ИКОНОМИЧЕСКИ ИЗСЛЕДВАНИЯ
ECONOMIC STUDIES

Volume 32(5), 2023

Olena Serhiienko[1]
Maryna Tatar[2]
Lidiya Guryanova[3]
Olena Shapran[4]
Mykhailo Bril[5]

IMPROVEMENT OF FINANCIAL INSTRUMENTS OF THE AGRICULTURAL SECTOR AND FOOD SECURITY EFFICIENCY INCREASING[6]

The methodical toolbox of lending to entities in the agricultural sector provides three levels of hierarchy management interaction – macro, meso and micro levels (state – region – agricultural enterprises) on the bases of the complex usage of economic and mathematical models and which contains six interrelated and sequential blocks was proposed. The method of agricultural enterprises crediting improvement is implemented in accordance with the strategic position of lending to agricultural enterprises through targeted support and the creditworthiness level, which can solve the following problems: observation and evaluation of the financial and economic indicators; classification of enterprises, recognition, and identification of enterprises in terms of creditworthiness; assessment of the differences between classes given dimension enterprises.
Keywords: agricultural sector; business entities; credit; creditworthiness level; food security; interaction; lending; loans; risks.
JEL: C1; G2; O13; O23; P32; Q12; Q14; Q17

1. Introduction

Given the overpopulation of the planet, the problem of providing humanity with food is becoming one of the most pressing problems of today, which raises the issue of food security.

[1] *Olena Serhiienko, Doctor of Economics, Professor, National Technical University «Kharkiv Polytechnic Institute», +380664376607, e-mail: elena.sergienko@khpi.edu.ua.*
[2] *Maryna Tatar, PhD in Economics, Associate Professor, National Aerospace University «Kharkiv Aviation Institute», +380999401195, e-mail: m.tatar@khai.edu.*
[3] *Lidiya Guryanova, Doctor of Economics, Professor, Simon Kuznets Kharkiv National University of Economics, e-mail: guryanovalidiya@gmail.com.*
[4] *Olena Shapran, PhD in Economics, Associate Professor, National Technical University «Kharkiv Polytechnic Institute», e-mail: olena.shapran@khpi.edu.ua.*
[5] *Mykhailo Bril, PhD in Economics, Associate Professor, Simon Kuznets Kharkiv National University of Economics, e-mail: mihail.bril@hneu.net.*
[6] This paper should be cited as: *Serhiienko, O., Tatar, M., Guryanova, L., Shapran, O., Bril, M. (2023). Improvement of Financial Instruments of the Agricultural Sector and Food Security Efficiency Increasing. – Economic Studies (Ikonomicheski Izsledvania), 32(5), pp. 115-142.*

Ensuring food security, in turn, is realized through the possibility of purchasing food taking into account its price, purchasing power, and its availability in appropriate quantity and quality, which will lead to social stability, food demand, Ukraine's independence from imports, development of its food production goods, the creation of reserves to stabilize food security in an emergency, unforeseen circumstances. Thus, the availability of food in sufficient quantity and quality to ensure the livelihood of society is a major challenge at the national and global levels. According to the Global Food Security Index assessment developed by Economist Impact, the level of food security decreased significantly in Ukraine (from 54th in 2020 to 71st in 2022), in the Russian Federation (from 24th in 2020 to 43rd place in 2022), in Belarus (from 23rd to 55th). There is a deterioration in the position of the Czech Republic in the rating, which moved from 5th to 16th place. The Slovak Republic, on the contrary, moved from 40th in 2020 to 36th place. Bulgaria ranked 29th place in 2022 in terms of food security out of 113 countries (Economist Impact. Global Food Security Index, 2022).

The globalization of the food problem determines the strategic goals of the world's leading agricultural countries which should guarantee a stable, affordable, sufficient, safe, and balanced level of nutrition. Ukraine is a member of the global political and economic system, in particular, the world food security system, and therefore must pursue a balanced state agricultural policy, take care of financing farmers, and timely resource provision of agricultural enterprises that provide food security.

Addressing the issue of insufficient financing of agricultural enterprises by improving the lending mechanism will ensure the effective functioning of agricultural policy and guarantee food security at all levels.

Crisis processes and modern global challenges negatively affected the interests' realization of a large number of business entities. Exchange rate and discount rate fluctuations, the introduction of quotas for the grain trade, constant changes in the taxation of entrepreneurs, low wages, and arrears of payments to the budget, unprofitable and bankrupt enterprises – all this affects the interests of employees, owners, and the state. In such conditions, the main export-oriented sector revival is extremely important.

Agriculture in Ukraine is one of the leading sectors of the economy. In addition to the stable provision of the country's population with quality, safe, affordable food, Ukraine's agriculture can make a significant contribution to solving the world problem of hunger.

The high level of development of the agricultural sector in Ukraine is largely due to favourable natural conditions. At the same time, climate change is creating new global challenges for the industry and necessitating additional investment in this sector.

At the same time, agricultural products are a resource component of production in various sectors of the national economy. The degree of saturation of the market with food products of agricultural processing, their quality, and price (availability) depends on providing the population with food, which in turn is one of the main production tasks.

Due to the growing demand for food, Ukraine has special expectations and responsibilities for increasing production. It should be noted that Ukraine is indeed gradually becoming a significant player in the global agricultural and food markets. The country occupies a leading

position in the trade of cereals and oilseeds, exports significant volumes of dairy products and sunflower oil, etc.

Now, undoubtedly, one of the reasons for the slow growth of productivity and agricultural production is the unattractive investment climate, military conflict, hostilities, and as a result insufficiently transparent, inconsistent, and burdensome government regulation for business. Now there is a lack of equipment and infrastructure in agriculture, especially since part of the agricultural machinery was damaged or destroyed as a result of warfare. The existing facilities are physically and technologically obsolete.

The need to renew fixed assets in the agro-industrial sector, where their depreciation reaches 80%, and for some agricultural enterprises even more and there is an acute shortage of agricultural machinery requires significant additional long-term financial resources, using non-traditional forms and schemes of crediting.

The level of collateral remains quite high, which in some commercial banks is three or even four, or five times higher than the loan amount. Two types of liquid assets are used for the pledge itself: young animals and future harvests. The value of mortgaged property is mostly lower than market prices. The loan amount is not limited. The problem of liquidity of mortgaged property and its use to provide movable and immovable assets remains relevant. Techniques and buildings are practically not accepted as collateral.

There is a lack of funds for the production of agricultural and food products with high-added value.

Also as a result of the pandemic and social and behavioural constraints, supply chains are disrupted, producers' access to markets is lost and demand for products falls. Some subsectors remain underdeveloped, including forestry, fishing, and aquaculture.

So the agricultural sector, which is the national economy leader in terms of goods exports, demonstrates steady growth dynamics and needs additional resources for its development. Lending to agricultural enterprises is an important source of stimulating the development of the real sector of the economy, which leads to the saturation of the domestic market with agricultural products, trade increase and food security strengthening. Problems of financing the agricultural sector and insufficient inflow of financial and credit resources continue to be the main factor hindering the agricultural production development in Ukraine.

The agricultural producers' financial support through credit resource usage is one of the most important issues in stimulating production in economic modernization. Increasing the solvency and creditworthiness of agricultural producers expands their opportunities in obtaining credit resources and increasing production capacity and solving social problems.

Along with the attractiveness of lending to agricultural enterprises, the disadvantages of such lending, as well as the peculiarities of lending in different countries, must be analyzed. For example, if in Ukraine the interest rates on loans are high, which makes it more difficult for agricultural enterprises to obtain loans, then in the Slovak Republic the interest rates are quite low, but the low-interest rates result in an increase in total loans (26,3% in 2020), and the stagnating interest costs (Ministry of Agriculture and Rural Development of the Slovak Republic. Green Report, 2020).

Some groups of countries use different approaches and features of agricultural lending mechanisms. Thus, such countries as Great Britain, the Slovak Republic, the Czech Republic, China, Austria, and the Netherlands involve a network of commercial banks in agriculture, which provide credit by providing state guarantees and subsidizing interest rates. There are countries that provide credit to agricultural production through a system of cooperative banks (France, Germany, Japan, Poland), as well as countries that operate non-bank credit organizations in agriculture (USA, Canada), credit cooperative systems for micro crediting of small family farms (countries of Central and Eastern Europe).

At the same time, each country has its own specifics in the organization of providing agricultural producers with financial resources. For example, in the USA and Germany, the financial system of agriculture includes various financial institutions. In France, Japan, the Netherlands, and Israel, most financial operations in agriculture are carried out through the involvement of one or two specialized banks. There are no specialized agricultural banks in Great Britain and the credit policy for agriculture is carried out in the same way as for other sectors of the economy. A specialized agricultural bank operates in the Netherlands, which provides about 90% of credit financing for farmers (Rudych, Zubchenko, 2016).

The article's purpose is the theoretical and methodological principles and practical recommendations development for lending to the agricultural sector.

However, there is a discrepancy between the volume of lending and the results of activities obtained by agribusiness entities. The growth of the loan portfolio of banks, aimed at this area, is accompanied by miscalculations in the implementation of prudent credit policy and assessment of customers' creditworthiness.

That is why it is necessary to find approaches, forms and methods to improve the system of lending to businesses in the agricultural sector of the economy in order to create favourable conditions for economic growth.

2. Literature Review

Researchers from different countries of the world are engaged in the study of agricultural development and the problems of its financing for a long period of time, as evidenced by publications dated from different time periods. Most researchers focus on improving the regulatory framework and bringing it in line with modern needs, simplifying the provision of administrative services for agricultural producers, studying the availability of financial resources for agricultural producers, ensuring uninterrupted sales, providing producers with access to knowledge and services, ensuring the development of the subsector, etc.

