

Prospects for the formation of investment support for the technological growth of the agricultural sector of the Ukrainian economy in the post-war period

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Abstract. During the war and after its end, Ukraine needs to restore its economy, in particular the agri-food sector, which is one of the key sectors of the national economy. Investment support for the technological growth of the agro-food sector can be of decisive importance for this, because it allows to achieve high productivity, competitiveness and sustainable development of this industry, which in turn will contribute to ensuring the food security of the country, raising the standard of living of the population and reducing the outflow of labor force abroad. The purpose of the article was to analyze and determine promising ways of attracting investments to support the technological development of the agro-food sector in post-war Ukraine. Using the analysis of literary sources and statistical data, the state of the agricultural sector of Ukraine in the pre-war and post-war periods is considered and analyzed. The structure and investment attractiveness of Ukrainian enterprises are investigated. The state of business subjects in the field of agriculture was analyzed and with the help of expert assessments, it was established that small entrepreneurship is the driving force of the development of the economy and economic relations, although it is risky for investment. Using statistical analysis, the structure of foreign investment is investigated and it is established that the main problem of attracting foreign investment is outdated equipment and technologies, so it is necessary to integrate innovations into agriculture. So, after analyzing the strengths and weaknesses, opportunities and threats, it was established that appropriate financing can help implement modern resource-saving technologies in agro-food production, promote the implementation of innovative approaches, namely the introduction of modern methods of soil treatment, the

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use of rational water use, the introduction of automation and mechanization of production processes, the use of drones and modern monitoring systems, as well as the introduction of modern methods of storage, processing and sales of products, which will ensure increased production efficiency, reduced environmental consequences and increased competitiveness of Ukrainian agricultural enterprises on the international market. The practical value of the research lies in the ability to provide recommendations on creating a favorable investment climate, improving legislation, ensuring the protection of investors' rights, as well as infrastructure development and support for research projects in the field of agro-food production

Keywords: resource-saving technologies; progressive development; small business; innovations; agriculture

INTRODUCTION

The agricultural sector is one of the most important elements of the economy of market economies, and its importance cannot be overestimated, as it forms the basis of the national economy and food security. The Ukraine Recovery Plan for 2022-2032 (n.d.), adopted at the Lugano conference in July 2022, identifies the agricultural sector of the national economy as a priority. Its further effective development is primarily associated with the restoration and reclamation of lands damaged as a result of military actions, the establishment of processing of produced agricultural products, the increase in the volume of value-added products and the increase in export batches of such products (Chumachenko *et al.*, 2022). According to preliminary estimates by experts, the restoration and restart of agricultural production requires 10-year investments in the amount of 37 billion dollars USA, as stated in the analytical report Kyiv Strategy Consulting (2022). According to the Minister of Environmental Protection and Natural Resources (2023), during the year of the full-scale war, experts of the State Environmental Inspection have already documented more than 2,300 crimes against nature. The amount of losses reaches almost 1.9 trillion hryvnias. Although in the pre-war period, Ukraine demonstrated rapid improvement in environmental indicators. Thus, according to the results of the evaluation of the comprehensive Index of Environmental Indicators, which shows how close the country is to achieving the goals of environmental policy, Ukraine took 60th place in 2020, and already in 2021 it took 52nd place (EPI Results, 2022).

Despite weather risks, war, logistics complications, and the energy crisis, agriculture remains the main sector of the Ukrainian economy, so there is a need to ensure its functioning and adaptation to difficult conditions. Agriculture has always been the backbone of the country in times of crisis, which shows the largest harvest in 2021 in the history of the country, compared to other sectors of the economy, which, on the contrary, reduced their pace (Ministry of Agrarian Policy and Food of Ukraine, 2022). Therefore, the solution to the problems in ensuring the development of the country's

economy should be comprehensive and affect the political, economic, environmental, social and especially scientific and technological spheres. During the period of military operations, which is characterized, in particular, by a high degree of riskiness of investment activity, analysts note that the predominant investment is in strengthening working capital and preserving existing production capacities. Experts predict a slowdown in the pace of implementation of advanced technologies, justifying this both by a reduction in the amount of funds allocated for innovation, and by logistical and infrastructural problems related to the provision of agricultural production with the latest machinery, equipment, seeds, fertilizers, etc. At the same time, in those farms where innovative solutions have already been implemented, an important task is to continue them. It is believed that the increased investment risks of the agricultural business will be compensated to some extent by further growth in global food prices (Taran *et al.*, 2020). Ensuring economic development and the growth of agricultural production in difficult, modern conditions is impossible without adequate financial support, in which investments and innovations have a leading place. Investments largely determine the growth rate of production and are a powerful incentive for scientific and technological development. Investments aimed at the development of agricultural production are particularly important, since the development of all other sectors of the economy, the acceleration of reproduction processes and the improvement of its efficiency directly depend on it. It is obvious that the recovery of the agricultural sector of the Ukrainian economy is impossible without an increase in innovation and investment activity in the agricultural sector, prospects for technical re-equipment, modernization of production, etc. Solving the problem of increasing economic efficiency in agricultural enterprises of various sizes requires the introduction of technological innovations, the basis of which is the selection and application of resource-saving technologies depending on the optimal technological level (the optimality of the technology is

determined by the requirements for the innovativeness of agricultural technology and the saving of material and other resources) (Taran *et al.*, 2020; Bashtannyk *et al.*, 2020). However, this requires additional financing for agricultural production, including credits from international organizations and partner countries.

