kachanova, T. Manushkina, O. Petrova, N. Shevchuk

Productivity of high-oleic sunflower when grown in the conditions of the Southern Steppe of Ukraine.....41

А. В. Бурковська, П. О. Коваль

Інноваційні технології у банківському секторі України в період цифровізації51

A. Burkovska, P. Koval

Innovative technologies in the banking sector of Ukraine in the period of digitalization.....51

О. С. Крамаренко, С. І. Луговий, О. І. Юлевич, С. С. Крамаренко

Аналіз багаторічної динаміки відтворювальних ознак свиноматок великої білої породи.....64

O. Kramarenko, S. Luhovyi, O. Yulevich, S. Kramarenko

Analysis of long-term dynamics of reproductive characteristics of sows of the large white breed.....64

С. І. Павлюк

Роль креативних індустрій в місцевому економічному розвитку74

S. Pavliuk

The role of creative industries in local economic development74

Н. В. Мірошкіна, Т. М. Борко

Філософія сільського господарства як спосіб осягнення аграрної практики85

N. Miroshkina, T. Borko

Philosophy of agriculture as a way of understanding agrarian practice85

Conceptual foundations of the behavioral approach to managing the system of financial and economic security of the state

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Abstract. Despite the fact that the use of the behavioral approach in the management of the system of financial and economic security of the state is relatively new, the study of the behavioral orientation of the financial system as one of the factors of functional changes will contribute to the formation of an effective mechanism for ensuring financial security. The growing role of the human factor, which is central in gender-oriented and behavioral aspects, increases the level of relevance of applying the behavioral approach in the process of managing the system of financial and economic security of the state. The purpose of this study is to substantiate the conceptual foundations of the behavioral approach to managing the state's financial and economic security system, which includes gender-oriented and behavioral aspects, and complements the systemic approach to managing the state's financial and economic security system. The features of state management of financial and economic security systems in various states are summarized and the main models and research centers of financial and economic security system management in the world are systematized. It is noted that the application of a behavioral approach to the management of the financial and economic security system of the state allows us to consider that the organizational behavior of a social organism is a set of reactions of the financial and economic system to the adjustment of external and internal conditions of functioning for the purpose of self-preservation and potential development. Such behavior is formed taking into account the personality management system, gender balance, individual psychological characteristics and natural properties. The toolkit of the gender-oriented component of the behavioral approach is summarized and the influence of the gender structure on the level of financial and economic security of the state is analyzed based on the results of the survey of respondents. The existing gender differences in the scientific views of men and women economists are summarized and the questions are specified, on which the largest statistically significant difference between the points of view of women and men in the field of managing the system of financial and economic security of the state is recorded. The essence of the economic category "behavioristic approach to managing the system of financial and economic security of the state" is specified, which is considered as a specific approach to ensuring the financial and economic security of the state and permanent monitoring of the phenomena and processes that occur in the system of its guarantee, which is based on gender and behavioral aspects, studies the features of management decision-making with mandatory consideration of psychological, mental and emotional features for the purpose of managing and forecasting the behavior of participants in financial and economic relations at the state level

Keywords: gender-oriented approach; behavioral aspect; psychological features of management; human factor; administrative management

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INTRODUCTION

The complex process of managing the financial security system of the state in modern dynamic conditions of the difficult-to-control influence of specific external threats, dependence on external sources of financing, and adjustments to approved budgets occurs with the growing role of the human factor, which is central to gender-oriented and behavioral approaches to the management system of the state's financial security.

The current macroeconomic situation led to the activation of destructive processes in Ukraine, the transmission of which poses a significant threat to the national security of the state, negatively affecting the level of its macroeconomic stability. Therefore, existing approaches to the regulation of security processes in the financial and economic sphere require a systematic, logically constructed set of scientific knowledge that would take into account the rapid change in threats due to emergency situations and reflect the financial and economic security of the state in its multidimensionality. This cross-sectoral problem is currently unsolved and corresponds to the most urgent needs of the economy and society.

In the work of Ch.I. Nkeki (2018) paid attention to the problems of risk and debt management during the financial crisis, but did not specify the impact of combinations of these factors on the dynamics of post-crisis recovery. Authors B. Scheubel & L. Stracca (2019) examined the global financial safety net for more than 150 countries between 1960 and 2014. The established research base covers only four elements: foreign exchange reserves, IMF financing, central bank swap lines, and regional financing mechanisms. In the work of B. Scheubel *et al.* (2019) considered the role of the global financial cycle for the financial security of developing countries in different types of crises and over time, the work mainly focuses on currency crises.

Authors C. Koutserimpas *et al.* (2019) analyzed the peculiarities of the management of the financial and economic security system in emergency situations during the years of the economic crisis in Greece, which does not allow us to assert the relevance of the results for other countries. In the work of V.Yu. Keretsman (2019) investigated the theoretical and practical aspects of state regulation of the development of regions in the system of managing the financial and economic security of the state. In the study of B. Yang (2020), a financial security risk ontology model was built based on risk association and machine learning.

In the work of M. Fudge *et al.* (2021) states that well-being has acquired an important importance in the policy of regional development and management of the system of financial and economic security of the state, emphasizing the need for the synthesis of well-being

and regional development within the framework of a carefully developed interdisciplinary approach. Authors Q. Yang *et al.* (2022) investigated the impact of regional development plans on China's regional economic growth using a multistage difference-in-differences strategy. In the work of H. Zhang & X. Wei (2022), the authors focused on the fact that the border effect can be an effective tool for promoting regional development in countries with developing economies.

Authors Zh. Yang *et al.* (2022) analyzed that the digital economy has a positive effect on quality regional development and strengthening of the state's financial and economic security system. In addition, the problem of managing the system of financial and economic security of the state for a long time has been causing active discussions among researchers regarding the feasibility of applying certain methodological approaches to the management of the financial security system (Davydenko *et al.*, 2022), the features of the introduction of a systemic-behavioral approach to the system of guaranteeing the financial security of economic systems (Leliuk, 2015), specific aspects of monitoring and assessing the state of financial security of the state (Sirenko *et al.*, 2019).

Thus, the main goal of this study was to substantiate the conceptual foundations of the behavioral approach to managing the state's financial and economic security system, which includes gender-oriented and behavioral aspects and complements the systemic approach to managing the state's financial and economic security system.

MATERIALS AND METHODS

A thorough bibliometric analysis using Google Analytics tools, Vosviewer v.1.6.18, SciVal made it possible to single out research groups with a strong scientific output on researching various approaches to managing the system of financial and economic security of states. The use of Vosviewer v.1.6.18 made it possible to build bibliometric networks containing researchers and individual publications in the field of justifying the feasibility of applying a behavioral approach to managing the system of financial and economic security of the state. These networks are built on the basis of citations and bibliographic connections, as a result of which the obtained information is used in the formation of a list of the main groups of literary sources of authors who considered the problem under investigation.

The theoretical and methodological basis of this research is the system of scientific provisions of applied and fundamental research of scientists in the fields of: strategic management, economic theory, theory of development, strengthening and guaranteeing the

financial and economic security of states, theories of international relations.

System-structural analysis and synthesis were used to solve the identified tasks in the work – to identify the key aspects of each subsystem of the financial and economic security of the state and to form correct questions in the process of interviewing experts. The question of the systemic and structural nature of financial and economic security arose due to the need to find out how the change in each of its subsystems affects the change in the general security system of the financial and economic system. In addition, it is clarified how the application of the behavioral approach in a specific structural part of financial and economic security (tax security, monetary security, budget security, currency security, macroeconomic security) is connected with strengthening the general level of financial and economic security of the state.

Historical and dialectical methods, as well as the method of scientific abstraction, were applied during the specification of the essence of the economic category “behavioristic approach to managing the system of financial and economic security of the state.” Thus, an in-depth study of the processes and phenomena of economic life made it possible to single out the main, most essential features of this economic category, abstracting from other categories that were considered secondary in this analysis.

The expert assessment method was used in the process of analyzing the influence of the gender structure on the level of financial and economic security of the state. The survey data of 351 expert respondents (167 men and 184 women) were used for this analysis. Experts were chosen based on their place of work (field of higher education), as well as the presence of a scientific degree. It is taken into account that the basic conditions for the effective application of this method are a high level of erudition and expert knowledge of the problem under investigation (confirmed by the presence of scientific degrees in the field of economics of the respondents), as well as the ability of experts to give clear answers. It should be noted that all the experts who participated in the survey were not interested in certain options for answers to the questions in the field of the influence of the gender structure on the level of financial and economic security of the state.

The use of the expert evaluation method was based on the assumption that based on the generalized opinions of the selected experts, an adequate conclusion can be drawn regarding the presence or absence of the influence of the gender structure on the level of financial and economic security of the state.

Descriptive-statistical and graphic methods are used to describe, compare and highlight the features of

the main models and research centers of management of financial and economic security systems in the world.

The abstract-logical method is applied at all stages of substantiation of the conceptual foundations of the behavioral approach to managing the system of financial and economic security of the state. With the help of the abstract-logical method, the essence of the economic category “behavioristic approach to managing the system of financial and economic security of the state” was formulated, the main hypothesis was put forward, generalizations and conclusions were formed.

RESULTS

Each developed country is characterized by certain features of the state management system of financial and economic security, some of which significantly affect the process of guaranteeing the financial and economic security of other countries. The most used approaches are system, process, program-target, resource, value, resource-functional and stationary approaches (Dyakonova & Petrenko, 2013).

Thus, ensuring the financial and economic security of Germany is based on the promotion of price stabilization, foreign economic balance and a high level of employment at the necessary rates of economic growth. Special attention was paid to the consolidation of state budgets, the stability of the euro, and control over the rate of growth of state debt. Among the features of the state management of the system of financial and economic security of Great Britain, it is advisable to single out the fact that the government relies on private business in the process of preventing financial threats, maximally supporting entrepreneurial activity in the state, promoting effective dialogue between business and the state through the functioning of an extensive system of institutions (the Trade Council for Eastern Europe, the Confederation of British Industry and others) (Hubarieva, 2015).

In Spain, the system of ensuring the interests of the state in the economic and financial spheres is based on a flexible legislative and regulatory framework, effective development programs, and a clear demarcation of the competences of organizations, ministries, and agencies in the process of implementing these programs. Countries such as Denmark, Luxembourg, Belgium, and the Netherlands, in the process of protecting national interests in the economic and financial spheres, rely on the modernization of economic and financial systems taking into account competition on the world market (Hubarieva, 2015).

Poland, the Czech Republic, Slovakia, Hungary support the convergence of their national interests in the economic and financial spheres with the interests of Western European countries, and also focus on reducing economic backwardness from the leading countries

of the European Union, reducing the level of dependence on imports and structural deformation of industry (Pidkhomnyi, 2015).

The main models and research centers of the management of financial and economic security systems in the world are presented in Figure 1.

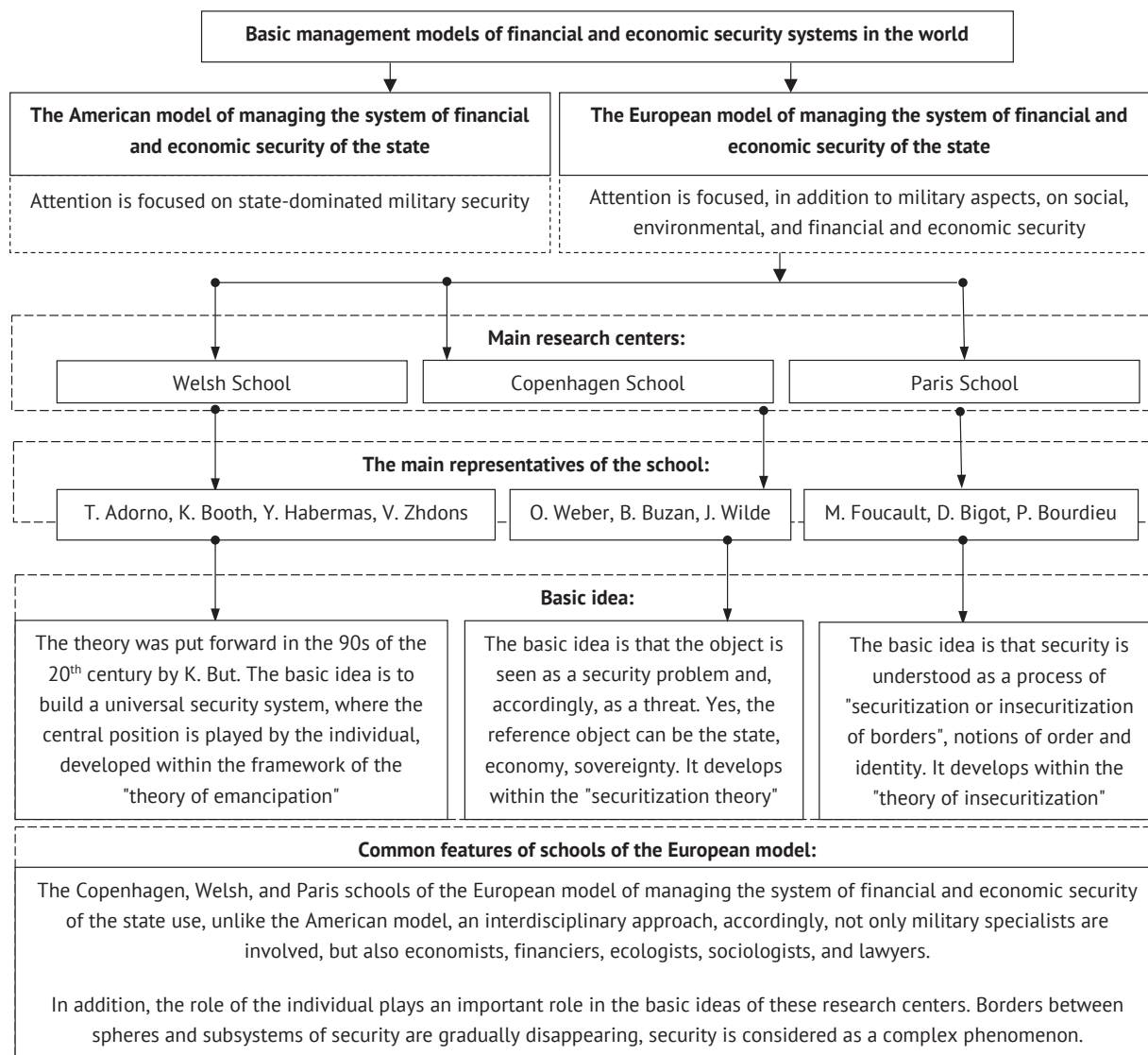


Figure 1. The main models and research centers of management of financial and economic security systems in the world
Source: generalized based on R. Floyd & S. Croft (2011), I. Hubarieva (2015)

The author of the article believes that taking into account the behavioral orientation of the financial and economic system as one of the factors of its functional changes will contribute to the formation of an effective management mechanism of the system of financial and economic security of the state. Thus, the peculiarities of the behavior of the social organism responsible for managing the system of financial and economic security of the state are formed, including as a result of the functioning of the mechanisms of emotional competence and sensitive perception. Management of the system of financial and economic security of the state from the point of view of a systemic-behavioral approach

should take place on the basis of the hypothesis that the financial and economic security of the state is a supersystem with corresponding components, which is considered taking into account the behavior, interpersonal communications and features of a social organism that makes decisions in the process of managing it.

The application of a behavioral approach to the management of the system of financial and economic security of the state allows the author to believe that the organizational behavior of a social organism, which affects the guarantee of the necessary security level, is a set of reactions of the financial and economic system to the adjustment of external and internal conditions

of functioning for the purpose of self-preservation and potential development. Such organizational behavior is formed taking into account the personality management system, gender balance, individual psychological characteristics and natural properties (emotionality, activity), as well as interests, the system of needs and the available opportunities for their satisfaction, motives.

Accordingly, the author of the article believes that the application of behavioral innovative aspects to the management of the system of financial and economic security of the state is justified by: the possibility of identifying the relationship between the psychology of a social organism that investigates financial and economic security and the effectiveness of state management decisions; systematization of the reasons for making incorrect management decisions in the process of guaranteeing financial and economic security in the presence of real scenarios of the development of the financial and economic system and adequate forecast indicators.

In addition, according to the author, among the factors influencing the level of financial and economic security of the state, including it is also necessary to consider gender balance, because the gender gap in views on the management of the system of financial and economic security of the state has significant consequences regarding the level of effectiveness of the introduced preventive measures to strengthen the financial and economic security of the state.

According to research by B.S. Frey & R. Eichenberger (1993), in the United States of America economics professors most often play the role of advisors, while in European countries they quite often take a direct part in the formation and implementation of economic policy

in important government positions. Accordingly, gender balance is especially important in European countries.

In Ukraine, international standards and norms in the field of promoting gender equality, including in the field of management, are taken into account at the level of state policy and legislative framework (Order of the Ministry of Finance of Ukraine..., 2019; Order of the Cabinet of Ministers of Ukraine..., 2020), but, according to the author, the actual institutional practice is not fully supports the implementation of existing tools, accordingly, the results of the introduction of gender-sensitive policies are limited.

The toolkit of the gender-oriented component of the behavioral approach to managing the system of financial and economic security of the state consists of: gender analysis, statistics and budgeting. Gender analysis is the collection of information for the purpose of assessing the impact caused by the existing level of gender gap in social groups on the process of decision-making effectiveness in the field of strengthening the state of financial and economic security, and, conversely, the analysis of the impact of the developed courses of action on women and men, understanding and consideration gender trends in society and the economy (Bannier & Schwarz, 2018).

Gender-sensitive budgeting is a tool of the gender-oriented component of the behavioral approach to managing the system of financial and economic security of the state, the economic essence of which is to take into account the general gender concept during the formation, evaluation and use of budgets at all levels (Bannier & Schwarz, 2018). Note that gender policy in the process of managing the system of financial and economic security of the state is divided into several types (Fig. 2).

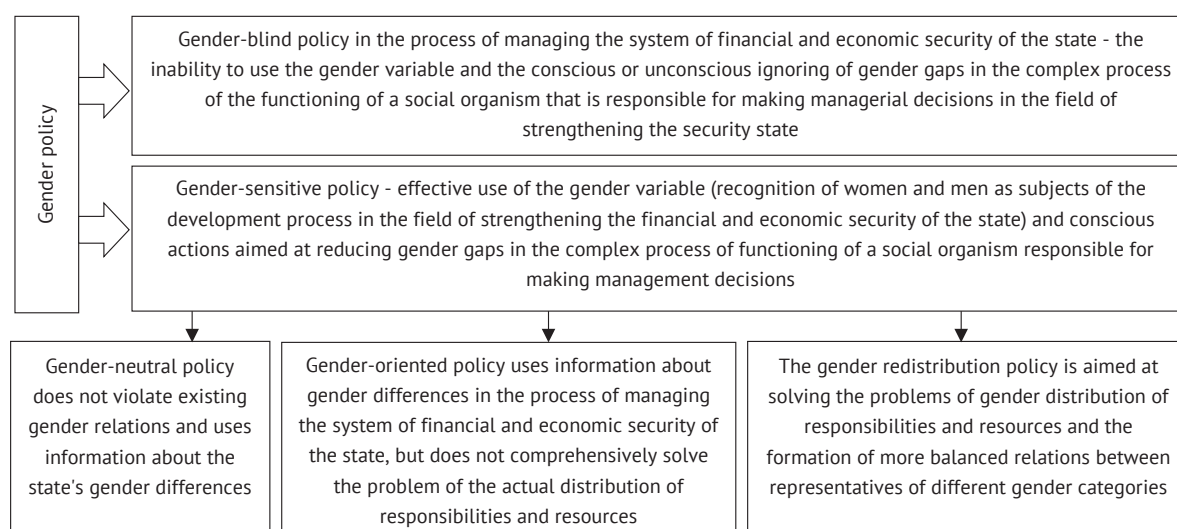


Figure 2. Classification of gender policy in the sphere of management of the system of financial and economic security of the state

Source: summarized based on Ivanina (2016), Bannier et al. (2018)

It is worth noting that in the countries of the European Union, according to the study of the influence of women on politics "Women in decision making roles in the European Union" (Openblog, 2016), the situation regarding gender balance in the sphere of economy and finance is better compared to Ukraine, but it cannot be considered optimal. Thus, only 8% of the Ecofin Council of the European Union on economic and financial issues are women, besides, there is no woman in the European Union who would head the Ministry of Economy.

In 2020, the Order of the Cabinet of Ministers of Ukraine approved the National Action Plan aimed at implementing UN Security Council Resolution 1325 "Women, Peace, Security" (Order of the Cabinet of Ministers of Ukraine..., 2020), but the legislative approval of this Plan is not realistic received positive evaluations from experts, taking into account the fact that the above-mentioned document, firstly, does not have a mandatory nature, in addition, there is no requirement to publicize the results of its implementation.

In the Global Gender Gap Index (2022) of the World Economic Forum on the gender gap, Ukraine ranks 81st among 146 countries, which indicates, among other things, the presence of a tendency to "alienate" women from economic activity, lack of an effective gender policy, lagging behind global trends. Thus, the global weighted average distance to parity is 70.7% (respectively, the gap between men and women is 29.3%). Given the current situation, it will take about 100 years to eliminate global inequality. It is interesting that one of the largest global gaps between men and women remains precisely in the sphere of economy and finance, which needs more than 200 years to overcome (World Economic Forum..., 2022).

In order to find out the presence or absence of the influence of the gender structure of economic science on the level of financial and economic security of the state, as well as the possibility of improving the indicators of the financial and economic security of the state by reducing the gender gap and balancing the representation of men and women in a diversified range of issues of financial and economic science, which are on the agenda, an analysis of the scientific positions of men and women economists (184 women, 167 men) who work in the field of higher education and also have scientific degrees was carried out. The survey contained questions in 4 areas:

- principles and methodology of assessing the level of financial and economic security of the state (issues related to system taxonomy, priority of principles of monitoring the state of financial and economic security of the state; factors influencing the level of financial and economic security of the state, a set of indicators and methods of calculating the integral index of the state of financial and economic security state security);

- areas of ensuring the financial and economic security of the state (issues related to effective measures in each of the spheres of economic security);

- the influence of behavioral aspects on the level of financial and economic security of the state (questions about the relationship between psychological, emotional and mental factors and the state of financial and economic security of the state, the significance of asymmetric distribution of input information, which is the basis of the analysis of the state of financial and economic security of the state);

- the impact of gender balance in social groups responsible for making management decisions on the level of financial and economic security of the state (questions about the existence of gender prejudices and stereotypes, the wage gap by gender, the feasibility of introducing a policy to ensure gender balance, the presence of advantages and potential positive consequences of the gender balance in social groups identified as responsible for decision-making in the process of managing the system of financial and economic security of the state).

The results of calculations of the standardized coefficient of Cronbach's alpha (1) according to the method of L.J. Cronbach (1951) testified that the value of the coefficient for each large-scale measurement of opinion in this study exceeded 0.81, accordingly, the obtained results can be considered reliable.

$$\alpha_{st} = \frac{N \cdot \bar{r}}{1 + (N-1) \cdot \bar{r}}, \quad (1)$$

where α_{st} – Cronbach's alpha coefficient; N – the number of components under investigation; $\bar{r}$ – the average correlation coefficient between the components.

The obtained results made it possible to generalize existing gender differences in the scientific views of male and female economists.

The largest statistically significant difference was recorded between the points of view of women and men on the following issues:

- taxation (women are characterized by a greater inclination to a progressive taxation system);

- distribution of budget funds (men are less likely to support socially responsible programs, and are also interested in environmental protection and ecological issues);

- riskiness (in the decision-making process, men are prone to a higher level of risk compared to women);

- behavioral aspects of the influence on the state security level of the financial and economic system (women pay less attention to the significance of the asymmetric distribution of input information, which is the basis of the analysis of the state of financial and economic security of the state).

– gender gaps (men are less inclined to believe that gender stereotypes and prejudices are a significant obstacle in the process of managing the system of financial and economic security of the state; women are more likely to consider the issue of the wage gap as a problem of ensuring gender balance).

It was found that men and women really have slightly different views on certain issues of financial

policy, basic principles and methodology of financial science, accordingly, ensuring gender balance in the groups that form financial policy can be considered as a factor in changing the effectiveness of this process.

Let us present the essence of the economic category “behavioristic approach to managing the system of financial and economic security of the state” in Figure 3.

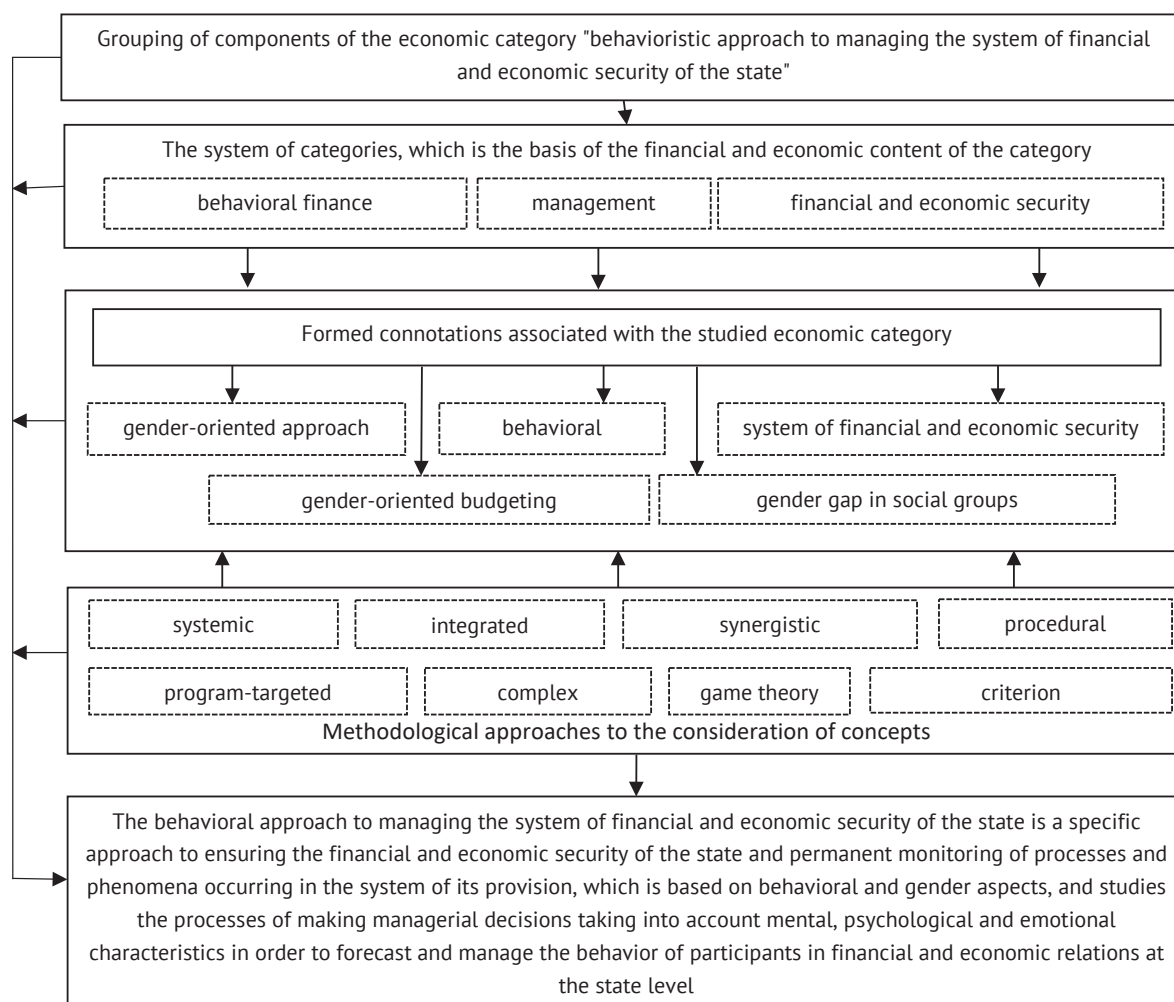


Figure 3. The essence of the category “behavioristic approach to managing the system of financial and economic security of the state”

Source: author’s development

It is worth noting that a behavioral approach to the management of the system of financial and economic security of the state can be especially useful in the process of ensuring budgetary security, completing the decentralization reform, and transforming local self-government. It is the behavioral aspect of the behaviorist approach that makes it possible to justify the state of society as a taxpayer from a psychological point of view, because the factor of taxpayers’ trust in the authorities plays a decisive role in the taxation process, including local self-government bodies.

DISCUSSION

In a thorough scientific work, A.M. May *et al.* (2018) published the results of a survey of European specialists, which was aimed at identifying the gender gap in the opinions of women and men on basic principles, methods, and policies, while in this study by the author, the range of survey questions to respondents was limited to the problems of ensuring the financial and economic security of the state, and the obtained results became the basis for the formed conclusions regarding the possibility of improving the indicators of the

financial and economic security of the state due to the reduction of the gender gap and the balancing of the representation of men and women in a diversified range of issues of financial and economic science.

The authors of A.M. May *et al.* (2013) also analyzed the differences in the views of men and women, but the paper presents the results of a survey that took place among economists in the United States of America, who are members of the American Economic Association, in addition, the range of questions was limited to aspects of politics. The conclusions obtained in the work of A.M. May *et al.* (2013), are confirmed by the results of the author's research in that there are significant differences in the views of male and female economists, respectively, gender diversity is an important aspect in expanding the scope of issues considered in the working group. Deepening these results, the author's research concluded that the largest statistically significant difference between the points of view of women and men in the field of ensuring the financial and economic security of the state was recorded on the following issues: taxation (women are more inclined to a progressive taxation system); distribution of budget funds (higher interest of women in issues of ecology, social responsibility, justice, environmental protection); behavioral aspects of influence on the state security level of the financial and economic system; risk-taking (in the decision-making process, men are prone to a higher level of risk compared to women); the issue of ensuring gender equality (men are less inclined to believe that gender stereotypes and prejudices are a significant obstacle in the process of managing the state's financial and economic security system).

In the scientific results presented in the study of A.O. Ostrovska (2013), attention is paid to the impact of behavioral finance on overcoming the crisis of the real sector of the economy. Developing this hypothesis, the author's research proves that in the process of managing the system of financial and economic security of the state, it is necessary to take into account that participants of social groups have mental models – ways of understanding, ideas and action strategies based on experience. It is noted that mental models are formed, among other things, based on gender stereotypes, life experience, moral, mental, psychological and emotional features of the subject. It is emphasized that the set of mental models of each member of social groups involved in the process of managing the system of financial and economic security of the state affects the formation of his personal paradigm - the essential method of decision-making, his point of view, understanding and interpretation of the existing situation or problem, as well as personal relationship subject. These conclusions justify the author's opinion that the improvement

of gender balance will affect the directions of discussions and increase the level of financial and economic security of the state.

In a study by J. Paule-Vianez *et al.* (2020), the authors emphasize that market efficiency has been questioned since the emergence of behavioral finance, and also use bibliometric analysis to highlight trends in this field of research. The obtained results show the growth potential of behavioral finance. In this work, the author also carried out a bibliometric analysis using a special toolkit, which made it possible to single out research groups with a powerful scientific work on researching various approaches to managing the system of financial and economic security of states, to build bibliometric networks containing researchers and individual publications in the field of feasibility studies application of the behavioral approach to managing the system of financial and economic security of the state.

The team of authors in their work V. Ramiah *et al.* (2015) also point out that behavioral finance, the lack of gender equality, allows for market inefficiencies, whose participants are prone to normal human errors arising from heuristics and biases. In this author's article, consideration of this assumption is continued: trends in the field of ensuring gender equality in Ukraine are analyzed, it is found that at the moment, according to the gender equality index, Ukraine ranks 81st among 146 countries, which indicates, among other things, the presence of a trend of "alienation" women from economic activity, lack of an effective gender policy, lagging behind global trends.

In the work of S.V. Leliuk (2015), the researcher's attention is paid to the theoretical substantiation of the essence of the concept of "system-behavioristic approach". Developing these scientific results, in this research of the author, on the basis of a generalized system of categories, which is the basis of the financial and economic content of the studied concept, formed connotations associated with the studied economic category, and generalized methodological approaches to the consideration of the concept, the essence of the economic category "behavioristic an approach to managing the system of financial and economic security of the state". It has been proven that the integration of a behavioral approach to the management of the financial and economic security system of the state means that the comprehensive principle of equality between women and men must be taken into account in the formation of a social organism that makes decisions aimed at strengthening the state of financial and economic security of the state, identifying factors influencing its condition and mitigation of threats. In addition, each project or course of action must be evaluated taking into account the gender perspective.

The authors of the article, M. Burke *et al.*, obtained interesting scientific results in the field of research. (2022), in which academics focus on indicators of change in cryptocurrency income associated with an increase in the number of cases/deaths from COVID-19. The authors of the publication found that the level of government intervention reduces the impact of COVID-19 cases/deaths on cryptocurrency profitability, and it is also shown that during periods of increased government intervention, an increase in the number of COVID-19 cases has a positive effect on cryptocurrency profitability. This author's publication does not consider aspects of the impact of the number of cases/deaths from COVID-19, however, the results of the existing differences between the scientific positions of women and men in the spheres of behavioral aspects of the impact on the state security level of the financial and economic system and risk-taking (in the decision-making process, men are prone to a higher level of risk compared to women) allow us to make assumptions about the existence of different reactions of men and women in the process of making financial decisions in situations associated with an increase in the number of cases/deaths from COVID-19, which is planned to be investigated, confirmed or refuted in the following scientific research.