The content, functions and features of credit and credit relations were reflected in the scientists' papers: Azarenkova, Belenkova (2011), Azarenkova et. al. (2013), Dekhtyar et. al. (2018), etc. The specifics of lending in the agricultural sector of the economy are described in the papers by such authors as Berezina (2013), Gerasimova (2010), Gubenko (2010), Gudz (2017), Hutorov et. al. (2018), Jankelova et. al. (2017), Kucher et. al. (2019), Krasnorutskyy (2013), Lyashenko, Kotenko (2016), Yatsiv (2013) and others.

The agricultural credit policy in developing countries is considered by (Schaefer-Kehnert, Von Piachke, 2020).

Serebrennikova et. al. (2020) identify the characteristics of subjects of lending to agricultural enterprises; expand the understanding of the essence of the Bank's social functions and determine the significance of State regulation of agricultural lending.

The innovation policy of the agricultural sector is studied by Berezina (2013). The agricultural sector financial ensuring mechanism in crisis conditions is proposed in a paper by Gerasimova (2010).

Agricultural product competitiveness is considered by Gubenko (2010), Martynchyk (2014) and Yatsiv (2013). Strategic management of the agrarian sector of the economy based on the analysis of value chains is described by Hutorov et. al. (2018). Development prospects of Ukraine's foreign trade in agricultural products in the context of European integration and global challenges are presented by Matyushenko et. al. (2018). But these studies have not attempted to determine the relationship between access to credit and various factors, for example, agricultural production.

The state and the main problems of the credit mechanism in agriculture of Ukraine are described by Dadashev, Cheremisina (2012). They summarize the characteristics and the necessity of collateral activities of agricultural producers in modern economic conditions. They identify the main causes hindering the intensification of credit facilities in the agricultural sector and the basic directions of the stabilization mechanism of agricultural lending units. The authors emphasize that for banking institutions credit relations are risky. The main types of risks include seasonality of production and demand for products (and it's related to fluctuations in cash flow and borrower solvency), high dependence of business results on weather conditions, insufficient liquidity of the collateral offered to secure the loan; the necessity for the creditor to form significant insurance reserves to cover possible losses from credit operations, which reduces the profitability of these operations, the underdevelopment of the insurance market in the country, which now provides agricultural producers with formal insurance protection. This point of view is also used by Bezrodna et. al. (2019). But in our opinion, this conclusion is one-sided, because, in addition to the risks that agricultural enterprises' lending operations carry to banks, credits are also active bank operations, on which the bank earns and without which the normal functioning of a commercial bank and the banking system as a whole is impossible.

Ascui, Cojoianu (2019) develop a natural capital credit risk assessment framework based on a bottom-up review of the material risks associated with natural capital impacts and dependencies for Australian beef production. It demonstrates that implementing natural capital credit risk assessment is feasible in agricultural lending, using a combination of quantitative and qualitative inputs. Implementation challenges include the complexity and interconnectedness of natural capital processes, data availability and cost, spatial data analytical capacity, and the need for transformational change, both within lending organisations and across the banking sector.

The agricultural sector has certain features of capital formation within the financial system of the state. This is reflected in the requirements and approaches to the development of

financial policy by the state and in the corresponding mechanism for its implementation. Being an important tool within this mechanism, lending is aimed at ensuring the economic growth of the agricultural sector. State support facilitated the system of subsidizing loans by providing funds to reduce the cost of loans for farmers in Ukraine, thus encouraging increased productivity in the agricultural sector at the initial stage. However, gradually, this caused a debt agricultural economy that became dependent on the state and started negatively affecting the elimination of structural, intersectoral, and territorial disparities in the agricultural sector (Lemishko, Schevchenko, 2021). We agree with the authors that a high level of credit dependence is negative. In addition to the factors mentioned by the authors of the debt dependence of the agrarian economy on the state, we would like to add that the use of credit funds also increases the level of expenses of agricultural enterprises for servicing the loan. High demand for credit funds also contributes to the growth of interest rates, which is also negative. Therefore, in our opinion, an optimal balanced ratio between supply and demand for credit funds should be ensured.

Toth et. al. (2019) describe the impact of integration and globalization on business risk and loans in Slovak agriculture. They say that the decrease in employment in agriculture is a result of technological progress, changes in individual family preferences and low income in agriculture in comparison to other sectors of the economy. In production commodities with low labor input dominate. Cereals, oilseeds and industrial crops dominate the agriculture production in Slovakia. Large farms benefit in the form of an economy of scale and the agricultural output of farms remains low in Slovakia. The paper compares the risk of crop and animal production based on individual farm data using Markowitz's portfolio theory. Crop production is more risky due to the higher effects of weather conditions compared to animal production. The second part of the paper evaluates the changes in the access to credit and finance gap of farms in Slovakia. Based on individual interviews with representatives of demand and supply of loans the paper concludes that large the Common agricultural policy is playing a dominant role in access to credit. Banks consider the CAP subsidies to be a stable income factor and good collateral for loans. The loan market is dominated by short-term loans and the majority of the market offers are coming from 4 commercial banks. The finance gap exists towards small farmers and farmers with animal production and special crops. Our analysis of Financial needs in the agriculture and agri-food sectors in Slovakia, 2020 largely confirms Toth et. al. (2019) research and showed that the key elements of financial demand from the Slovak agriculture sector are:

- Slovak farmers are less worried about rising production costs and declining output prices, compared to the EU-24;
- farmers mostly apply for short and medium-term loans;
- loans are used for working capital needs and investments in machinery, buildings and land;
- loans are a major source of external financing and the uptake of loans has been increasing since EU accession in 2004;

- as much as 75% of agriculture loans are directly linked to CAP support measures, according to banks interviewed. This is because RDP support catalyses investment loans and CAP direct payments are used as guarantees;
- Slovak farmer's loan applications are rejected more often than the EU-24 average;
- banks reject loans applications due to an economically unviable project or an unviable farm, a lack of sufficient collateral, a lack of credit history and the high investment risk of new entrants;
- small-sized farms and young farmers have particularly low access to loans due to poor credit history, a lack of collateral and because they are often considered economically unviable.

Stoeva, Dirimanova (2021) analyze the changes in Bulgarian agriculture which is characterized by great intensity and dynamics, as well as the dynamics in the development and specificity of land relations in Bulgaria in the context of the CAP. The results pointed out the fragmentation of the use of agricultural land and the existence of a large number of small farms. In Bulgaria in recent years, extensive farming has been given a strong impetus at the expense of intensive farming, a process that is of a sustainable nature and has a clear causal link.

Fecke et. al. (2016) investigate the influencing factors of loan demand in agriculture. The authors find that interest rate, GVA, grace periods and farmers' business expectations have significant effects on the loan demand in agriculture. According to the results, the interest rate has a significant negative effect, whereas the granted grace periods, the GVA in agriculture and farmers' business expectations have significant positive effects on the loan demand.

Osabohien et. al. (2022) examine how agricultural sector performance will be enhanced in Nigeria through access to credit. Results showed that agricultural credit proxied by the agricultural credit guarantee scheme fund (ACGSF) and commercial bank credit to agriculture significantly increased agricultural performance by 10.30% and 17.05% respectively. Also, other explanatory variables included in the model (arable land and agricultural employment) tend to increase agricultural performance by 65.51% and 12.40% respectively. Based on findings, the study recommended that farmers should be provided with sufficient access to credit which will enhance their ability to purchase agricultural inputs required to increase productivity. In our opinion, this research confirms the significant role of credit in ensuring the agricultural complex efficient functioning.

Demyanenko (2016) gives methodical recommendations on credit support for agricultural producers. According to Demyanenko (2016) regardless of the pricing of the factors in the credit market, agricultural enterprises need to set a low fee for the use of credit resources. This objective requirement is due to the low profitability of agricultural production, compared with other industries national economy and, consequently, the inability to pay to the creditor the market interest for the received credit.

Despite the existence of papers related to the agricultural enterprises' creditworthiness assessment, there are no end-to-end diagnostic models that make it possible to assess the

effectiveness of the use of credit funds at various levels of the hierarchy (macro, regional, micro), which can improve the coherence of economic policy.

Lending to the agricultural sector in Ukraine remains one of the main obstacles to the effective development of agriculture, which is manifested mainly in ignoring the specifics of agricultural production and the specifics of the agricultural sector in lending, which highlights the need to improve methodological tools for lending to the agricultural sector.

The limited capacity of agricultural enterprises to use financial instruments is explained by:

- the presence of specific risks in the activities of farms, which, accordingly, restrains the demand for credit services;
- low supply of credit services to agricultural enterprises by financial institutions;
- low level of use of existing credit instruments in the interaction of agricultural enterprises and financial institutions.
- At the same time, the limited state financial support of agricultural enterprises in Ukraine is due to:
- change of organizational and legal forms of the subjects of the agricultural sector;
- the destruction of the existing resource base of agricultural producers in connection with the transition to market principles of management;
- inconsistencies, contradictions, and fragmentation of measures of state regulation of the agricultural sector;
- the presence of numerous violations in the existing system of state financial support of agricultural enterprises, including and due to a subjective factor.

Currently, the unresolved problems of lending to agricultural enterprises remain:

- expensive banking resources and imperfect lending mechanisms for the agricultural sector;
- the limited ability of credit unions to lend to agricultural enterprises, on the one hand, and distrust of agricultural enterprises themselves to these financial institutions, on the other hand;
- insufficient collateral for agricultural producers and underdeveloped use of warehouse certificates by farmers as collateral for loans.

However, the adequate applied decision-making tools in these areas are insufficiently studied, which is proposed in this article for solving all development-related issues (finance, regulation, potential, and accessibility to certain resources and market sectors). Given the unresolved issues, this article is devoted to improving credit mechanisms, improving the borrower's creditworthiness assessment on the bases of integrated application of multidimensional analysis methods, and methodological approaches to the borrower's creditworthiness assessment of the agricultural sector.

3. Common Fundamentals

The research is based on the confirmation of the following empirical hypotheses:

Hypothesis 1. Effectively attracted credit funds and investment resources have a positive effect on both the agricultural sector's rate of growth and its marginality.