CONCLUSIONS

It is emphasized that the activation of destructive processes in the economy of Ukraine requires the adjustment of existing approaches to the regulation of security processes in the financial and economic sphere, taking into account the modern dynamic conditions of the difficult-to-control influence of specific external threats. The current macroeconomic situation leads to the activation of destructive processes in Ukraine, the development of which is a threat to ensuring the financial and economic and, accordingly, national security of the state, therefore the existing approaches to the regulation of security processes in the financial and economic sphere require a systematic, logically constructed complex of scientific knowledge, including through the implementation of a behavioral approach

to the management mechanisms of the state's financial and economic security system in conditions of global instability.

The essence of the economic category "behavioristic approach to managing the system of financial and economic security of the state", which is considered as a specific approach to ensuring the financial and economic security of the state and permanent monitoring of the phenomena and processes that take place in the system of its guarantee, based on gender and behavioral aspects, studies the features of managerial decision-making with mandatory consideration of psychological, mental and emotional features in order to manage and forecast the behavior of participants in financial and economic relations at the state level, and analyzed the tools of the gender-oriented component of the behavioral approach to managing the system of financial and economic security of the state (gender analysis, statistics and budgeting).

It has been proven that the management of the system of financial and economic security of the state is often characterized by gender blindness, namely the inability to take into account the gender variable or the unconscious or conscious ignoring of existing gender gaps in the functioning of a social organism responsible for the process of making managerial decisions aimed at ensuring the state of financial and economic security state. The existence of a gender gap affects the peculiarities of the implementation of financial and economic policy, as well as the level of effectiveness of the introduced preventive measures to strengthen the level of financial and economic security of the state.

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CONFLICT OF INTEREST

None.

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Концептуальні основи біхевіористичного підходу до управління системою фінансово-економічної безпеки держави

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Анотація. Незважаючи на те, що застосування біхевіористичного підходу в управлінні системою фінансово-економічної безпеки держави є відносно новим, дослідження біхевіористичної спрямованості фінансової системи як одного з факторів функціональних змін сприятиме формуванню дієвого механізму забезпечення фінансової безпеки. Зростання ролі людського фактору, який є центральним у ґендерно-орієнтованому та поведінковому аспектах, підвищує рівень актуальності застосування біхевіористичного підходу в процесі управління системою фінансово-економічної безпеки держави. Метою даного дослідження є обґрунтування концептуальних основ біхевіористичного підходу до управління системою фінансово-економічної безпеки держави, який містить ґендерно-орієнтований й поведінковий аспекти, та доповнює системний підхід до управління системою фінансово-економічної безпеки держави. Узагальнено особливості державного управління системами фінансово-економічної безпеки в різних державах та систематизовано основні моделі та центри досліджень управління системами фінансово-економічної безпеки у світі. Зазначено, що застосування біхевіористичного підходу до управління системою фінансово-економічної безпеки держави дозволяє вважати, що організаційна поведінка соціального організму є набором реакцій фінансово-економічної системи на коригування зовнішніх та внутрішніх умов функціонування з метою самозбереження та потенційного розвитку. Така поведінка формується з урахуванням системи керування особистістю, ґендерної збалансованості, індивідуально-психологічних особливостей та природних властивостей. Узагальнено інструментарій ґендерно-орієнтованої складової біхевіористичного підходу та проаналізовано вплив ґендерної структури на рівень фінансово-економічної безпеки держави на основі результатів опитування респондентів. Узагальнено наявні ґендерні відмінності у наукових поглядах чоловіків та жінок економістів та конкретизовано питання, за якими зафіксована найбільша статистично значуща різниця між точками зору жінок і чоловіків у сфері управління системою фінансово-економічною безпекою держави. Уточнено сутність економічної категорії "біхевіористичний підхід до управління системою фінансово-економічної безпеки держави", яка розглядається як специфічний підхід до забезпечення фінансово-економічної безпеки держави та перманентного спостереження за явищами і процесами, які відбуваються в системі її гарантування, що базується на ґендерних та поведінкових аспектах, вивчає особливості прийняття управлінських рішень з обов'язковим урахуванням психологічних, ментальних та емоційних особливостей з метою управління та прогнозування поведінки учасників фінансово-економічних відносин на державному рівні

Ключові слова: ґендерно-орієнтований підхід; поведінковий аспект; психологічні особливості менеджменту; людський фактор; адміністративний менеджмент

Perspectives for the use of genomic selection for genetic improvement of dairy cattle in Ukraine

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Abstract. An important problem in modern dairy cattle breeding is the achievement of a high level of genetic progress in economically important traits through the implementation of effective breeding programs. For this purpose, genomic selection is currently used in many countries of the world. The aim of the study was to investigate possibilities of use of genomic selection in dairy cattle breeding in Ukraine. On the basis of analysis of "Catalogue of sires of dairy and dual-purpose breeds for reproduction of cows in 2020" (sperm of these sires was used in Ukraine) two methods of breeding value estimation were compared: 1) traditional method based on pedigree and performance of progeny; 2) genomic method based on effects of SNPs. Considerable advantage of sires with genomic evaluations was proved. These sires excel sires with traditional evaluation for milk yield by 1.6 times, for fat percentage by 2.2 times, for fat yield by 1.7 times, for protein percentage by 2.1 times and for protein yield by 1.7 times. Using estimates of breeding values of sires pair-wise genetic correlations between main genetic traits were computed. The negative genetic relationship between milk yield and fat and protein percentages was revealed. Values of energy corrected milk (ECM) of daughters and dams of sires across breeds and countries of origin were calculated. It was shown that dams of sires of Holstein and Jersey breeds had highest values of energy corrected milk (9,132.0 kg and 8,041 kg, respectively) while dams of sires of Ukrainian Black-and-White dairy breed had lowest values of this trait (5,848.1 kg). According to country-of-origin daughters of sire's form USA, Canada and the Netherlands had highest values of energy corrected milk. Values of response to selection using traditional breeding program and genomic selection were compared. It was proved that by means of shortening generation intervals on pathways of genetic improvement "sires of bulls", "sires of cows" and "dams of bulls" using genomic selection it is possible to increase rate of genetic progress for milk yield from 100.1 kg to 180.0 kg that is by 80%

Keywords: dairy breed; energy corrected milk; genetic improvement; genetic correlation; response to selection; genomic evaluation

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INTRODUCTION

Traditional breeding programs for dairy cattle are based on progeny testing of young bulls. However, such programs require 6-7 years to obtain reliable estimates of breeding values and are very expensive (it is necessary to obtain 60-100 daughters for each bull while most of progeny tested bulls are not used for reproduction).

Genomic selection allows shorten time period necessary to obtain reliable breeding values of young bulls and is more cost-effective compared to progeny testing schemes. Breeding programs based on genomic selection are currently used in many countries of the world.

The effectiveness of breeding programs depends on their profitability. In implementing such a program, it is important to predict the expected genetic progress that is associated with the response to selection (Ruban & Danshin, 2019).

At the beginning of the 21st century the possibility of predicting the breeding values of animals in the early stages of ontogenesis using multiple markers that cover the entire genome was proved (Weller, 2019). This led to the formulation of what is known now as “genomic selection” (Misztal *et al.*, 2020). But at that time this approach was not implemented due to the lack of sufficient number of genetic markers. In 2009,

after sequencing the genome of cattle, the features of polymorphism of individual nucleotides (SNP – Single Nucleotide Polymorphism), and relationship of SNPs with the important traits were revealed. Later use of technology of micro-panels of DNA (DNA – microarray) has made genomic selection more widely used in the breeding programs of many species of farm animals and especially in dairy cattle (VanRaden, 2020).

In 2009-2011 breed associations in a number of countries around the world implemented genomic selection using DNA micro-panel technology (BovineSNP50 BeadChip), and the overall profitable effect of such programs increased the application of genomic testing in other countries. Number of genotyped animals permanently increases. For example, number of genotyped animals in USA and Canada increased from 22,344 in 2009 to more than 6.5 million in 2022 (Wiggans & Carrillo, 2022).

Widespread implementation of genomic selection is associated with considerable development of methodology of genomic prediction used for evaluation of genomic breeding values (Ahmadi & Bartholomé, 2022).

Figure 1 presents a general scheme of organization of selection in dairy cattle.

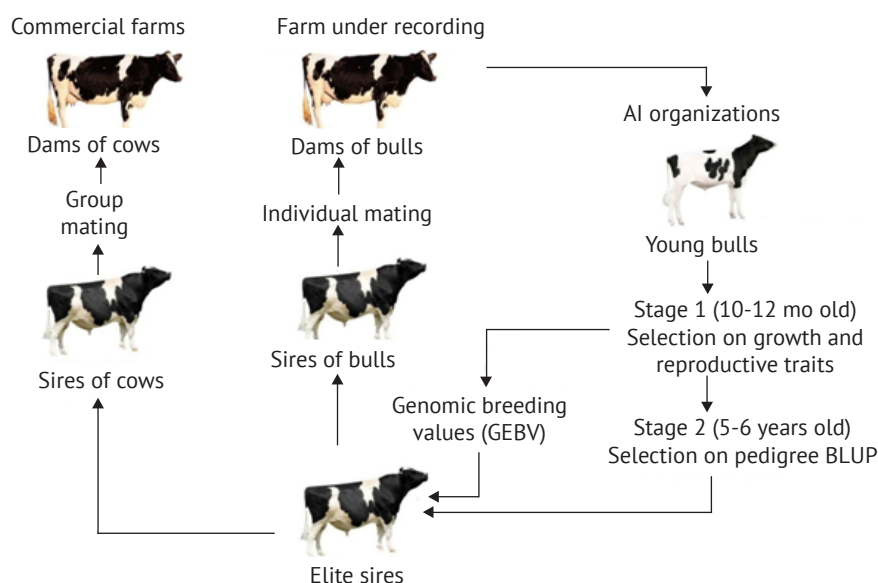


Figure 1. General scheme of breeding program in dairy cattle using two methods of evaluation of breeding values: traditional (pedigree BLUP) and genomic (genomic BLUP)

Source: S. Ruban & V. Danshin (2019)

On farms under recording individual data on productivity, product quality, health status and level of reproduction are collected with the determination of the best animals for selection. From these animals' young bulls are selected to AI organization, and best of them pass to group of elite sires or “sires of bulls”.

Selection of this category of animals can be carried out in two ways: 1) traditional two-stage selection, when at the first stage bulls are selected at the age of 10-12 months on growth and reproductive traits, and at the second stage, at the age of 5-6 years, they are selected on estimates of breeding values (pedigree BLUP) using

progeny testing; 2) bulls are genotyped out at the age of 6-10 months, selected on genomic breeding values (genomic BLUP) and the best of them are used since the age of 10-12 months (time of start of accumulation of sperm for artificial insemination) in individual mating programs to obtain the best cows to form the next generation (Fig. 1). Most of the frozen sperm from sires is used for artificial insemination of cows and heifers. The main purpose of selection is to obtain healthy offspring capable to produce a certain amount of milk with a certain composition and quality (Ruban & Danshin, 2019).

The base of the organizational scheme of genomic selection is a reference population with known genotypes of animals for SNPs and the corresponding phenotypes. Based on these data, the prediction equation is constructed, which allows to calculate genomic estimates of breeding value for animals – candidates for selection (young bulls and heifers). According to these estimates, in accordance with the breeding objectives, animals of next generation are selected. This is two-step procedure. Recently, single-step genomic BLUP combining information on both genotyped and non-genotyped animals is widely implemented (Lourenco *et al.*, 2020; Mäntysaari *et al.*, 2020; Bermann *et al.*, 2022).

A good example of the practical use of genomic selection in dairy cattle is the HD Genomics program for the Norwegian Red breed. The total population of this breed is 200,000 cows, so about 100,000 bulls and the same number of heifers are born annually. Data on performance, health, and pedigree are collected for each animal. Annually, 8,000 young bulls and 12,000 young heifers are selected for genotyping in order to calculate the genomic breeding values on a set of traits. From the evaluated animals, 50-60 elite bulls are selected to obtain sperm, which is used for artificial insemination, and from the evaluated heifers 120 elite heifers are selected for the production of embryos (Norwegian Red breeding program, 2021).

The use of genomic estimates of breeding value causes significantly reduce of generation intervals. B.O. Makanjuola *et al.* (2020) investigated the changes in the intervals on the four pathways of genetic improvement in the populations of Holstein and Jersey breeds in the United States for the period from 1990 to 2018. On four pathways of selection due to the introduction of genomic selection the average generation interval reduced from 6-6.5 years (traditional selection) to 2.5-3 years, i.e., 2 times. At the same time, the largest reduction in the generation interval occurred in the category of sires of bulls – from 8 to 2-3 years. The reduction of generation intervals on the main pathways of selection led to a corresponding acceleration of the rate of genetic progress (Wiggans & Carrillo, 2022). For example, genetic gain in fat yield for Holstein bulls increased 6 times since 2009 (Guinan *et al.*, 2023). Generally, genomic selection program for dairy cattle has doubled the rate of genetic gain in the United States (Wiggans & Carrillo, 2022). At the same time, an increase in the rate of inbreeding is observed (Lozada-Soto *et al.*, 2022). Mitigation of the negative effects of inbreeding depression on different traits also requires use of genomic information (Gutierrez-Reinoso *et al.*, 2021).

The aim of the study was to investigate possibilities of use of genomic selection in dairy cattle breeding in Ukraine.

MATERIALS AND METHODS

Material of the study were estimated breeding values of 937 sires for milk production traits (milk yield, fat percentage, fat yield, protein percentage and protein yield) taken from the catalogue of dairy and dual-purpose service sires of Ukraine (39 AI organizations) in 2020 (Polupan *et al.*, 2020). Table 1 contains descriptive statistics of milk production traits of daughters of sires used in the study.

General level of milk production was estimated as energy corrected milk (ECM) according to N.G. Hossein-Zadeh (2017):

$$ECM = \frac{fat\ yield, kg \cdot 38.3 + protein\ yield, kg \cdot 24.2 + milk\ yield, kg \cdot 0.7832}{3.14} \quad (1)$$

Annual response to selection (R) was calculated as (Simm *et al.*, 2021):

$$R = \frac{S_{SB} + S_{SC} + S_{DB} + S_{DC}}{L_{SB} + L_{SC} + L_{DB} + L_{DC}}, \quad (2)$$

where $S_{SB} = i_{SB} \cdot r_{gISB} \cdot \sigma_a$ – genetic superiority of sires of bulls; $S_{SC} = i_{SC} \cdot r_{gISC} \cdot \sigma_a$ – genetic superiority of sires of

cows; $S_{DB} = i_{DB} \cdot r_{gIDB} \cdot \sigma_a$ – genetic superiority of dams of bulls; $S_{DC} = i_{DC} \cdot r_{gIDC} \cdot \sigma_a$ – genetic superiority of dams of cows; $i_{SB}, i_{SC}, i_{DB}, i_{DC}$ – corresponding values of selection intensity; $r_{gISB}, r_{gISC}, r_{gIDB}, r_{gIDC}$ – corresponding values of selection accuracy; σ_a – additive genetic standard deviation; $L_{SB}, L_{SC}, L_{DB}, L_{DC}$ – corresponding values of generation interval.

Table 1. Descriptive statistics (Mean±SD) of milk production traits of daughters of sires used in the study

Breed	n	Milk yield, kg	Fat percentage, %	Fat yield, kg	Protein percentage, %	Protein yield, kg
Holstein	446	10,104±3,331	3.82±0.17	386.0±129.6	3.13±0.08	316.3±77.6
Jersey	29	9,810±674	4.79±0.16	469.9±31.6	3.63±0.07	356.1±22.1

Table 1, Continued

Breed	n	Milk yield, kg	Fat percentage, %	Fat yield, kg	Protein percentage, %	Protein yield, kg
Montbeliard	11	5,699±1,608	3.90±0.21	222.3±74.2	3.58±0.16	204.0±37.8
Simmental	37	5,663±1,605	3.84±0.17	217.5±62.2	3.27±0.17	185.2±37.7
Ukrainian Black-and-White dairy breed	55	5,246±1,675	3.75±0.13	196.7±74.2	3.11±0.09	163.2±71.4
Ukrainian Red dairy breed	23	5,410±1,674	3.78±0.11	204.5±65.5	3.18±0.12	172.0±39.1
Ukrainian Red-and-White dairy breed	39	4,831±1,389	3.73±0.12	180.2±51.1	3.08±0.11	148.8±45.7

Source: data of the catalog of dairy and dual-purpose sires used for reproduction of cattle in 2020 (Polupan *et al.*, 2020)

Statistical analysis was carried out using program IBM® SPSS 17.0 that offers advanced statistical analysis and is ease of use, flexible and scalable.

Analysis of variance was conducted using linear model:

$$y = \mu + a + e, \quad (3)$$

where y – estimated breeding value of a sire, a – effect of method of breeding value evaluation, e – error.

Genetic correlations between milk production traits (milk yield, fat percentage, fat yield, protein percentage and protein yield) were computed as Pearson correlations between corresponding estimates of breeding values of sires.

All procedures were carried out in accordance with the ethical considerations regarding the involvement of animals according to the recommendations of ARRIVE (n.d.). The authors of this study assure compliance with all ethical standards in research involving animals.

RESULTS AND DISCUSSION

Based on the data of the catalog of dairy and dual-purpose sires used for reproduction of cattle in 2020 (Polupan *et al.*, 2020), traditional (pedigree BLUP) and genomic (GBLUP) estimates of breeding values of sires for milk production traits were compared (Table 2). A considerable advantage of sires with genomic estimates of breeding values was observed.

Table 2. Estimated breeding values sires with traditional and genomic evaluations for milk production traits

Trait	Traditional evaluation (pedigree BLUP), 462 sires	Genomic evaluation (GBLUP), 475 sires
	Mean±s.e.	Mean±s.e.
Milk yield, kg	+783.37±25.71	+1,220.75±25.36
Fat percentage, %	+0.089±0.010	+0.197±0.010
Fat yield, kg	+39.87±1.10	+69.05±1.09
Protein percentage, %	+0.056±0.005	+0.120±0.05
Protein yield, kg	+31.01±0.81	+53.25±0.80

Source: data of the catalog of dairy and dual-purpose sires used for reproduction of cattle in 2020 (Polupan *et al.*, 2020)

Table 3 contains results of analysis of variance of influence of method of breeding value evaluation on estimated breeding values of sires for milk production traits.

For all milk production traits, the influence of method of breeding value evaluation on estimated

breeding values of sires was significant. Thus, the genomically evaluated sires are superior to the sires with the traditional estimates.

Using estimates of breeding values of sires genetic correlations between milk production traits were calculated (Table 4).

Table 3. Analysis of variance of influence of method of breeding value evaluation (traditional versus genomic) on estimated breeding values of sires for milk production traits

Source of variation	Trait	Sum of squares	df	Mean square	F	p
Method of breeding value evaluation	Milk yield	4.480E7	1	4.480E7	146.723	0.000
	Fat percentage	2.755	1	2.755	58.811	0.000

Table 3, Continued

Source of variation	Trait	Sum of squares	df	Mean square	F	p
Method of breeding value evaluation	Fat yield	199,481.990	1	199,481.990	354.736	0.000
	Protein percentage	0.958	1	0.958	93.832	0.000
	Protein yield	115,882.651	1	115,882.65	382.178	0.000
Error	Milk yield	2.855E8	935	305,356.432		
	Fat percentage	43.795	935	0.047		
	Fat yield	525,786.785	935	562.339		
	Protein percentage	9.547	935	0.010		
	Protein yield	283,507.123	935	303.216		
	Milk yield	1.277E9	937			
Total	Fat percentage	65.945	937			
	Fat yield	3,525,259.000	937			
	Protein percentage	17.838	937			
	Protein yield	2,074,931.000	937			

Source: data of the catalog of dairy and dual-purpose sires used for reproduction of cattle in 2020 (Polupan *et al.*, 2020)

Table 4. Genetic correlations (r_g) between milk production traits

Traits	n	r_g
Milk yield – fat percentage	1,195	-0.200**
Milk yield – protein percentage	972	-0.195**
Fat percentage – protein percentage	972	+0.705**
Fat yield – protein yield	1,067	+0.791**
Protein percentage – fat yield	969	+0.398**
Fat percentage – fat yield	1,193	+0.580**
Milk yield – fat yield	1,243	+0.658**
Milk yield – protein yield	1,070	+0.836**
Fat percentage – protein yield	1,031	+0.126**
Protein percentage – protein yield	969	+0.352**

Note: ** – $p < 0.01$

Source: data of the catalog of dairy and dual-purpose sires used for reproduction of cattle in 2020 (Polupan *et al.*, 2020)

There is a negative genetic relationship between milk yield and fat and protein contents in milk (-0.200 between milk yield and fat percentage and -0.195 between milk yield and protein percentage), which confirms the risk of reduction of the last two traits as a result of selection on milk yield. In all other cases the relationships were positive. Highest positive genetic

correlations were between milk yield and fat yield (+0.658) and between milk yield and protein yield (+0.836). All genetic correlation coefficients were significant ($p < 0.01$).

Based on the catalog data (Polupan *et al.*, 2020) the values of energy corrected milk (ECM) of daughters and dams of sires according to breeds were calculated (Table 5).

Table 5. Genetic Energy corrected milk (ECM) of dams and daughters of sires according to breed

Breed	Dams	Daughters
Ukrainian Red-and-White dairy breed	6,279.3	3,789.9
Ukrainian Red dairy breed	6,719.5	4,200.7

Table 4, Continued

Breed	Dams	Daughters
Ukrainian Black-and-White dairy breed	5,848.1	4,227.6
Simmental	6,871.8	4,439.3
Montbeliard	7,384.0	4,651.9
Holstein	9,132.0	7,509.6
Jersey	8,041.0	8,531.9

Source: data of the catalog of dairy and dual-purpose sires used for reproduction of cattle in 2020 (Polupan *et al.*, 2020)

This trait makes it possible to comprehensively assess the level of milk production, taking into account fat and protein contents. The highest values of ECM have dams of Holstein and Jersey sires (9,132.0 kg and 8,041 kg, respectively), the lowest – sires of the Ukrainian Red-and-White dairy breed (5,848.1 kg). Other breeds occupy an intermediate position in terms of the value of this trait. Regarding the high values of ECM for the daughters of sires, the leading place is occupied by the Jersey breed (8,531.9 kg), and the second – Holstein breed (7,509.6 kg). Daughters of sires of Ukrainian

Red-and-White dairy breed, Ukrainian Red dairy breed and Ukrainian Black-and-White dairy breeds have values of ECM is in the range from 3,789.9 to 4,651.9 kg, which indicates the possibility of improvement of this trait by means of selection. Given the fact that up to 80% of frozen sperm of sires is imported to Ukraine (Polupan *et al.*, 2020) ECM values of the daughters of sires depending on their country of origin were analyzed (Fig. 2). Daughters of sires from the USA, Canada and the Netherlands, where genomic selection has been intensively used recently, have the highest values of ECM.

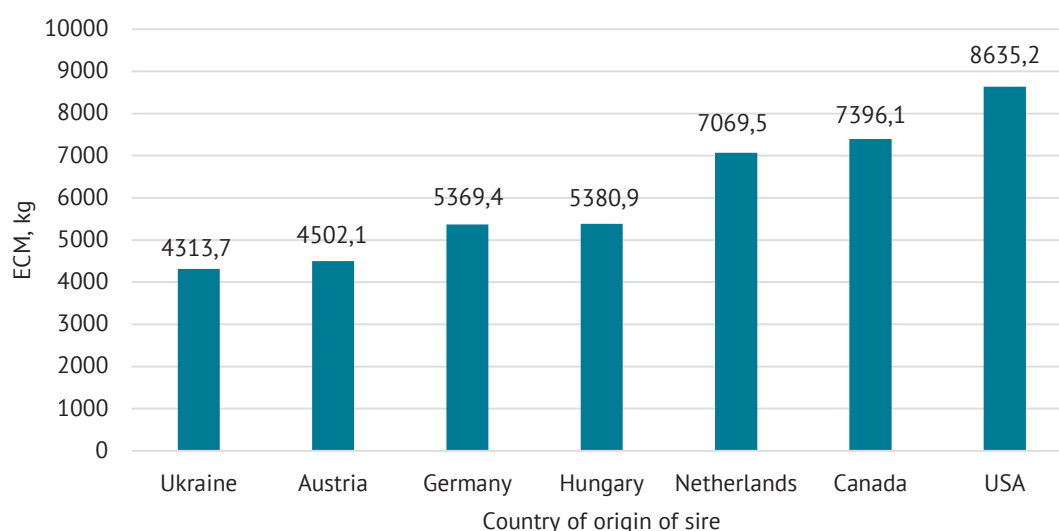


Figure 2. Energy corrected milk (ECM) of daughters of sires according to country of origin

Source: data of the catalog of dairy and dual-purpose sires used for reproduction of cattle in 2020 (Polupan *et al.*, 2020)

In order to determine the potential effectiveness of genomic selection in dairy cattle breeding in Ukraine the average annual responses to selection (R) in milk yield in the population of Ukrainian Black-and-White dairy cows using traditional selection and genomic selection were compared (Table 6).

The calculations showed that by reducing the generation intervals on such pathways of genetic improvement as “sires of bulls”, “sires of cows” and “dams of bulls”, it is possible to increase the level of genetic progress in milk yield from 100.1 kg up to 180.0 kg, i.e., by 80%.

Recently genomic selection became conventional method of dairy cattle breeding in many countries, replacing traditional breeding programs based on expensive and time-consuming progeny testing (VanRaden, 2020). Genomic selection allows to obtain estimates of breeding values of animals at early age with relatively high accuracy. Urgent prerequisite of implementation of genomic selection is forming reference population (animals with known phenotypes and genotypes) to obtain prediction equation which is used to compute genomic breeding values of candidates of selection. Size of reference population to a great extent influences

the accuracy of genomic prediction (van den Berg *et al.*, 2019). As a result, genomic selection can be easily implemented in large dairy breeds (like Holstein).

According to A.-C. Doublet *et al.* (2019) in France genomic selection induced an increase in mean annual genetic gains of 50, 71 and 33% for Montbéliarde, Normande and Holstein bulls, respectively; in the same time the generation intervals were reduced by a factor of 1.7, 1.9 and 2, respectively. In Australia the rates of genetic gain for the national economic index (Balanced Performance Index) has increased by ~160% in Holstein females and ~100% in Jersey females (Scott *et al.*, 2021).

F. Lembeye *et al.* (2022) estimated genetic progress from selection on the VEL (Valor Económico Lechero) selection index developed for Chilean dairy cattle

based on selection schemes using progeny testing (PT) and genomic selection (GS). Authors concluded that compared to PT, a more profitable alternative might be the implementation of a GS-scheme, that would result in a faster genetic gain in the aggregate breeding value or merit for all the traits included in the selection objective (0.323-0.371 vs. 0.194 σ_g /year).

Use of genomic selection in small local breeds is difficult because a limited number of animals can be included to reference population. Nevertheless, in several studies it was shown that under certain conditions (for example, use of combined reference populations from closely related breeds) genomic selection still may be implemented in such breeds (Marjanovic *et al.*, 2021).

Table 6. Comparison of annual genetic response of milk yield (*R*) in Ukrainian Black-and-White dairy breed depending on method of selection

Pathway of selection	Proportion of selected animals, %	Selection intensity, i	Accuracy of selection, r _{gl}	Genetic superiority, (S=i·r _{gl} ·σ _a)	Generation interval (L), years
Traditional selection (σa = 562.5 kg)					
Sires of bulls	3	2.27	0.90	1,149	6
Sires of cows	15	1.55	0.70	610	7
Dams of bulls	1	2.67	0.40	601	5
Dams of cows	85	0.27	0.40	61	6
Sum				2,421	24
R		2,421/24 = 100.1kg			
Genomic selection (σa = 542.8 kg)					
Sires of bulls	3	2.27	0.75	924	3
Sires of cows	15	1.55	0.75	631	3.5
Dams of bulls	1	2.67	0.75	1087	2.5
Dams of cows	85	0.27	0.40	59	6
Sum				2,701	15
R		2,701/15 = 180.0 kg			

Source: data of the catalog of dairy and dual-purpose sires used for reproduction of cattle in 2020 (Polupan *et al.*, 2020)

Until now no research on possible effectiveness of use of genomic selection in breeding of Ukrainian dairy cattle was done. It should be noted that genetic progress in the Ukrainian dairy breeds is very small. The main reasons are small numbers of cows, lack of comprehensive and regular recording and out-of-date methods of genetic evaluation. One of the advantages of genomic selection is possibility to apply recording only to reference population and so reduce costs of phenotyping (Obšteter *et al.*, 2021). So, investigating possible implementation of genomic selection in dairy cattle breeding in Ukraine seems to be reasonable.

Results of the study indicate that genomically evaluated sires used in Ukraine have significantly higher breeding values for milk production traits than sires with traditional evaluations. Reason is faster genetic progress resulting from shorter generation intervals with genomic selection (Hagan & Cue, 2019).

Analysis of energy corrected milk showed that both dams and daughters of sires of Ukrainian dairy breeds generally have lower total milk production than dams and daughters of imported sires.

Comparison of expected annual genetic gain in milk yield in Ukrainian Black-and-White dairy breed for

traditional and genomic selection suggests that use of genomic selection can considerably accelerate genetic progress and this result is similar to results of other authors (Lee *et al.*, 2020; Scott *et al.*, 2021; Guinan *et al.*, 2023).

It should be noticed that can genomic selection can be implement in any dairy breed without increasing the level of investment (Obšteter *et al.*, 2021). Reliability of genomic estimated breeding values in small dairy populations can be considerably increased by using multi-trait single step genomic BLUP (Zhang *et al.*, 2022).

Further investigations are needed to study possible effects of implementation of genomic selection on economically important traits (milk quality, longevity, fertility etc.) of dairy cattle as well as genetic diversity in local dairy breeds in the Ukraine.

CONCLUSIONS

Analysis of variance showed significant influence of method of breeding value evaluation on estimated breeding values of sires. Genomically evaluated sires had higher estimated breeding values for milk production traits than sires with the traditional estimates.

There is a negative genetic correlation between milk yield and fat and protein contents in milk (-0.200 between milk yield and fat percentage and -0.195 between milk yield and protein percentage). Highest positive genetic correlations were between milk yield and fat yield and between milk yield and protein yield.

The highest values of energy corrected milk had dams of Holstein and Jersey sires, the lowest – sires of the Ukrainian Red-and-White dairy breed, while other breeds occupied an intermediate position in terms of the value of this trait. The high values of energy corrected milk had daughters of Jersey and Holstein sires. Daughters of sires of Ukrainian Red-and-White dairy breed, Ukrainian Red dairy breed and Ukrainian Black-and-White dairy breeds have values of energy corrected milk is in the range from 3,789.9 to 4,651.9 kg. With regard to country of origin daughters of sires from the USA, Canada and the Netherlands had the highest values of energy corrected milk.

The use of genomic selection in breeding of dairy cattle in Ukraine can substantially increase genetic progress by means of shortening generation intervals. Reducing the generation intervals on such pathways of genetic improvement as “sires of bulls”, “sires of cows” and “dams of bulls”, it is possible to increase the level of genetic progress in milk yield from 100.1 kg up to 180.0 kg, i.e., by 80%.

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CONFLICT OF INTERESTS

None.

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Перспективи застосування геномної селекції для генетичного покращення молочної худоби в Україні

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Анотація. Важливою проблемою в сучасному молочному скотарстві є досягнення високого рівня генетичного прогресу по економічно важливим ознакам шляхом впровадження ефективних селекційних програм. Задля цього нині в багатьох країнах світу використовують геномну селекцію. Метою дослідження було вивчення можливостей застосування геномної селекції в розведенні молочної худоби в Україні. На основі аналізу «Каталогу плідників молочних і комбінованих порід для відтворення корів у 2020 р.» (сперму цих плідників використовували в Україні) порівнювали два методи оцінки племінної цінності: 1) традиційний метод, заснований на родоводі і продуктивності потомства; 2) геномний метод, заснований на ефектах SNP-маркерів. Доведено значну перевагу плідників з геномними оцінками. Ці плідники перевершують плідників з традиційною оцінкою за надоєм молока в 1,6 рази, за відсотком жиру в 2,2 рази, за виходом жиру в 1,7 рази, за відсотком білка в 2,1 рази і за виходом білка в 1,7 рази. На основі оцінок племінної цінності плідників були розраховано генетичні кореляції між основними селекційними ознаками. Виявлено негативний генетичний зв'язок між надоєм та вмістом жиру та білка. Були розраховані значення скорегованого на енергію надою (ЕСМ) дочок і матерів плідників для різних порід і країн походження. Показано, що найвищі показники скорегованого на енергію надою мали матері плідників голштинської та джерсейської порід (9132,0 кг та 8041 кг, відповідно), а найнижчі – матері плідників української чорно-рябої молочної породи (5848,1 кг). Відповідно до країни походження дочки бугаїв з США, Канади та Нідерландів мали найвищі значення скорегованого на енергію надою. Порівнювали значення відповіді на відбір за традиційною селекційною програмою та геномною селекцією. Доведено, що за рахунок скорочення генераційних інтервалів на шляхах генетичного покращення «батьки бугаїв», «батьки корів» і «матері бугаїв» за допомогою геномної селекції можна підвищити швидкість генетичного прогресу за надоєм від 100,1 кг. до 180,0 кг, тобто на 80 %

Ключові слова: молочна порода; скорегований на енергію надій; генетичне покращення; генетична кореляція; відповідь на відбір; геномна оцінка

Time spent on milking mares and their ethological indicators

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Abstract. Dairy horse breeding in Ukraine is not a traditional branch of animal husbandry, although its products most closely correspond to the physiology of human digestion and are especially indispensable in children's nutrition, since the chemical composition of mares' milk is close to that of women. To obtain mare's milk, it is necessary to take into account the technological features of keeping, feeding animals and obtaining products specific to a particular farm, which should be reflected in technological maps. The most time-consuming process in the production of milk of all types of animals is the milking process, therefore the purpose of this work was to develop standards of time consumption for the further development of technological maps in dairy breeding and to study the productive and ethological indicators of dairy mares taking into account the serial number of milking. The research was carried out at the Kumys farm, a breeding breeder for the breeding of the Novoaleksandrivsky weight-carrying breed of horses of the Dibriv Horse Stud No. 62 branch of the State Enterprise "Studying of Ukraine" using video surveillance, time measurement, biometrics, and mathematical calculations. It was established that the

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time spent on milking is directly dependent on the productivity of mares and increases with the serial number of milking. Ethological studies have shown that mares willingly go to milking and in the same order and sequence to the left and right milking machines. Supplementation with oat grains takes place during milking at the milking plant, the time spent there is not enough to consume the daily requirement due to concentrated feeds, and the time spent by mares in the pre-milking area exceeds the normative indicators. Standards for time spent on the milking process have been developed, taking into account the ethological features of mares and suggestions for its improvement through the organization of standardized individual feeding and the frequency of milking, which will increase the gross production of marketable milk. The practical value of the work consists in determining the time spent on milking mares, depending on their productivity, which will later be used as normative indicators during the development of technological maps

Keywords: duration of milking; timing; performance of mares; behavior; heavy breed; koumiss

INTRODUCTION

The Kumys farm of the Dibriv stud farm in Poltava region was organized in 1984, which is connected with the transfer of some horses of the Novooleksandriv horse breed from the Novooleksandriv stud farm of the Donetsk region. During this time, both the technology of keeping and the genetic potential of animals changed somewhat. Thus, according to D. Volkov & S. Lyutykh (2014), only in the period 2000-2012, the number of lines in the breed decreased from seven to three, and significant changes took place in the breed, both in terms of numbers and basic breeding characteristics: origin, type of body structure, measurements, work capacity, fertility, quality of offspring. Therefore, the issue of improving technological maps for the production of mares' milk, one of the main sources of costs for which is the milking process, becomes urgent.

In his works, O. Havryk (2021) notes that for the development of animal husbandry, it is necessary not only to improve the production process in general, but also the correct organization of management accounting is necessary, which will allow to reduce the cost of production and ensure the efficiency of the industry with the help of cost accounting and the calculation of certain standards.

Work Í. Barreto *et al.* (2019) indicate that the main source of milk and milk products is cattle, which account for 82% of the world's total milk, with the rest mainly coming from buffaloes, goats and sheep, and less than 1% of milk coming from other animals such as like camels, horses, donkeys, which can be defined as "secondary dairy species".

In Ukraine, dairy horse breeding is represented by single koumiss farms in Poltava, Luhansk and Kyiv regions, which combine the production of mares' milk and the production of koumiss with meat or breeding specialization of the industry.

The expediency of using mare's milk is indicated by the work of S. Aitbaeva & B. Bimbetov (2016), who note that children aged 1-3 years should be introduced to

the diet of saumal (freshly milked mare's milk), starting with 20-40 ml, depending on age, and after getting used to the enzymatic function, increase the single dose to 50-70 ml for an average daily portion of 250-350 ml, and for children of preschool age (3-7 years), the single dose is 60-80 ml. Based on these recommendations, simple calculations can be made, from which it follows that with a norm of only 250 ml of milk per day, the annual need per person will be 91.25 l, and with a mare's milk productivity within 2500 l of milk per lactation – one mare can provide the annual needs of only 27 people. According to P. Verbytskyi *et al.* (2008) the volume of production of milk and koumiss in Ukraine does not satisfy the needs of the population and increases its scarcity, so it is advisable to set up small koumiss farms on the basis of industrial farms. Taking into account the medical and health-promoting and biological features of koumiss, koumiss farms should be organized in close proximity to the main consumer – sanatorium-treatment facilities.

It is possible to increase the volume of production of mare's milk both by increasing the herd and increasing its milk productivity, and by improving and adapting existing technologies to various natural and climatic zones, which will make it possible to realize the genetic potential of animals to the maximum. According to I. Suprun (2020), for the revival of horse breeding, its stabilization and further effective development, rational coordination of production, substantiation and development of organizational provisions, standards of management of the horse breeding industry are necessary.

Scientific developments and the development of technological maps, which will provide for all technological operations taking into account time, material, energy resources, biological, economic and ethological characteristics of horses, deserve special attention. Authors J. Auclair-Ronzaud *et al.* (2022) point out that studies in dairy farming have mainly focused on qualitative milk parameters, and information on quantitative

characteristics is incomplete, partly due to a lack of consensus on the method of milk yield measurement. Undoubtedly, the most time-consuming process in the production of milk of all types of animals is the process of milking, and time consumption is mainly presented for dairy cows, therefore the purpose of this work was to determine the duration of milking, the total stay of mares in milking machines and the pre-milking area, the amount of concentrated feeds, features of their reaction behavior and productive indicators, depending on the serial number of milking.

LITERATURE REVIEW

The increased interest in horse milk is due to the unique properties of this type of milk and products made from it, as indicated by the work of D. Baibokonov *et al.* (2021). According to G. Czyżak-Runowska *et al.* (2021) mare's milk has valuable nutritional and medicinal properties and is recommended in the diet of people with weakened immunity, in particular, the elderly, and is considered useful for the prevention of atherosclerosis.

The work of A. Musaev *et al.* (2021) indicates that in terms of chemical composition and nutritional properties, mare's milk is close to human milk, does not cause allergies and can be a substitute for the most common cow's milk, and in terms of the composition of essential amino acids and the biological value of proteins, it significantly exceeds it. Research by L. Figliola *et al.* (2021) indicates that food allergy in young children is mainly represented by a hyperergic (immunological) reaction to one or more cow's milk proteins. Its prevalence in children of the first year is not exactly known and is estimated to be from 2 to 6%, and it is also noted that in almost half of children, the clinical manifestations of allergy to cow's milk proteins (CBM) decrease or disappear at the end of the first year, and up to 80% – during the first 3 years of life. Based on this, we can conclude that it is necessary to find sources, substitutes for cow's milk, one of which can be the milk of mares.

The expediency of including fermented milk products from mare's milk in the diet of children 1-11 years old is evidenced by the results of research by A. Yakunin *et al.* (2017), and F. Fantuz *et al.* (2016) note that the only significant fermented mare's milk product available on the market is koumiss, which is widely used primarily for its medicinal and nutritional value. Thus, the research results of Q. Li *et al.* (2022) showed that koumiss regulates the condition of the gastrointestinal tract, improves the assimilation of nutrients, improves the body's lactose intolerance, increases immunity, prevents scurvy and atherosclerosis, and helps in the treatment of tuberculosis. Researchers I. Barreto *et al.* (2019) point out aspects that deserve attention and that support recommendations for the use of mare's milk as a human

food, namely its similarity to human milk, its high palatability, the therapeutic properties of koumiss (which derive from its richness in probiotics), the balance between casein and whey proteins, the presence of bioactive compounds and the nutritional value of the lipid fraction. In fact, the results obtained in the studies analyzed above have proven the functionality of this milk as a food product and suggest that its inclusion in the human diet may have several beneficial health effects.

In the work of E. Jastrzębska *et al.* (2017) indicated that mare's milk contains a wide range of valuable nutrients with health-promoting properties, and the world market offers an increasing number of food and cosmetic products made from it.

In the conditions of Ukraine, the industrial production of mares' milk is carried out on farms with a small number of herds (10-30 milking mares), namely on breeding breeders from the breeding of the Novoaleksandrivska weight-carrying breed of horses, since they make good use of rough, green and pasture fodder, and also differ fairly high milk yield per 100 kg of live weight. Such an insignificant number of farm livestock is explained by the small number of reproductive composition of mares in the Novoaleksandrivskaya breed.

Thus, the results of research by I. Tkachova (2021) indicate that only 114 mares were involved in breeding work with this breed. According to S. Forest (2018) there are only about 30 producers of mare's milk in Germany alone and most are located throughout Europe, mainly in the Netherlands, Belgium and France, and notes that horses will not produce much milk because they are not genetically programmed produce milk like a cow, and according to J. Auclair-Ronzauda *et al.*, (2022) the factors affecting milk yield are mare live weight, fatness at calving and age. Authors S. Nahorny *et al.* (2020) explain that such a small composition of enterprises is due to the general reduction of the horse population in Ukraine. Thus, the total number of horses in all categories of farms decreased by 56% from 2005 to 2019, and according to the State statistics service of Ukraine (2021), for the period from 2019 to 2021, the number of horses in farms of all categories decreased by another 17.2% and on January 1, 2021, it amounted to 202,000 heads. At the same time, the main number of horses is concentrated in households, and only 6% of their total number are kept in agricultural enterprises. The number of breeding horses has also decreased, the share of which for the period of 2019 is only 1.3% of the total number of livestock. Especially significant reductions in the breeding stock occurred in the period from 2010. Thus, the decrease of the Ukrainian riding breed is – 78.7%, the Orlovskaya Rysista – 62.8%, the Hutsul – by almost 53%. The situation is similar with the Novoaleksandrivska weight-carrying breed, which,

according to the FAO (Food and Agriculture Organization) classification, approaches the border of “rare” and “endangered”.

Also, I. Suprun (2020) notes that in the conditions of a long crisis over the past 14 years, breeding horse breeding in Ukraine has undergone a significant decrease in the number of livestock, a narrowing of the breed structure and a change in the form of ownership. As of the beginning of 2019, according to the State Register of Breeding Subjects in Livestock Breeding, there are 38 stud farms and 20 breeding breeders in Ukraine. The largest population of breeding horses is concentrated in the eastern regions of Ukraine: Luhansk, Kharkiv, Dnipropetrovsk, Kirovohrad, Zaporizhia. It has been established that the leaders in terms of numbers among factory horse breeds are the Ukrainian riding horse, the Oryol trotting horse, and the thoroughbred riding horse.

According to V. Pabat & I. Honcharenko (2019), the small number of horses in farms of all forms of ownership is a temporary phenomenon, and as the state economy grows, the importance of the industry in the national economy will increase, which will lead to the need for specialists in the zooengineering profile.

MATERIALS AND METHODS

The time spent on the milking process and the reaction of the mares' behavior were determined at the end of the lactation period (133-193 days of lactation) during two accounting days – October 20 and 21, 2022 at the Kumys farm, a breeder for the breeding of the Novoaleksandriv weight-carrying breed of horses of the branch “Dibrivsky stud farm No. 62” SE “Konyarstvo Ukrainy” of Myrhorod district, Poltava region. The research was carried out at the initiative of the authors with the permission of the enterprise administration, during which the ethological features of the technological group of dairy mares ($n=10$) were studied through individual time-lapse observations, and the productivity indicators were based on the results of the control milk yield for each of the three, provided by the technology in the milking farm. During the research, all rules for keeping and handling animals during the research were observed according to Law of Ukraine No. 27 “On Protection of Animals from Cruel Treatment” (2006). No animal during the study was harmed or suffered as a result of harsh treatment.

All indicators were studied based on the results of the work of the same operator. The amount of milk produced was determined from each mare and measured using electronic scales with an accuracy of 1 g. The results of the research were processed by biometric methods on a PC in the Microsoft Office Excel environment using software. Daily milk productivity was calculated according to the formula of I.A. Saigin:

$$V_c = \frac{V_F \cdot 24}{t}, \quad (1)$$

where V_c – the mare's daily milk yield; V_F – the amount of milk expressed during the considered time, l ; t – the time during which the calculated milk was expressed; 24 – the number of hours in a day (Karnozhytskyi *et al.*, 2012).

Dairy mares were evaluated by four measurements: height at the withers, oblique length of the body, breast girth, and instep girth using a measuring stick and tape. The height at the withers was measured with a measuring stick from the highest point of the withers vertically to the floor, the oblique length of the body was measured with a measuring stick from the front protrusion of the shoulder-scapular joint to the rear protrusion of the buttock, the chest girth was determined using a tape that passed through the withers, touching the back corners of the shoulder blades, and the girth of the wrist – with a tape in its lower part of the upper third. The ratio of the interrelated diameters of the animal's body was expressed as a percentage, calculated by body structure indices according to the formulas:

$$\text{Format index} = \frac{\text{Oblique length of the body} \cdot 100\%}{\text{Height at the withers}}, \quad (2)$$

$$\text{Chest girth index} = \frac{\text{Girth index} \cdot 100\%}{\text{Height at the withers}}, \quad (3)$$

$$\text{Ossification index} = \frac{\text{Wrist girth} \cdot 100\%}{\text{Height at the withers}}. \quad (4)$$

Before conducting the observations, the specific conditions of mares' milk production, the way they are kept, feeding rations, the condition and features of the equipment used, the duties of the operators were specified, and the regimes of work and rest were analyzed.

The research involved the preliminary determination before observation of the fixation points, that is, the moments of the end of one element and the beginning of another. Measurements were made with an accuracy of 1 second using a digital stopwatch. In order to more accurately determine the time spent, video recording of all technological operations of the milking process was carried out in parallel, after which a comparative analysis of the obtained results was carried out. Of the total operating time, the time for obtaining milk during the milking process was studied, namely, taking into account the time from connecting the milking cups to removing them from the udder, since preparatory and final operations during milking of mares take a small amount of time, compared to similar operations in dairy farming, as well as the sequence of their entry, the total time spent by mares at the milking station and one head in the milking machine.

All procedures were carried out in accordance with ethical considerations regarding the involvement of

animals according to the recommendations of ARRIVE (n.d.). The authors of this study assure compliance with all ethical standards in research involving animals.

RESULTS AND DISCUSSION

The technology of the Kumys farm, a breeding breeder for the breeding of the Novoaleksandrivsky weight-carrying breed of horses of the Dibriv Horse Breeding No. 62 branch of the SE "Konyarstvo Ukrainy" provides for seasonal production, since insemination takes place within 2 months (February-March) and, accordingly, calving takes place in March-April. Milking of mares begins when the foals are one month old, after which they are trained to mechanized milking using the DDU-2M milking unit and DDA-2M two-stroke milking machines, the design feature of which is the automatic adjustment of work modes, depending on the intensity of milk production. Before the start of milk production, the device works with a rest cycle, that is, for one pulsation of the device, the triad "suction – compression – rest" is carried out in a gentle mode, and at the beginning of the phase of intensive milk release, the device automatically switches to the mode of continuous suction, outputting the main amount in 20-25 seconds. When the speed of milk delivery decreases, the device starts working again in the mode with a rest cycle. Milking with a two-mode DDA-2M device does not cause mastitis in mares even if it is used on the teats for too long. Therefore, the

operator can freely work with two devices at the same time. The optimal mode of operation of the device is ensured at a vacuum of 0.42-0.45 kg/cm². The throughput capacity of the DDU-2M installation when milking with two machines in 2 machines is 50-60 mares per hour. The duration of lactation of mares ranges from 6-7 months, after which the foals are completely weaned from them. Milk is sold in the form of the final product of its processing – koumiss.

In the summer, dairy mares are kept on walking and feeding grounds, after three milkings – on a pasture with foals, and at night until 6 a.m. – also on grounds, that is, mares and foals are together for about 17.5 hours a day and separately, respectively – 6.5 hours. In the winter, mares are kept on walking and feeding grounds (during the day), and at night in the capital premises – in sections of 10 heads at the rate of 6.5-7 m² per head (Marchenko *et al.*, 2018). Three milkings are used on the farm, the first of which takes place at 8 in the morning, the next at 10 and 12, respectively, i.e. the time interval until the first milking, and between the following is two hours, after which foals are brought to the mares, which are deliberately kept until 6 in the morning, i.e. mares are without foals for 6.5 hours. The milking plant consists of two milking machines (Fig. 1), which are a welded construction of metal pipes and are located at an angle of 20-26°C relative to each other, between which the workplace of the machine milking operator is located.



Figure 1. General view of the DDU-2M milking unit for milking mares

Notes: 1 – left machine; 2 – right machine; 3 – workplace of machine milking operator; 4 – door with a hinged feeder; 5 – guiding split; 6 – storage area

Source: developed by the authors

The mares enter the milking machines from the pre-milking platform, the time spent on which should not exceed 10 minutes, along the guide split 80-90 cm wide. Although this design allows two mares to be milked simultaneously with two milking machines, milking is done by one milking machine

and one operator, because the company where the research was conducted has a small number of dairy mares. Ethological studies have shown that mares willingly go to milking and almost in the same order and sequence to the left and right milking machines (Table 1).

Table 1. Sequence and machine in which mares were milked

No.	Serial milking number and mare's nickname							
	I		II		III		The highest occurrence	
	left	right	left	right	left	right	left	right
1	Turbina	Raffaella	Turbina	Frau	Turbina	Raffaella	Turbina	Raffaella
2	Frau	Torba	Referee	Raffaella	Frau	Feofania	Frau	?
3	Troya	Fura	Torba	Fantasia	Torba	Fura	Torba	Fura
4	Biosphere	Fantasia	Troya	Biosphere	Troya	Fantasia	Troya	Fantasia
5	Referee	Feofania	Fura	Feofania	Referee	Biosphere	Referee	Feofania

Notes: the color assigned to the mare is highlighted in color

Source: developed by the authors

The first two mares enter the free stalls at the same time, in the future - alternately after the release of the previous one, and the last two are also released at the same time. During milking, mares are fed with oat grains, the consumption time of 1 kg of which is 5.140 ± 0.243 minutes. The average age of the technological group of dairy mares is 8 years and ranges from 4 to 14. In the experiments of G. Czyżak-Runowska *et al.* (2021) also noted significant age ranges of the technological group of dairy mares, which ranged from 5 to 14 years. The oldest mares are Raffaella (born in 2008) and Turbina (born in 2011) and who, perhaps, occupy the highest step in the hierarchy and are the first to be milked, or have some life experience with feeding concentrated feed in milking machines. Also, these mares can be the largest in size and cause physical competition with other mares of the group, but the data in Table 2 indicate that they are not physically different from the general herd, from which we can conclude that the main factor behind competition is age of animals. It should be noted that even with a slight violation of the milking sequence, the mares still follow the machine that they are used to milking from the beginning of lactation, and thus the orderliness and consistency of the milking

machine for a particular animal can be Raffaella judged by the most frequent occurrence and sequence of milking. In this case, the right loom remains unpainted, the second position in the milking sequence, and it would be logical to enter a mare named Biosphere there, but she confidently occupies the penultimate step in the sequence, sharing it with the mares Fantasia, Troya and Feofania. Such a "fight" for the competition during the second milking in the right milking machine can be explained by the inconsistency between the mares and Frau, who was the first in the right milking machine during the second milking, chasing away Raffaella, which is again explained by the competition for the first milking and the opportunity to consume concentrated feeds

First-born mares deserve special attention: Fura and Feofania (Table 2), which, at first glance, may occupy a lower hierarchical rank and to a lesser extent can compete with more mature and physically formed individuals. Thus, the mare Fura was always milked third in the right stall, and Feofania was the last and also in the right stall. According to J. Auclair-Ronzaua *et al.* (2022), younger mares produced less milk than older mares, which indicated incomplete development of mammary gland tissues in primiparous mares.

Table 2. Characteristics of the technological group of dairy mares

The name of the mare	Age, years	Milk yield for three milking sessions, kg	Height at stifle	Measurements of mares, sm			Physiological indexes		
				Oblique length	Chest circumference	Heel circumference	Format	Chest circumference	Bone density
Turbina	11	2,365	163	162	209	23.5	99.3	128.2	14.4
Rafaella	14	2,295	164	161	201	24	98.2	122.6	14.6
Torba	9	2,606	154	160	207	23.5	103.9	134.4	15.3
Frau	5	1,318	163	165	204	24	101.2	125.1	14.7
Fura (f)	5	1,658	165	163	198	23.5	98.8	120.0	14.2
Troya	9	1,882	164	167	208	23.5	101.8	126.8	14.3

Table 2, Continued

The name of the mare	Age, years	Milk yield for three milking sessions, kg	Height at stifle	Measurements of mares, sm			Physiological indexes		
				Oblique length	Chest circumference	Heel circumference	Format	Chest circumference	Bone density
Fantasia	11	1.18	159	167	208	24	105.03	130.8	15.1
Biosphere	7	2,389	159	162	204	23	101.9	128.3	14.5
Feofania (f)	4	2,308	155	156	197	23	100.6	127.1	14.8
Referee	5	2,211	158	161	200	23	101.9	126.6	14.6
Average	8.000 ±1.054	2,021 ±0.154	160.4 ±1.249	162.4 ±1.056	203.6 ±1.392	23.5 ±0.129	101.263 ±0.683	126.990 ±1.267	14.650 ±0.109

Notes: nickname (f) – mare with first lactation

Source: developed by the authors

As can be seen from the data in Table 2, the technological group of dairy mares is quite different in age, and in terms of measurements and body structure indices, they meet the standards of the breed, with a somewhat small format index, which is significantly affected by the oblique length of the body. No significant difference in milk productivity between firstborns and adult mares, as well as the influence of animal age, was found, which can be explained by the small group of studied

animals, among which there were only two mares with the first lactation. In the work of J. Auclair-Ronzauda *et al.* (2022) noted that the maximum potential milk productivity of mares is reached at the age of 7 years. This study emphasized the effect of age, but did not record an increase in milk yield up to 7 years of age and a decrease thereafter. It was established that the time spent on milking is directly dependent on the productivity of mares (Table 3).

Table 3. Time spent on technological operations, depending on the serial number of milking

Indexes	Serial number of milking			Average	Overall for 3 milking
	I	II	III		
Time spent on milking, min	8.55	9.16	10.28	9.33	27.99
Total time of stay of mares in milking, sec	51.300 ±4.578	55.000 ±3.521	61.700 ±3.022	56.000 ±3.044	168
Total time of stay of mares in milking, min	14.45	16.24	17.10	15.93	47.79
Total time of stay of mares in milking, min	2.959 ±0.236	2.593 ±0.243	2.806 ±0.314	2.786 ±0.106	8.358
Time of stay of 1 head in the milking machine, excluding the 2nd and penultimate, min	2.618 ±0.068	2.323 ±0.182	2.413 ±0.215	2.451 ±0.087	7.354
Time of stay of 1 head in the milking machine, excluding the 2nd and penultimate, min	4.325 ±0.205	3.675 ±0.525	4.380 ±0.180	4.127 ±0.226	12.38
Duration of stay of the last mare on the pre-milking platform, min	11.52	11.49	14.09	12.367	37.10
Duration of stay of the last mare on the pre-milking platform, min	1.85	1.34	1.18	1.457	1.38

Source: developed by the authors

Thus, for the productivity of mares 0.463 kg of milk during the first milking 0.685 and 0.874 kg during the second and third, the time spent on milking one head is 51.3 sec and 55.0 and 61.7, respectively, but the total time spent on obtaining 1 kg of milk are reduced from 1.85 minutes during the first milking to 1.64 and 1.18

during the second and third, that is, inversely proportional to the average milk yield from one mare during the control milking and the daily milk productivity in general. The lowest indicators of milk productivity of mares were obtained during the first milking, with a further increase during the second and third (Fig. 2).

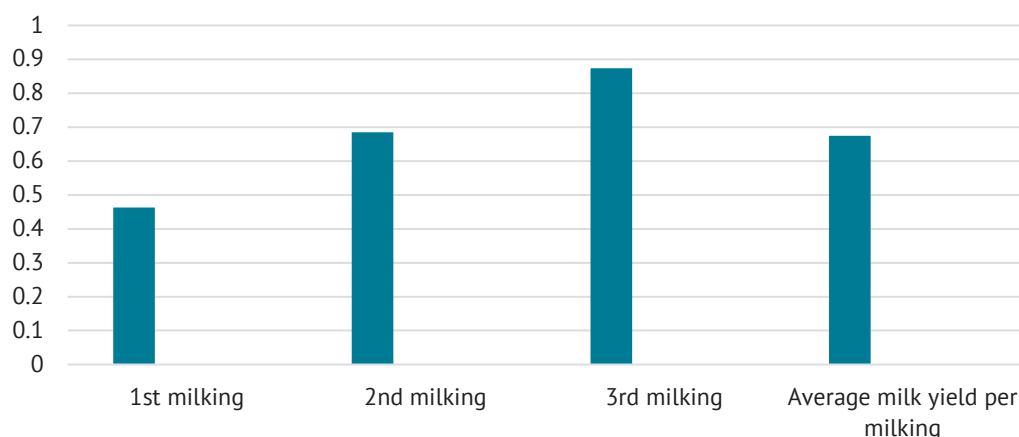


Figure 2. Milk productivity of mares

Note: milk yield per head, kg

Source: developed by the authors

Such insignificant indicators of milk productivity of mares, on average for one milking 0.674 ± 0.119 kg/goal, are explained by the fact that the accounting was carried out at the end of the lactation period and amounted to an average of 150.5 days of lactation, and according to A. D'Alessandro & G. Martemucci (2012) peak lactation in mares occurs on day 48. According to N. Miraglia *et al.* (2020), milk productivity depends on many factors, including rearing, housing and feeding systems, milking strategy and type (hand or machine), individual milk yield, stage of lactation, animal body size and condition, and the amount of milk collected per milking varies within 500-2000 ml for the main ones and 200-900 ml for the first-borns.

A similar regularity of the increase in milking milking sequence number was also obtained in the scientific and economic experiments of T.A. Yussyuk (2017), which is explained by the fact that mares retain milk to feed foals and give it in larger quantities during the second and third, which is characteristic of equids and depends on the biological structure of their mammary gland, and J. Auclair-Ronzaud *et al.* (2022) explain that the increase in the level of oxytocin provoked by the first milking can have consequences for the subsequent increase in milk yield and that the mare's response to stimulation during milking is different and individual.

It is significant that the time spent by the last mare on the pre-milking platform, which should not exceed 10 minutes, also depends on the milk productivity of the mares and their time spent in the milking machines, which is 12.367 minutes on average, i.e. 23.7% higher than the normative indicators. Also, the amount of concentrated fodder consumed (oat grain) depends on the time the mares stay in the milking machines and is an average of 2.8 minutes, during which one head can consume only 0.54 kg of oats, and for three milkings –

1.62 kg. The feeding rations of dairy mares provide for the feeding of 6 fodder units per day, or 6 kg in the form of oat grains, the difference of which (4.38 kg) they must receive on the walking and feeding grounds, which equalizes the normalized individual feeding of each head separately.

In this case, the second and penultimate mare according to the serial milking number is in the most advantageous position, since two heads are simultaneously milked, later they alternate one by one and two are released at the same time, and their time in the milking machine significantly increases to 4.12 minutes, compared to others – 2.45. Therefore, in order to solve this problem, it is necessary to organize individual feeding of mares on walking and feeding grounds, which requires significant capital investments in production, or to increase the duration of the stay of mares in milking machines due to the addition of additional ones, or to reduce a technological group of dairy mares, which will also reduce the time they stay at the pre-milking area.

It should also be noted that the average daily milk productivity of mares is 7.5 kg of milk per day and only 2.02 kg (for three milkings) is used for the production of kumis, i.e. 27%, and 5.48 is spent on feeding the foal. T. Bat-Oyun *et al.* (2018) note that in the steppes of Central Asia, mares are milked 4-5 times a day, while on more intensive dairy farms located in Europe, they are milked more often, depending on consumer demand, up to eight times a day at two-hour intervals. Milking is carried out at least 2 hours after weaning the foal from the mare. This distinctive feature of dairy farming gave rise to the neologism "milking session", that is, the time from the separation of the foal to the end of each milking. Thus, in an 8-hour working day, one operator can cover only three milkings per working shift, and with more milkings, an operator is needed for the next shift.

On the one hand, this phenomenon increases the costs of manual labor, and on the other hand, it contributes to the employment of the population of rural areas. According to N. Miraglia *et al.* (2020), horse breeding is one of the most promising activities in rural development, which is considered a key strategy for restructuring the agricultural sector through diversification and innovation. The variety of horse breeds involved not only in their use for work and tourism, but also in activities related to the production of food and non-food products and is a strong argument for the preservation of endangered breeds and populations. Many breeds occupy specific niches and contribute to biodiversity through their own genetic characteristics derived from adaptive mechanisms developed over centuries of evolution in specific local environments. The revival of interest in mare's milk and its derivatives today is supported by newly created dairy horse enterprises that have developed in France, Italy, Mongolia, China, Kazakhstan, Kyrgyzstan, Greece, Germany and many other countries.

CONCLUSIONS

To calculate technological maps, it is necessary to take into account the milk productivity of mares and use as standards the time spent on milking one head of 51.3 seconds for the productivity of 0.463 kg of milk, 55 s for the productivity of 0.685 kg and 61.7 s for the productivity of 0.874 kg, respectively. Ethological studies have shown that mares willingly go to the milking plant, since it is there that they are fed with concentrated fodder, but the stay time even for three milkings is not enough to consume their daily norm. Older mares are the first to be milked, and all others follow a certain order and sequence, following the machines where

they are used to being milked. The duration of stay of the last mares in line at the pre-milking platform exceeds the normative 10 minutes, which can be solved by reducing the technological group, or by building additional milking machines and thus increasing the time of feeding horses with concentrated fodder. The reaction of animal behavior can serve as an indicator of technological parameters and must be taken into account when developing new and improving existing technologies for the production of livestock products. During the three-time milking of mares, there is a direct linear relationship between its serial number, milk yield and time consumption – an increase in milk yield and time consumption from the first to subsequent milkings. Due to the small technological group of dairy mares, the research did not reveal any relationship between milk productivity, age and serial number of lactation.

For the purpose of standardized feeding, it is necessary to organize individual feeding of dairy mares with concentrated fodder, depending on their productivity. To increase the level of profitability of kumys production, transfer the milking of mares from three to five times, which will increase the production of marketable milk. In order to calculate technological maps, standards of time consumption not only for the milking process, but also standards for care, feeding, accustoming young mares to milking, grazing, etc., are needed, which is what further scientific research is focused on.

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CONFLICT OF INTEREST

None.

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Витрати часу на доїння кобил і їх етологічні показники

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Анотація. Молочне конярство в Україні не є традиційною галуззю тваринництва, хоча його продукція найбільше відповідає фізіології травлення людини і особливо незамінна у дитячому харчуванні, оскільки молоко кобил за хімічним складом наближається до жіночого. Для отримання молока кобил необхідно враховувати технологічні особливості утримання, годівлі тварин та одержання продукції, притаманних конкретному господарству, що повинно відображатись в технологічних картах. Найбільш трудоемним процесом у виробництві молока усіх видів тварин є процес доїння, тому метою цієї роботи була розробка нормативів витрат часу для подальшого розроблення технологічних карт у молочному конярстві та вивчення продуктивних і етологічних показників дійних кобил з урахуванням порядкового номера доїння. Дослідження проводили на кумисній фермі, племінному репродукторі з розведення Новоолександрівської ваговозної породи коней філії «Дібрівський кінний завод № 62» Державного підприємства «Конярство України» з використанням методів відеоспостереження, часового вимірювання, біометрії, а також математичних розрахунків. Встановлено, що витрати часу на доїння знаходяться в прямій залежності від продуктивності кобил і підвищуються з порядковим номером доїння. Етологічні дослідження показали, що кобили охоче ідуть на доїння і в однаковій черговості і послідовності на лівий та правий доїльні станки. Підгодівля зернами вівса відбувається під час доїння на доїльній установці, часу перебування на якій не достатньо для споживання норми добової потреби за рахунок концентрованих кормів, а час перебування кобил на переддоїльному майданчику перевищує нормативні показники. Розроблено нормативи витрат часу на процес доїння, з урахуванням етологічних особливостей кобил і пропозиції з його удосконалення за рахунок організації нормованої індивідуальної годівлі та кратності доїння, що збільшить валове виробництво товарного молока. Практична цінність роботи полягає у визначенні витрат часу на доїння кобил, залежно від їх продуктивності, які в подальшому будуть використані як нормативні показники під час розробки технологічних карт

Ключові слова: тривалість доїння; хронометраж; продуктивність кобил; поведінка; ваговозна порода; кумис

Productivity of high-oleic sunflower when grown in the conditions of the Southern Steppe of Ukraine

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Abstract. In modern agricultural systems, the basis of cultivation technology and an important factor determining the yield and quality of high-oleic sunflower seeds is regulation of mineral fertilizer rates. Therefore, the determination of their influence on the productivity of the culture determines the relevance of the conducted research. The purpose of the study is to determine the optimal rates of mineral fertilizer application to increase the yield of high-oleic sunflower hybrids in non-irrigated conditions of the Southern Steppe of Ukraine. To achieve the goal, a field study was conducted in the fields of the Mykolaiv State Agricultural Research Station of the Institute of Irrigated Agriculture of the National Academy of Agrarian Sciences of Ukraine. The subjects of the study are high-oleic sunflower hybrids Kadet, Hektor and Oplot, the originator of which is the V.Ya. Institute of Plant Breeding. Yuryev of the National Academy of Agrarian Sciences of Ukraine. As a result of the study, it was found that when applying $N_{90}P_{90}K_{60}$, the Kadet hybrid formed the largest diameter of the basket – 19.5 cm, under the same feeding conditions, the diameter of the basket in the Hektor and Oplot hybrids was 14.3 cm and 16.4 cm, respectively. The largest mass of 1000 seeds for the level of $N_{90}P_{90}K_{60}$ fertilization was established in the hybrid Cadet – 59.8 g, and at the level of fertilization $N_{30}P_{40}K_{30}$ the lowest mass of 1000 seeds – 41.7 g was formed in the hybrid Hektor. In addition, in the high-oleic sunflower hybrid Kadet, the content of crude fat in seeds and oleic acid in oil was the highest compared to other hybrids in all variants of fertilization. The application of mineral fertilizers also

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affected the yield of high-oleic sunflower, so the yield of the Kadet hybrid was 24.1% higher with the application of $N_{90}P_{90}K_{60}$, compared to the variant of application of $N_{30}P_{40}K_{30}$, and the yield of the Hektor and Oplot hybrids was 33.3% and 28%, respectively, which makes it possible to state that the level provision of mineral fertilizers helps to increase crop productivity. The obtained results provide an opportunity to improve the technology of growing high-oleic sunflower under conditions of insufficient moisture, and the perspective of further research may be to study the effect of increased norms of each individual macroelement or their joint effect on the productivity and quality of the high-oleic sunflower crop

Keywords: oil; hybrid; fertilizer; productivity; plant nutrition

INTRODUCTION

High-oleic sunflower is a hybrid variety of sunflower that has a high content of oleic acid in the seeds. Oleic acid is a monounsaturated fatty acid that is more beneficial to human health than other fatty acids such as palmitic and stearic acids. When frying in high-oleic oil, much less so-called trans fats, which can initiate oncological processes, are released. High-oleic oil withstands a greater number of frying cycles, which is valuable when using it in deep-frying, when making margarine from high-oleic oil, 10-15% less energy is required. In addition, high oleic oil is an excellent alternative to olive oil (Ryzhenko *et al.*, 2020).