Hypothesis 2. There are regional, spatial, and structural imbalances in the availability of credit resources and the efficiency of their use. There is a discrepancy between the lending volume and the economic results obtained by agricultural enterprises.

Hypothesis 3. The dominant influence on the creditworthiness level of agricultural market subjects is formed by a set of different-level factors that depend on natural and climatic, economic, political, institutional, informational, legal, and technical conditions of functioning.

Hypothesis 4. The risks of lending to the agricultural sector are determined by a significant number of external and internal factors. System-providing risks, system-forming risks, mortgage risks, natural and climatic risks, and production risks are distinguished as dominant.

The development of a model basis of end-to-end analytics will make it possible to assess the level of efficiency of the use of credit resources, identify imbalances in regional development and regions with maximum returns for agricultural enterprises, and identify specific risks and factors for making more informed decisions of credit resources management.

To realize the article's purpose, a complex toolkit of modelling in the direction of their influence on agricultural enterprises indicators according to the scenarios of the development was proposed, which involves the implementation of the following stages:

1. Determination of the goals and objectives of the development of agricultural enterprises crediting.
2. Analysis of the current state of lending to agricultural enterprises.
3. Planning measures for the regional development of agricultural enterprises.
4. Assessment and forecasting of the agricultural enterprises' creditworthiness.
5. Making decisions regarding the improvement of lending to the agricultural sector of the economy.
6. Controlling the results and correction of credit activities of business entities in the agricultural sector of the economy.

The following methods of scientific research were used in the research process:

- comparative and factor analysis (for identifying specific features of the classification of lending to the agricultural sector);
- discriminant analysis (for assessment of the classification function for agricultural enterprises classes);
- univariate and multivariate variance analysis (for determination of the differences between the creditworthiness class and the size of agricultural enterprises);

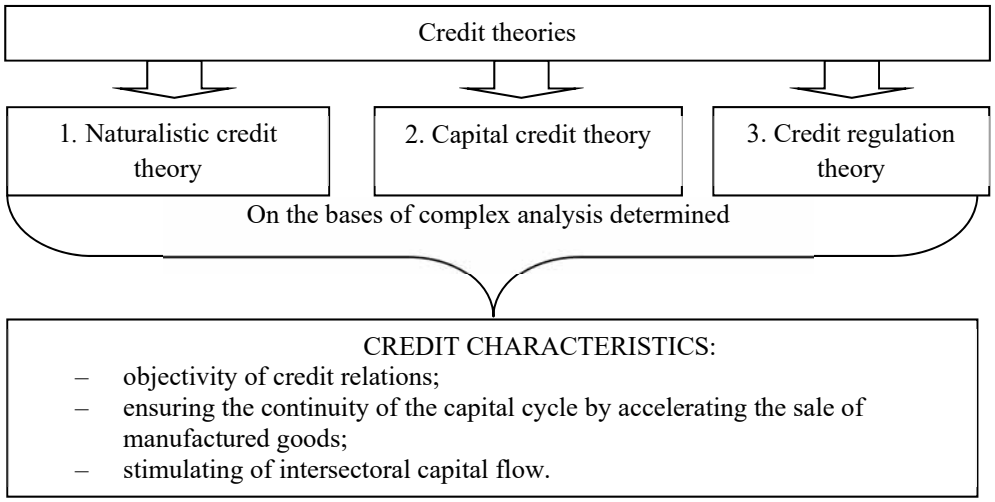
- methods of factor analysis (for confirmation of the hypothesis of grouping agricultural enterprises' credit risks by components);
- hierarchical and iterative methods of cluster analysis (for the selection of agricultural enterprises classes according to the risk level);
- models of fuzzy sets (for determination of the correspondence between the credit risk level and the change in the agricultural enterprises' creditworthiness level).

The choice of research modelling methodology is determined by the following advantages, which are implemented in the paper:

- wide possibilities of usage, especially in conditions of uncertainty and risk;
- convenience in combination with other economic and statistical methods;
- a set of statistical evaluations of the effectiveness of lending to agricultural enterprises and its impact on the regional development of the agricultural sector;
- dynamic spatial analysis of agricultural enterprises' credit risks;
- creditworthiness management scenarios for agricultural enterprises and financial institutions.

The article highlights the credit characteristics and substantiates the use of a complex approach to determine credit by different theories, which makes it possible to interpret the credit origin (see Figure 1). The systematization of factors (climatic, economic, social, legal, and institutional) in the agricultural sector was done, which allows us to take into account their impact when assessing the risks of loan non-repayment by the borrower.

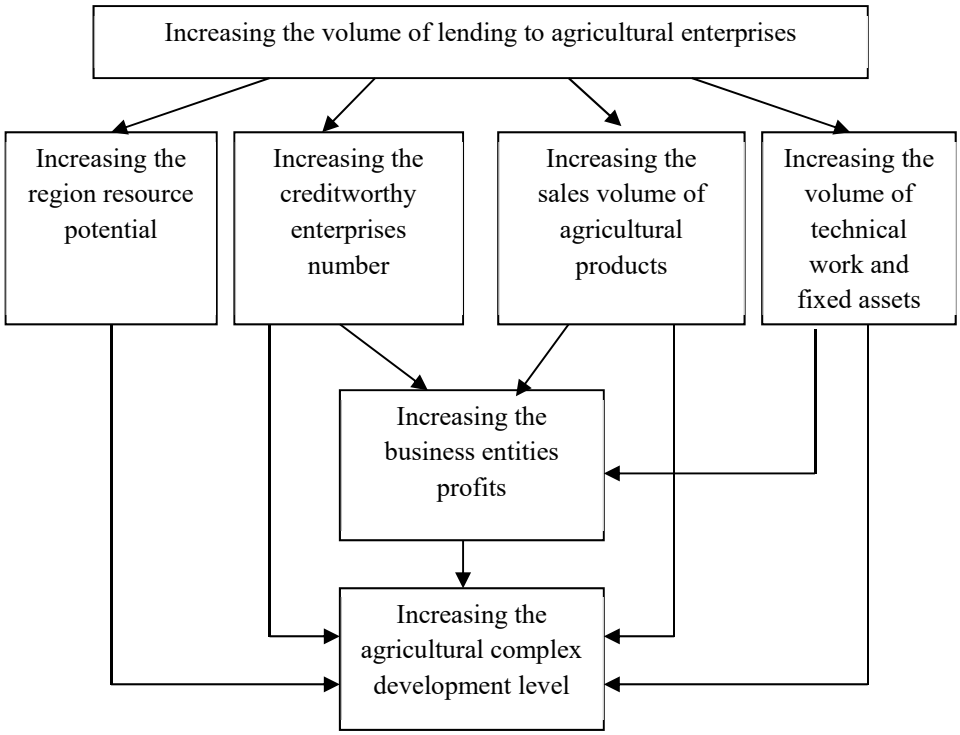
Figure 1. Characteristic features of credit according to various theories



Source: developed by the authors on the bases of Bezrodna et. al. (2019), Jankelova et. al. (2017).

It should be noted that the increase in lending will affect the agricultural complex effectiveness (see Figure 2).

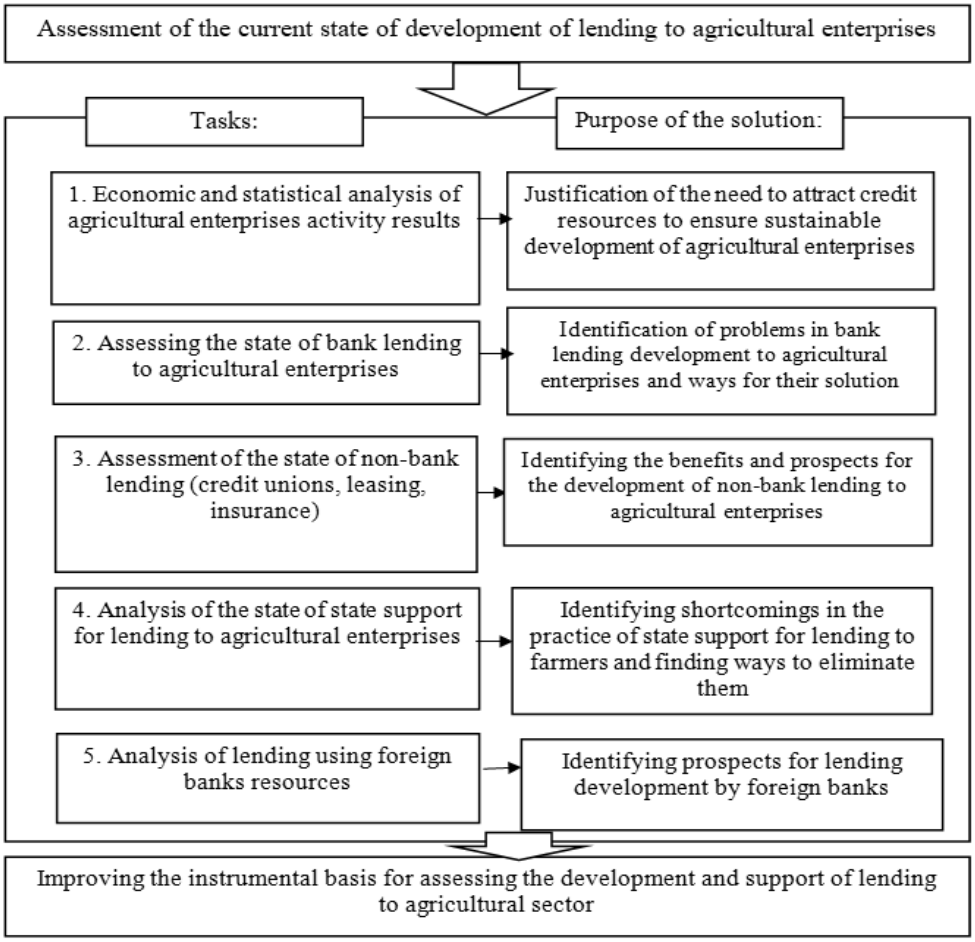
Figure 2. Influence of lending level on the efficiency of agricultural complex activity



Source: developed by the authors on the bases of Krasnorutskyy (2013), Kucher et. al. (2019).