High-oleic sunflower is grown in many countries, including Ukraine, Kazakhstan, Canada, the USA, and others. High-oleic sunflower is an important crop not only for oil production, but also for use in the feed sector, as well as as an energy crop for biofuel production, which increases the importance and relevance of conducting research on its productivity. The productivity of high-oleic sunflower can vary depending on growing conditions, such as soil, climate, humidity level, presence of pests and diseases.

Thus, in their work, S. Kalenska *et al.* (2020) claim that in Ukraine, high-oleic sunflower can yield from 2.5 to 4 tons per hectare. Productivity depends on many factors, including the quality of the seed, the use of mineral fertilizers and the application of the irrigation system.

I. Kolosok (2022) believes that to increase the productivity of sunflower, it is important to use high-quality seeds and apply the necessary amounts of mineral fertilizers, especially nitrogen, phosphorus and potassium. It is also important to maintain a sufficient level of soil moisture and protect plants from pests and diseases.

A similar opinion is expressed by J. Akuaku *et al.* (2020), who claim that fertilization can have a positive effect on the yield of high-oleic sunflower. Thus, according to the research carried out by the authors, it was established that the introduction of fertilizers with an increased content of phosphorus and potassium in areas with high-oleic sunflower led to an increase in productivity by 6-8%. In addition, research by R. Vozhegova *et al.* (2013) proved that the correct

cultivation technology can also lead to an increase in the yield of high-oleic sunflower by 15-20%.

It is worth noting that a number of scientists, in particular O. Kovalenko *et al.* (2021), agree that an important factor that can affect the performance of high-oleic sunflower is the use of proper agricultural practices, such as proper soil preparation, pre-sowing seed treatment, regular watering and supplemental plant nutrition. These aspects add importance and relevance to the study of the formation of productivity of high-oleic sunflower depending on the elements of cultivation.

The sunflower fertilization system takes into account specific growing conditions and plant needs, since there is no universal approach to providing fertilizers to the crop. Taking into account such factors as climatic conditions, soil properties, physiological features of the sunflower hybrid, it is recommended to use an individual approach to providing nutrients.

Since the issue of mineral nutrition of high-oleic sunflower hybrids in conditions of insufficient moisture remains incompletely studied, the purpose of the study is to determine the effect of fertilizers on yield, the content of crude fat in seeds and the content of oleic acid in the oil of high-oleic sunflower.

MATERIALS AND METHODS

To determine the productivity of high-oleic sunflower, a field experiment was conducted using laboratory and field observations of the growth and development of hybrids of the culture grown under different conditions of mineral fertilization. The research was carried out in the fields of the Mykolaiv State Agricultural Research Station of the Institute of Irrigated Agriculture of the National Academy of Agrarian Sciences of Ukraine in 2020-2022.

The study was carried out on the southern chernozem in the carbonate forest, this type of soil is characterized by the presence of a high content of potassium, medium – phosphorus and insufficient – nitrogen. It is a medium-loamy soil with a mechanical composition characterized by a humus horizon thickness of up to 50-70 cm and a humus content of 3.6%. The content of

easily hydrolyzed nitrogen is about 0.1-0.5 mg per 100 g of soil, mobile forms of phosphorus – 8.7-9.5 mg per 100 g of soil, the amount of exchangeable potassium – 30.2 mg per 100 g of soil. The pH value of the soil is 7.5.

The objects of the study were three hybrids of high-oleic sunflower: Cadet, Hector and Oplot, the originator of which is the Institute of Plant Breeding named after V.Ya. Yuryev of the National Academy of Agrarian Sciences of Ukraine.

Since climatic factors are of great importance for the formation of the high-oleic sunflower crop, it should be noted that the territory on which the study was carried out belongs to the zone of insufficient moisture, and during the research, all years were characterized by a lack of moisture.

The experiment was repeated three times, the total size of the plot was 300 m², the area of the accounting plot was 90 m². The predecessor of sunflower is winter wheat. Sunflower hybrids were sown between April 25 and 30, the sowing rate is 50,000 similar seeds per hectare.

In all variants of the experiment, organic fertilizer (manure) was applied to the soil under field plowing before sowing sunflower at the rate of 25 t/ha, and 2/3 of the norm of phosphorus and potassium fertilizers was applied under field tillage, and 1/3 of the norm in the spring for cultivation nitrogen 1/3 of the norm of phosphorus and potash and the remaining 2/3 of nitrogen fertilizers were applied 2 weeks after sowing as top dressing according to the experimental scheme: I option – N₃₀P₄₀K₃₀, II – N₄₀P₆₀K₆₀, III – N₉₀P₉₀K₆₀. Urea was used as a nitrogen fertilizer, granulated superphosphate as a phosphorous fertilizer, and potassium chloride as a potassium fertilizer.

Data on sunflower growth parameters, such as the diameter of the basket and the weight of 1000 seeds, were obtained directly during harvesting by measurement and weighing. The content of crude fat in seeds is determined by the defatted residue (according to Rushkovsky), the content of oleic acid in oils – by the refractometric method. Calculation of sunflower productivity was carried out manually, from each plot. In addition, during the data analysis, a statistical analysis was conducted to determine the average and relative values of the influence of the mineral fertilizer level on the yield of sunflower hybrids and a comparative analysis to compare the data obtained for 2020-2022.

All experiments were repeated three times for each variant of the experiment. Processing of the obtained research results for reliability was carried out using the multivariate MANOVA method of variance analysis using Microsoft Excel software and the Statistica 10 program package. Differences in the obtained results are possible at the level of significance $P \leq 0.05$ according to the Student's test.

RESULTS

One of the key aspects of the high-oleic sunflower fertilization system is the provision of sufficient amounts of macro- and micronutrients to meet plant needs. Organic and mineral fertilizers can be used for this.

Usually, the high-oleic sunflower fertilization system involves the introduction of complex mineral fertilizers that contain nitrogen, phosphorus and potassium, as well as trace elements necessary to ensure normal growth and development of plants. It is important to consider that the distribution of fertilizers must be balanced and meet the needs of plants, soil and climatic conditions, as well as take into account the loss of fertilizers due to evaporation, washing and other factors. When applying fertilizers to various agricultural crops, in particular, to high-oleic sunflower, it should be noted that the maximum result is achieved only with the correct selection of optimal doses and types of fertilizers, which are applied in the most optimal phase of crop vegetation (Trotsenko *et al.*, 2020).

Fertilizer helps to increase the resistance of agricultural crops to adverse environmental factors, which directly affects the increase in their productivity. Without proper and timely application of nutrients, high-oleic sunflower will grow slowly, and its seeds will be small. In addition, an insufficient amount of nutrients in the soil can lead to a decrease in the growth and development of sunflower plants, and the plant itself can be affected by pests and diseases (Tsyliuryk *et al.*, 2021).

It is important to note that sunflower fertilization can significantly affect the quality of the crop. The optimal rate and type of fertilizers, their timing and method of application can determine the quantity and quality of seeds, as well as the content of fatty acids in them, which plays an important role in shaping the quality of sunflower oil (Melnyk *et al.*, 2019).

One of the tasks of the research was to study the features of mineral nutrition of high-oleic sunflower and its fertilizer needs, therefore it is important to note that one ton of grown high-oleic sunflower yields approximately 8 kg of nitrogen, 3 kg of phosphorus and 15 kg of potassium, and mineral fertilizer provides a culture of macro- and trace elements in the most vulnerable phases of development: seedlings, budding, as well as the seed filling phase.

Nitrogen is a key element for stimulating the growth and development of high-oleic sunflower plants, increasing its photosynthetic activity, as well as for the formation of large and high-quality seeds. Phosphorus is an important element for energy processes in plants, promotes the development of the root system, the formation of seeds, as well as increasing the yield of crops. Potassium is necessary to maintain the water balance, affects the resistance of plants to stressful

conditions, the development of flower buds, as well as the formation of seeds and the improvement of their quality (Kovalenko *et al.*, 2021).

In the conducted research, the introduction of different rates of mineral fertilizers on the studied hybrids of high-oleic sunflower had a significant impact on the indicators of the crop yield structure for three years, namely the diameter of the basket and the weight of 1000 seeds.

The sunflower basket is the main reproductive organ of the plant, where seeds are formed, so its size and structure are important for the formation of crop yield. In addition, the diameter of the basket can be an important indicator when determining the quality and quantity of seeds, as well as for determining the efficiency of sunflower cultivation technology in general.

Thus, in the course of the study, it was established that the largest sunflower basket diameter at the $N_{90}P_{90}K_{60}$ fertilizer level was formed by the Kadet hybrid – 19.5 cm,

the Hektor and Oplot hybrids under the same feeding conditions formed smaller baskets by 5.2 cm and 3.1 cm, and were 14.3 cm and 16.4 cm, respectively (Table 1).

It is worth noting that the application of mineral nutrition also affected the mass of 1000 sunflower seeds, despite the fact that this is a genetically determined feature. Thus, at the $N_{30}P_{40}K_{30}$ level of fertilization, the smallest mass of 1,000 seeds was established in the Hektor hybrid, which was 41.7 g. The highest mass of 1,000 seeds at the $N_{90}P_{90}K_{60}$ fertilization level was formed by the Kadet hybrid, which was 59.8 g.

So, with the application of $N_{90}P_{90}K_{60}$, the diameter of the sunflower basket in the Kadet hybrid was 23.4% greater than with the application of $N_{30}P_{40}K_{30}$, and the weight of 1000 seeds was 29.2%, respectively. Thus, the increase in the structural parameters of the high-oleic sunflower crop in the study occurred due to the supply of sufficient nutrients from mineral fertilizers, which affected the growth and development of plants.

Table 1. Basket diameter and weight of 1,000 seeds of sunflower hybrids (average for 2020-2022)

High-oleic sunflower hybrid	Fertilizer application scheme	Basket diameter, cm	Weight of 1000 seeds, g
Kadet	$N_{30}P_{40}K_{30}$	15.8	46.3
	$N_{40}P_{60}K_{60}$	16.6	56.3
	$N_{90}P_{90}K_{60}$	19.5	59.8
Hektor	$N_{30}P_{40}K_{30}$	10.3	41.7
	$N_{40}P_{60}K_{60}$	12.7	46.5
	$N_{90}P_{90}K_{60}$	14.3	49.6
Oplot	$N_{30}P_{40}K_{30}$	10.3	48.7
	$N_{40}P_{60}K_{60}$	12.7	51.3
	$N_{90}P_{90}K_{60}$	16.4	54.9

Source: developed by the authors

The results also established that the application of mineral fertilizers had a significant effect on sunflower yield indicators. On average, over three years, the highest yield was formed in the Kadet and Oplot hybrids, and amounted to 3.6 t/ha and 3.2 t/ha, respectively, when applying $N_{90}P_{90}K_{60}$, the yield of the Hektor hybrid at the same level of fertilizer was 2.8 t/ha, which was 0.8 t/ha

and 0.4 t/ha lower than that of the Kadet and Oplot hybrids, respectively (Table 2). Thus, the yield of the Kadet hybrid with the application of $N_{90}P_{90}K_{60}$ was 24.1% higher than with the application of $N_{30}P_{40}K_{30}$, and the yield of the Hektor and Oplot hybrids was 33.3% and 28%, respectively, which indicates that the level of mineral fertilizer supply increases the productivity of high-oleic sunflower.

Table 2. Yield of sunflower hybrids, t/ha

High-oleic sunflower hybrid	Fertilizer application scheme	Year			Average during 2020-2022
		2020	2021	2022	
Kadet	$N_{30}P_{40}K_{30}$	2.6	3.1	2.9	2.9
	$N_{40}P_{60}K_{60}$	2.9	3.2	3.4	3.2
	$N_{90}P_{90}K_{60}$	3.4	3.8	3.6	3.6
HIP _{0.05}		1.24	1.47	1.33	1.47
Hektor	$N_{30}P_{40}K_{30}$	1.9	2.2	2.3	2.1
	$N_{40}P_{60}K_{60}$	2.1	2.5	2.3	2.3
	$N_{90}P_{90}K_{60}$	2.8	3.1	2.6	2.8

Table 2, Continued

High-oleic sunflower hybrid	Fertilizer application scheme	Year			Average during 2020-2022
		2020	2021	2022	
HIP _{0.05}		1.62	1.43	1.31	1.62
	N ₃₀ P ₄₀ K ₃₀	2.4	2.5	2.6	2.5
Oplot	N ₄₀ P ₆₀ K ₆₀	2.6	3.1	2.7	2.8
	N ₉₀ P ₉₀ K ₆₀	3.1	3.3	3.2	3.2
HIP _{0.05}		1.62	1.47	1.53	1.23

Source: developed by the authors

Based on the obtained yield data, it is important to note that high-oleic sunflower is sensitive to an increase in nitrogen and phosphorus fertilizers, since the increase in yield between the N₄₀P₆₀K₆₀ and N₉₀P₉₀K₆₀ norms of the Kadet hybrid was 12.5%, and the Hektor and Oplot hybrids were 21.7% and 14.3%, respectively.

Indicators of the quality of oil raw materials are a very important element of the characteristics of sunflower products. This is due to the fact that oil feedstock is the main component used to produce sunflower seed oil. Also, these indicators make it possible to evaluate oil raw materials and determine whether they are suitable for the production of high-quality sunflower oil.

The crude fat content of sunflower seeds is the amount of fat-like substances contained in one gram of seeds. Oleic acid is a monounsaturated fatty acid that is one of the main fatty acids found in sunflower oil.

Therefore, the content of crude fat in seeds and the amount of oleic acid in sunflower oil are important indicators for the productivity and quality of high-oleic sunflower. To improve these indicators, it is necessary

to use sunflower varieties and hybrids that have a high content of oleic acid and to carry out proper plant care, including regular watering and application of necessary mineral fertilizers.

In the conducted research, it was established that mineral fertilizers, in addition to the yield of sunflower seeds, also affect the content of crude fat in them. Thus, the influence of mineral nutrition on the content of crude fat in seeds and oleic acid in high-oleic sunflower oil was studied using a laboratory method. The obtained data indicate that different fertilization rates can increase these quality indicators. Thus, the content of crude fat in seeds and oleic acid in sunflower oil gradually increased with the introduction of higher rates of nitrogen, phosphorus and potassium. The Kadet sunflower hybrid has the highest content of both crude fat in seeds and oleic acid in oil compared to Hektor and Oplot hybrids in all fertilization options. The lowest content of crude fat in seeds – 36.9% and oleic acid in oil – 76.7% was noted in the hybrid Hektor in the variant of application of mineral fertilizers N₃₀P₄₀K₃₀ (Table 3).

Table 3. Content of crude fat in seeds and oleic acid in sunflower oil, % (average for 2020-2022)

High-oleic sunflower hybrid	Fertilizer application scheme	Crude fat content	Oleic acid content
Kadet	N ₃₀ P ₄₀ K ₃₀	44.8	84.8
	N ₄₀ P ₆₀ K ₆₀	46.6	85.4
	N ₉₀ P ₉₀ K ₆₀	47.4	87.3
Hektor	N ₃₀ P ₄₀ K ₃₀	36.9	76.7
	N ₄₀ P ₆₀ K ₆₀	38.2	78.4
	N ₉₀ P ₉₀ K ₆₀	39.3	80.6
Oplot	N ₃₀ P ₄₀ K ₃₀	42.3	80.7
	N ₄₀ P ₆₀ K ₆₀	44.1	81.5
	N ₉₀ P ₉₀ K ₆₀	45.2	83.2

Source: developed by the authors

Thus, according to the obtained results, the indicators of crop texture, quality characteristics of high-oleic sunflower seeds and oil, as well as its yield are significantly influenced by the rates of mineral fertilizers.

However, to determine the reliability of the obtained results, a correlation-regression analysis was

performed. This statistical method is a powerful tool used to determine relationships between two or more variables. In the case of the performed study, correlation-regression analysis was used to determine the relationship between the application of mineral fertilizers and the yield of high-oleic sunflower hybrids.

Also, this analysis will make it possible to build a model that predicts the yield of hybrids depending on the use of mineral fertilizers.

According to the conducted correlation-regression analysis, a tendency to increase the yield of high-oleic

sunflower hybrids in case of an increase in the level of mineral fertilizers was revealed. The reliability value for the Cadet hybrid is $R=0.9932$, for the Hector hybrid $R=0.9423$, and for the Oplot hybrid $R=0.9932$, which means that the model accurately describes the available data (Fig. 1).

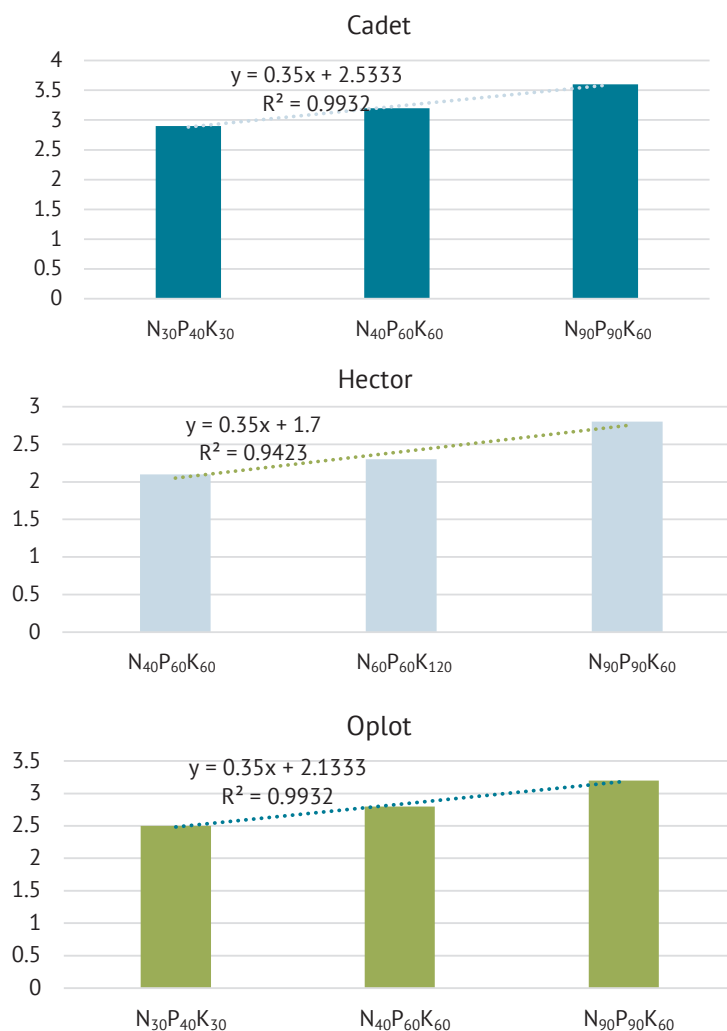


Figure 1. Correlation-regression analysis of the effect of mineral fertilizers on the yield of high-oleic sunflower hybrids (average for 2020-2022)

Source: developed by the authors

So, the obtained research results confirm that the relationship between the application of mineral fertilizers and the productivity of high-oleic sunflower is linear and directly proportional. Therefore, it is possible to recommend an increase in the amount of mineral fertilizers to achieve higher productivity of high-oleic sunflower. However, at the same time, recommendations for the application of mineral fertilizers should be followed to avoid their excessive use, which can affect both the quality of high-oleic sunflower products and the environment.

Thus, in the course of the study, it was established that increasing the rates of mineral fertilizers can affect

the increase in the diameter of the basket, the weight of 1000 seeds, the content of crude fat in the seeds and oleic acid in the oil of high-oleic sunflower, as well as obtaining an increase in yield even under arid climatic conditions.

This allows us to state that in the conditions of insufficient moisture on the southern chernozem in the carbonate forest, preference should be given to the Kadet hybrid in the cultivation of high-oleic sunflower, and the optimal level of mineral fertilizer is $N_{90}P_{90}K_{60}$.

DISCUSSION

The technology of growing high-oleic sunflower is an important factor affecting its productivity. The crop

fertilization system includes the application of various types of fertilizers. This is due to the fact that high-oleic sunflower plants require large amounts of nutrients for their growth and development, most of which they cannot obtain from the soil in sufficient quantities.

Insufficient soil nutrients can lead to reduced yields, reduced seed quality, and increased risk of disease and pests. Therefore, it is important to provide high-oleic sunflower hybrids with a sufficient level of nutrients by applying fertilizers in the right amount and at the optimal time.

M. Duca *et al.* (2022) believe that the high-oleic sunflower fertilization system includes the application of various types of fertilizers with different concentrations and amounts depending on agrotechnical measures, soil type, climatic conditions, and other factors. The main elements of sunflower fertilizer are nitrogen, phosphorus, potassium and trace elements.

According to B. Casali *et al.* (2022), combining the use of organic fertilizers with mineral fertilizers, it is possible to obtain the most effective way of increasing the productivity of high-oleic sunflower, which is also reflected in the performed research. But in order to achieve a high crop yield, the nutrient regime of the soil must be improved in accordance with the needs of the crop, as well as to maintain the fertility of the soil itself.

V. Giannini *et al.* (2022) believe that organic fertilizers can contain nitrogen, phosphorus, potassium and other nutrients that decompose gradually and provide long-term effects on sunflower growth. Inorganic fertilizers usually contain large amounts of macronutrients and can quickly improve the condition of the crop. According to T. Howell *et al.* (2015), the system of fertilization of high-oleic sunflower can also use such organic fertilizers as compost, humus, humates, etc., which help to increase soil fertility and improve its structure.

A. Jan *et al.* (2022) in their works note that when growing high-oleic sunflower, it is recommended to apply starter fertilizers that contain phosphorus and potassium. Yes, you can apply 80-120 kg/ha of superphosphate and 60-80 kg/ha of potassium chloride. And during the development of the plant, it is necessary to make additional fertilizers, as top dressing, especially nitrogen, which will contribute to the formation of more seeds. To do this, you can apply up to 150 kg/ha of ammonium nitrate or 200 kg/ha of urea, which is also reflected in the performed research.

C. Nobile *et al.* (2020) notes that in order to reduce the negative impact of fertilizers on the environment and reduce the costs of fertilizers, it is possible to apply systems of precision agriculture and balanced fertilizer supply using modern technologies and equipment.

A. Ryzhenko *et al.* (2020) believe that the formation of the basket diameter of high-oleic sunflower can be

significantly influenced by the fertilization system. Thus, the introduction of nitrogen fertilizers can help increase the diameter of the basket, since nitrogen is a key element for the growth of plants and the formation of their organs, including the basket. With an insufficient level of nitrogen in the soil, the plant can be limited in its growth and development, which can lead to a decrease in the size of the basket, which also confirms the performed research.

However, V. Trotsenko *et al.* (2020) point out that it is worth considering that excessive application of nitrogen fertilizers can also have a negative effect on plant development and crop quality. Excessive amounts of nitrogen can increase the height of the plant, but this will not always be accompanied by a corresponding increase in the size of the basket, as well as an increase in the moisture content of the plant and an increase in the risk of disease and pests.

The research results are echoed in the scientific works of O. Tsyliuryk *et al.* (2021) who state that the fertilization system can affect the mass of 1000 high-oleic sunflower seeds. The authors established that the application of phosphorus fertilizers can improve the formation and development of the plant's root system and provide energy for its growth, which in turn affects the mass of seeds. Potassium is an important element for the development of plants and maintaining their resistance to stressful conditions such as drought and low temperatures. An insufficient level of potassium in the soil can lead to a decrease in the mass of seeds and the overall yield of sunflower, which is also demonstrated by the results of the performed study.

The results of the conducted research are also confirmed in the scientific works of O. Kovalenko *et al.* (2021), who claim that in the conditions of the Southern Steppe of Ukraine, high-oleic sunflower can demonstrate a sufficiently high yield under justified norms of mineral nutrition.

However, R. Vozhegova *et al.* (2013) point out that excessive application of fertilizers in sunflower cultivation technology can have a negative impact on plant development, seed quality and yield, therefore, in order to ensure optimal values of crop structure indicators and overall productivity, it is important to follow the balance of application of different types of fertilizers and recommendations regarding their rates.

Research by Z. Flagella *et al.* (2002) showed that different rates and composition of mineral fertilizers can have different effects on the content of crude fat in seeds and oleic acid in sunflower oil. For example, the use of fertilizers containing nitrogen and phosphorus can contribute to an increase in the crude fat content of the seeds, while the use of fertilizers containing potassium can contribute to an increase in the oleic acid content of sunflower oil.

Similar results were also obtained in the studies of E. Domaratsky *et al.* (2018), in which the authors claim that the application of nitrogen fertilizers in a complex with phosphate and potassium fertilizers increases the content of crude fat in seeds and the amount of oleic acid in sunflower oil. However, according to the results of P. Deepika & D. Ali (2020), the use of nitrogen fertilizers can contribute to an increase in crude fat content, while the use of phosphoric fertilizers can have the opposite effect, in which the content of crude fat in seeds decreases.

Therefore, B. Li *et al.* (2022) note that the effect of fertilizers on crude fat and oleic acid content may depend on many factors, such as soil type, climatic conditions, and high-oleic sunflower hybrids used. Therefore, in order to obtain the best results, it is necessary to take into account all these factors when applying fertilizers and carrying out agrotechnical measures. Thus, the effect of fertilization on the content of crude fat in seeds and oleic acid in high-oleic sunflower oil can be complex and depend on a complex of factors that requires additional study.

Taking into account the mentioned research of the authors, as well as the results of the conducted research, it can be stated that the increase in the productivity of high-oleic sunflower depends on the use of mineral fertilizers, therefore, it is necessary to observe their rational introduction when growing the crop.

CONCLUSIONS

In order to achieve the maximum productivity of high-oleic sunflower, it is necessary to use agricultural methods that include the introduction of nutrients for additional enrichment of the soil with the necessary macro- and microelements. As a result of the research, it was established that at the $N_{90}P_{90}K_{60}$ fertilizer level, the largest diameter of the basket – 19.5 cm was formed in the Kadet hybrid, this indicator was 14.3 cm and 16.4 cm in the Hektor and Oplot hybrids under the same feeding conditions, respectively.

The highest mass of 1000 seeds at the $N_{90}P_{90}K_{60}$ fertilization level was established in the high-oleic sunflower hybrid Kadet – 59.8 g, and at the $N_{30}P_{40}K_{30}$

fertilization level, the smallest mass of 1000 seeds, which was 41.7 g, was formed in the Hektor hybrid. The content of crude fat in the seeds and oleic acid in the oil in all variants of fertilization was the highest in the high-oleic sunflower hybrid Kadet compared to the hybrids Hektor and Oplot.

The application of mineral fertilizers affected the yield of sunflower, so with the application of $N_{90}P_{90}K_{60}$, the yield of the Kadet hybrid was 24.1% higher than with the application of $N_{30}P_{40}K_{30}$, and the yield of the Hektor and Oplot hybrids was 33.3% and 28%, respectively, which indicates that the level of provision of mineral fertilizers contributes to increasing the productivity of high-oleic sunflower.

The conducted correlation-regression analysis of high-oleic sunflower productivity data determined a tendency to increase this indicator in the event of an increase in the level of mineral fertilizers. Therefore, the prospect of further research may be to study even higher levels of each individual macroelement, as well as their joint impact on the yield structure and quality of the high-oleic sunflower crop.

Thus, it was established that increasing the rates of mineral fertilizers can influence the increase in the indicators of the structure of the crop of high-oleic sunflower and obtaining an increase in its yield even under adverse arid climatic conditions. However, it is important to follow the fertilizer recommendations to avoid deterioration in the quality of crop products.

Therefore, in order to increase the production and genetic potential of high-oleic sunflower hybrids in conditions of insufficient moisture, it is advisable to use mineral fertilizers under the condition of their rational application. The practical significance of the obtained results makes it possible to improve the technology of growing high-oleic sunflower in farms of various forms.

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CONFLICT OF INTEREST

None.

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Продуктивність високоолеїнового соняшнику при вирощуванні в умовах Південного Степу України

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Анотація. У сучасних системах землеробства основою технології вирощування та важливим фактором, що визначає врожайність та якість насіння високоолеїнового соняшнику, є регулювання норм мінеральних добрив. Тому визначення їх впливу на продуктивність культури зумовлюють актуальність проведеного дослідження. Мета дослідження – визначити оптимальні норми внесення мінеральних добрив для підвищення врожайності гібридів високоолеїнового соняшнику в незрошуваних умовах Південного Степу України. Для досягнення мети проведено польове дослідження на полях Миколаївської державної сільськогосподарської дослідної станції Інституту зрошуваного землеробства Національної академії аграрних наук України. Об'єкти дослідження – гібриди високоолеїнового соняшнику Кадет, Гектор та Оплот, оригіномом яких є Інститут рослинництва імені В.Я. Юрєва Національної академії аграрних наук України. В результаті дослідження встановлено, що при внесенні $N_{90}P_{90}K_{60}$ гібрид Кадет сформував найбільший діаметр кошику – 19.5 см, за тих же умов живлення у гібридів Гектор та Оплот діаметр кошику становив відповідно 14.3 см та 16.4 см. Найбільша маса 1000 насінин за рівня удобрення $N_{90}P_{90}K_{60}$ встановлена у гібриду Кадет – 59.8 г, а за рівня удобрення $N_{30}P_{40}K_{30}$ найменша маса 1000 насінин – 41.7 г сформувалась у гібриду Гектор. Крім того, у гібриду високоолеїнового соняшнику Кадет вміст сирого жиру в насінні та олеїнової кислоти в олії у всіх варіантах внесення добрив був найвищим порівняно до інших гібридів. Внесення мінеральних добрив вплинуло й на врожайність високоолеїнового соняшнику, так урожайність гібриду Кадет була на 24.1 % вищою за внесення $N_{90}P_{90}K_{60}$ у порівнянні до варіанту внесення $N_{30}P_{40}K_{30}$, а врожайність гібридів Гектор та Оплот на 33.3 % та 28 % відповідно, це уможливило стверджувати, що рівень забезпечення мінеральними добривами сприяє підвищенню продуктивності культури. Отримані результати дають можливість удосконалити технологію вирощування високоолеїнового соняшнику за умов недостатнього зволоження, а перспективою подальших досліджень може бути вивчення дії підвищених норм кожного окремого макроелемента чи їх спільного впливу на продуктивність та якість урожаю високоолеїнового соняшнику.

Ключові слова: олія; гібрид; добриво; врожайність; живлення рослин

Innovative technologies in the banking sector of Ukraine in the period of digitalization

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Abstract. Today, interbank competition is gaining momentum, so the introduction and development of innovative technologies in the provision of banking services is becoming particularly relevant. In addition, the improvement of innovative technologies in the banking sector will ensure the efficient operation of the banking system and increase the level of the economy of Ukraine by increasing innovative ways of carrying out financial transactions. The goal is to study the prospects for the integration of financial technologies in the banking sector, to identify strengths and weaknesses, as well as threats and opportunities for the influence of these technologies in the banking industry. The theoretical and methodological main articles are the works of Ukrainian scientists on the implementation of banking innovations and financial technologies. Empirical and theoretical research methods were used in the research process, which made it possible to reveal the essence of the concept of innovative activity and innovative technologies. An analysis of modern promising innovative technologies in Ukraine and in the world was carried out. With the help of SWOT analysis, the strengths and weaknesses of innovative technologies, such as: ManuScan, electronic wallets, electronic payment systems, were investigated. Special attention was paid to the category of threats of such innovative technologies as hacking and virus attacks, since these innovative technologies are used in the banking and financial system at the state level. Innovative technologies are analyzed as a complete innovation of changes in the activity of the financial sphere of Ukraine with the aim of improving the use of the banking and financial sphere of Ukraine, increasing monetary transactions both on the territory of Ukraine and outside of it. The activity of banking institutions using the latest, improved financial products and services is considered. The practical value of the study is that it can become a basis for achieving stable and efficient functioning of banks in the future, as well as provide recommendations for the implementation of the latest electronic payment systems, which are currently gaining popularity

Keywords: retinal or pupil scanner; banking services; fintech; electronic wallets; electronic payment system

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INTRODUCTION

In recent decades, innovative technologies have developed rapidly in global banking practice. Their appearance is explained by the search for new ways of carrying out banking activities with the aim of obtaining high profits.

L. Kloba (2018) noted that the digitalization process is aimed at cooperation with fintech startups with long-term goals to introduce innovative work methods, banking products and services to increase and expand the client base and increase the bank's competitiveness, which is the result of digitalization. The digitalization process itself is primarily related to the transformation of scientific research and development with the aim of improving banking products and services.

V. Kunytsia & Yu. Tsevukh (2019) noted that financial innovations throughout historical development are actively implemented in the practical activities of foreign countries. The authors identified the main reasons for the development of financial innovations, among which information technologies, which are actively interconnected with other financial processes, play a significant role. According to the authors, these innovations are able to increase the efficiency of existing processes, as well as launch completely new ones, thus increasing the interest of customers. The authors highlighted innovative technologies that play the main trend in the development of the financial and banking system. However, independent development at the moment is not as effective as the process of synergy between companies that create innovations and institutions that deliver improved services to their customers.

V. Honcharuk (2019) proved that the digitalization of banks' activities is connected with the transformation of scientific research and development, other scientific and technological achievements into new or improved banking products and services, into an updated or improved banking technological process used in practical activities, or a new approach to the realization of products and services, their adaptation to current customer requirements. The attractive features of digital banking products are high reliability, profitability and quality. Digitization of banks' activities is aimed at obtaining profit from the introduction of modern financial technologies.

M. Matyukha (2019) indicated that in the last few years, the theoretical and practical issues of the requirements for the automation of banking systems have been highlighted in the specialized literature, but the issues will continue to be relevant in the process of designing, developing and using these banking systems.

A. Kovaleva (2021) noted that the banking sphere of Ukraine is undergoing transformation taking into account new requirements. Today, digital technologies

have become an indispensable tool in the banking and financial sector and are developing rapidly. Therefore, the further functioning of the banking sector at the current stage of development is directly related to the development of innovative technologies, which in recent years are an information vector not only for a separate banking system, but also for the entire financial sector and the country's economy as a whole.

The purpose of the article was an in-depth study of the essence of innovations, their content, as well as their role for the banking sector of Ukraine in the era of digitalization; the study of such innovative technologies as electronic scanners, electronic wallets and electronic payment systems in the financial sphere of the economy will enable their effective use in the financial and banking system, increasing the number of transactions with high efficiency and increasing the number of satisfaction of customer needs.

LITERATURE REVIEW

L. Bondarenko & M. Politylo (2018) studied in their works the problems of innovative work of Ukrainian banks in the financial sphere, studied the importance and feasibility of innovative activities of banking institutions to ensure their effective development in the financial market. The foreign experience of innovative banking products and technologies was also studied, thanks to which the main global banking innovations were highlighted. Further prospects of innovative activity in the Ukrainian banking sector in the coming years are analyzed.

D. Dorofeiev (2018) investigated the theoretical and methodological principles of determining the essence of the economic nature, studied the economic nature of financial relations that take place in the financial sector. In his activities, he defined financial innovations as a complete innovation and change in the activities of financial banking institutions that carry out their activities on improved and modified financial innovations. Also, he classified financial innovations according to the scope of their occurrence and use, according to the objects of implementation and to the list of the use of tools in order to improve the management of innovation processes.

L. Kloba (2018) in his work investigated the digitalization process in banking institutions as a complex of modern economic and organizational and managerial innovations. Today, in the conditions of intensified competition in the market, digitalization contributes to the expansion of the client base, the market share of banking services, the reduction of the volume of expenses and the improvement of the financial stability of the banking institution. Digitalization of banking institutions is primarily related to the transformation

of scientific research and development into the latest or already improved banking products and services used in practical activities. The result of digitization for banking activities is the latest products and services with newer qualities, which includes new intelligent products, modern technological equipment and processes, new approaches to market formation of modern innovative banking products and services.

S. Fatonah *et al.* (2018) conducted a focused review of the available literature for e-commerce e-payment systems to highlight the scope of e-payment systems.

Y. Kryvysh & A. Dranitsyna (2019) studied the essence and meaning of the concept of banking innovations, their classification and the relationship between the innovative activity of banks and the formation of customer loyalty and the growth of trust in banks. They established the distinction between financial and banking innovations, considered the chronology of the development of significant banking innovations, and established the relationship between the innovative activities of banking institutions and the scientific achievements of mankind. In particular, product, process, marketing, technological and managerial innovations were established. Special emphasis is placed on the relationship between the innovative activity of banking institutions and the parallel increase in the level of trust in banks.

V. Kuniysia & Yu. Tsevuikh (2019) in his works paid attention to the main trends in the development and use of financial innovations in the banking sector, as well as innovations in the field of finance and approaches to their study. Research on the close cooperation of banking institutions with various FinTech companies that are actively implementing innovative solutions, but are unable to test their innovations at scale without the help of established financial institutions.

T. Handayani & A. Novitasari (2020) analyzed the determination of the level of efficiency of digital wallets as a transaction medium. It was found that the number of users of digital wallets is increasing over time, due to the rapid increase in the number of smartphone users. The advantages and disadvantages of electronic wallets were analyzed.

N. Arkhireiska & O. Kuchkova (2021) studied the current trends of the payment market of Ukraine in the direction of cashless payments and electronic wallets. We analyzed the load of the electronic payments system of Ukraine for the period from 2010 to 2020. They analyzed the performance indicators of the NBU electronic payment system and the amount of transfer payments within Ukraine.

A. Ali & A. Salameh (2023) investigated various aspects of the payment and settlement system. We found negative trends in traditional payment systems and

calculations in Saudi Arabia. We analyzed the dissatisfaction of users of payments and settlements with such elements as different payment sizes and tracking.

MATERIALS AND METHODS

In the research process, general logical methods and methods of cognition were used, including: empirical and theoretical levels of cognition. When applying the empirical level, the following research tools were used: description, classification, observation, comparison, modeling and forecasting.

The description and classification method were used to identify and classify innovative digital technologies and tools used in banking institutions and their general trends. Thanks to the method of observation, the integration of innovative technologies into the banking and financial systems, which have an impact and cause positive and negative trends in the systems, were investigated. The method of comparison was comparing the results before and after the introduction and use of innovative technologies in the banking and financial systems. Modeling and forecasting for the study of further prospects and threats from the active implementation and use of innovative technologies in the financial and banking sphere based on the experience of foreign countries, such as: Saudi Arabia, Indonesia.

Among the general logical methods and methods of theoretical knowledge, the following were used: analysis, synthesis and induction. The analysis carried out the distribution of the impact of innovative technologies with the help of SWOT analysis on strengths and weaknesses, as well as the identification of threats and opportunities for the activities of the banking sector. The weighting coefficient, which is the $W_c \times A_e$ indicator, was calculated by the ratio of such indicators as the weighting coefficient and the authors' evaluation. With the help of synthesis, a combination of the individual data obtained from the implementation of the implementation of innovative digital technologies into a single whole was carried out. Through the method of induction, the results were summarized based on the observation of the application of financial innovations in other countries and the generalization of the conclusion about the nature of the use of these technologies and their impact on the economy of Ukraine.

In order to interpret the research results, the following stages of the research process were used:

1. The research is a search and description of innovative digitization processes, as well as innovative technologies and their impact on the banking and financial sector of the Ukrainian economy.

2. Research algorithm, in which a plan of measures for the application of innovative technologies in the banking sector of Ukraine was carried out, in particular: a set of

scientific research methods was selected, which included empirical, theoretical and general-logical methods and techniques of cognition in order to study the impact of innovative technologies on the banking and financial sector; a sampling strategy was formed, which involved researching the problem of the impact of innovative technologies and determining their threats and weaknesses in the financial sphere offered in the banking sector.

3. Data collection, their analysis and interpretation regarding regulatory support, the practice of using innovative technologies in the banking sector, the availability of digital literacy of the main users of the bank, the creation of digital infrastructure at the state level, for the purpose of formulating a conclusion, as well as preparing a scientific article.

Among the materials used in this article, the information base of legislative and regulatory acts Law of Ukraine No. 40-IV "On Innovative Activity" (2002), which reveals the essence of innovative activity and regulates the process of innovative activity under the influence of digitalization in Ukraine.

The study used graphs of the load of the electronic payments system in Ukraine by the number of initial payments and the amount of initial payments, charts of the total volume of payments, million pieces, processed in the electronic payments system, and the total amount of payments, trillion UAH, processed in the electronic payment system payments, as well as involved banking institutions in using the electronic payment system in their payment system, such as: JSC CB "Privat Bank", JSC "Oshchadbank", JSC "Raiffeisen Bank Aval" and others (Report on the compliance..., 2020).

Information from the experience of Saudi Arabia and Indonesia with the active use of electronic wallets in their financial system was studied from the scientific activity of Ukrainian authors (Tovkun & Akhmedova, 2020), as well as the strengths and weaknesses of the use of electronic wallets in the banking system of Ukraine were studied (Yarosh & Romanovska, 2017).

Regarding the study of the technology of the electronic palm vein scanner and the use of such scanners in practice for the purpose of researching prospects and threats, the materials of the Infocom website "Biometric personal identification system" (Biometric personal identification system, n.d.) were analyzed.

RESULTS AND DISCUSSION

According to the Law of Ukraine No. 40-IV "On Innovative Activity" (2002), the term "Innovative activity" means activity aimed at the use and commercialization of the results of scientific research and development and leads to the release of new competitive goods and services to the market.

L. Avramchuk & I. Korkach (2019) noted that all civilized countries are trying to reduce the number of cash transactions and cash in circulation as much as possible. For this, central banks and governments apply a number of measures, one of which is settlement using payment systems with plastic cards (primarily domestic, as well as international).

V. Honcharuk (2019) noted that the digital economy is a relatively new concept in Western and Ukrainian literature, which has many understudied aspects and "white spots", in particular regarding the construction of its financial infrastructure. Therefore, the identification of the key components of the financial infrastructure of the digital economy is an urgent task for Ukraine, especially in the context of the strengthening of crisis tendencies in the global financial system.

In the era of digitization, a new trend that is gaining popularity is "Biometric identification". This technology was supported by the EU as a reliable identification of a person. Thus, in Ukraine there is a system "ManuScan", developed by the Sinfocom company, which is able to identify a person by scanning the pattern of veins in the palm. This method of identification is considered the most simple and reliable than such complex protection systems as scanning the retina or pupil of the eye (Biometric personal identification system, n.d.).

According to the Infocom website (Biometric personal identification system, n.d.), the scanner sensor illuminates the hand with safe infrared radiation, the system recognizes the palm vein pattern, which is unique to each person, even twins, and does not change throughout life, for greater safety is also monitored the presence of a pulse, and the system grants access to the premises or territory only to those whose vein pattern is entered into the identification system.

In the course of researching this technology, we will use SWOT analysis, the application of which for a banking institution is shown in Table 1.

Table 1. SWOT analysis of the application of the "ManuScan" system from Sinfocom for a banking institution

Strengths	Weighting coefficient (Wc)	Authors' evaluation (Ae)	Wc x Ae	Weaknesses	Weighting coefficient (Wc)	Authors' evaluation (Ae)	Wc x Ae
Accurate and fast identification of a person	0.3	6	1.8	Impossibility of application when the power grid is turned off in the region	0.4	9	3.6

Table 1, Continued

Strengths	Weighting coefficient (Wc)	Authors' evaluation (Ae)	Wc x Ae	Weaknesses	Weighting coefficient (Wc)	Authors' evaluation (Ae)	Wc x Ae
Hygienic application	0.4	7	2.8	High costs for the purchase of equipment	0.3	7	2.1
Stable performance under any weather and climatic conditions (from -25°C to +85°C)	0.3	6	1.8	Insufficient distribution for use in domestic banking institutions	0.3	7	2.1
Total:			6.4				7.8
Opportunities	Weighting coefficient (Wc)	Authors' evaluation (Ae)	Wc x Ae	Threats	Weighting coefficient (Wc)	Authors' evaluation (Ae)	Wc x Ae
Transition to a simplified identity verification system	0.3	7	2.1	The possibility of hacking	0.3	8	2.4
Integration into all access control systems	0.3	8	2.4	Replacing the identity verification system in banks	0.2	5	1.0
Triple encryption system	0.4	9	3.6	Collection and storage of information about a person for life	0.5	9	4.5
Total:			8.1				7.9

Source: authors' own development based on *Biometric personal identification system* (n.d.)

Having conducted a SWOT analysis of the Sinfocom ManuScan system for use in banking institutions, it was established that the sum of the products of the weighting coefficients and the authors' evaluations is dominated by opportunities, the total score of which was 8.1. Among the component possibilities, the following were considered: the transition to a simplified system of identity verification, which shows the development of innovative technologies and their further direction to simplify the identification of people; integration into all access control systems, which will provide an opportunity to monitor and check all employees of the banking institution; the triple encryption system significantly increases the chances of protecting data about all users, which is an essential point for consumers when using digital technologies.

In second place according to the total score, there are threats with 7.9 points. Among them, the greatest attention should be paid to the collection and storage of information about a person for life. And it is not surprising, because by leaving information in the global database, a person forever leaves behind a digital footprint. The replacement of the identity verification system in banks also plays a significant role for banking institutions, because the banking institution needs to replace the old system with a new one, which is quite a costly affair, and also the transformation of an already familiar technology into an as yet unknown (new, modern) one will take some time and require certain energy

and mental efforts of the bank's staff. The last factor – the possibility of hacking – will always be present, because no matter what the security system is, there is always a risk of its hacking.

Weaknesses in the use of technology scored 7.8 points. One of the weaknesses was the impossibility of using the technology when the power grid was turned off in the region, which is quite a common phenomenon today. Almost all technologies depend on the supply of electricity (and this problem has not yet been solved). The cost of purchasing equipment is also the main drawback, because for each computer that will be part of this system, it is necessary to purchase its own scanner. However, it is important that cheap scanners are not durable and have a high error rate, which requires the purchase of more reliable and therefore more expensive ones. Insufficient prevalence for Ukrainian banking institutions is still in the position of weaknesses. However, with the speed of development of new technologies, we believe this will not last long.

Among the strengths that received the lowest number of points (6.4), the accuracy and speed of operations deserve special attention, which essentially simplifies ordering for consumers in the online store and work in rather harsh conditions. Such a factor as hygiene ensures contactless application of the technology, while the user does not even need to touch the scanner, which is very important during the coronavirus pandemic.

M. Chuprina & T. Lazorenko (2021) noted that this technological and innovative system is currently used mainly in homes, but in the future they plan to use it widely in banking institutions as well.

The next innovative technology in the banking sector is digital wallets based on the electronic payment system. Today, electronic payment systems are mostly taken care of by the banking sector. The implementation of such systems by the National Bank of Ukraine made it possible to quickly reduce the number of intrabank and interbank payments. When making a payment in an online store, most consumers do not want to leave their data on sites and applications for each individual purchase. This problem was solved by creating digital wallets. Thus, the user does not need to enter his card data every time when paying for any goods or services on the website of the online store. Masterpass wallet allows you to use any bank card: MasterCard, Visa. This technology is supported by most banks, because making a payment from your card to such a wallet (or vice versa) creates electronic money circulation (Masterpass wallet..., n.d.).

Saudi Arabia has foreign experience in using electronic wallets with their "Sadad" payment system. Statistics showed that in 2007, payments amounted to 43,513,397 payments, of which 43.39% were through the Sadad system itself, and 56.61% were through others. However, already in 2021, the indicators amounted to 311,568,408 payments, among which

94.09% were through the "Sadad" system, and 5.91% were through other systems. This example shows that the number of payments not only increases absolutely, but also proportionally. A negative trend is observed in the traditional payment and settlement system, i.e. payments and settlements using personal and commercial checks, as well as interbank commercial checks 2012-2021. Mada and E-payment (SADAD and SARIE) are the largest sources of online payments, while POS is the fastest growing means of payment and settlement in Saudi Arabia. The contribution of traditional means of payment and settlement is insignificant and tends to decrease. Most of the customers who use online payment and settlement services are satisfied with different sizes (Ali & Salameh, 2023).

Currently, the banking industry is one of the demonstrative examples of rapid digital development. It should be noted that the leaders of the banking sector pay considerable attention to IT development services – digital factories are emerging. Thus, one of Canada's largest banks, the Bank of Nova Scotia, or Scotiabank, recently announced the development of a new digital factory project that will create and implement digital innovations and solutions for the bank's clients (Malakhova, 2019).

In order to investigate the expediency of using the electronic wallet system in a banking institution, we will compile a SWOT analysis (Table 2).

Table 2. SWOT analysis of the application of the electronic wallet system in a banking institution

Strengths	Weighting coefficient (Wc)	Authors' evaluation (Ae)	Wc x Ae	Weaknesses	Weighting coefficient (Wc)	Authors' evaluation (Ae)	Wc x Ae
Speed of operations	0.3	9	2.7	This platform is not supported by some organizations	0.3	7	22.1
Conduct operations anywhere	0.4	9	33.6	Impossibility of access when the power supply is turned off	0.4	8	33.2
Carrying out operations around the clock in 24/7 mode	0.3	9	2.7	Insecurity of electronic account from blocking	0.3	8	22.4
Total:			9.0				77.7
Opportunities	Weighting coefficient (Wc)	Authors' evaluation (Ae)	Wc x Ae	Threats	Weighting coefficient (Wc)	Authors' evaluation (Ae)	Wc x Ae
Saving time for transactions	0.4	9	33.6	Presence of hacker and virus attacks	0.4	9	33.6
The possibility of carrying out operations abroad	0.3	6	11.8	Charging a higher commission	0.3	6	11.8

Table 2, Continued

Opportunities	Weighting coefficient (Wc)	Authors' evaluation (Ae)	Wc x Ae	Threats	Weighting coefficient (Wc)	Authors' evaluation (Ae)	Wc x Ae
The possibility of receiving additional funds	0.3	6	11.8	Gradual replacement of paper money	0.3	8	22.4
Total:			77.2				77.8

Source: authors' own development based on V.I. Yarosh & Yu.A. Romanovska (2017)

Having conducted a SWOT analysis of the application of the electronic wallet system in a banking institution, the weaknesses and strengths of this system in Ukrainian banking institutions were investigated. Yes, strengths have the highest rating – 9 points. An important component here is the implementation of operations in any place, which is a priority for consumers of this service today. After all, there is no need to stand in line or even leave the house, it is enough to have a mobile phone with Internet access nearby.

The next components that scored the same number of points are the speed of transactions and 24/7 access. These components are important for banks and no less important for consumers, which affects their choice, and ultimately affects the competitiveness of a banking institution both on the national and global financial markets.

Threats have the second highest overall score – 7.8 points. Among the threats with the highest rating (3.6 points) are hacker and virus attacks. Since electronic wallets involve the storage and circulation of electronic money, it is extremely important to ensure reliable protection of these systems, both for individual consumers and for the country's economy as a whole. The increase in protection systems affects the increase in the interest of customers in electronic wallets – this is an obvious fact.

However, another threat posed by the electronic wallet system is exclusion from the system of circulation of paper money. Electronic money is becoming more and more popular in the financial market not only because of its convenience, but also because of its

environmental friendliness. Environmental safety implies the need to save paper (and forests on the planet). The only thing that can prevent the complete disappearance of paper forms of money from circulation is the replacement of natural paper with artificial paper.

Among the weaknesses, which have a total score of 7.7 points, such main components can be identified as: the lack of protection of the electronic account against blocking and the impossibility of access when the power supply is turned off, which is a rather significant and everyday drawback for such electronic technology, which so far cannot be avoided, but can be minimized.

This type of payment system is included in "Electronic payment systems" (SEP). Today, this system belongs to banking institutions. According to the report of the National Bank of Ukraine, the workload of SEP in 2010-2021 steadily increased (Report on the compliance..., 2020), which can be seen in Figure 1.

It was established that during the researched period, the number and amount of initial payments increased every year. And although the amount of payments tended to decrease in the period 2013-2015, it later increased and amounted to UAH 65 trillion by the end of 2021 (Report on the compliance..., 2020).

As for the number of initial payments, it grew steadily throughout the studied period, and by the end of 2021 it already amounted to more than 400 million units. (Report on the compliance..., 2020). These indicators testify to the incredibly effective growth of SEP in the banking sector of Ukraine (Fig. 2).

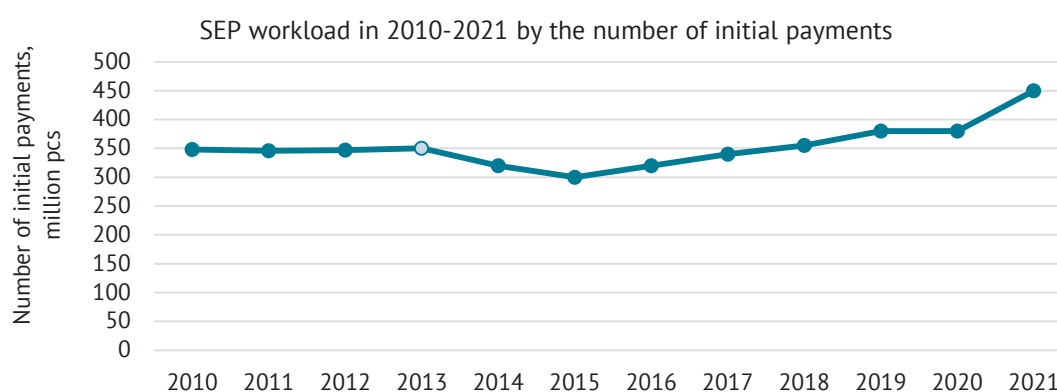


Figure 1. SEP workload in 2010-2021 by the number of initial payments

Source: developed by the authors based on research Electronic payment system... (2021)

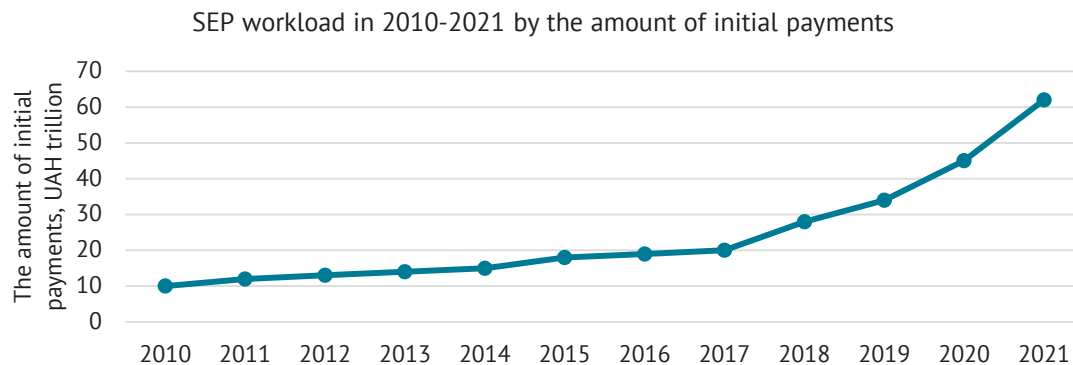


Figure 2. SEP workload in 2010-2021 by the amount of initial payments

Source: developed by the authors based on research *Electronic payment system...* (2021)

According to the NBU report (Report on compliance..., 2020), in 2020, SEP processed 385.3 million initial payments in the amount of UAH 44.8 trillion, which is 0.4% more in number and 38.1% in amount, than in the previous year, in general, in 2020, SEP processed an average of 1.5 million payments in the amount of UAH 178.6 billion per day (Report on the compliance..., 2020).

It was established that the total volume of payments had a growing pace and reached its maximum value in 2020, which is due to the introduction and flourishing of innovative technologies. Thus, the indicators were calculated among the five largest SEP participants (by payment amount) (Report on the compliance..., 2020):

1. National Bank of Ukraine – 25.9% of the amount of payments;
2. State Treasury Service of Ukraine – 7.4% of the amount of payments;
3. JSC CB “PrivatBANK” – 7.1% of the amount of payments;
4. JSC “Oschadbank” – 6.0% of the amount of payments;
5. Raiffeisen Bank Aval JSC – 5.5% of the amount of payments.

So, three banks (JSC CB “PrivatBANK”, JSC “Oschadbank”, JSC “Raiffeisen Bank Aval”) in 2020 showed the greatest result and were at that time leading and recognized, because they actively implemented innovative methods of payments

Having conducted an analysis of the total volume and amount of payments processed in the SEP for 2016-2020, it is possible to conclude that these indicators increased during the period under study. Whereas in 2016, the indicator of the total volume of payments was 313 million units, while in 2020 this indicator was 385 million units, which shows a significant increase in the number of payments made in the SEP and their growth. However, in 2019, during the pandemic, there was a significant increase in the number of payments (Fig. 3).

Thus, the total amount of payments in trillions of hryvnias processed in the SEP in the 2016-2020 period also had a significant growth. In 2016, this figure was 20 trillion UAH, and in 2020 it will be 45 trillion UAH, twice. Thus, in 2019, during the pandemic, a significant upward trend is also observed. Therefore, the general trend is to increase the number and amount of payments through SEP, and therefore to give preference to SEP clients (Fig. 4).

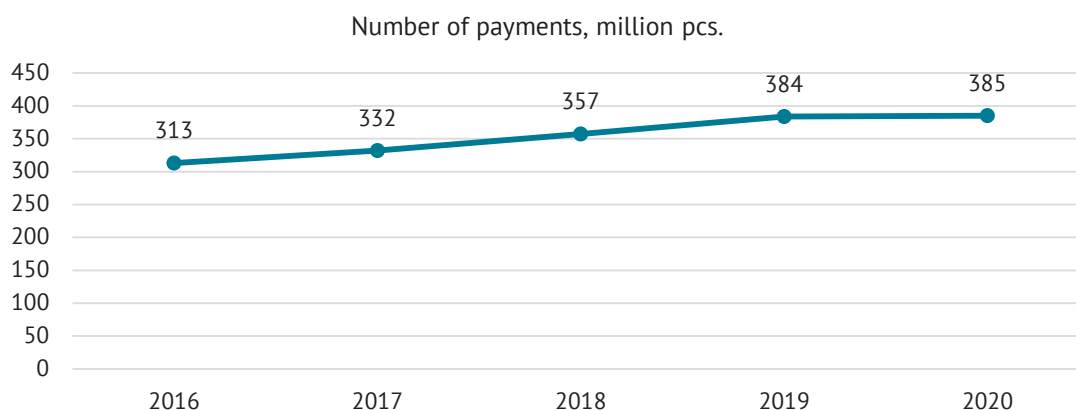


Figure 3. Total volume of payments, million pcs. processed in SEP 2016-2020

Source: developed by the authors based on research *Report on the compliance...* (2020)

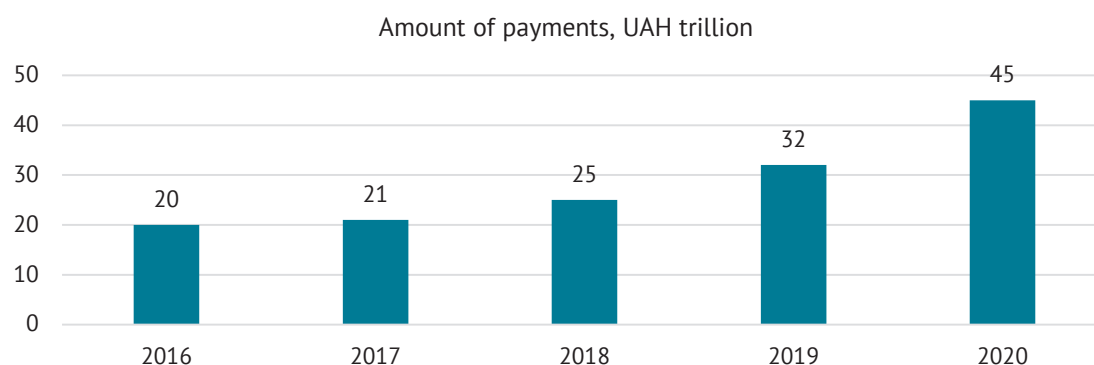


Figure 4. Total amount of payments, UAH trillion, processed in SEP 2016-2020

Source: developed by the authors based on research Report on the compliance... (2020)

For a more qualitative study of the use of the electronic payment system, a SWOT analysis was used to identify strengths and weaknesses, opportunities and threats (Table 3).

Having studied the strengths and weaknesses of the use of the electronic payment system with the help of a SWOT analysis, it was established that the overall score is dominated by threats (8.7 points). Among the listed threats, special attention is paid to the gradual replacement of paper money in the

financial market and the bankruptcy of one or more payment service providers. Since the SEP affects the general method of payments, it is capable of creating a global economic revolution, displacing paper forms of money from the financial market. And such a risk as the bankruptcy of payment system providers can shake the implementation of financial transactions and cause negative consequences for the entire payment system. The next place was taken by strengths (total score was 8.4 points).

Table 3. SWOT analysis of the use of the electronic payment system in the banking sector of Ukraine

Strengths	Weighting coefficient (Wc)	Authors' evaluation (Ae)	Wc x Ae	Weaknesses	Weighting coefficient (Wc)	Authors' evaluation (Ae)	Wc x Ae
Ensuring continuity of payments	0.3	8	22.4	Impossibility of access when the power supply is turned off	0.3	7	22.1
Use of a new cryptographic information protection system	0.4	9	33.6	Emergency events	0.3	8	22.4
Conducting operations 24/7	0.3	8	22.4	Quite a significant volume of operations	0.4	9	33.6
Total:			88.4				88.1
Opportunities	Weighting coefficient (Wc)	Authors' evaluation (Ae)	Wc x Ae	Threats	Weighting coefficient (Wc)	Authors' evaluation (Ae)	Wc x Ae
Creation of prerequisites for transparent interaction of payment systems and remote service systems	0.4	8	3.2	Carrying out hacker and virus attacks	0.3	9	2.7
Carrying out operations abroad	0.3	7	2.1	Gradual replacement of paper money in the financial market	0.4	9	3.6
Verification of SEP participants by the Paying Organization.	0.3	9	2.7	Bankruptcy of one or more payment service providers	0.3	8	2.4
Total:			8.0				8.7

Source: developed by the authors based on research Report on the compliance... (2020)

Among the important components of strengths is the use of a new cryptographic information protection system (3.6 points). This protection system provides for the transformation of information data into a form inaccessible for understanding and transmission. However, like any security system that can be hacked, this system has the same risk, but to break it requires methods based on complex quantum solutions, which makes it difficult for hackers.

Regarding the weaknesses (the total score is 8.1), it should be noted that 3.6 points is taken here by a fairly significant volume of transactions, which is explained by the increase in the number of transactions between participants, and this can affect the implementation of errors when the system is loaded.

Extraordinary events, which are another weakness, include unplanned situations: natural disasters or power outages, which can make it impossible to access payment transactions.

Among the opportunities (total score – 8 points), the main ones are the creation of prerequisites for transparent interaction of payment systems and remote customer service systems, because in the innovative period, remote service is a convenient and more effective way to which almost all users of payment systems switch. Such a factor as verification of SEP participants by the Payment Organization allows to constantly monitor and prevent the possibility of hacking and suspicious transactions, which minimizes risks.

The banking system is an extremely powerful transformer of savings into investments. The implementation of scientific achievements and inventions in the organization of banking services ensures the constant improvement of banking products and applied technologies of customer service. That is why the study of problems related to the innovative activities of domestic banks is extremely relevant (Yashchenko, 2019).

Of course, there are still threats to the use of this system, but the strengths and opportunities are becoming increasingly important over time. Progress does not stand still, it moves rapidly and, in our opinion, will lead to the replacement of paper money with electronic money with a quantum protection system. At the same time, the possibility of hacking will practically disappear, but under the condition that these protection systems will work only within the banking sector.

The authors of the article investigated the security of payment systems, thereby creating public trust in electronic payment systems. It is thanks to digital innovations that dynamic changes are taking place in the business environment, where the process of transition from cash transactions to electronic transactions is ongoing, however, S. Fatonah *et al.* (2018) argued that building public trust in electronic payment systems can

influence the future of electronic payment systems. The introduction of electronic payment system was not introduced to replace cash, but as a better alternative to cash and trade barter, because electronic payment system is an important aspect of electronic commerce. Other methods are strongly recommended for future research to collect data, improving and generating latent problem solutions for several issues, especially those related to future electronics.

The research conducted showed that the introduction and use of electronic wallets brought positive changes in the transaction activity in the population communities, but T. Handayani & A. Novitasari (2020) argued that the development of transactions is currently quite fast, comparing with the development of technology and information. Digital wallets are used not only in cities, but also in other regions, which ensures the convenience of transactions for all users, regardless of their location. The number of users of digital wallets is increasing over time, parallel to the number of smartphone users, which is one of the various aspects that are driving the growth in the use of digital wallets. Based on this, the use of digital wallets will increase with the development of electronic systems based on the web network, which are becoming more and more complex every year. In this way, countries will be able to make a financial transition from conventional banking operations using cash to electronic banking operations.

The authors of the article came to the conclusion that the further development of the electronic payment system contributes to the negative trend in settlements using personal and commercial checks, as well as interbank commercial checks, and later their gradual withdrawal from the financial and banking markets, however, A. Ali & A. Salameh (2023) argued about the gradual replacement of registered commercial checks and interbank commercial checks by electronic payment systems. They also investigated customer satisfaction with online payment and settlement services, as they primarily care about security, which is the main factor and the main factors for ensuring customer satisfaction in the payment and settlement system, the fear of hacking bank websites, the security of all transactions and the confidentiality of customer interest, as the disclosure of the source of income, the lack of a standard format for transferring funds, the complexity of tracking transactions and the lack of a systematic process to learn about transfers from other parties creates a low traceability of the payment system. Therefore, all variables in the banking system are to increase the security and tracking of payments and settlements. One of the main negative trends in the use of electronic and settlement systems was the excessive cost of transactions in Sadiivska Arabia.