Assessment of the current state of lending to agricultural enterprises makes it possible to analyze the opportunities for farmers to access credit resources from various sources, the feasibility of attracting credit resources and conditions for their provision, to identify shortcomings in the agricultural credit system that exists today in Ukraine based on which it is possible to develop an effective instrumental basis for the development of financial and credit mechanism to support the agricultural sector. For this purpose, it is necessary to solve such tasks (see Figure 3).

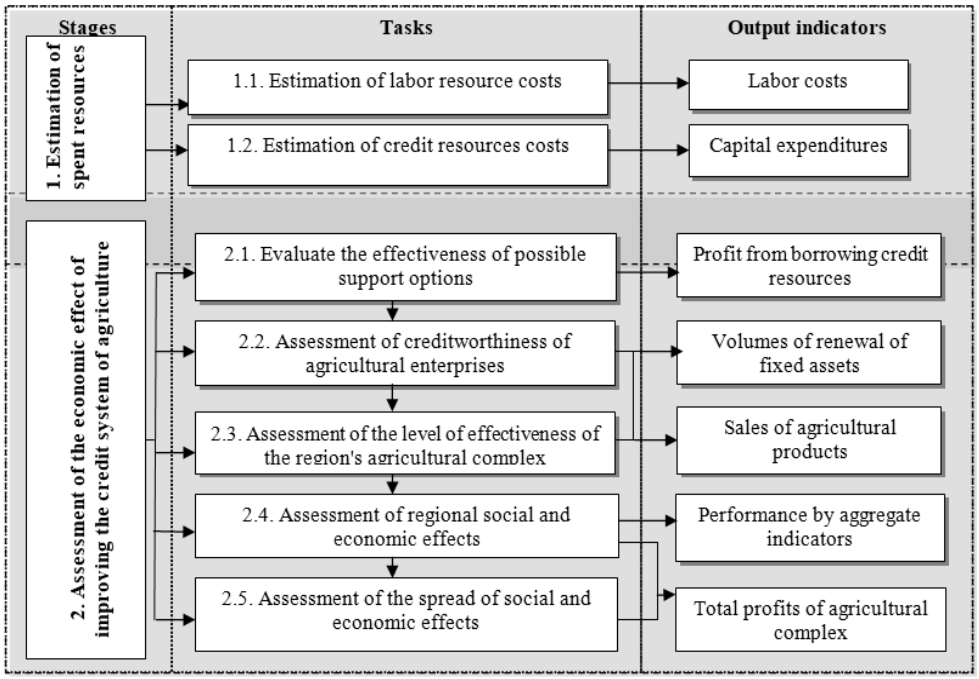
Figure 3. The main tasks of the research of the lending development state to agricultural enterprises



Source: developed by the authors.

To take into account the whole set of factors that affect the effectiveness of agricultural enterprises, the assessment of the effectiveness of support should be complex and solve such a set of tasks shown in Figure 4.

Figure 4. A set of tasks to assess the effectiveness of improving the lending system of agricultural enterprises

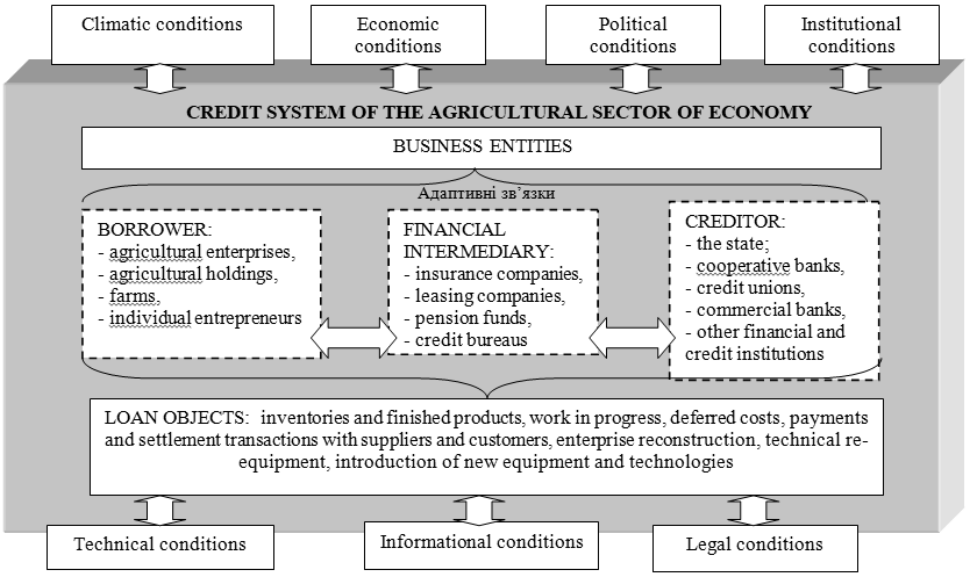


Source: developed by the authors.

The agricultural sector credit system's effectiveness depends on taking into account the climatic, economic, political, institutional, informational, legal and technical conditions. The purpose of this system is to ensure the continuity of the capital cycle by increasing production, accelerating agricultural products sale, and stimulating the process of reproduction and development of the agricultural sector of the economy (Figure 5).

It is proved that the factors of the institutional environment have a stabilizing effect on agricultural production development. The institutional factors in modern conditions can become the most important for lending to the agricultural sector of the economy. The main influence of institutional factors is manifested through formal and informal institutions. It was found that the interests of formal institutions do not always correspond to the interests of informal institutions, which leads to a mismatch between the interests of participants in the credit process.

Figure 5. Credit system of the agricultural sector of economy



Source: developed by the authors on the bases of Lyashenko, Kotenko (2016).

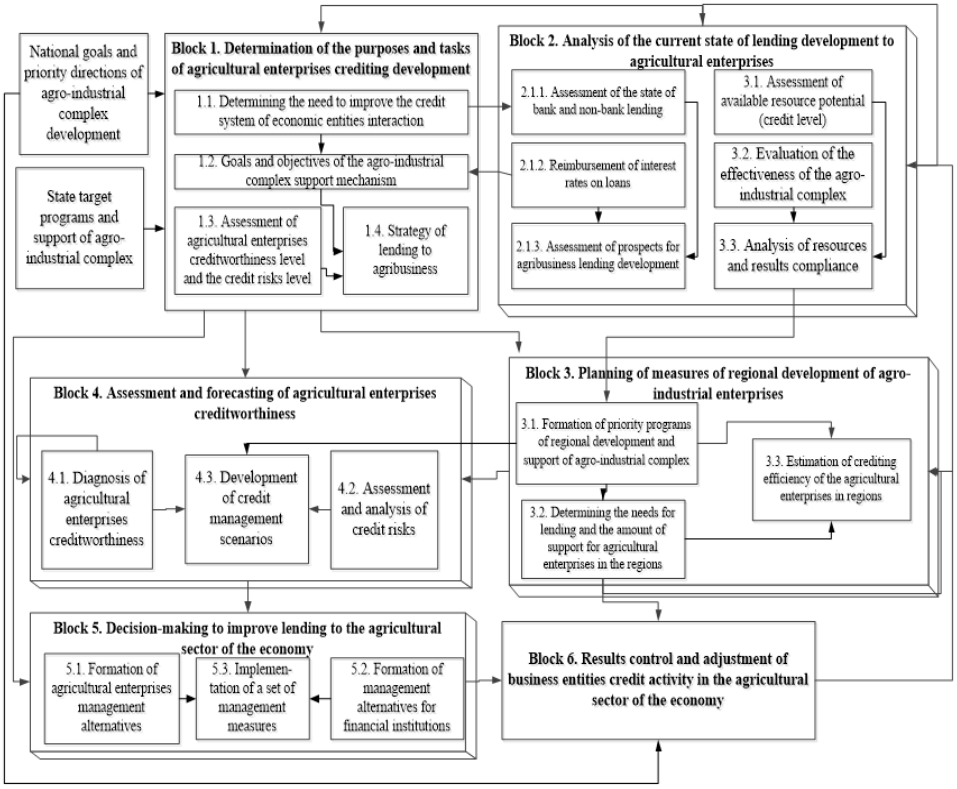
An important role is given to the analysis of the specifics of lending in the agricultural sector, which indicates a shortage of working capital and high-interest rates, the inefficiency of agricultural production, the low creditworthiness of the borrower, and the predominance of short-term lending.

The generalization of the main approaches to determining the essence of the lending tools to agricultural entities makes it possible to clarify the economic forms and methods of relations between the state, credit institutions, and economic entities to ensure food security.

Analysis of the current state of lending to Ukraine's agricultural enterprises shows significant problems in lending development to agricultural enterprises, due to the inefficiency of the administrative and organizational structure of credit management, as well as the underdeveloped financial and credit systems to support the agricultural sector and modern credit programs.

To overcome the shortcomings and improve the management system in the paper we propose methodological tools for lending to agricultural businesses entities, which involves the interaction of three levels of the management hierarchy – macro-, meso- and micro-levels (state – region – agricultural enterprises) and aims to improve the financial and credit system to support the agricultural sector and identify management scenarios in accordance with the priority areas of agricultural sector development (Figure 6).

Figure 6. Methodical tools for lending to agricultural businesses entities



Source: developed by the authors on the basis of the material by Sergienko, Gula (2018).

To assess the effectiveness of agricultural sector support processes in the regions, a set of economic and mathematical models were built on the bases of econometric production functions, which make it possible not only to calculate the necessary criteria, conduct a complex analysis but also use models to predict efficiency indicators, study the impact of changes in production factors and expenditure of resources on agricultural enterprises results, develop recommendations for each situation.