The article states that today's banking sector has already undergone radical changes under the influence of digitalization, but I. Kochuma (2021) argued that the development of the digital transformation process is caused on the one hand by customers who are increasingly using digital innovations to provide banking services, and on the other other use of such innovative technologies on the part of the bank allows to create fundamentally new banking products and services, attracting modern fintech companies that are actively entering the financial services market today. The interaction of such systems will lead to non-standard and effective development of innovative banking business models.

The authors of the article analyzed the trend of development and implementation of the electronic payment system, their strengths and weaknesses, as well as threats and opportunities, but, L. Avramchuk & I. Korkach (2018) argued that in order to develop and implement measures to improve money circulation through massive non-cash payments and reduce the share of cash settlements, it is necessary to create a transparent financial system and attract significant financial resources through the banking system.

The authors of the article investigated that the introduction of digital technologies created the conditions for virtual conduct of real business, instead of M. Chuprina & T. Lazorenko (2021) argued that the introduction of innovative lending technologies in the field of Internet commerce was carried out due to the increase in the provision of a package of Internet services in the banking and financial system.

The study showed that for the successful further development of electronic payment systems in Ukraine, it is necessary to take into account the modern requirements and experience of developed countries in this field, however, L. Tovkun & A. Akhmedova (2020) argued that changes should be made to Ukrainian legislation that would allow not only banks to issue electronic money, which would contribute to ending the monopoly in this field and increasing competition and effective regulation of the electronic money market. In addition, the NBU should develop a provision that would define a list of requirements and criteria that the issuing company must meet, which in turn would be a model for such institutions, which should be ready for such a process both technically and organizationally.

The authors of the article investigated the positive and negative advantages of using electronic wallets in Ukraine, but, C. Okonkwo *et al.* (2023) investigated the main factors that influence the adoption and performance of e-wallets based on theories of innovation diffusion, technology adoption model and information systems success, from 631 Cameroonian e-wallet users,

using Cameroon, a Central African country, as the case study. Among the main five factors that are positive for the population from the use of electronic wallets are: relative advantage, utility, quality of information, quality of system and quality of service. It was found that ease of use does not significantly affect the use of an e-wallet.

CONCLUSIONS

By conducting research on digital innovations such as: Sinfocom's ManuScan system – an electronic scanner, electronic payment systems and electronic wallets, the strengths and weaknesses, as well as the opportunities and threats of these systems were identified. In the "ManuScan" system, the category of possibilities prevails over all others, in which the triple encryption system, which is the main feature of this technology – the protection of data and all information about users, is the most highly rated. The next category was threats, where the collection and storage of information about a person for life became important. However, today all innovative technologies are used for the purpose of collecting information and offering the user requests to search the Internet or to protect his data. However, for banking and financial institutions, the advantages will be the quality and security capabilities of the system to ensure that their data is reliably protected.

The e-wallet system has many strengths, such as making transactions anywhere. Today, for users of the Internet, the advantage in choosing a digital innovation will be accessibility from any point, which ensures the speed of operations. Therefore, this technology has an advantage in the choice for the population in making payments.

In the system of electronic payments, the biggest threat is the gradual replacement of paper money on the financial market, which ensures the transition of the country to electronic currency. And during a power outage, it is generally impossible to access electronic money.

The total volumes and amounts of payments through the SEP in the periods of 2016-2020 were analyzed and an upward trend was revealed. Consequently, the population of Ukraine increasingly prefers to make payments through SEP, which facilitates the process of making payments. It became especially relevant during the pandemic, when there was a significant growth of electronic systems and technologies for making online payments.

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CONFLICT OF INTEREST

None.

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Інноваційні технології у банківському секторі України в період цифровізації

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Анотація. На сьогодні міжбанківська конкуренція набуває наростаючого характеру, тому впровадження та розвиток інноваційних технологій у наданні банківськими послугами набуває особливої актуальності. Крім того, удосконалення інноваційних технологій в банківській сфері забезпечить ефективну діяльність банківської системи та підвищення рівня економіки України, шляхом збільшення інноваційних шляхів здійснення фінансових операцій. Мета полягає у дослідженні перспектив інтеграції фінансових технологій у банківський сектор, визначенні сильних та слабких сторін, а також загроз та можливостей впливу даних технологій у банківській галузі. Теоретико-методологічну основу статті становлять праці українських науковців із питань впровадження банківських інновацій та фінансових технологій. В процесі дослідження було використано емпіричні та теоретично-оглядові методи дослідження, що дало змогу розкрити сутність поняття інноваційна діяльність та інноваційні технології. Здійснено аналіз сучасних перспективних інноваційних технологій в Україні, та у світі. За допомогою SWOT-аналізу було досліджено сильні та слабкі сторони інноваційних технологій, таких як: ManuScan, електронні гаманці, електронні системи платежу. Особливу увагу було приділено категорії загроз таких інноваційних технологій, як хакерські та вірусні атаки, оскільки ці інноваційні технології використовуються в банківській та фінансовій системі на державному рівні. Проаналізовано інноваційні технології як повне нововведення змін у діяльність фінансової сфери України з цілю покращення використання банківської та фінансової сфери України, підвищення грошових операцій як на території України, так і за її межами. Розглянуто діяльність банківських установ з використанням новітніх, вдосконалених фінансових продуктів і послуг. Практична цінність дослідження полягає в тому, що воно може стати базою у досягненні стабільного та ефективного функціонування банків у майбутньому, а також надати рекомендації по впровадженню новітніх систем електронних платежів, які на сьогодні набирають популярності

Ключові слова: сканер сітківки або зіниці ока; банківські послуги; фінтех; електронні гаманці; система електронних платежів

Analysis of long-term dynamics of reproductive characteristics of sows of the large white breed

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Abstract. In the field of pig breeding, the main goal is to increase the level of fertility and survival of piglets in order to maximize the size of the nest both at birth and at weaning per sow per year. The purpose of this study was to determine the features of the long-term dynamics of the main reproductive features of sows of the large white breed using time series analysis, as well as the role of climatic factors (primarily, temperature) in the manifestation of these dynamics. For the analysis, we used primary data on sows of the large white breed, which were kept in the conditions of Tavriyski svini LLC (Skadovsky district, Kherson region, Ukraine) during 2007-2017. The presence of a trend was determined using the Spearman rank correlation coefficient. In addition, autocorrelation coefficients were estimated for lags from 1 to 45 months. to detect the presence and duration of cycles. It was established that during the research period there was a negative trend in relation to the total number of piglets at birth and, conversely, a positive trend in relation to the average weight of one piglet at birth and weaning. In addition, pronounced cyclicity of changes was revealed for the time series of the average weight of one piglet at birth and the average weight of one piglet at weaning. It was established that a higher temperature in the winter months led to a decrease in the average weight of one piglet at birth, but contributed to an increase in the number of piglets at weaning. Significant temperature deviations from the optimum (in either direction) in March-May led to a decrease in the fertility of sows due to an increase in the number and proportion of stillborn piglets in the nest.

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Finally, higher summer temperatures contributed to an increase in the number of stillborn piglets, and there was a tendency for the mean birth weight of one piglet to decrease with increasing air temperatures in summer. Thus, the role of three processes was established in the formation of features of long-term dynamics of reproductive characteristics of sows: a) long-term trend; b) cyclic processes; c) random seasonal fluctuations associated with the reaction of animals to heat stress

Keywords: trend; cycle; nest size; live weight of piglets at birth and weaning; heat stress

INTRODUCTION

Since the beginning of the 1990s, the main goal of the pig industry has been to increase the reproductive performance of sows (primarily, the level of multiple fertility) in order to maximize the size of the litter both at birth and at weaning per sow per year (Biermann *et al.*, 2014). At the same time, it has been repeatedly proven that the reproductive characteristics of sows are significantly influenced by environmental factors, such as air temperature (Tantasuparuk *et al.*, 2000; Suriyasomboon *et al.*, 2006; Amavizca-Nazar *et al.*, 2019), relative air humidity and temperature-humidity index (THI) (Suriyasomboon *et al.*, 2006; Tummaruk *et al.*, 2010), photoperiod (Chokoe & Siebrits, 2009), season of the year (Tantasuparuk *et al.*, 2000; Tummaruk *et al.*, 2010) etc.

High temperatures play a particularly important role, since pigs are characterized by a low transpiration rate, which prevents their thermoregulation and maintenance of the temperature regime within the limits that ensure a normal level of productivity. Pigs use thermoregulation to maintain their body temperature within their thermal comfort zone (18°C to 20°C). Thus, if the ambient temperature exceeds 25°C, the animals will be subjected to heat stress (Wegner *et al.*, 2014).

According to (Tast *et al.*, 2002), in the body of pigs, with an increase in temperature, the synthesis of prolactin by the pituitary gland, which is necessary to increase the secretory activity of the corpora lutea, is inhibited approximately on the 30th day of puberty. This can cause interruption of the normal course of pregnancy and irregular sexual cycle of sows.

At the same time, the temperature regime and THI are reflected differently on the reproductive function of sows and the survival of piglets. Increasing the values of these indicators during mating had a positive effect on the fertility of sows, but similar conditions during farrowing, on the contrary, had negative consequences (Wegner *et al.*, 2014).

In addition, a probable joint effect of year and season of farrowing on the size of the nest and the total weight of the nest and individual piglets at birth and weaning was established (Ek *et al.*, 2016; Thiengpimol *et al.*, 2017). These results may indicate that it is not so much the calendar year or the calendar month of the year that is important, but the features of the climatic

characteristics of a certain farrowing year/season/month and, first of all, their deviation from the optimal value at which the reproductive functions of sows can be realized as much as possible.

On the other hand, non-random components of temporal variability (for example, trend and/or cycles) may manifest on different time scales exceeding one year. In this case, elements of time series analysis (TSA) may serve as the most suitable methods.

TSA has previously been used to create stochastic models for short-term prediction of milk production in dairy cows (Deluyker *et al.*, 1990) and ewes (Macciotta *et al.*, 2000). In addition, in the work of R.M. Lark *et al.* (1999) showed that TSA can be used to describe the pattern of milk yield variability in the first 48 days of lactation among healthy cows and animals with ketosis. And in the work of E.A. Goodall *et al.* (1993) based on TSA methods, a mathematical model was built for predicting the incidence of fasciolosis in cattle.

In the study of M. van Straten *et al.* (2008) quantified changes in daily body weight of high-yielding dairy cows during the first 120 days of lactation. As a result, the presence of 7-day and 21-day cycles of changes in live weight was revealed. At the same time, the connection between the latter and the activity of the ovaries suggests that they had a physiological origin and are also related to the estrous cycle.

Also, TSA has already been used repeatedly in pig breeding, for example, when analyzing the incidence of mycobacteriosis in pigs (Carpenter & Hird, 1986), echinococcosis (Adachi & Makita, 2017), ascariasis (Goodall *et al.*, 1991) and other diseases, including reproductive porcine respiratory syndrome (Arruda *et al.*, 2018). In addition, based on the analysis of sound signals using TSA, an automated online procedure for recognizing and localizing the sounds of a sick pig's cough was developed, which allowed early diagnosis of sick animals (Exadaktylos *et al.*, 2008). TSA was also used to analyze physiological processes in the body of pigs, for example, jaw movement and tissue deformation (Liu *et al.*, 2004).

Thus, the main goal of this study was to determine the features (presence of a trend and/or cyclicity) in the analysis of long-term dynamics of the main reproductive characteristics of sows of the large white breed

using TSA, as well as the role of climatic factors in the manifestation of these dynamics.

MATERIALS AND METHODS

For the analysis, primary data on sows of the large white breed (BBP) were used, which were kept in the conditions of "Tavriyski Swyni" LLC (Skadovsky district, Kherson region, Ukraine). In total, data on 860 farrowings from 312 sows during January 2007 – July 2017 were used.

The following reproductive traits were recorded for each farrowing: total number of piglets at birth (TNB), multiparity (NBA), number of stillborn piglets (NSB), proportion of stillborn piglets (FSB), average weight per piglet at birth (AWPB), number of piglets at birth weanings (NW), piglet mortality from birth to weaning (PWM) and average piglet weight at weaning (AWPW).

All sow farrowing dates were recoded using the year/month of farrowing (YMF Code) format, so a code of "1" was assigned to sows that farrowed during January 2007 and a code of "127" to sows that farrowed during July 2017

A trend in the ACP is considered a statistically probable increase (or, conversely, a decrease) of the characteristic under investigation during the time interval under consideration against the background of minor fluctuations caused by both endo- and exogenous factors. Changes in the magnitude of the characteristic during the time interval may, in addition, be not just random in nature, but contain a relatively regular alternation of increase and decrease. The autocorrelation coefficient (AR) is used to determine the presence of such cyclicity in the time series. The autocorrelation coefficient is an estimate of the pairwise correlation coefficient between the values of the original time series and the same values, but shifted by a certain number of time intervals (in this case, the single time interval was one month), which is called lag. If the estimate of the autocorrelation coefficient (for a certain lag k) is likely to exceed zero, it is assumed that the original time series and the same time series, but shifted by k time intervals, coincide, that is, cyclicity occurs (Wakchaure *et al.*, 2010).

The first important characteristic of the time series, for which the presence of non-random fluctuations is proven, is the first value of the lag, at which positive estimates of the AR coefficient gradually turn into negative estimates ($k1$). The values of $k1$ correspond to the moment when the time series moves from the zero value (that is, the arithmetic mean for all values of the time series) to the largest or, conversely, the smallest.

The second important characteristic of the time series is the first value of the lag, at which the lowest negative estimates of the AR coefficient ($k2$) are achieved. The value of $k2$ corresponds to the moment when the

time series passes through a complete cycle – from the zero value to the largest (or smallest) and again to zero. Thus, this value is equal to half the duration of a complete cycle (Chatfield, 2003).

The presence of a trend was determined using Spearman's rank correlation coefficient (R_s) for estimates calculated on the basis of the method of least squares (LSE – least squares estimates) of the main reproductive characteristics of BBP sows. The General Linear Model (GLM) was used to calculate LS-estimates:

$$Y_{ijk} = \mu + P_i + YMF\ Code_j + e_{ijk}, \quad (1)$$

where Y_{ijk} – a sign of reproduction; μ – the overall average value; P_i – the fixed effect of the i th farrowing ($i=1, 2, \dots, 10$); $YMF\ Code_j$ – fixed effect of the j th code "year/month of farrowing" ($j=1, 2, \dots, 127$); e_{ijk} – an error.

All calculations were performed using the "General Linear Model" module of the MINITAB Release 13.1 software package (MINITAB Inc. 2000).

For traits for which the null hypothesis regarding the absence of a trend was rejected with a significance level of $P < 0.05$, the LS-estimates calculated according to model (1) were subsequently adjusted (ie, detrended) using the formula:

$$LSE_{adj} = LSE - (a + b \cdot YMF\ Code), \quad (2)$$

where LSE_{adj} – the adjusted LS score; LSE – LS-estimate obtained on the basis of model (1); a, b – linear regression coefficients.

The presence of a non-random component of time series variability was assessed using estimates of autocorrelation coefficients for lags from 1 to 45 months, using the "Time Series Analysis" module of the STATISTICA v. application program package. 6.0 (StatSoft Inc.).

To explain the patterns of temporal variability of LS-estimates of the reproductive traits of the studied sows, three climate indicators were used for each calendar month of the year: average monthly air temperature (AMT), deviation from the long-term average temperature (DAT) and absolute deviation from the long-term average temperature (ADAT). All temperature values were obtained for the weather station located in the city of Kherson and were listed in the archive for the years 2007...2017 (Meteopost..., n.d.).

The influence of these climatic parameters on the variability of the reproductive traits of BVP sows was assessed using the Spearman rank correlation coefficient separately for each season of the year: winter (December-February), spring (March-May), summer (June-August) and autumn (September-November).

All procedures were carried out in accordance with the ethical considerations regarding the involvement of

animals according to the recommendations of ARRIVE (n.d.). The authors of this study assure compliance with all ethical standards in research involving animals.

RESULTS

Presence of a trend. Probable estimates of Spearman's rank correlation coefficient were found only for three reproductive traits of WBP sows, namely TNB ($R_s = -0.214$; $P = 0.016$), AWPB ($R_s = 0.607$; $P < 0.001$) and AWPW ($R_s = 0.345$; $P < 0.001$). Thus, there was a negative time trend for TNB and a positive time trend for AWPB and AWPW during the study period (ie, January 2007 to July 2017). Accordingly, only LS-adjusted scores (LSE_{adj}) of these traits calculated using formula (2) were used in further analysis.

Previously, in the work of Southwood & Kennedy (1991), a probable positive trend was established in

relation to NW (0.051 ± 0.021 piglets/year) of first-born piglets of the Landrace breed during 1977-1987. A probable, but negative trend was found when analyzing the signs of reproduction of BBP and Landrace sows on two farms in Nebraska (USA) during 1988-1994 – for NBA it was $0.09-0.11$ piglets, and for litter weight – $0.29...0.80$ kg in a 6-month period (ten Napel & Johnson, 1997).

In this study, LS scores for TNB decreased by 0.0085 ± 0.0035 piglets per month, i.e., by 0.10 piglets/year. For AWPB and AWPW, in contrast, LS estimates increased by 0.0032 ± 0.0004 and 0.0246 ± 0.0058 kg/month, respectively, that is, by 0.038 and 0.295 kg/year.

Presence of cyclicity. It was established that for TNB (detrended series) and PWM, the nature of the dynamics of the time series was characterized by a random alternation of positive and negative LS-estimates, which are completely stochastic in nature (Fig. 1; Fig. 2).

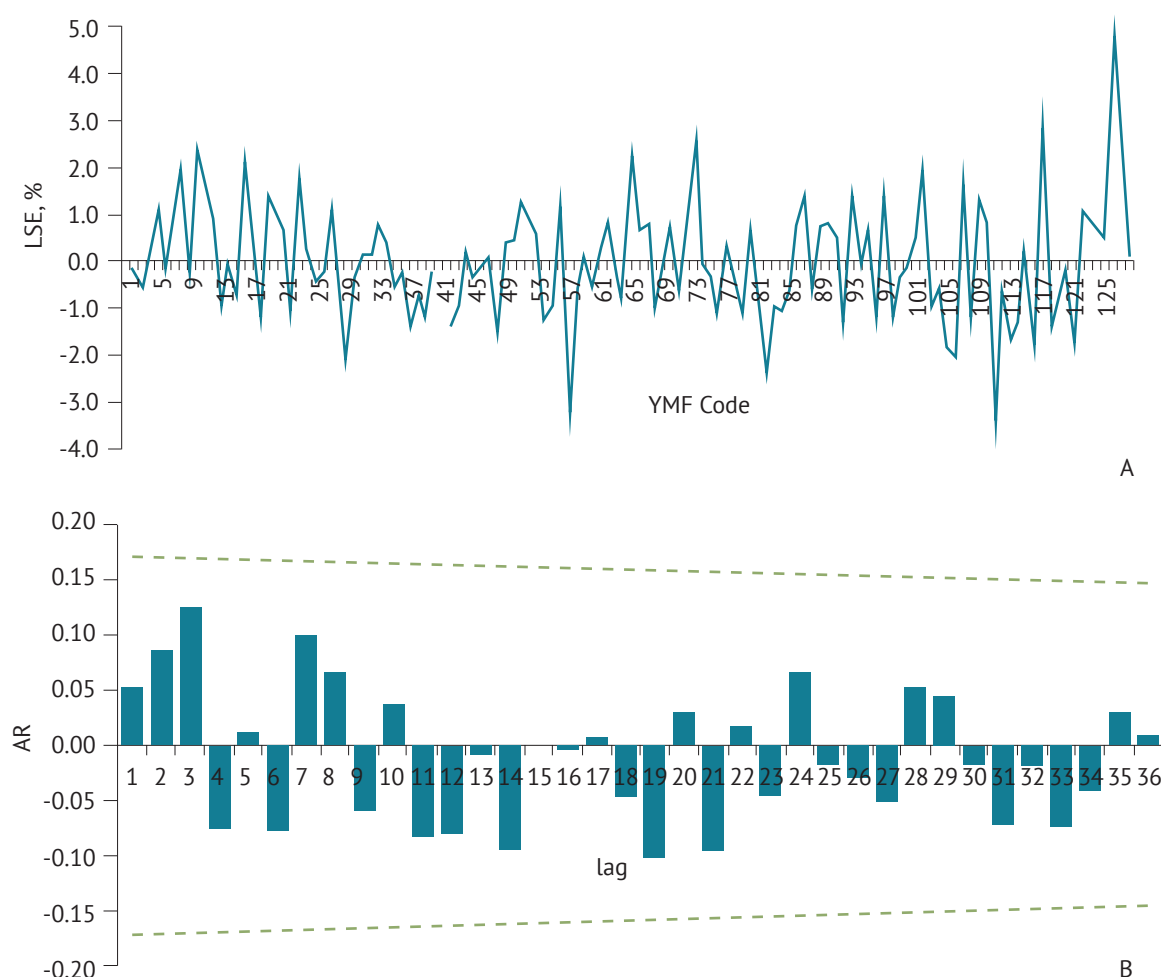


Figure 1. (A) Detrended time series of LS estimates of the total number of piglets at birth from January 2007 to July 2017; (B) Estimates of the autocorrelation coefficient (AR) of the LS estimates of the total number of piglets at birth

Notes: the dashed line marks the 95% confidence interval of the autocorrelation coefficient

Source: author's development

On the other hand, for AWPB and AWPW, the periods of increase and decrease of LS-estimates replaced each other with a certain regularity. For example, probable positive estimates of the autocorrelation coefficient for AWPB were noted for lags of 1...8, 10...12, and 15 months, while probable negative ones were found for lags of 30, 33, and 36 months. (Fig. 3A).

For the time series of LS estimates for AWPB, the value of k_1 was 21...23 months, and the value of k_2 was 41...42 months. (Fig. 3A). Thus, the time interval of a complete

cycle of increase and decrease of LS-estimates for AWPB was approximately 82...84 months, i.e., 6.8...7.0 years.

For AWPW, probable positive estimates of the autocorrelation coefficient were noted for lags of 1, 2, and 5 months, while probable negative ones were noted for lags of 16, 18, and 19 months. (Fig. 3B). Thus, estimates of k_1 and k_2 for this time series were 9 and 18 months, respectively. The time interval of a complete cycle of increase and decrease of LS-estimates for AWPW was approximately 36 months, that is, 3 years.

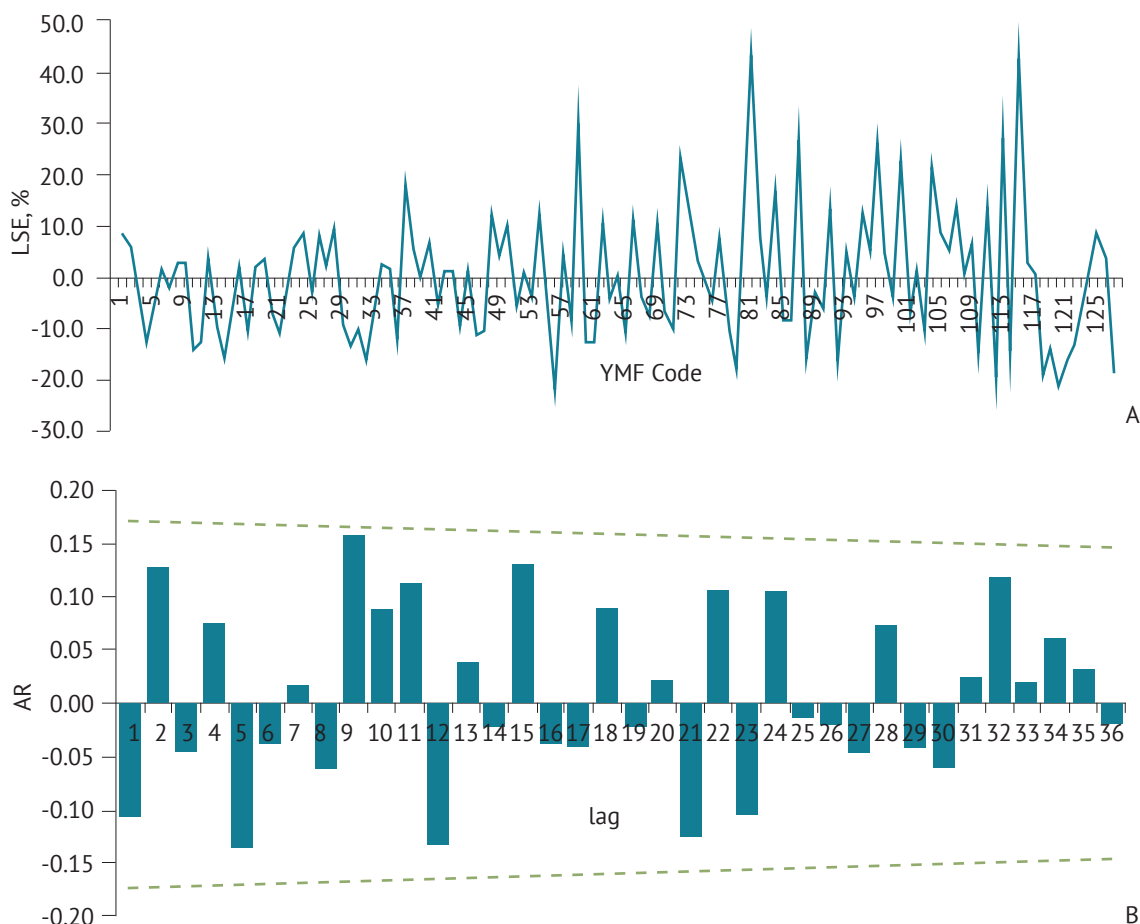


Figure 2. (A) Time series of LS estimates of piglet mortality from birth to weaning from January 2007 to July 2017; (B) Autocorrelation coefficient (AR) estimates of LS estimates of piglet mortality from birth to weaning

Notes: the dashed line marks the 95% confidence interval of the autocorrelation coefficient

Source: author's development

Similar, more or less pronounced fluctuations were previously noted in the analysis of temporal variability (in the format month/year of farrowing) of the main reproductive characteristics (abortion rate, TNB, NBA, NW) of crossbred sows BBP × Landrace (Scanlan *et al.*, 2019). For cattle, such cycles can take 5-7 years (Wakchaure *et al.*, 2011). For the rest of the signs that were included in the analysis (NBA, NSB,

FSB and NW), probable positive estimates of the autocorrelation coefficient were noted most often for very small lags (1-2 months), which may indicate the presence of a certain “inertia” of the formation mechanisms reproductive properties of BBP sows, the level of which can be maintained for another 1-2 months. after the influence of factors of endo- or exogenous nature on them.

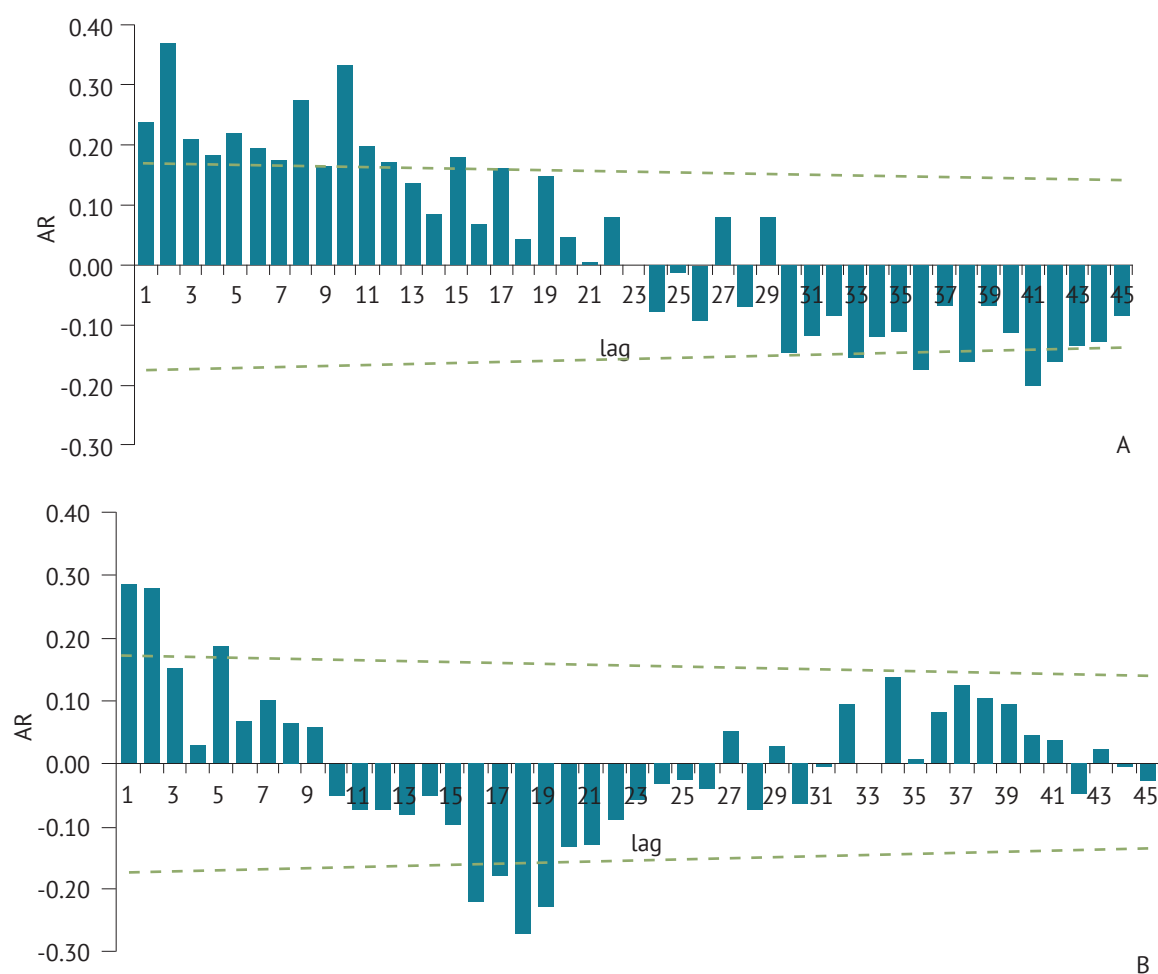


Figure 3. (A) Estimates of the autocorrelation coefficient (AR) of the detrended time series of LS-estimates of the average birth weight of one piglet; (B) Estimates of the autocorrelation coefficient (AR) of the detrended time series of LS estimates of the average weight of one piglet at weaning

Notes: the dashed line marks the 95% confidence interval of the autocorrelation coefficient

Source: author's development

On the other hand, short cycles correspond to the duration of the seasons of the year (during which meteorological characteristics are relatively constant), and thus environmental conditions (primarily air temperature) are able to influence the processes of formation of reproductive characteristics of sows.

Influence of air temperature. It was found that for farrowings in the winter months, there were probable relationships between the following parameters of temperature and reproductive traits of sows: AMT and AWPB ($R_s = -0.377$; $n = 32$; $P = 0.033$), DAT and AWPB ($R_s = -0.364$; $n = 32$; $P = 0.040$), AMT and NW ($R_s = 0.353$; $n = 32$; $P = 0.047$), DAT and NW ($R_s = 0.447$; $n = 32$; $P = 0.010$). Thus, a higher temperature in the winter months led to a decrease in the average weight of piglets at birth, but contributed to an increase in the size of the nest at weaning.

For farrowings in the spring months, a significant effect of ADAT was found on NBA ($R_s = -0.393$; $n = 31$; $P = 0.029$),

NSB ($R_s = 0.438$; $n = 31$; $P = 0.013$) and FSB ($R_s = 0.530$; $n = 31$; $P = 0.002$). Thus, significant temperature deviations from the optimum (in either direction) in March-May led to a decrease in the fertility of sows due to an increase in the number and share of stillborn piglets in the nest.

Finally, for farrowings during the summer months, a significant effect of AMT was found on NSB ($R_s = 0.380$; $n = 32$; $P = 0.032$) and AWPB ($R_s = -0.346$; $n = 32$; $P = 0.052$). Thus, a higher summer temperature contributed to an increase in the number of stillborn piglets, and, accordingly, there was a tendency for the average birth weight of piglets to decrease with increasing air temperature in summer. It is characteristic that, both in the winter months and in the summer, a significant increase in air temperature led to similar consequences – a decrease in the average weight of piglets at birth, which can be explained by the manifestation of heat stress of sows during farrowing.

DISCUSSION

In the study of Tantasuparuk *et al.* (2000) showed that air temperature in the first four weeks after mating of sows had a significant negative effect ($P < 0.001$) on their litter size at farrowing – the number of piglets born decreased by 0.07 piglets as the maximum temperature increased during this 4-week period by 1°C.

Similar regularities were found in the work of Suriyasomboon *et al.* (2006) – high temperature and relative air humidity had a negative effect on sow nest size indicators. These results are consistent with the results of an experimental study (Omtvedt *et al.*, 1971) in which it was shown that sows exposed to heat stress during late pregnancy gave birth to fewer live piglets and, accordingly, had more stillborn piglets in the litter than sows kept at a comfortable temperature.

High temperature, high relative humidity, and/or high THI during brooding significantly reduced the total number of piglets in the nest. At the same time, this negative effect was manifested to a greater extent among gilts than among adult sows (Tummaruk *et al.*, 2010).

Heat stress during the period from 7 days before successful insemination to 12 days after it had the greatest effect on the total number of piglets born. Therefore, the temperature regime during effective insemination of sows can be used as a reliable predictor of heat stress in commercial pig farms (Bloemhof *et al.*, 2013).