Production functions models for lending effectiveness assessing agricultural enterprises in Ukraine regions are given in Table 1. Data for the construction of models are taken from the official website of the State Statistics Service of Ukraine and the official websites of agricultural enterprises, where financial statements are published.

Table 1. Production functions models for lending effectiveness assessing to agricultural enterprises in Ukraine regions

№	Variables of production functions models	Assessment of adequate
1 (X19)	X19 – Products of agricultural enterprises X9 – Short-term loans volumes X4 – Labor costs	$x_{19} = 25.28 \cdot x_9^{0.094} \cdot x_4^{0.786}$ R=0.966; F=417.35
2 (X7)	X7 – Net profit (loss) X9 – Short-term loans volumes X4 – Labor costs	$x_7 = 0.106 \cdot x_9^{0.284} \cdot x_4^{1.411}$ R=0.905; F=79.85
3 (X7)	X7 – Net profit (loss), X9 – Short-term loans volumes, X22 – Number of employees in agricultural enterprises	$x_7 = 6.265 \cdot x_9^{0.237} \cdot x_{22}^{1.63}$ R=0.902; F=77.46
4 (X7)	X7 – Net profit (loss) X13 – Amount of financial support for farms on a revolving basis X22 – Number of employees in agricultural enterprises	$x_7 = e^{6.57+0.0007x_{13}+0.061x_{22}}$ R=0.924; F=93.52
5 (X14)	X14 – Average volume of agricultural production by farms, X13 – Amount of financial support for farms on a revolving basis X22 – Number of employees in agricultural enterprises	$x_{14} = e^{5.52+0.685 \cdot x_{13}+0.0075 \cdot x_{22}}$ R=0.967; F=396.03

Source: developed by the authors using Statistica.

The analysis of the economic efficiency of agro enterprises of Ukraine regions makes it possible to conclude that even the presence of a high level of lending without a reasonable, clearly defined, adequate strategy of credit funds usage will not ensure high efficiency of their activities which demand agricultural enterprises lending improvement in accordance with the level of their creditworthiness, taking into account the whole set of credit risks.

The paper proposes an approach on the bases of the spatial multi-element matrix of compliance of the components and is the basis for assessing the impact of lending efficiency on the results of agricultural enterprises in accordance with their groups and allows us to determine individual features of the studied process in regions to select regulatory levers. Evaluation of the efficiency of the agro-industrial complex in the region is proposed by (Gudz, 2017). The organizational and economic measures to support lending to agricultural enterprises at different levels are presented in Table 2.

On the bases of Ukraine's region positioning, according to the level of results of agricultural enterprises' activity and their lending activity, the matrix of development directions has been developed taking into account the level of agricultural development of the regions (Tab. 3). It is proved on the bases of the obtained results, that the strategic line of agro enterprises crediting by regions according to the agricultural development level of regions is the transition from mainly basic support of agricultural enterprises crediting to crediting and financing of their specific projects that ensure the activity effectiveness for all management levels on the basis of certain directions of credit development taking into account the agro enterprises' creditworthiness level.

Table 2. Organizational and economic measures to support lending to agricultural enterprises

Management level	Organizational and economic measures
State	Reforming the legal, judicial and executive systems to provide support for lending to the agricultural sector
	Improving the legal framework for lending to agricultural enterprises
	Ensuring the implementation of crops with seeds of varieties and hybrids of high reproductions, compliance with modern technologies on the terms of preferential lending
	Introduction of mechanisms to reduce the cost of loans to farmers at the legislative level with the involvement of state banks
	Development of a sound concept of reforming the insurance system in agriculture
	Involvement of international banking and other financial institutions in lending (investing) the agricultural enterprises' development
Regional	Creating favourable economic and financial conditions for the cooperation of agricultural enterprises and the development of rural communities
	Establishment of regional centres for the cooperation of agricultural enterprises, credit institutions and innovation centres for small and medium business development in the agricultural complex
	Introduction of tax benefits aimed at stimulating regional development of agricultural enterprises
	Expansion of elements of agricultural lending infrastructure
	Implementation of targeted programs of the regional development of agricultural complex with the provision of targeted lending
	Organization of management consulting and measures for entrepreneurs' financial literacy improving
Entrepreneurial	Organization of monitoring of information on available agribusiness lending services, search for favourable conditions, consultations with specialists
	Search and implementation of ways to increase the enterprise's creditworthiness
	Finding ways to update production technologies, use leasing of machinery and equipment
	Participation in regional and state-targeted lending programs for agricultural enterprises
	Participation in regional events of management consulting and entrepreneurs' financial literacy improving

Source: developed by the authors.

Table 3. Matrix of crediting development directions of agricultural enterprises by regions

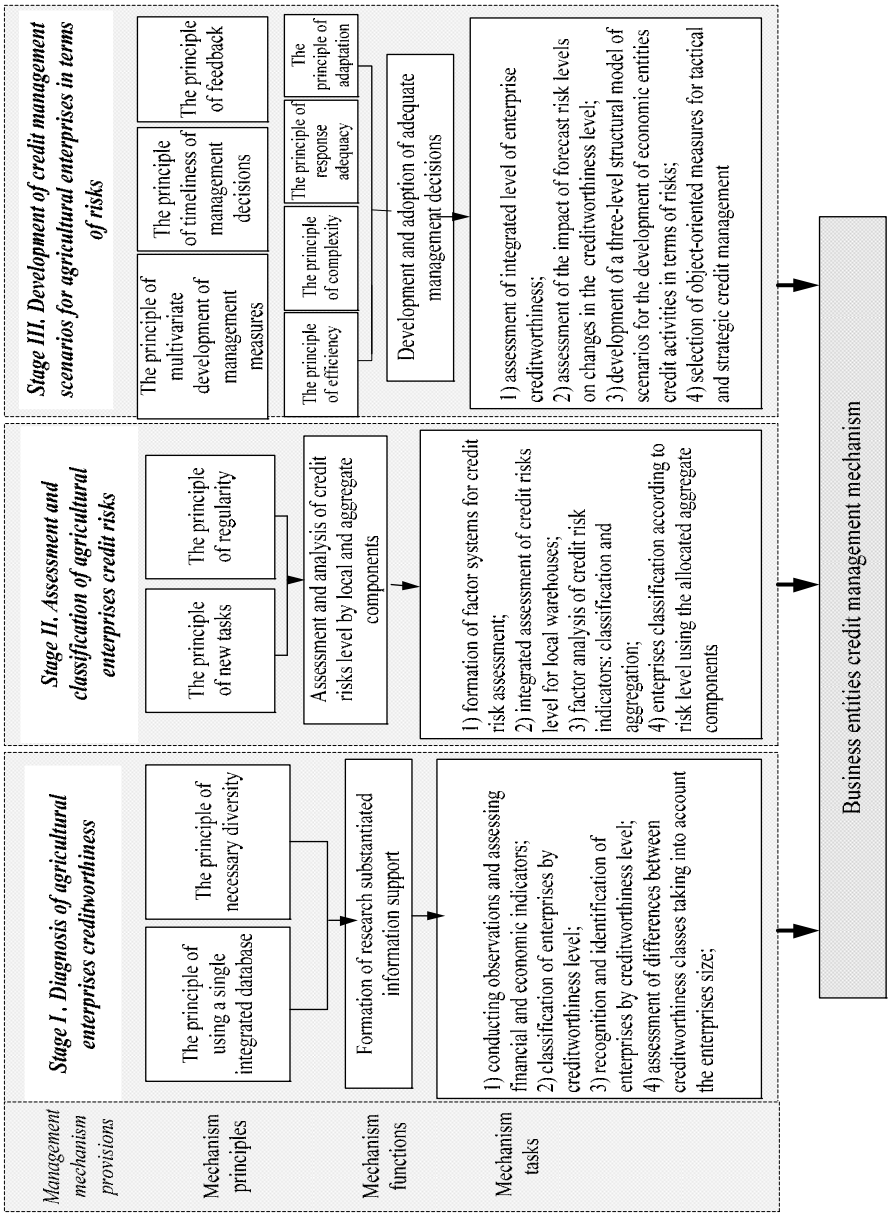
Activity results level				
	High	*Stimulation-investment* (Vinnytsia, Dnepropetrovsk, Poltava regions)		*Investment stimulation (*Kyiv, Kharkiv, Cherkasy regions)
	Medium	*Compensation-stimulation* (Zaporizhia, Sumy, Khmelnytskyi, Chernihiv regions)		*Stimulation-support* (Kirovohrad, Mykolaiv, Odessa, Kherson regions)
	Low	*Compensation- support* (Lviv and Ternopil regions)	*Stimulation- compensation* (Volyn, Donetsk, Zhytmir, Zakarpattia, Ivano-Frankivsk, Luhansk, Rivne, Chernivtsi regions)	
		Low	Medium	High
		Agricultural enterprises crediting level		

Source: developed by the authors on the bases of Gudz (2017), Martinchik (2014).

The paper proposes a complex credit management mechanism for agricultural enterprises on the bases of a process approach which is studied in papers by Ayvazyan et. al. (1989), Dubrov, Troshin (1998), Klebanova et. al. (2018).

The principles, functions, and tasks of the proposed mechanism are presented in Figure 7.

Figure 7. Principles, functions and tasks of agricultural enterprises credit management mechanism



Source: developed by the authors.