In the work of Wegner *et al.* (2014) found that high values of air temperature and THI before farrowing led to a decrease in sow fertility (NBA). On the other hand, increased temperature and THI values after farrowing were associated with more piglets at weaning (NW). Piglet birth-to-weaning mortality (PWM) decreased significantly with increasing temperature and THI values after farrowing ($P < 0.05$).

In the study of Brito *et al.* (2022) investigated the effect of heat waves (HW), defined as three consecutive days with ambient temperature $\geq 25^{\circ}\text{C}$ and THI > 74 , on reproductive traits in sows. It was found that sows that were exposed to significant heat waves during farrowing gave birth to more mummified and stillborn piglets than sows that reproduced under optimal conditions.

According to the recently published results of a meta-analysis (Guo *et al.*, 2018), conducted to identify the negative effects of heat stress on the reproductive functions of sows, it was established that heat stress, first of all, had a negative effect on the live weight gains of piglets

from birth to weaning, but was manifested to a lesser extent on nest sizes and live weight of piglets at birth.

CONCLUSIONS

It was established that during 2007-2017 there was a negative trend in relation to TNB and, conversely, a positive trend in relation to AWPB and AWPW. LS estimates during this period decreased by 0.10 piglets/year for TNB, while for AWPB and AWPW, on the contrary, they increased by 0.038 and 0.295 kg/year, respectively. In addition, a somewhat pronounced cyclical nature of changes was found for AWPB and AWPW. The time interval of a complete cycle of increase and decrease of LS-estimates for AWPB was 6.8...7.0 years, and for AWPW – 3 years.

It was established that a higher temperature in the winter months led to a decrease in the average weight of piglets at birth, but contributed to an increase in the size of the nest at weaning. Significant temperature deviations from the optimum (in either direction) in March-May led to a decrease in the fertility of sows due to an increase in the number and proportion of stillborn piglets in the nest. Finally, higher summer temperatures contributed to an increase in the number of stillborn piglets, and, accordingly, there was a tendency for the average piglet weight at birth to decrease with increasing air temperature in summer. It was noted that a significant increase in air temperature both in winter and summer led to similar consequences – to a decrease in the average weight of piglets at birth, which can be explained by the manifestation of heat stress in sows during farrowing.

Thus, the role of three processes has been established in the formation of the features of the long-term dynamics of the reproductive characteristics of BBP sows: a) a long-term trend; b) cyclic processes; c) random seasonal fluctuations associated with the reaction of animals to heat stress. To the greatest extent, all these processes were manifested in the average weight of piglets both at birth and at weaning.

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CONFLICT OF INTEREST

None.

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Аналіз багаторічної динаміки відтворювальних ознак свиноматок великої білої породи

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Анотація. В галузі свинарства головною метою є підвищення рівня багатоплідності та збереженості поросят для максимізації розмірів гнізда як при народженні, так і при відлученні в розрахунку на одну свиноматку за рік. Метою даного дослідження було визначення особливостей багаторічної динаміки головних ознак відтворення свиноматок великої білої породи за використання аналізу часових рядів, а також ролі кліматичних факторів (насамперед, температури) в прояві цієї динаміки. Для аналізу було використано первинні дані щодо свиноматок великої білої породи, які утримувалися в умовах ТОВ «Таврійські свині» (Скадовський район, Херсонська область, Україна) протягом 2007-2017 рр. Наявність тренду було визначено із використанням коефіцієнта рангової кореляції Спірмена. Крім того, було оцінено коефіцієнти автокореляції для лагів від 1 до 45 міс. для виявлення наявності та тривалості циклів. Встановлено, що протягом періоду дослідження мав місце негативний тренд у відношенні загальної кількості поросят при народженні та, навпаки, позитивний – у відношенні середньої маси одного поросяти при народженні та відлученні. Крім того, виявлено виражену циклічність змін для часових рядів середньої маси одного поросяти при народженні та середньої маси одного поросяти при відлученні. Встановлено, що більш висока температура в зимові місяці призводила до зниження середньої маси одного поросяти при народженні, проте сприяла підвищенню кількості поросят при відлученні. Значні відхилення температури від оптимальної (у будь-який бік) у березні-травні призводили до зниження багатоплідності свиноматок за рахунок підвищення кількості та частки мертвонароджених поросят у гнізді. Нарешті, більш висока літня температура сприяла підвищенню кількості мертвонароджених поросят і мала місце тенденція до зниження середньої маси одного поросяти при народженні при підвищенні температури повітря влітку. Таким чином, при формуванні особливостей багаторічної динаміки відтворювальних ознак свиноматок встановлено роль трьох процесів: а) довготривалого тренду; б) циклічних процесів; в) випадкових сезонних коливань, що пов'язані з реакцією тварин на тепловий стрес

Ключові слова: тренд; циклічність; розмір гнізда; жива маса поросят при народженні та відлученні; тепловий стрес

The role of creative industries in local economic development

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Abstract. Creative industries contribute to the use of the cultural and resource potential of the region (cultural traditions, historical and architectural heritage) and their direction for local economic development. The purpose of the article is to identify the trends in the development of creative industries in Ukraine, their role and significance for the tourism industry, and on this basis to justify the advantages of their synergistic connection to the local economic development of the Mykolaiv region. The research uses a set of scientific research methods of a general (analysis and synthesis, induction and deduction, abstraction, formalization) and special (content analysis, comparison, graphic) nature, which made it possible to reveal meaningful interpretations of regularities regarding the interpretation of the concepts of “creative industries” and “creative tourism”, as well as characterize the synergistic relationship between them. It was found that creative industries have a positive impact on the country's economy, in particular, the cultural sector accounts for 3.1% of the global gross domestic product, and cultural and creative industries provide almost 50 million jobs. It was established that Ukraine has a significant potential of creative industries, the value of which in the economy is constantly growing, so the export of creative industries accounts for 30% of the total. It has been established that Ukraine has a significant potential of creative industries, the value of which in the economy is constantly growing, so exports of creative industries account for 30% of the total. The scientific works of Ukrainian scientists, as well as scientists of other countries, on the influence of creative industries on the development of tourism were analyzed, as a result of which attention was focused on a number of advantages that can be combined into three groups: the tourism industry (a new unique tourist experience; expansion of the offer without any what additional investments; high-quality and sustainable tourism with high added value and purchasing power); community and population (diversification of the local economy; creative entrepreneurship; sustainable development of the territory; investment attractiveness; new forms of cooperation; improving the quality of life and well-being; social cohesion; community empowerment); the field of culture (positive influence on the development of cultural infrastructure; preservation and restoration of intangible cultural heritage; cooperation in the cultural sphere; formation of creative communities). It is the search for new and creative ways to develop the tourism sector (opening of domestic destinations, development of new routes and territory development projects) that will contribute to increasing the competitiveness of the tourism industry

Keywords: creativity; intangible cultural heritage; tourism; synergy; favorable economic environment; territorial communities

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INTRODUCTION

The modern development of society establishes new benchmarks and directions for successful management. The last decades of the 20th century were characterized by the intense impact of globalization on the world economy, while changes in the system of economic relations are now being observed in favor of the digital and creative economy thanks to innovations in the information and communication sphere and its creative interpretation. The so-called creative economy has also become the focus of socio-economic and political development of many countries of the world, and creative industries are a significant source of income for national economies. Based on these statements, the study of trends in the development of creative industries in Ukraine as a whole (including the Mykolaiv region) is essential for identifying such industries that have the potential to create added value, innovation, jobs and increase the welfare of society.

As N.D. Chala (2018) notes in her research "...nowadays there is an ongoing scientific discourse: what exactly will be the driver of economic growth, what industry will contribute to the recovery of the economy. Scientific schools based on the works of J. Schumpeter claim that high growth rates can be ensured only at the expense of innovative development. Scientific schools of evolutionary economics, in particular E. Reitner, claim that the country must gradually go through each stage of economic development, there can be no jumping over a step. Along with this, creative industries have recently been increasingly considered in the scientific discourse as a driver of economic development".

The new development paradigm links economy and culture, while it encompasses economic, cultural, technological and social aspects of development at both macro and micro levels. A key role in it is played by creativity, knowledge and access to information, which are powerful drivers of economic growth and development in a globalized world (Nikolaieva *et al.*, 2021). The concept of "creativity" appeared only in the 20th century. (it is believed that the term "creativity" in the economic sense was introduced into scientific circulation only in the mid-1990s, and reflected the generation of new ideas and their transformation into values, i.e. adding a utilitarian character to them) (Bezikovych *et al.*, 2007). The word "creativity" is associated with originality, imagination, inspiration and ingenuity. The combination of innovation and creativity contributed to the formation of the concept of "creative industries", as an industry that combines the creation, production and commercialization of creative contents, and therefore affects the formation of the revenue part of the budget, job creation, investment attractiveness, etc. (Levytska, 2022).

For the first time, the term "creative industries" was used in 1994 (Australia) with the publication of the Creative Nation report, and it gained more publicity in 1997, when the UK Department for Culture, Media and Sport created a working group on creative industries (UNCTAD, 2010).

The concept of "creative industries" can be defined as cycles of creation, production and distribution of goods and services that use creativity and intellectual capital as the main resources. They include a set of knowledge-based activities that produce tangible and intangible goods, intellectual or artistic services that are filled with creative content as well as economic values and meet market requirements. Over time, the creative industries have expanded their sphere of influence, namely from the arts to potentially commercial activities (UNCTAD, 2008).

The most modern is the classification of creative industries, the so-called model of the United Nations Conference on Trade and Development (UNCTAD), which includes four groups and nine subgroups of creative industries, in particular: cultural heritage, arts, media and functional creativity. Accordingly, the components of the first group, namely, elements of intangible cultural heritage and cultural, historical, and natural monuments are the connecting link between the creative industry and tourism.

There is a synergistic effect between creative industries and tourism (Richards, 2019; McKercher, 2020), i.e. a tourist consumes a significant amount of creative products (culture, art, etc.), and the creative economy, in turn, contributes to improving the image of the territory and attracting tourists (Šťastná *et al.*, 2020), and the combination of tourism and industrial production as a tourist destination will contribute to the emergence of a new innovative product (Ardhala *et al.*, 2016), the corresponding existing intangible heritage and creative industries can become a tourism asset for creative cities and contribute to their development (Arcos-Pumarola *et al.*, 2023).

World experience proves that cultural and creative industries make a significant contribution to the world economy. For example, the culture sector accounts for 3.1% of the global gross domestic product, and cultural and creative industries provide 6.2% of employment (almost 50 million jobs), although these are mainly young people and women aged 15-29, and the work is short-term and low-paid (UNCTAD, 2022). However, creative industries are one of the key areas of the 2023 Agenda (UNESCO, 2023).

The purpose of the article was to establish a synergistic effect from the interaction of creative industries and tourism, as well as to determine, on this basis, potential

directions of tourism development in the context of local economic development of the Mykolaiv region.

LITERATURE REVIEW

In order to qualitatively understand the concept of “creative industries”, it is advisable to make some conceptual statements about their essence. In his research, R.E. Caves (2003) examines the economics of art, focusing on how art is marketed and artists are compensated for their work. Researcher D. Throsby (2000) talks about the so-called model of concentric circles. His assumption is based on the fact that the cultural value of goods and services distinguishes these industries and places them closer to the center of cultural concentric circles. Creative ideas and influences flow outward through concentric circles in this model. The ratio of cultural and commercial content decreases as they are separated from the center.

The UK's Department for Culture, Media and Sport (2001) defines the creative industries as those “which originate in individual creativity, skill and talent and which have the potential to create wealth and jobs through the creation and exploitation of intellectual property”.

According to the definition of UNESCO, the concept of “creative industries” is interpreted as “the creation, production and commercialization of intangible meanings of a cultural nature (spiritual, material, intellectual and emotional features of society or a group of people), which include not only art, but also a way of life, value systems, traditions and beliefs (UNESCO, 2009).

N. Boccella & I. Salerno (2016) outlining the role of cultural industries and the creative economy as the main driving forces of economic growth and local development show how the interpretation of the essence of “creative industries” has changed from the beginning of the 80s to today. Initially, this term was applied to those forms of cultural production and consumption that have a symbolic center or an expressive element (music, art, fashion and design, media, craft production, etc.). Subsequently, it began to apply to a significant part of the production of goods and services produced by the cultural industries, depending on the introduced innovations.

The definition of creative industries as “a type of economic activity, the purpose of which is to create added value and jobs through cultural (artistic) and/or creative expression” is specified in Law of Ukraine No. 2778-VI “About culture” (2010). The list of creative industries was approved by Resolution of the Cabinet of Ministers of Ukraine No. 265 “On approval of types of economic activity that belong to creative industries” (2019), which includes: folk crafts, visual arts; performing arts; literature, publishing and printed media; audio art; audiovisual art; design, fashion, new media and information and communication technologies; digital

technologies in art; architecture and urbanism; advertising, marketing, public relations and other creative services; libraries, archives and museums. Based on the essence of the classification, it should be noted that creative industries are able to actively realize all the potential in the field of tourism or become a tool for its development. As practice shows, the realization of creativity in the tourism industry is already taking place (Nikolaieva *et al.*, 2021).

G. Richards (2019) emphasizes the mutual positive influence of culture and tourism. In his research, the author emphasizes the importance of creativity for the formation of the development strategy of cities and regions, since the growth of creative development prompted the latter to develop creative tourism strategies, which in turn contributed to the creation of tourist destinations based on their own material and non-material resources, and a creative approach. According to A. Ardhalia *et al.* (2016) the benefits of the interaction of culture and tourism are as follows: the application of additional innovations that will contribute to the development of new products in all areas, the creation of additional jobs and an increase in the level of employment in those areas that do not have significant tourism resources. A group of authors consider cultural tourism as a driving force for rural development with the aim of transforming a productive rural area, oriented to intensive agricultural production, into a non-productive rural area, oriented in turn to sustainable territorial consumption, as well as a source of additional activity that brings both economic, and non-economic benefits (Šťastná *et al.*, 2020).

J. Lee & H. Lee (2015) believe that today's tourists are no longer satisfied with conventional tourism, as they increasingly try to engage with local cultural and creative heritage, as well as local activities and lifestyles of local people. Therefore, in the near future, tourism will change from mass to creative.

MATERIALS AND METHODS

The theoretical basis of the research was the provisions and approaches regarding the essence of creative industries, their classification, which are set out in the reports of the UN Conference on Trade and Development (UNESCO, 2009; UNCTAD, 2010); scientific works of Ukrainian and foreign scientists on the topic of creative industries and their relationship with tourism.

In the context of the specified goal, the following methods of scientific research were used: general and special methods. In particular, among general logical methods, the following are highlighted: analysis and synthesis (regarding the study of the essence of the concept of “creative industries” and “creative tourism”); induction and deduction (investigation of interaction

and synergistic relationship between creative industries and tourism); abstraction (in order to highlight the essential features of the object under study); formalization (regarding the display of knowledge about objects in a sign-symbolic form). Accordingly, the group of methods of a special nature of the research consisted of: the method of content analysis (studying and processing of scientific works for the purpose of further meaningful interpretation of the revealed regularities regarding the interpretation of the concepts of “creative industries” and “creative tourism”); comparison and graphic (study of the dynamics of changes in indicators of economic evaluation of creative industries).

During the research, some general scientific methods were applied: historical and terminological (study of the essence of the concept of “creative industries” in chronological order, study of the influence of creative industries on the development of tourism); systemic (justification of the need for the development of creative industries as a factor in the development of the regional tourist market).

The research was based on open data, analytical and statistical reports, program documents of creative industries and tourism; the results of scientists' research; global information sources of the UN Conference on Trade and Development, UNESCO, the Department of Culture, Media and Sport of Great Britain, as well as the legislation of Ukraine, the State Statistics Service.

The economic evaluation of creative industries in Ukraine is carried out on the basis of statistical data according to the following indicators: added value based on production costs of business entities (gross income from operating activities, taking into account production subsidies, excluding indirect taxes); the number of employed persons at economic entities (taking into account full-time, part-time and unpaid (owners, founders of the enterprise and members of their families) employees of the enterprise); the number of economic entities (enterprises-legal entities and natural persons-entrepreneurs); personnel costs of business entities (labor costs and deductions for social events), and since 2019, the volume of products (goods, services) sold by business entities in the field of creative industries (Ministry of Culture and Information Policy of Ukraine, 2018).

RESULTS AND DISCUSSION

An essential characteristic of creative tourism is that it focuses on intangible heritage, that is, it is emotion, creativity and people. In addition, creative tourism combines not only a pleasant vacation, but also new experiences and direct participation in the processes of creating a tourist product.

According to M.I. Senkiv & R.N. Mokh (2022), tourism has become an important tool in the implementation of

creative strategies for the development of new models and approaches to the sustainable recovery of tourism itself, which supports communities, creates jobs, contributes to the protection of heritage.

G. Richards & K. Raymond (2000) first proposed to interpret creative tourism as “tourism that offers visitors the opportunity to develop their creative potential by actively participating in master classes and studying local experiences specific to the place of rest or in the places where they are held.” As defined by UNESCO, creative tourism is “travel aimed at an interesting and authentic experience, involving the exploration of art, cultural heritage or a distinctive destination, provided by a connection with local people” (UNESCO, 2006).

M. Al-Ababneh & M. Masadeh (2019) note that creative tourism combines four components (local population, creative product and process, atmosphere that stimulates creativity) and provides an opportunity for tourists to develop their creative potential through active participation in various educational activities with the participation of the local population. And local entrepreneurs, in turn, create additional value at the expense of their own creative potential. In turn, the group of authors Wisudthiluck *et al.* (2015) emphasizes that creative tourism is the interaction of tourists and the local population with the aim of a deep understanding of the culture and socio-ecological values of the community, as well as obtaining unforgettable impressions from this cooperation.

Summarizing modern views on the concept of “creative tourism”, the opinion was formed that creative tourism can be interpreted as a trip during which there is observation or direct participation in the creative process inherent in a certain area (region, city, village) in order to penetrate the culture, get acquainted with traditions, everyday life, art, crafts, festivals, gastrotourism, active recreation, etc.

The conducted analysis of the dynamics of the main indicators of the economic evaluation of creative industries in Ukraine during 2013-2020 (Fig. 1; Fig. 2) shows that the contribution of creative industries to the economy of Ukraine is growing at a fairly fast pace. It is worth noting that the limitation to this period does not allow to fully conduct a qualitative analysis, since there is no generalized official information for the years 2021-2022 on the indicators indicated below, and the information available for the first quarter of 2021 is presented in a slightly different format, which does not allow its use for carrying out a full-fledged comparison in dynamics with previous indicators.

The number of employees employed by business entities by types of economic activity belonging to creative industries during the studied period had a clear tendency to increase from 252.3 thousand people in

2013 to 360.3 thousand people in 2020, respectively, the relative value this indicator ranged from 2.53 to 4.0%. A similar trend is observed in the number of economic entities in the field of creative industries, from 97.1 thousand units (2013) to 230.7 thousand units (2020), that is, their number has increased by 2.4 times, and the share in the total number of economic entities in 2020 was 11.7%, which is 6.06% more than the level of 2013.

The IT sector (the share in the structure is about 60%), advertising and PR (17%), film and television (7%) shows the highest quality results. The role of creative industries is also growing in Ukraine's international trade, particularly in the area of trade in services. The export of creative services (exactly 30% of the total export of services) is growing rapidly. The main export destinations of creative goods are Germany, Poland, Denmark, and Latvia (Nikolaieva *et al.*, 2021).

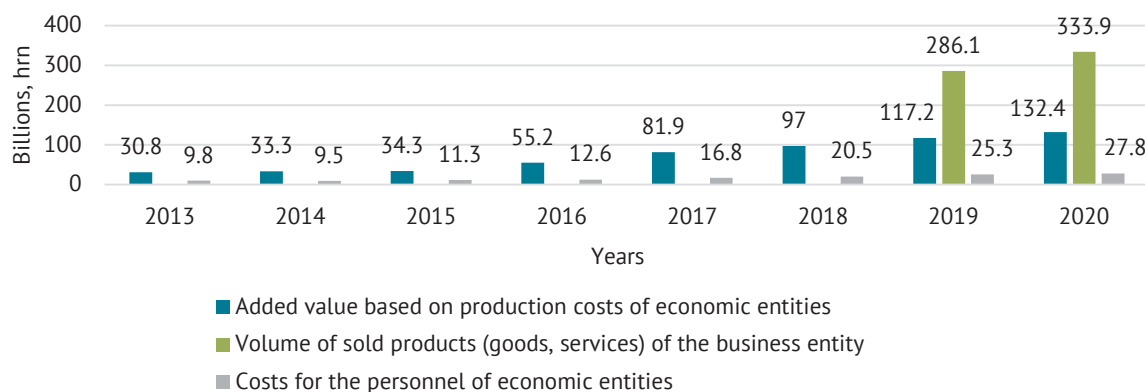


Figure 1. Indicators of economic assessment of creative industries of business entities by types of economic activity that belong to creative industries

Source: developed by the author based on the materials of the Ministry of Culture and Information Policy of Ukraine (2018; 2021)

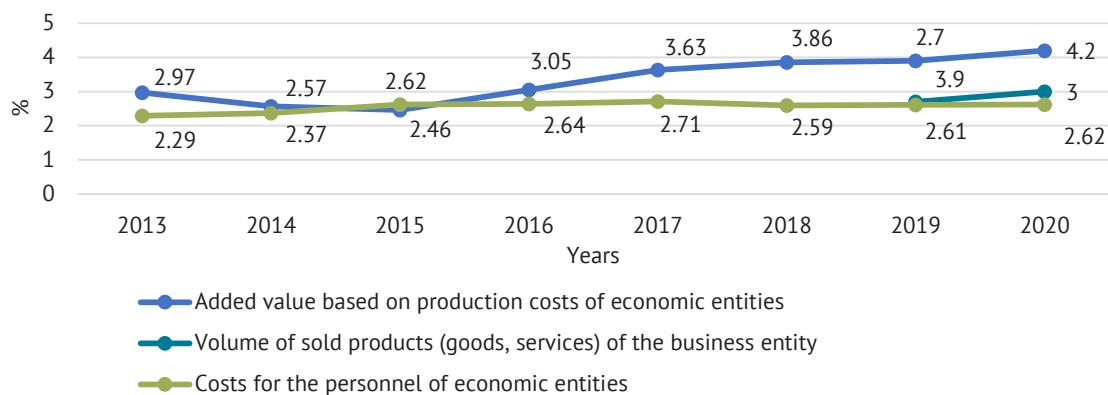


Figure 2. Shares of value added by production costs, the volume of sales and personnel losses of business entities by types of economic activity that belong to the creative industries, in value added by production costs of business entities by all types of economic activity, %

Source: built by the author based on the materials of the Ministry of Culture and Information Policy of Ukraine (2018; 2021)

In the first quarter of 2022, the total number of taxpayers decreased by more than 60%, and the amount of declared income in the field of creative industries decreased by 41%, which is common to all sectors (Ministry of Culture and Information Policy of Ukraine, 2022). According to the Kyiv School of Economics (2022), as a result of Russia's war against Ukraine, as of August 22, 2022, the amount of direct damage to infrastructure in the field of culture, tourism, and sports is \$1.3 billion. USA, indirect – 4.3

billion dollars. the USA, and the total need for the restoration of the industry is 2.3 billion dollars. USA. This situation is different from the pandemic, when "contact" sectors suffered the most losses, while others continued to grow. Therefore, the detected decrease in the number of business entities that paid tax payments will cause unemployment and the outflow of labor (talents). Therefore, already in 2023, one of the priorities of state policy and international aid should be the preservation of employment and the

restoration of economic activity, even in the case of low economic activity of enterprises.

Regardless of the current situation, it is advisable to cite the main advantages of creative industries as a factor in the development of the regional tourism market: a new, unique tourist experience from a trip; diversification of the offer without any additional investments, only due to the optimization of intangible cultural heritage; positive impact on the development of cultural infrastructure; restoration of intangible cultural heritage; social cohesion of local residents and community empowerment; management tool; quality and sustainable tourism with high added value and purchasing power, based on authenticity and creativity as the main resource; taking into account the seasonality of tourism, which allows for a better distribution of activities throughout the year.

Thus, an example of the realization of creativity in Ukraine is the functioning art village “Obyrok Island” (Chernihiv region), which was founded by the spouses L. Kanter and D. Karpenko in 2007. The artists chose a semi-empty village, bought several houses there and set up their daily life. Art-village “Ostriv Obyrok” is a full-fledged hub, with the possibility of year-round residence for the development of a creative community, where artists from different countries meet, create a cultural product and cross-sectoral partnerships, develop and implement projects, exchange ideas and experience, conduct intercultural dialogue, support ideas of sustainable development and cultural diversity. In addition, the founders actively develop artistic and educational areas, for example, they hold the festivals “Kolyadki International” and “Bread” (familiarization with the full cycle of grain and bread production), and organize themed recreation camps and art events

(Official website of Obyrok Art Village, n.d.). Since 2018, the Obyrok farm has joined the European network of eco-villages Global Ecovillage Network, and is also an active member of the Ukrainian network GEN Ukraine. In addition, the art residence has many partners, including the Ukrainian Cultural Fund, the State Tourism Development Agency, the Chernihiv Regional State Administration and the Baturyn OTG. The art village “Obyrok Island” can be considered as a potential tourist magnet of the Baturyn community of Chernihiv region, offering green and event tourism services, as it has a unique history, numerous historical monuments and interesting locations (Official website of Obyrok Art Village, n.d.).

The combination of elements of intangible cultural heritage with the festival movement also has a positive effect on the development of the regional tourist market, in particular, in Figure 3 presents the most famous Ukrainian festivals. So, for example, there are many people who want to visit the “Sorochyn Fair” (Poltava region) or “Malanka Fest” (Chernivetsky region), and therefore, from one point of view, this is an increase in the interest of tourists, and from the other, it is a positive influence on the development of related industries with tourism.

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Figure 3. The most famous Ukrainian festivals

Source: developed by the author based on the materials of Information and reference site “Ukraine” (n.d.), Zruchno.Travel (n.d.), Doba.ua (n.d.), Official website of EthnoSvit (n.d.)

The development of a network of tourist routes and excursion programs in the Mykolaiv region is facilitated by a large number of archaeological, historical-cultural and tourist-recreational objects, namely: Mykolaiv Zoo, Museum of Strategic Missile Forces, Mykolaiv Astronomical Observatory, Museum of Shipbuilding and Fleet, National Historical archaeological reserve "Olvia" and Berezan Island; National Nature Park "Buzky Gard"

(Arbuzynskiy, Aktovskiy and Petropavlivskiy canyons); kite festival "Ultra Fest Trykhaty" and others. Of course, the mentioned locations need some changes, first of all, the improvement of the infrastructure, as well as the introduction of innovations (creation of new routes, service technologies, use of digital technologies, etc.). Along with this, there are several areas that are widely represented and have strong potential, but are poorly developed (Table 1).

Table 1. Potential directions of tourism development in the Mykolaiv region

Type of tourism	Constituent elements	Possible areas of activity
Gastrotourism	Local producers, production of local products, tasting, authentic gastronomic cuisine	Oyster and snail farms, horse farms, farms for growing grapes, fruit trees, lavender, wine and cheese production, etc.
Recreation	Historical-cultural and tourist-recreational potential, local business, rafting and recreation services	Diversification of services and activities: conducting quests, performances, quest-excursions, theatrical excursions, archaeological, cultural-artistic, ethnographic expeditions, escape rooms, rock climbing, collection of medicinal herbs, etc.
Event tourism	Historical-cultural and tourist-recreational potential, local business, festivals	Ethnic and religious festivals (Ivana Kupala, Malanka, Maslyana), "collective" ethnic festivals, gas festivals, music and sports festivals, etc.
Ethno-tourism	Historical-cultural and tourist-recreational potential, local business	Visiting existing settlements that have preserved the features of traditional culture and lifestyle of certain peoples; establishment of "living history" museums, where various animation programs are held, aimed at recreating the historical environment of the region (buildings, antiquities, daily life, behavior, material and spiritual culture of previous eras, etc.).

Source: developed by the author based on the materials of Mykolaiv City Development Fund (2021)

In view of the above, the main opportunities for the development of creative tourism products of the Mykolaiv region and beyond should be characterized: the formation of tourist destinations with balanced development of communities, where social and economic life will be largely ensured by the development of the tourism industry; systematization and standardization of quality and expansion of the range of tourist services; creation of recreational and tourist infrastructure on historical, cultural and natural and recreational territories and objects of the region, etc.

Accordingly, the obstacles in this direction are: the imperfection of the legislative and regulatory framework; insufficient level of development of tourist and recreational and engineering infrastructure; unsatisfactory state of intangible cultural heritage elements that can be used as tourist destinations; lack of full funding, low quality of service, limited range of tourist services and tourist information.

It should be noted that the mentioned opportunities and obstacles are typical for most regions of the country. Thus, the introduced reform of decentralization can become a cornerstone for the sphere of culture and tourism, since under centralized funding they received funds according to the residual principle, and newly created communities primarily finance urgent social and communal infrastructure objects (kindergartens, schools, hospitals, roads etc.).

Although the situation is favorable where a strong center has united with weaker territories: then they will get chances for stronger management, in particular in the cultural sphere, for greater financial income, for correct management decisions. The worst format is "weak with weak", and here a thinking core should be born that will strategically develop a plan for the development of a specific territory, including cultural institutions (Tymoshchuk & Sereda, 2020).

Although, despite the noted, an example of a successful case is the village of Nizhne Selishche in Transcarpathia, a once depressed village whose socio-economic and cultural life has completely changed. Orest Del Sol (native Parisian) founded the Green Grove eco-farm in 2006. In 2013, the Prygar couple opened the "Selyska Syrovarnia" cheese factory, which is the highlight of Transcarpathia. Cultural art was added to the production. Since 2007, the international theater festival "Bird" has been held in the village for talented young people from Ukraine and Europe, who bring their vision and inspiration to the community.

To summarize, the festival is a week of workshops in theater, cinema, conceptual art, land art, scenography, sound, showing plays and films. The experience gained is transformed into new projects and ideas of the villagers. A hostel is set up for guests on the basis of an abandoned school, funds for operating costs are paid from the fee for staying there. The hostel space is used

for conferences, seminars, performances, parties, and yoga classes. In addition, the attitude of the villagers towards the environment has been changed, thanks to the sorting of household waste and garbage (Varosh, n.d.).

One cannot but agree with the vision of scientists such as O.M. Radionova *et al.* (2020) that “creativity means not only the formation of new ideas, but also their innovative application. Creativity can be realized in the historical or artistic heritage of territories, in such assets as architecture and landscape, local traditions, festivals, rituals, common hobbies and interests.” For example, a great example of the combination of cultural products and creative tourism is the visit by tourists to certain places in countries that are mentioned in various feature films or works.

Thus, the flow of tourists to New Zealand after the release of the movie “The Lord of the Rings” increased twice with the opening of the village of Hobbiton (Li *et al.*, 2017). Visiting Bran Castle in Romania by tourists is also associated with a significant number of stories and films about Count Dracula (Official website of Bran Castle, n.d.). An example of the combination of culture, festival activities and tourism is the Templar chapel, which was built in the 13th century. (the village of Hvarshchany, Poland). Rebuilt at the expense of citizens, it became the center of the community's cultural life. Festivals and knightly battles are held annually in the surrounding area, and an authentic hotel and themed restaurant are available to tourists (McGreevy, 2020).

Negative changes in the tourism industry caused by the COVID-19 pandemic have made adjustments and forced businesses to diversify their activities. So, with the closure of the borders, outbound tourism became unavailable, but domestic tourism acquired a new meaning. Most of the subjects of the tourism sphere resorted to finding new and creative ways of development, including the opening of many domestic destinations, the development of new routes, the creation of new tourism development projects in one or another territory, etc. (Behsudi, 2020).

As a result of the research of creative industries as a factor in the development of the regional tourism market and taking into account the practical world experience, the opinion was formed that the development of creative industries and creative tourism should be ensured by strategic planning.

K. Mastika *et al.* emphasize the expediency and effectiveness of developing creative strategies. (2023), according to which the mission is “the creation of tangible and intangible products with defined criteria: value, rarity, irreplaceability. Effective management and development of local resources, thanks to cooperation between stakeholders.” Supporting venture businesses, medium-sized businesses and entrepreneurs is a top

policy priority for the creative tourism industry in J. Lee & N. Lee (2015).

Such researchers as Ch. Stipanović & E. Rudan (2014) indicate the dependence between the efficiency of using the tourist potential of the territory and the lack of creative development strategies. It is the latter that they explain to the low level of awareness of the local population about this area. They see the creation of a network of macro-destinations, which are characterized by the synergy of creative and individual micro-destinations, as the main direction of the development of the tourism industry.

The leading role in the implementation of creative development strategies belongs to local management entities in the field of tourism and culture (Gato *et al.*, 2022). The main tasks of which are: determining priorities for the development of the industry, raising the level of education of the local population, implementing marketing communications, as well as carrying out measures to strengthen the role of tourist resources in the development of the local economy.

Thus, according to G. Richards (2019), creative tourism is mainly its individual form and an alternative to mass tourism, and the attraction of a small number of highly motivated visitors will contribute to a greater socio-economic and cultural effect than an attempt to attract a mass tourist.

Each community has its own potential, for example, some have excellent natural resources, others are rich in historical and cultural heritage, gastronomic potential, handicrafts, etc. Therefore, it is a valid opinion that every village or city should find a point of attraction, and if there is none, then even invent one in order to attract people and create a mythology of the territory around it. In other words, everyone has the potential to develop creative industries, but a joint vision of their development must be worked out between local self-government bodies, businesses and the population of the community.