According to the method of creditworthiness diagnostics, we have obtained 3 discriminant recognition functions for the studied sample of 14 agricultural enterprises:

$$\begin{cases} Z_1 = -73,39 + 2,55 \cdot K_3 + 6,21 \cdot K_4 + 3,52 \cdot K_5 + 16,17 \cdot K_6 + 37,43 \cdot K_7 - 19,15 \cdot K_8 + 23,79 \cdot K_9 \\ Z_2 = -4,86 + 1,56 \cdot K_3 + 3,78 \cdot K_4 + 2,24 \cdot K_5 + 5,96 \cdot K_6 + 5,73 \cdot K_7 - 0,49 \cdot K_8 + 3,27 \cdot K_9 \\ Z_1 = -40,12 + 3,39 \cdot K_3 + 17,24 \cdot K_4 + 5,11 \cdot K_5 + 23,59 \cdot K_6 + 19,71 \cdot K_7 - 0,24 \cdot K_8 + 4,45 \cdot K_9 \end{cases} \quad (1)$$

where Z – integral indicator; K_3 – coefficient of financial independence; K_4 – a ratio of non-current assets to equity; K_5 – return on equity; K_6 – coefficient of profitability of sales by financial results from operating activity; K_7 – coefficient of profitability of sales on financial results from ordinary activity; K_8 – return on assets for net income; K_9 – turnover ratio of current assets.

For the selection of the most important factors in each of the creditworthiness classes, the impact of certain indicators on the results of the discriminant analysis was assessed. The influence of indicators on the vaporization of the dependent variable (discriminant function) is stored according to the formula:

$$R_{\kappa_j} = \frac{|a_j^*|}{\sum_{j=1}^{m} |a_j^*|} * 100\% \quad (2)$$

where R_{k_j} is the influence value of the j-th (in percentage) factor variable (Kj) on the variation of the dependent variable; $|a_j^*|$ is the modulus of the indicator value (K_j).

For enterprises with a sufficient creditworthiness level, the largest impact of the variable K_7 is observed, and for enterprises with a low and satisfactory level of creditworthiness – K_6.

The methods of variance analysis used in the study of agricultural enterprises' creditworthiness allowed us to determine the nature of the differences for their study population; test the hypothesis of the influence of factors and their interrelation at the appropriate significance level. The result is an assessment of agricultural enterprises' creditworthiness indicators variability, due to the action of each of the studied independent variables, the interaction of their totality, and random factors.

The agricultural enterprises' efficiency, as well as the level of their creditworthiness as a result indicator of the effectiveness of financial and economic activities largely depend on the risks level caused by a large number of factors of the internal and external environment that directly affect their goals, strategy, and tactics. By the proposed mechanism for agricultural enterprises' creditworthiness management, the following tasks of assessing and classifying their credit risks have been solved:

1) formation of a system of factors for credit risks assessment;

2) integral assessment of credit risks level by local components;

3) factor analysis of credit risk indicators, their classification, and aggregation;

4) classification of enterprises by risk level by selected aggregate components.

The results of factor analysis of the studied agricultural enterprises on the formed local indicators of credit risks and their components are presented in Table 4.

Table 4. Results of factor analysis of credit risk classes for agricultural enterprises

Components of aggregate credit risk classes	Designation of factors / (variance percentage)	Designation of local risk groups	Informativeness coefficient	Name of local credit risk components / (factor loading)
System providing risks	F2 (18.44%)	(R_vr)	0.87	currency risk (0.86)
		(R_dr)		government regulation risk (0.93)
System forming risks	F4 (10.53%)	(R_pr)	0.79	interest rate risk (0.7)
		(R_ir)		inflation risk (0.82)
		(R_zr)		price risk (0.78)
Mortgage risks	F1 (37.29%)	(R_zl)	0.8	liquidity decrease risk (0.75
		(R_vz)		risk of collateral loss (0.69)
Natural and climatic risks	F3 (14.69%)	(R_tk)	0.78	temperature fluctuations (0.9)
		(R_o)		precipitation (0.5)
		(R_v)		wind (0.61)
Production risks	F5 (9.68%)	(R_vtv)	0.81	risk of crop or it part loss (0.73)
		(R_zpr)		risk of productivity decrease (0.95)
		(R_tech)		technological risk (0.60)

Source: developed by the authors.

The aggregate classification of enterprises by the credit risk level on the bases of cluster analysis methods is presented in Tab. 5, where: L – low, M – medium, H – high-risk level.

Table 5. Classification of agricultural enterprises by aggregate components of credit risk on the bases of cluster analysis methods

№	Name of agricultural enterprise	R1	R2	R3	R4	R5
1	PJSC “Gunivskaya Agro Firm”	M	L	M	M	H
2	PJSC Agro Firm “Verbivske”	H	L	L	H	M
3	PJSC “Ohoche”	H	M	H	M	L
4	PJSC Agro Firm “Provesyn”	H	M	H	H	L
5	PJSC Agro Firm “Rosia”	L	H	M	H	H
6	OJSC Malovyskivska Agro Firm “Agrotechservice”	L	L	H	L	H
7	PJSC “Agro Firm named after G. S. Skovoroda”	H	M	L	H	M
8	JSC “Ukraina”	H	H	L	H	L
9	PJSC Agro Firm “Yatran”	M	M	L	L	M
10	OJSC «Agro Firm “Globyvska”	L	M	M	M	H
11	OJSC Agro Firm “Zorya Novobuzya”	H	H	M	H	H
12	CJSC “Kolos”	M	L	L	H	L
13	CJSC Agro Firm “Sumy-Nasinna”	H	L	H	L	H
14	CJSC 14 “Tsukrove”	L	M	M	H	L

Source: developed by the authors on the bases of (Sergienko et. al., 2013).

The implementation of the results of the assessment, analysis, and classification of credit risks will increase the validity of management decisions and the efficiency of agricultural enterprises; improve the policy of credit development in the agricultural sector.

The implementation of solutions for creditworthiness management is ensured by developing, selecting, and implementing scenarios for managing the activities of agricultural enterprises by coordinating forecast estimates of trends in their development and the impact of negative factors on them.

The credit management principles are the basis for building a model of formation and selection of alternatives for improving its management, which are offered in the form of a cube of situations and allow us to solve two main tasks: positioning the real creditworthiness state on the bases of two-levels assessment due to structural elements; identification of possible and promising transitions to those cube quadrants that allow us to achieve the main goal of agricultural enterprises' creditworthiness level increasing.

The structural form of the model of formation and selection of scenarios for agricultural enterprises development in terms of risks is:

$$SK_t = \{UK_t; \mathrm{UR\_ZS}_t; \mathrm{UR\_VS}_t\} \quad (3)$$

where:

SK_t – a set of scenarios for the agricultural enterprises lending development;

UK_t – general integral enterprise's creditworthiness level on the rating scale;

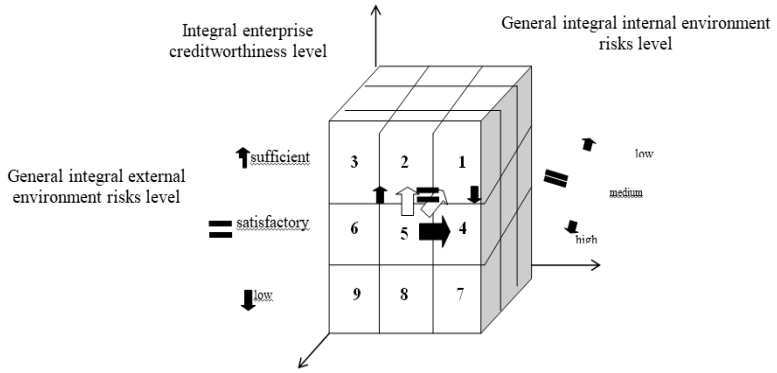
UR_ZS_t – general integral external environment risks level according to the components of the assessment;

UR_VS_t – general integral internal environment risks level according to the components of the assessment.

Methods of forming scenarios for socioeconomic systems development are described by (Kulba, 2004). Multilevel structural models of development scenarios of the international trade market subjects in the agricultural sector in the conditions of risks are proposed in the paper (Shapran et. al., 2019). The model of formation and selection of credit management alternatives for agricultural enterprises is presented in Figure 8.

The comparison of the research results is the basis for the development of a set of management measures depending on the option of credit management strategy as a systematic list of typical strategic and tactical financial decisions. Depending on changes in business conditions, the legal framework of the country, the expansion of risk factors of the external and internal environment, as well as the improvement of methods and approaches to credit management, the established set of measures may expand and change.

Figure 8. Situations cube of formation and choice of alternatives for agricultural enterprises credit management



Source: proposed and built by authors on the bases of Kulba (2004), Lepa (2006).

Complex analysis of agricultural enterprises lending, carried out in all possible directions, made it possible to solve the research objectives, highlight the main problems of lending to agricultural enterprises in Ukraine and shortcomings in financial and credit relations management at different levels, and identify key factors which influence on situation development and priority directions of crediting development.

4. Results and Suggestions

The proposed models for assessing the economic efficiency of agricultural enterprises lending allow us to assess the impact of the use of credit resources aimed at the effectiveness of their activities, as well as the problems of their lending in the regional context. Models for assessing the impact of lending on the level of production and net profit make it possible to predict the effectiveness of borrowing and justify the development of lending to agricultural enterprises in the regions of the country.

The developed and implemented methods for diagnosing the agricultural enterprises' creditworthiness, which make it possible to solve the following tasks: conducting observations and evaluation of financial and economic indicators; classification of enterprises by creditworthiness level; recognition and identification of enterprises by creditworthiness level; assessment of differences between classes in terms of creditworthiness. On the bases of the set of methods of multidimensional analysis, differences were identified both based on a one-dimensional assessment system (by creditworthiness class and size) and a two-level assessment of the combined cross-influence of factors on creditworthiness.

The proposed hypothesis of grouping and formation of credit risk classes of agricultural enterprises based on the application of factor analysis methodology makes it possible to distinguish five main groups of external and internal risks: mortgage risks such as liquidity

decrease risk, risk of collateral loss; system providing risks: currency risk, government regulation risk; system forming risks: interest rate, inflation and price risks; natural and climatic risks: temperature fluctuations, precipitation, wind; production risks: risk of crop or it a part loss, risk of productivity decrease and technological risk.