CONCLUSIONS

Creative industries during 2013-2020 show gradual and constant growth by all indicators. Moreover, the largest share in the economy of Ukraine belongs to the IT sector, advertising and PR, cinema and television, and exports of creative industries make up a third of the total. As for the problems of modern creative industries, many of them remain unsolved, in particular, in the legislative-legal, organizational-administrative and terminological fields.

It should be noted that the creative sector needs state support and international assistance in order to restore economic activity and preserve employment. According to the results of the research, it is creative

industries that can actively realize their potential in the field of tourism and become a tool for its regional development, since creativity is realized in the intangible cultural heritage of territories, in particular in such assets as architecture, landscape, local traditions, festivals, rituals, hobbies etc. Yes, there are many successful examples of transforming depressed rural areas into viable communities.

Among the advantages of the synergy of creative industries and tourism, it is advisable to highlight the following: diversification of the local economy, preservation of intangible cultural heritage, sustainable development of the territory, improvement of the quality of life and well-being of the local population, investment attractiveness, new forms of cooperation, public initiatives, the formation of creative communities, creative entrepreneurship, cooperation in the cultural sphere, etc. It follows from this study that the state and local self-government bodies should be interested in the development of creative industries, thanks to their own policies.

Development and adoption of relevant strategies, development programs, creation of reliable legal regulation of the sphere, introduction of systematic and qualitative analysis of the sector, financing, fiscal and credit policy, grants, public-private partnership, active international cooperation will contribute to the development of creative industries. Creative industries can become a new source for the development of tourism products that will enhance the narrative of a tourist destination and contribute to the diversification of tourism activities. The perspective of further research is the substantiation of the methodology for developing the strategy of creative industries and creative tourism.

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CONFLICT OF INTEREST

None.

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Роль креативних індустрій в місцевому економічному розвитку

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Анотація. Креативні індустрії сприяють використанню культурно-ресурсного потенціалу регіону (культурні традиції, історична й архітектурна спадщина) та їх спрямуванню на місцевий економічний розвиток. Мета статті полягає у виявленні тенденцій розвитку креативних індустрій в Україні, їх ролі та значення для галузі туризму, та на цій основі обґрунтувати переваги від їх синергетичного зв'язку на місцевий економічний розвиток Миколаївської області. У дослідженні використовується сукупність методів наукового дослідження загального (аналіз та синтез, індукція й дедукція, абстрагування, формалізація) та спеціального (контент-аналіз, порівняння, графічний) характеру, що дозволили виявити змістовні інтерпретації закономірностей щодо трактування понять «креативні індустрії» та «креативний туризм», а також охарактеризувати синергетичний зв'язок між ними. Виявлено, що креативні індустрії позитивно впливають на економіку країни, зокрема, на сектор культури приходить 3,1 % світового валового внутрішнього продукту, а культурні та креативні індустрії забезпечують майже 50 млн. робочих місць. Встановлено, що Україна має значний потенціал креативних індустрій, вартість якого в економіці постійно зростає, так на експорт креативних індустрій приходить 30 % від загального. Проаналізовано наукові роботи українських вчених, а також вчених інших країн щодо впливу креативних індустрій на розвиток туризму, у результаті чого акцентовано увагу на низці переваг, які можна об'єднати в три групи: галузь туризму (новий унікальний досвід туриста; розширення пропозиції без будь-яких додаткових інвестицій; якісний та стійкий туризм з високою доданою вартістю й купівельною спроможністю); громада та населення (диверсифікація місцевої економіки; креативне підприємництво; сталий розвиток території; інвестиційна привабливість; нові форми співробітництва; покращення якості життя та добробуту; соціальна згуртованість; розширення можливостей громади); галузь культури (позитивний вплив на розвиток культурної інфраструктури; збереження та відновлення нематеріальної культурної спадщини; співробітництво в культурній сфері; формування креативних спільнот). Саме пошук нових та креативних шляхів розвитку туристичної сфери (відкриття внутрішніх дестинацій, розробка нових маршрутів та проектів розвитку території) сприятиме підвищенню конкурентоспроможності галузі туризму.

Ключові слова: креативність; нематеріальна культурна спадщина; туризм; синергія; сприятливе економічне середовище; територіальні громади

Philosophy of agriculture as a way of understanding agrarian practice

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Abstract. In recent years, in scientific publications on the philosophy of economy, economic and agrarian sciences, attention to the philosophical aspects of the study of rural life and agricultural production has increased. This indicates that the philosophy of agrarian activity is formed as an integral part of the philosophy of economics and agrarian economy. The purpose of the article is to determine the scientific status of the philosophy of agriculture as a worldview basis for managing agrarian practice. The authors chose structural and systemic analysis and synthesis as the main methods of research, which allowed to isolate the concept of the philosophy of agriculture and to learn its essence. The article defines the philosophical aspect of the study of agricultural practice, which is an object of management in the context of social, cultural and economic life of people. Within the framework of philosophy, agriculture is considered not only as the basis of human livelihood, but also as a factor in the creation of civilization and culture. The study determined that the subject of the philosophy of agriculture is the relationship in the “man-nature-economy” system in the context of agrarian life. The theoretical value is that the philosophical problems of agriculture are systematized within the classical approach to the structure of philosophical knowledge (that is, ontology, epistemology, anthropology, praxeology of agriculture and socio-philosophical problems of agriculture are highlighted). General philosophical methodological approaches are formulated and defined, on the basis of which the philosophy of agriculture can develop as a meta-knowledge in relation to agrarian sciences and the practice of managing the agrarian sphere. The subject of the philosophy of agriculture is defined. The practical value lies in the fact that the research result can be included as a topic in educational courses in philosophical disciplines for students of higher education in the economic and agrarian profile of training. The results of the study enrich the information and analytical knowledge necessary for the comprehensive education of ecological culture, nature-centric economic behaviour of specialists in the agrarian sphere of production

Keywords: nature; being; management; worldview basis; practical philosophy; noospheric dimension; economic philosophy; agricultural production

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INTRODUCTION

Agrarian practice has always needed its own worldview. This was reflected in such a field of philosophical knowledge as business philosophy. The modern philosophical understanding of agriculture has its own specificity. Its relevance is related to the need to understand the complex processes taking place in the agrarian sector of the economy, as well as in connection with the further development of agrarian knowledge. The implementation of new technologies in crop production, agriculture and animal husbandry, the use of biotechnology, the problem of reviving the Ukrainian countryside, the creation of a reliable agro-food base in Ukraine, the need for constant improvement of the methodological base for the analysis of complex systems (soils, biogeocenoses, landscapes) requires constant worldview understanding.

Such research cannot take place without the synthesis and generalization of data from a large number of sciences about living and non-living nature, as well as socio-economic sciences that investigate the objects and phenomena of the agrarian world. The question arises about the role of the philosophical approach in the study of the agrarian world as a special part of being and the development of theoretical and supra-theoretical foundations of agricultural sciences, as well as the selection of a separate direction of research, which, in the future, will become an independent subfield of the philosophy of economy and economic philosophy – the philosophy of agriculture. Although the problems of agriculture were of interest to ancient philosophers, the philosophy of agriculture was formed as an independent sub-branch of the philosophy of economy only at the beginning of the 21st century. Philosophical and worldview questions are raised in the existing publications on agricultural issues and on the methodology of agricultural sciences. But to date, the problem field of the philosophy of agriculture as a sub-branch of philosophical and economic knowledge has not been defined, its subject has not been formulated, its structure has not been defined.

This creates difficulties for understanding the status of the philosophical problems of agriculture and understanding its importance both for the development of agrarian knowledge and for the development of philosophy itself. All this caused the need for philosophical reflection on the worldview aspect of agrarian knowledge and the determination of the status of the philosophy of agriculture, and the importance of the philosophical and worldview issues of agrarian practice has been highlighted in many recent publications.

In the context of life support, O. Kotykova *et al.* (2020). Ethical problems of modern nature use in

agriculture and social problems of the rural population were considered by K. Kramer & F.L.B. Mejiboom (2022). In 2010-2020, training courses on certain problems of agricultural production appear in Ukraine, an example is the course "Philosophy of organic production and balanced use of nature", which is taught at the Lviv National Agrarian University and reflected in the educational and methodological manual (Nakonechnyi & Kopytko, 2022).

The authors of the course especially emphasized the mental foundations of farming and organic production in Ukraine. The problems of agriculture in the context of education and science have become the subject of monographic studies - a collective monograph of Kharkiv National Agrarian University named after them is dedicated to them. V. Dokuchaeva "Agrarian education and science: socio-philosophical understanding" (Zazdravnova *et al.*, 2020).

I. Spassky (2021) considered the problems of the ontologization of the economy in the context of S. Bulgakov's heritage. The historical aspect of the philosophy of Ukrainian agrarianism has become a relevant issue in the context of understanding the sources of the identity of the Ukrainian people. The legacy of the ideologues of Ukrainian agrarianism also attracts the attention of scientists (Kornovenko & Pasichna, 2021).

The purpose of the article was to establish the status of the philosophy of agriculture in the system of philosophical knowledge as a way of understanding agrarian practice. The following tasks follow from the set goal: to provide a definition of the concept of "philosophy of agriculture", to define its subject, to reveal the specifics of the problems of the philosophy of agriculture, and to highlight structural elements. In the course of the research, the essence of the concept of "philosophy of agriculture" (given definition) was revealed, the subject of agriculture was defined, the specifics of the problems of agriculture were revealed, as well as the importance of these problems for the management of agrarian practice and the structural elements of agriculture were highlighted. All this constitutes scientific novelty.

MATERIALS AND METHODS

The research is based on the dialectical method (general-philosophical) and structural-systemic analysis and synthesis (general-scientific) methods. The advantage of the chosen methods is that they allow us to consider the problem of the formation of the philosophy of agriculture in the development and relationship with other forms of social consciousness (science, religion), as well as in connection with the development of agricultural practice. This made it possible to build

the concept of the philosophy of agriculture as a holistic global knowledge of agricultural practice, which is characterized by systematicity, integrity, intersubjectivity and coherence. The dialectical method includes several principles. Based on the principle of development, the historical content of the formation of the philosophy of agriculture and the prospects for the further development of its problems are determined. On the basis of the method of descent from the abstract to the concrete, the content of the categories of the philosophy of agriculture is determined. The principle of general connection made it possible to consider philosophical knowledge about agrarian practice in the context of classical branches of philosophy. The principle of determinism led to the conclusion that the formation of philosophical approaches to agriculture is caused by the immediate problems of the development of agrarian practice and its reflection in the forms of social consciousness. Also, on its basis, the structural components of the philosophy of agriculture are highlighted. The system-structural synthesis made it possible to combine the structural components of the philosophy of agriculture, which were selected on the basis of the classical approach, into a single conceptual whole.

Phenomenological and hermeneutic methods are an alternative to the chosen methods. But the phenomenological method requires considering phenomena as phenomena of human consciousness, and this creates the risk of subjectivization of the knowledge obtained, and the hermeneutic method, as a method of analyzing a philosophical text, carries the risk of immersion in the study of the author's personal opinion, and not in the study of the problem.

The information (source) base of the research was modern publications, both in scientific periodicals and monographs, which relate to worldview, value and social issues, which are reflected in agricultural knowledge and are presented not only by specialists in the field of philosophy, but also in economics and agricultural production. The theoretical basis that determined the approach to the analysis of the information (source) base and the construction of the proposed concept were the teachings of the Ukrainian naturalist philosopher V. Vernadskyi (2004) about the noosphere and the teachings of the representative of modern German economic philosophy P. Kozlovsky (1999) about the human-creating essence of work.

RESULTS AND DISCUSSION

A feature of the modern stage of the development of philosophical knowledge is the growing interest in the so-called practical philosophy, which is directly related to the solution of applied problems facing society. In his time, Aristotle divided philosophy into theoretical

(comprehensive), practical (knowledge of human activity and its results), and visual (creative). He classified ethics, economics and politics as practical philosophy. Of course, in this classification of philosophical knowledge, the philosophy of agriculture belongs to practical philosophy. Firstly, it is aimed at understanding human activity and its result, and secondly, human agricultural activity includes ethical, economic and political aspects, that is, it is aimed at a direct understanding of human activity. In addition, philosophy is a means of self-discovery of agrarian sciences: in the process of overcoming crisis situations in the development of scientific knowledge, creating new hypotheses, an agrarian scientist necessarily goes beyond the limits of his professional knowledge, addresses the entire human culture, and it is philosophy that acts as a way of knowing here. However, philosophy not only provides specific sciences with a methodological and worldview basis. There is a feedback relationship between philosophy and specific sciences, it itself receives impulses and material from them for its further development, the latter is also applied to agricultural sciences.

The difficulties of a systematic review of the philosophical aspects of agriculture are connected with the fact that today economic philosophy and the philosophy of the economy are research directions that are not sufficiently formalized. These fields of knowledge are in search of their own worldview and methodological foundations. The number of works that are directly aimed at the philosophical problems of the economy is not large, but among these works there are those that are dedicated to the philosophical understanding of agriculture.

The philosophy in thinking about agriculture appears already in the works of ancient thinkers. Among them are Hesiod, Aristotle, Xenophon, Plato, Theophrastus, Marcus Cato, Marcus Varro, Lucretius Carr, Lucius Columella. They tried to give knowledge about agriculture a rational form. They connected the development of agriculture with social relations, developed ideas about organic land use measures (Tsytisiura *et al.*, 2022). Before the Age of Enlightenment, the understanding of agriculture was fragmentary. During the Enlightenment, the school of physiocrats began to consider agriculture as the source of all other forms of wealth, which provides conditions for other occupations and industrial movements. Physiocrats achieved recognition for the natural wealth of the earth as a priority in economic life. According to A. Smith (2018), the labor of the farmer is the only labor that produces, while the industrial worker does not increase the substance, but only changes the form of the latter. In the future, the philosophical problems of agriculture merge with other problems of economic philosophy and stand out separately quite rarely.

In the system of philosophy and humanities, agriculture can be considered within the framework of

several approaches used for the study of economic practice (Table 1).

Table 1. *Classification of approaches to the humanitarian understanding of agricultural practice*

Name of the approach	Content of the approach	Representatives of the approach
Gradual-technological	Considers the agrarian sphere in the context of changes in technological factors	D. Bell, E. Toffler
Cultural and sociological	Provides a view of agriculture through the influence of cultural and ethical factors on the economy	H. Simmel, M. Weber, A. Toynbee, P. Kozlovsky
Structural and functional	Forms a vision of agriculture from the standpoint of values and regulatory standards that are shared by everyone who performs certain roles in the activity process	T. Parsons
Humanistic	Directs consideration of agriculture in the context of human existence and the search for harmony in its interaction with nature and culture	T. Adorno, H. Marcuse, E. Fromm, Y. Habermas

Source: developed by the authors based on T. Yashchuk (2017)

In the scientific and philosophical heritage of Ukrainian thinkers, methodological approaches are considered, which will be useful for building modern philosophical views on agriculture. The historical and cultural view of agrarian relations in Ukraine was presented by P. Kulish in his own concept of farm philosophy, and the ideology of Ukrainian agrarianism was created by V. Lypinsky (Kornovenko & Pasichna, 2019). M. Tugan-Baranovsky (1994) studied the levels and forms of organization of economic life, substantiated the activity approach to it, distinguished the personal and impersonal in economic life. V. Vernadskyi (2004) proposed a noospheric paradigm, where consideration of economic life finds global and cosmic meaning.

Philosophical problems of agriculture cannot be separated from the philosophy of management in general and economic philosophy. The philosophy of economy and the philosophy of economics explore the general formal structure of management, axiological foundations, spiritual and ethical foundations of economic activity, epistemological assumptions about the nature and nature of the rationality of economic theories. On the one hand, the general philosophy of agriculture and economic philosophy act as a methodological basis for the philosophical understanding of agriculture, and on the other hand, the philosophical understanding of agriculture itself acts as one of the sources of the construction of the general philosophy of agriculture. A. Priyatelchuk (2012) noted that the philosophy of economy is a branch of philosophical and economic knowledge, where the identification of the essence of the economic existence of a person is possible and valid through the analysis of the triad "nature-man-economy". Nature is the primary basis, the only and necessary source of obtaining means for life. This is most clearly revealed in agriculture. Therefore,

the philosophy of agriculture can be defined as a way of understanding the relations in the system "man-nature-economy" in the context of agrarian life, and the relations in this system are the subject of the philosophy of agriculture.

The philosophical approach makes it possible to consider agriculture as an open, complex, non-linear system, which is characterized by irreversibility, the possibility of the emergence of new ties and relationships that are subject not only to natural laws, but also to the creative will of man. Philosophical understanding of agriculture reveals worldview orientations, thanks to which a person creates the conditions for his own development through agricultural activity. The act of economic activity within the framework of philosophy is understood in all its depth, gets the opportunity to get rid of a purely objective meaning and open up in the sphere of the spirit.

Philosophical understanding of agriculture is caused by the need for justification and practical implementation of the state's agrarian policy, formation of the worldview of specialists in agricultural science and production in the conditions of searching for ways to overcome negative social and economic processes directed by the difficult socio-economic and ecological situation, decline in production, deformation of the moral foundations of social life. The founder of the philosophy of economy S. Bulgakov, who lived and worked for part of his life in Ukraine, noted that "economy is a struggle for life with the natural forces of nature, a struggle between life and death, freedom and necessity, mechanism and organism" (Bazilevich, 2006). To the greatest extent, this characteristic is manifested precisely in agriculture.

I. Spassky (2018) believes that the modern approach to the philosophy of economy involves logos, energy

and substance aspects. This allows us to reveal the dynamics of agriculture at different levels of existence. Through the logos approach, the regularities of the development of the economy are understood, through the energy approach – the sources of its development, and through the substantive approach – the inclusion of the economy into the structures of existence not only of society, but also of the entire geographical envelope of the planet. This view shows the economy in logos, energy and substance integrity. The study of the economy cannot be limited to the framework of economic science, because it cannot cover cultural, ethical, axiological and religious aspects of its development. Neither the economic nor the production views of the economy allow us to reveal its dynamics in connection with the dynamics of being (Spassky, 2018).

The philosophy of agriculture considers agriculture not only as a condition of human existence and life. In it, it appears as a special means of self-realization of a person in the process of changing the world around him and his own (personal) world, that is, the macrocosm and the microcosm. In the course of such a change, a person realizes himself as a biosocial and spiritual integrity. It allows you to discover the meaning of agricultural life in the spiritual sphere. Only within the limits of the philosophy of agriculture are such factors of human agrarian activity covered as experiences, worldview, mood, mood, mood, moods, evaluations. With such an approach, human activity is deprived of purely objective assessments and needs to be recognized as creativity and self-realization. It is understood as a force that is included in existence and at the same time constructs it. Human self-realization as a subjective orientation is an energetically creative source of agricultural development.

The philosophy of agriculture as a research direction should seek answers to the following questions: “How does the meaning of agricultural activity correlate with social life as a whole in cultural, economic, religious, ethical dimensions? How are rational and irrational related in agricultural activity? What is the specificity of the connection between the subject and the object of such activity?”

The ontological aspect of the philosophy of agriculture consists in the study of the existence of agriculture. In a broad sense, the ontological problematics of the philosophy of agriculture involves consideration of the question of the existence and non-existence of forms of management on Earth in conditions where sustainable development will remain a wish or a project. In modern conditions, this question acquires an existential meaning, because a person feels with a special force his finitude and the apocalyptic nature of existing existence. A person has no confidence that this world can be saved

from wars, technological cataclysms, and environmental threats. From the standpoint of V. Vernadsky's noospheric teaching, agriculture is an ontological reality, a cosmos in which a person must continue to create (Iehorova, 2021). Agriculture exists through the constant generation of itself, the formation of new structures and the development of its own elements. Moreover, in order for agriculture to exist as a system, it must constantly reproduce the premises of itself as its own output. Therefore, in the noospheric dimension, agriculture is a sphere of human creative activity related to the preservation and improvement of life. Agrarian practice is still, first of all, the practice of transforming living matter and this raises the question of responsibility before it (Gerber & Hiernaux, 2022). In a narrow sense, the ontological problematic of the philosophy of agriculture covers the objects of agricultural research (soils, agrobiogeocynoses, agrolandscapes, agrofirms, etc.).

The anthropological aspect of the philosophy of agriculture consists in the study of man as a subject of agricultural activity. In economic, legal, and sociological disciplines, the subject of agricultural activity is considered as a collective person who is guided by both rational and irrational motives. They are norms, traditions, customs, superstitions, unconscious intentions. In order to evaluate such factors, irrational motives are tried to be rationalized, to be presented as factors of making rational decisions. In relation to the individual, it is justified. But in reality, due to the specificity of agricultural activity, its fundamental syntheticity, where all disparate aspects (from economic and calculation to moral) merge, the economic entity is not a mechanical collection of people. It is formed through the interaction of conscious actions of people with different attitudes, who coordinate their activities in numerous and diverse economic acts. The problem here is the characterization of the rationality of the economic entity as a creator. It is this activity that includes a person in the ontological process, makes him belong to existence.

In the process of work, a person creates his own existence, which is equivalent to his own essence. It is in the process of work that a person as a spiritual being becomes the cause of himself (*causa sui*), that is, a subject that acts independently. Rural life and farming create special conditions for human life, which cannot but be noted by the anthropology of agriculture. These include the close interaction of physical and biological natural processes with the lives of individual people; special balance of physical and intellectual work in production activity; the shortest time path between costs and labor results; maximum psychological satisfaction from consideration of economic action, decision-making and profit-making; sacralization and transcendence of an individual's being in relation to himself and the

world; striving for harmony with the natural world. In the process of agricultural activity, a person not only transforms nature, but also transforms himself, while the consequences of such a transformation are not fully known (Veraart & Blok, 2021).

The epistemology of agriculture is immanently present in the philosophy of agriculture and is not separated from its other aspects. It includes the following question: what are the peculiarities of knowledge of agricultural activity (knowledge both external, which is carried out by the sciences of agriculture, and internal, which is carried out by the subject of agricultural activity), how is the position of the subject of knowledge of agricultural practice explained, in why is the non-classical approach to the knowledge of agriculture based on the development of the principles of additionality and anthropology? The total non-classical nature of truth in modern knowledge, including in relation to agriculture, which consists in the fact that truth can be achieved only through the unity of the Existent and the Proper, the very Truth, Goodness and Beauty. This means that the truth of agrarian knowledge can be achieved only when this knowledge will ensure the continuation of the human race and contribute to the preservation of life and the Earth, that is, contribute to the exit of humanity from the global ecological crisis. The implementation of the principle of the unity of the Existent and the Proper in the search for truth allows agrarian knowledge to become part of the knowledge of the harmony of the World, and this gives it spiritual meaning.

For a person who works in the agricultural sector, the object of work is a certain state of nature, which he has made cultural. Philosophy considers this phenomenon as a form of existence that has developed historically. The philosophical view differs from the agrarian view of living things in that the philosopher does not focus his attention on the details of the structure of a living organism. He focuses attention only on those features of living organisms that correspond to the general characteristics of all types of matter. That is, in living matter philosophers see a special status of material existence, those universal signs that allow us to speak of the surrounding nature as living matter. But philosophy and agrarian sciences proceed from general worldview principles in revealing the essence of living nature and its organic expediency.

Their specific feature is integrability. This means that they develop at the intersection of natural, technical and humanitarian sciences. The synthesis of natural-scientific, humanitarian and technical knowledge is due to the fact that these sciences investigate the relationship of man with nature, develop means, technologies and methods of ensuring the physical existence of mankind. Thus, agricultural sciences act as a

field of dialogue between natural-scientific, technical and humanitarian knowledge. The function of the philosophy of agriculture to be a tool for such a dialogue is revealed. Through philosophy, there is an understanding of the sociocultural determination of the development of agricultural sciences, the creation of one's own conceptual and categorical apparatus, the scientist's understanding of the peculiarities of development and the essence of modern post-classical knowledge. The creation of new agricultural production in non-classical conditions occurs as a synthesis of the efforts of a scientist and a direct producer of agricultural products (Bursten & Kendig, 2021).

Agrarian practice exerts its influence on the development of philosophical knowledge. It is clear that this influence is not direct, but on the contrary – mediated through natural science and agricultural science, which are directly related to practice. It is in agricultural sciences that new concepts of biogeocenoses, landscapes, soil evolution and the biosphere as a whole are formed. Biogeotic, agrobiotic, agroecological pictures of the world exert their influence on philosophical knowledge, expand the philosophical understanding of existence and the laws of its development. Philosophical conclusions are the result of the generalization of theoretical knowledge, which is presented in specific sciences, including agricultural ones. In turn, the reliability of philosophical knowledge, the practical value of cognitive principles formulated within the framework of philosophy (development, systematicity, determinism, general connection, historicism, additionality, etc.) can be tested, including in the field of agricultural sciences.

Axiological problems of agriculture are designed to reveal the valuable content of agriculture. In this case, we are talking about not only the economic value, but also the moral value of work, the value of the result of work for the existence of humanity and the restoration of natural resources.

The philosophy of agriculture is praxeological. This is natural, because in the center of her attention is the practical activity of a person on earth. Within the framework of praxeology of agriculture, worldview approaches to understanding the goals, character and values of activity in the agricultural sector were formed. We are talking about utilitarian, libertarian, egalitarian and systemic approaches. The utilitarian approach believes that the action that brings the maximum benefit to people is morally correct. Land, animals, and other resources are valued in the context of their productive utility, not by themselves. The libertarian approach is based on the fact that human freedom, including the freedom to manage, should not be limited by anything, as long as it does not harm the freedom of other people. At the same time, libertarianism does not require

helping others. The egalitarian approach emerged as a reaction to libertarianism, requiring the creation of conditions for equal access to water and land for all. The systems approach considers humanity as part of the global ecosystem. Agricultural ecosystems are not considered natural, but they must be built on principles that fit them into nature.

The socio-philosophical aspect of the problems of the philosophy of agriculture examines the inclusion of the agrarian sphere in society and its connection with economic, social, cultural, legal, and political processes. Here agriculture will appear as a place of mobility, a place of embodiment of everyday practices according to certain repetitive phenomenological patterns. Agriculture can be considered as a complex socio-cultural formation, a special space in which not only various human activities unfold, but also a transformed nature manifests itself (Pimenova, 2010; Fesenko, 2014). It was the emergence of agriculture that allowed humanity to move to a civilizational model of culture. Actually, the terms “rice civilization”, “maize civilization”, “millet civilization”, “wheat civilization” indicate cultures where millet, rice, maize, wheat occupy a leading place not only in the diet of people, but also in the entire system of industrial and natural connections between man and nature. Socio-philosophical problems of the agrarian sphere contain applied problems for the philosophy of agriculture, as for practical philosophy. First, it is a problem of social organization and social management of agricultural production and science. Secondly, the determination of the forms of agricultural enterprises that are optimal for the given conditions of agricultural production and social organization. Thirdly, the problem of economic profitability and safety of agricultural production, which should be not only profitable, but also one that preserves labor and resources, homeostatic, that is, one that ensures ecological balance with steady growth of agricultural production. Fourth, socio-biological consequences of the use of gene technologies. Fifth, the food problem.

In the aspect of social philosophy, agriculture is considered as a completely social phenomenon in its essence. In this sense, it is not an individual who is in charge, but the entire historical humanity. At the same time, separate economic acts are integrated into the overall result of the transformation of nature by man. By creating agriculture, mankind created the first supernatural productive system that allowed man to create his own world or a symbolic world with new values, meanings, properties, and patterns. The problems of genesis, essence and patterns of development of agrarian societies should also be included in the problem field of the philosophy of agriculture, since it is on its basis that such societies can be assessed from the standpoint

of progress and regression. For Ukraine, for example, the problem of modernization of agriculture is not only a technological problem, but also a socio-cultural one, the solution of which requires complex efforts on the part of the entire society and the state (Yekimov *et al.*, 2021). The search for ways of development is determined by the modern direction of the philosophy of economy – the philosophy of sustainable development (Bazaluk *et al.*, 2020; Petrunenko *et al.*, 2021).

The connection of economic activity with ethics, history and culture was emphasized by the German historical school of political economy. For her, the theory of the national economy is the science of man, the science of history and ethics, the science of spirit and culture (Strishenez & Galyant, 2018). This is a philosophical view of the economy as a whole, and of agriculture, which are in relation as a whole and a part. An outstanding representative of this school, P. Kozlovsky (1999), considers economic (economic) work as work that gives meaning to human life. It can be noted that the generic features of economic labor are reflected in its type, such as agricultural labor. In the context of his proposed view, agricultural activity cannot be considered as self-sufficient, it is intertwined with socio-cultural and religious activities, and has a national-ethnic character. The ethnic and religious aspects of agricultural work were also pointed out by P. Jeerat *et al.* (2022), S. Sumarwati (2022) and W. Li (2022). From the standpoint of the philosophy of economy, S.M. Bulgakov, agriculture should be considered as a mystical activity, where religious and pragmatic motives are intertwined, but the dominant is still the religious basis of this activity, since it unfolds in the world created by God (Bazilevich, 2006).

The content of socio-philosophical problems of agriculture is directly related to biophilosophy, ecophilosophy and bioethics. Biophilosophy forms a modern evolutionary picture of the world, methods of learning living systems; ecophilosophy examines the problems of ecological culture, ecological crisis, humanization of the natural world; within the framework of bioethics, moral aspects of biological science, biotechnologies, inclusion of man and his activities in ecosystems are investigated. The ethical content of agrarian innovation is at the center not only of scientific opinion, but also of the public, the assessment of biotechnology is often based on the concept of neoliberalism, which is the ideological basis of modern civil society. Biopower is the way to characterize the power of modern man in transforming the animal and plant world. The moral content of such power can be assessed through the methodology of discursive practices of postmodern philosophy, in particular, the philosophy of M. Foucault (Kramer & Meijboom, 2022).

CONCLUSIONS

Currently, it is not possible to talk about the existence of a generally defined approach to the philosophy of agriculture as a separate branch of the philosophy of agriculture with its own separate subject and methodology, but the philosophical issues were formed, since the consideration of problems and scientific knowledge in agricultural sciences has its own philosophical aspect. The philosophy of agriculture should be understood as a reflection of the metaphysical foundations of its existence, as well as the relations in the “man-nature-economy” system in the process of agricultural activity. The inclusion of agriculture in economic and socio-cultural processes, in the general evolution of society can be considered through the general methodological paradigms of the philosophy of economy. However, it should be added that the presented paradigms should take into account that agriculture is a field of activity that is directly carried out in the biosphere, which is in the process of transformation into the noosphere. Whether the noosphere will have a constructive character in relation to man and nature, or whether it will take on destructive, anti-humanistic features depends on the philosophical basis of land management.

Agrarian knowledge contains a number of problems of an integral nature, which are meta-scientific for them and cannot be solved within the boundaries of agrarian sciences themselves. First, it is the determination of the place or status of agricultural activity in the general system of social practice and in the social system; secondly, determining the place and role of agricultural knowledge in the general system of world-view and formation of the modern scientific picture of

the world; thirdly, the definition of the system of moral requirements that are put before the agrarian scientist and agricultural production.

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Philosophical issues of agriculture have their own ontology, epistemology, anthropology, axiology, praxeology, as well as socio-philosophical and ethical aspects. It manifests itself and can be considered through all traditional branches of philosophical knowledge.

Prospects for further study are determined by the sharpness and complexity, novelty and complexity of scientific and practical problems. The value basis of agriculture in the postmodern discourse, the philosophical foundations of the sustainable development of agriculture, the concept of “nature - man” as the embodiment of the ontological space of agriculture require further development.

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Філософія сільського господарства як спосіб досягнення аграрної практики

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Анотація. В останні роки у наукових публікаціях з філософії господарства, економічних та аграрних наук посилилася увага до філософських аспектів дослідження сільського життя та аграрного виробництва. Це вказує на те, що філософія аграрної діяльності формується як невід'ємна частина філософії економіки та аграрної економіки. Мета статті – визначити науковий статус філософії сільського господарства як світоглядної основи управління аграрною практикою. Основними методами дослідження автори обрали структурно-системний аналіз і синтез, які дозволили виокремити концепцію філософії сільського господарства а пізнати її сутність. У статті визначено філософський аспект дослідження сільськогосподарської практики, яка є об'єктом управління в контексті соціального, культурного та економічного життя людей. В межах філософії сільське господарство розглядається не тільки як основа життєзабезпечення людини, але і як фактор творіння цивілізації та культури. У дослідженні визначено, що предметом філософії сільського господарства є відносини в системі «людина-природа-господарство» у контексті аграрного життя. Теоретична цінність полягає в тому, що філософська проблематика сільського господарства систематизована в межах класичного підходу до структури філософського знання (тобто виділено онтологію, гносеологію, антропологію, праксеологію сільського господарства та соціально-філософську проблематику сільського господарства). Сформульовані та визначені загальнофілософські методологічні підходи, на базі яких філософія сільського господарства може розвиватися як метазнання стосовно аграрних наук та практики управління аграрною сферою. Визначено предмет філософії сільського господарства. Практична цінність полягає в тому, що результат дослідження може бути включений як тема в навчальні курси з філософських дисциплін для здобувачів вищої освіти економічного та аграрного профілю підготовки. Результати дослідження збагачують інформаційно-аналітичне знання, необхідне для всебічного виховання екологічної культури, природоцентричної економічної поведінки спеціалістів аграрної сфери виробництва

Ключові слова: природа; буття; управління; світоглядна основа; практична філософія; ноосферний вимір; економічна філософія; аграрне виробництво

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