The proposed methodology of scenario planning on the bases of fuzzy logic improves the assessment of the degree of credit risks impact on the change of indicators of agricultural enterprises' activity for the development of appropriate preventive measures and measures to counteract risks and selection measures of strategic and tactic creditworthiness management taking into account creditworthiness level, risks of external and internal environments and the enterprise size.

So, the agricultural sector credit management system of the economy is a set of financial and credit relations and should implement the main management functions arising from the creation of certain conditions for finding, attracting and efficient usage of business entities' financial resources in the agricultural sector (Table 6).

Table 6. Problems of agricultural enterprises crediting and ways of their solution

Problems, shortcomings, factors of influence	Ways to solve problems
State	
difficulty of state support obtaining, which is based mainly on targeted subsidies, the possibility of corruption	introduction of the mechanism of granting to agricultural producers of the state support directed on maintenance of crops of agricultural seeds of grades and hybrids of high reproductions, observance of modern technologies requirements
imperfection of the legal framework for lending to agricultural enterprises, insecurity of creditors and landowners	improvement of the legal framework for lending to agricultural enterprises, introduction of mechanisms to reduce the loan cost to farmers at the legislative level with the state banks involvement
insufficient development of legal, judicial and executive systems to resolve disputes in the lending process	development of a sound concept of reforming the legal, judicial and executive systems to resolve disputes in the process of lending to agricultural sector
imperfection of the insurance system in the field of agricultural complex	development of a sound concept of reforming the insurance system in the field of agriculture
instability of competitive positions of domestic agricultural products in foreign markets	introduction of effective mechanisms for adaptation to European requirements for food quality and safety
instability and non-transparency of state policy in agricultural complex, reforms ineffectiveness	development of a concept of reforming the country's agricultural sector and improving the legal framework for agrarian reform based on borrowing foreign experience in reforming the agricultural complex, taking into account national characteristics and interests of farmers
incomplete land reform, lack of a unified register of land plots and their legal owners	land reform on the bases of foreign experience
lack of motivation for cooperation and increase of small agricultural producers within rural communities	creation of favourable economic and financial conditions for the cooperation of agricultural enterprises and economic basis for rural communities' development
lack of appropriate mechanisms for regulating the agricultural market and the prices level for basic types of agricultural products	regulation at the state level of adequate purchase prices for agricultural products
lack of effective mechanisms to protect the domestic market and measures to create favourable conditions for export	implementation of effective mechanisms to restrict imports of agricultural products, creating favourable conditions for agricultural export

Problems, shortcomings, factors of influence	Ways to solve problems
banks financial products for agricultural enterprises are characterized by a high level of interest rate volatility	establishment at the state level of fixed interest rates on loans for agricultural enterprises; use of non-bank lending instruments (credit unions, leasing companies, insurance companies, international financial organizations)
Banking institutions	
in regions with predominantly agricultural production there are no available financial products for clients-representatives of the agricultural sector	development of additional credit products for the agricultural sector taking into account the peculiarities of regional and sectoral development; improving the conditions of long-term lending by commercial banks
lending to agricultural enterprises is mostly short-term due to the complexity of risk assessment	development and implementation of effective mechanisms for assessing the risks of agricultural production and development of credit products for medium-term and long-term lending on affordable terms
complicated procedure for obtaining a bank loan	simplification of the procedure for obtaining bank loans, focused on micro agricultural enterprises
the difficulty of determining the amount and component of credit security	training of qualified specialists in assessing the volume and components of credit security or concluding agreements with relevant organizations providing such services
lack of qualified staff in the bank for assessment the financial condition and prospects of agricultural borrower	training of qualified specialists for assessment the financial condition of the agricultural borrower or concluding agreements with organizations that provide such services; usage of special means of calculation to assess the agricultural enterprises' efficiency
lack of sufficient information about appropriate credit product in a wide range of agricultural enterprises	search for additional channels for the distribution of banking credit services for agricultural enterprises
high level of calculation complexity of technical and operational indicators and estimation of the business plan in case of crediting of agricultural machinery purchase	training of qualified specialists in the calculation of technical and operational indicators and evaluation of the business plan in the case of lending for the purchase of agricultural machinery or concluding agreements with relevant organizations that provide such services
Agricultural enterprises	
high risk of an industry with a relatively low level of profitability compared to other economic sectors	improvement of methods of risk assessment and profits, involvement of insurance mechanisms; differentiation of agricultural production
growth of receivables for sold products	improving the system of settlements with counterparties
low efficiency of agricultural enterprises	finding ways to reduce costs, increase productivity and return on capital
outdated technologies of production and use of morally and physically worn-out equipment	search for ways to update production technologies, use of leasing of machinery and equipment
slowed turnover of funds at the production stage due to the long technological process	differentiation of agricultural production and activities to accelerate the funds turnover
financial ignorance of agricultural enterprises owners	monitoring of information on available agribusiness lending services, search for favourable conditions, consultations with specialists
gradual and uneven accumulation of costs	reimbursement of seasonal expenses at the credit in order to prevent the withdrawal of significant funds from circulation
non-compliance with the accounting requirements for agricultural enterprises economic and financial activities	improvement of the system of accounting for economic and financial activities at enterprises, control of accounting

Source: compiled and aggregated by the authors on the bases of (Gerasimova, 2010), (Jankelova et. al., 2017), (Sergienko, Gula, 2018).

5. Conclusion

As a main contribution of the article, the following elements can be singled out:

- improvement of financial instruments for increasing the efficiency of the agricultural sector and food security;
- improvement of the instrumental basis for diagnosing the effectiveness of the credit funds usage by agricultural enterprises;
- fundamental spatial and dynamic diagnostics at different levels of the hierarchy (macro, regional, micro), which makes it possible to increase economic policy consistency.

The results of lending to agricultural enterprises confirmed the objective need to improve the credit system to support the agricultural sector and lending tools for agricultural enterprises, which should include goals, objectives, problems of assessing resource development opportunities and assessing the effectiveness of agricultural business and become a central and basic prerequisite effective management at all levels.

The proposed methodological tools for lending to businesses in the agricultural sector of the economy involve the interaction of three levels of the management hierarchy: macro, meso and micro levels (state – region – agricultural enterprises) and are aimed at financial and credit system improving to support the agricultural sector and identification of management scenarios by the priority areas of agricultural sector development, which will assess the effectiveness of lending in accordance with the objectives, identify levers of regulatory influence and control the results of their implementation for business entities.

The practical significance of the obtained results lies in the use of methodological developments, recommendations, and proposals for improving lending to businesses in the agricultural sector, which can be considered as ways to increase the agricultural enterprises' financial security level. The results of complex research on lending problems of economic entities in the agricultural sector of the economy at all levels of the management hierarchy can be used to increase the management decisions level on the formation of strategic alternatives of credit relations development in unstable and even crisis environment.

The results of the research can be useful both for agricultural enterprises and for the authorities, which must pursue a balanced state agricultural policy, take care of farmers' financing, timely resource provision and ensure a stable, accessible, sufficient, safe, and balanced level of nutrition of the population. Our future research will focus on the interconnection between the financial indicators of agricultural enterprises and the food security level as well as the impact of climate change on agriculture development.

References

Ascui, F., Cojoianu, T. (2019). Implementing natural capital credit risk assessment in agricultural lending. – Business strategy and the environment, 6, pp. 1234-1249.

Ayvazyan, S. A., Bukhshtaber, V. M., Enyukov, I. S. (1989). Applied statistics. Classification and dimension reduction. Moscow: Finance&Statistics, p. 587.

Azarenkova, G., Belenkova, O. (2011). Rating evaluation as a method of determining the creditworthiness of bank borrowers. – Bulletin of the NBU, 1 (10), pp. 219-224.

Azarenkova, G., Holovko, O., Ilhovska, H. (2013). Development of financial potential of economic entities as a basis for achieving financial and economic security: a monograph. Kharkiv: KhNU. V. N. Karazin, pp. 429.

Bezrodna, O., Ivanova, Y., Onyshchenko, V., Lypchanskyi S. (2019). Systemic risk in the banking system: measuring and interpreting the results. – Bank and Bank Systems, 14 (3), pp. 34-47. Available at: http://dx.doi.org/10.21511/bbs.14(3).2019.04 [Accessed 05 October 2022].

Berezina, L. (2013). Innovative policy of agrobusiness enterprises: tactical and strategic aspects. – Marketing and innovation management, 4, pp. 122–132.

Dadashev, B. A., Cheremisina, S. G. (2012). Credit of agroformations: problems and directions of stabilization. – Bulletin of the Poltava State Agrarian Academy, 2, pp. 142-149.

Dekhtyar, N., Mazorenko, O., Serpukhov, M. (2018). Estimation of Ukraine's foreign trade structure in order to determine the areas of export potential. – Innovative Marketing, Vol. 14, N 3, pp. 30-43. Available at: http://dx.doi.org/10.21511/im.14(3).2018.04 [Accessed 05 October 2022].

Demyanenko, M. Ya. (2016). Methodical recommendations on credit support of agricultural producers. – Accounting and finance of agro-industrial complex, 12, pp. 4-29.

Dubrov, A., Troshin, L. (1998). Multidimensional statistical methods. Moscow: Finance and statistics, p. 350.

Economist Impact. Global Food Security Index 2022. Available at: https://impact.economist.com/sustainability/project/food-security-index [Accessed 19 September 2022].

Electronic book StatSoft. Available at: http://statsoft.ru/resources/statistica_text_book.php [Accessed 05 October 2022].

Fecke, W., Feil, J. H., Musshoff, O. (2016). Determinants of loan demand in agriculture: empirical evidence from Germany. – Agricultural Finance Review, 4 (76), pp. 462-476.

Financial needs in the agriculture and agri-food sectors in Slovakia. Available at: https://www.fi-compass.eu/sites/default/files/publications/financial_needs_agriculture_agrifood_sectors_Slovakia.pdf

Gerasimova, T. P. (2010). Financial and credit support of agricultural production in the financial crisis. – Scientific Bulletin of the Bukovina State Financial Academy, 1 (18), pp. 28-34.

Garazha, O., Shyian, D., Cherneha I., Burliai A., Zharun O., Blenda N. (2021). Conceptual changes of fiscal regulation of agricultural land use: international experience and Ukrainian practice. – Economic Annals-XXI, 7-8(2), pp. 63-73.

Gubenko, V. (2010). Competitiveness of agricultural products: the position and opportunities under globalization. – Bulletin of Sumy National Agrarian University, 5 (2), pp. 3-7.

Gudz, Yu. F. (2017). Evaluation of the efficiency of the agro-industrial complex in the region. – Economic analysis, 27, pp. 20-29.

Hutorov, A. O., Lupenko, Yu. O., Yermolenko, O. A., Dorokhov, O. V. (2018). Strategic management of the agrarian sector of economy based on the analysis of value chains. – Bulletin of the Transilvania University of Brasov, Series II: Forestry, Wood Industry, Agricultural Food Engineering, 11(2), pp. 101-114. Available at: https://www.cabdirect.org/cabdirect/abstract/20193223282 [Accessed 05 October 2022].

Jankelova, N., Masar, D., Moricova, S. (2017). Risk factors in the agriculture sector. Agricultural Economics, 63(6), pp. 247-258. Available at: https://doi.org/10.17221/212/2016-AGRICECON [Accessed 05 October 2022].

Kucher, A. V., Lialina, N. S., Kucher, L. Yu. (2019). Investment Attractive of Land Use of Agricultural Enterprises. – International journal of ecological economics & statistics, 40(1), pp. 118-130. Available at: http://www.ceser.in/ceserp/index.php/ijees/article/view/6016 [Accessed 10 October 2022].

Kulba, V. V. (2004). Methods of forming scenarios for the development of socio-economic systems. M.: SINTEG, p. 291.

Klebanova, T., Guryanova, L., Chagovets, L. (2018). Business analytics of multidimensional processes. Kharkiv: KhNUE S. Kuznets, p. 272.

Klebanova, T., Sergienko, O. (2010). Model instrumental basis of strategic development of production and economic systems. – Economic cybernetics, 1-3, pp. 10-20.

Krasnorutskyy, O. (2013). Management of agricultural products sales: theory, methodology, practice: dissertation Ph D. Kharkiv, p. 375.

Lemishko, O., Shevchenko, N. (2021). Lending in the agricultural sector of Ukraine: challenges and solutions. – Economic Annals-XXI, 192(7-8(2)), pp. 74-87. Available at: https://www.webofscience.com/wos/woscc/full-record/WOS:000782979600007 [Accessed 10 October 2022].

Lepa, R. N. (2006). Situational mechanism of preparation and application of management decisions at the enterprise: methodology, models and methods: monograph. Institute of Economics of Industry. Donetsk: Yugo-Vostok, p. 307.

Lyashenko, O. V., Kotenko, T. M. (2016). Lending to business entities in the agricultural sector. – Scientific Notes, 20, pp. 53-61.

Management of innovative development the economic entities. (2018). collective monograf / edited by M. Bezpartochnyi, I.Britchenko, in 2 Vol. / Higher School of Social and Economic. Przeworsk: Wydawnictwo i Drukarnia NOVA SANDEC, 2, pp. 121-134.

Martinchik, O. A. (2014). Estimation of the competitive environment of agricultural enterprises of Zhytomyr region. – Business Inform, 7, pp. 149–153.

Matyushenko I. Y., Shtal T. V., Piddubna L. I., Piddubnyi I. O., Kvitka Y. M. (2018). Development prospects of Ukraine's foreign trade in agricultural products in the context of European integration and global challenges. – Journal of Advanced Research in Law and Economics, 9 (4), pp. 1343-1361.

Ministry of Agriculture and Rural Development of the Slovak Republic. Green Report. Available at: https://www.mpsr.sk/en/index.php?navID=16 [Accessed 19 September 2022].

Nashchekina, O., Sergienko, O., Sosnov, I., Tatar, M., Shapran, E. (2020). Model tools of credit risks assessment of agricultural enterprises in international trade. CEUR Workshop Proceedings, 2649, pp. 34-49. Available at: http://ceur-ws.org/Vol-2649/paper4.pdf [Accessed 17 October 2022].

Osabohien, R., Mordi, A., Ogundipe, A. (2022). Access to credit and agricultural sector performance in Nigeria. – African Journal of Science Technology Innovation & Development, 14 (1), pp. 247-255.

Parkhomenko, N., Otenko, I., Otenko V., Chepeliuk M. (2022). Development of export potential of Ukraine's agricultural sector. – Management, Economic Engineering in Agriculture and Rural Development, 22 (1), pp. 485-492. Available at: http://managementjournal.usamv.ro/pdf/vol.22_1/Art57.pdf [Accessed 10 October 2022].

Plyuta, V. (1980). Comparative multivariate analysis in economic research. M.: Statistics, p. 151.

Practical provision of information and analytical support of procedures for the development and acceptance of management solutions. Available at: http: //www.essor.com.ua/files/conf_rerort_2_ukr.pdf. [Accessed 10 October 2022].

Prognostication and planning of economic development: microeconomic and macroeconomic levels. (2019). Multi-authored monograph. Vol. 2. Lithuania: Publishing House "Baltija Publishing", p. 408.

Rudych O. O., Zubchenko V. V. (2016). Foreign experience of financing and crediting of agriculture. – Sustainable development of the economy, 4, pp. 183-188.

Schaefer-Kehnert, W., Von Piachke, J. D. (2020). Agricultural credit policy in developing countries. Available at: https://www.jstor.org/stable/25829945 [Accessed 17 October 2022].

Serebrennikova, A. I., Mikryukov, A. V., Tchilimova, T. A. (2020). Socio-economic aspects of bank lending to agriculture, IDSISA. Available at: https://www.e3s-conferences.org/articles/e3sconf/pdf/2020/36/e3sconf_idsisa2020_04014.pdf [Accessed 17 October 2022].

Sergienko, O., Shapran, O., Bilotserkivskyi, O., Alieksieieva, I. (2019). Multi-scale model elaboration for creditworthiness diagnostics of export production enterprises of the agricultural trade market. – Eureka: social and humanities, 6, pp. 19-30. Available at: http://eu-jr.eu/social/article/view/1082 [Accessed 17 October 2022].

Sergienko, O. A., Goroshko, A. S. (2018). Instrumentarium and a set of tasks for evaluating the effectiveness of agribusiness lending in the direction of Ukraine's potential development in international trade markets. Determinants of socio-economic development of Ukraine in terms of transformational changes: collective monograph, for general. ed. Dr. Econ. Sciences, Prof. V. P. Ilchuk. Chernihiv: ChNTU, pp. 149-165.

Sergienko, O. A., Gula, A. S. (2018). Estimation of crediting efficiency of agrarian and industrial complex by regions as a defining sector of the international trade. – Problems of economy, 2 (36), pp. 426-439. Available at: http://www.problecon.com/annotated-catalogue/?year=2018&abstract=2018_02_0 [Accessed 17 October 2022].

Sergienko, O. A., Gula, A. S. (2018). Development of international trade through the prism of improving the financial and credit system of support for economic entities in the agricultural sector of the economy. – Business Inform, 10 (489), pp. 188-198. Available at: http://www.business-inform.net/annotated-catalogue/?year=2018&abstract=2018_10_0&lang=ua&stqa=27 [Accessed 17 October 2022].

Sergienko O. A., Golofaeva, I. P., Tatar, M. S. (2013). Models of decision-making management of competitiveness of metallurgical enterprises. Competitiveness and innovation: problems of science and practice: monograph, pp. 228-249.

Soshnikova, L. A., Tamashevich, V. N., Uebe, G., Schaefer, M. (1999). Multivariate statistical analysis in economics. M.: UNITI-DANA, p. 598.

Stoeva, T., Dirimanova, V. (2021). Impact of Bulgaria's agricultural policy and structural changes in agriculture and land relations – an integral part of the CAP. – Scientific papers-series management economic engineering

in agriculture and rural development, 2, pp. 609-613. https://www.webofscience.com/wos/woscc/full-record/WOS:000664986400070 [Accessed 17 October 2022].

Sumets A., Serbov M., Skrynkovskyy R., Faldyna V., Satusheva K. (2020). Analysis of influencing factors on the development of agricultural enterprises based on e-commerce technologies. – Agricultural and Resource Economics: International Scientific E-Journal, 6(5), pp. 211-231. Available at: https://www.are-journal.com/index.php/are/article/view/373/268 [Accessed 17 October 2022].

Shapran, E. M., Sergienko, O. A., Sosnov, I. I. (2019). Multilevel structural models of development scenarios of the international trade market subjects in the agricultural sector in the conditions of risks. – Problems of economy, 4 (42), pp. 293-305. Available at: https://www.problecon.com/article/?year=2019&abstract=2019_4_0_293_305 [Accessed 17 October 2022].

STATSOFT. Available at: http://statsoft.ru/ [Accessed 17 October 2022].

The official website of the National Bank of Ukraine. Available at: http://bank.gov.ua. [Accessed 10 October 2022].

The official website of State Statistics Service of Ukraine. Available at: http://www.ukrstat.gov.ua [Accessed 10 October 2022].

Toth, M., Rabek, T., Strapekova, Z. (2019). Impact of Integration and Globalization on Business Risk and loans in Slovak Agriculture. 19th International scientific conference globalization and its socio-economic consequences 2019 – sustainability in the global-knowledge economy. Available at: https://www.webofscience.com/wos/woscc/full-record/WOS:000528040800126 [Accessed 10 October 2022].

Yatsiv, I. B. (2013). Competitiveness of agricultural enterprises: monograph. Lviv: Ukrainian bestseller, p. 427.