The research was aimed at identifying problems and opportunities of the agro-food sector, assessing risks and obstacles, as well as developing recommendations for government bodies, investors and business structures regarding the direction of investments in the development of new technologies, infrastructure modernization, and product quality improvement.

MATERIALS AND METHODS

This scientific article is a theoretical research in the process of writing which general scientific research methods were used. The method of theoretical generalization was used to consider theoretical provisions on the essence of investment support for technological growth of the agro-food sector of the Ukrainian economy in the postwar period. Using the analysis of literary sources and statistical data, the state of the agricultural sector of Ukraine in the pre-war and post-war periods is considered and analyzed. The structure and investment attractiveness of Ukrainian enterprises are studied. The state of economic entities in the field of agriculture was analyzed with the help of expert assessments and, using statistical analysis, the structure of foreign investment was studied.

The main stages of work on the scientific article were as follows: the preparatory step, which covered the chosen topic, its understanding and justification of its relevance. The topic of the article was chosen taking into account the interest in the problem and the possibility of choosing analytical material and statisti-

cal data. The stages of the work included drawing up a plan and structure of the scientific article, conducting the research and summarizing its results. Based on the review of information sources and literature, the tasks set by the authors, the state of the problem under study was determined. The final stage involved processing and analyzing the results of the research conducted in accordance with the assignment, as well as formulating conclusions and compiling a list of references. The correctness of the article and the list of references was checked in accordance with the publisher's requirements.

RESULTS AND DISCUSSION

As of the beginning of 2022, the economic system of Ukraine could be characterized as a multi-sector, socially-oriented market economy, aimed at taking into account public needs, based on an innovation-investment model and the wide dissemination and implementation of the latest scientific and technical achievements.

The full-scale military invasion has become a new and determining factor in the formation of the investment climate in Ukraine, which, together with corruption and a weak judicial system, constitutes the top three negative factors. At the same time, there are opportunities for the business environment in granting Ukraine the status of a candidate for accession to the European Union, removing export restrictions, and a "transport visa-free regime" with the EU. After all, Ukraine is quite rightly called the breadbasket of Europe (Russia's war..., 2022), the country is the leader in the export of sunflower oil and grain, and thanks to this it receives quite a large amount of revenue, which allows the state to invest, although the percentage of funding from the budget should be higher, nevertheless, this is possible thanks to commodity producers and natural conditions (Fig. 1).

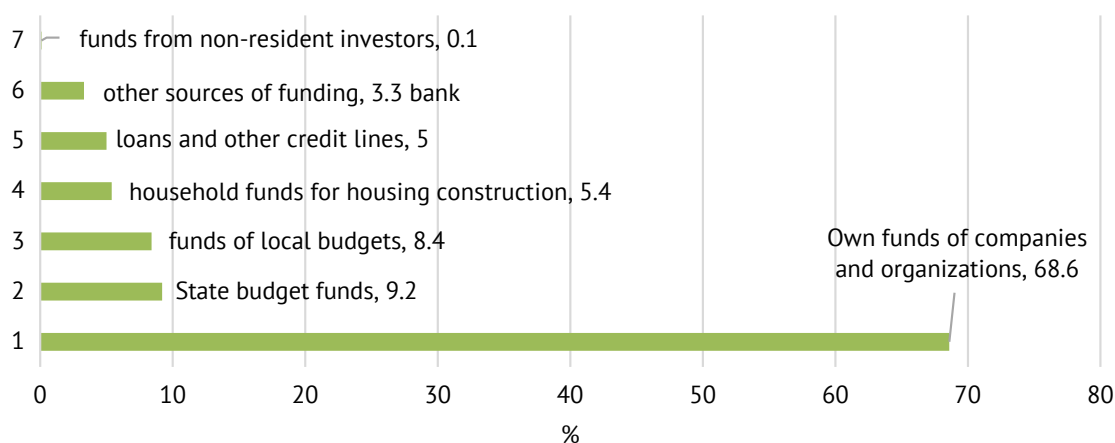


Figure 1. Structure of capital investments by sources of financing in January-December 2021

Source: developed by the authors on the basis of State Statistics Service of Ukraine (2021)

Thus, as shown in the Figure 1, the largest percentage, namely 68.6%, was directed to capital investments from the own funds of enterprises and organizations, which is 2.1% more than in 2020. Bank loans and other borrowings, although they tended to increase, still did not reach 10%. However, the weight of non-resident investors decreased by 0.3% compared to 2020, indicating the low investment attractiveness of Ukrainian enterprises. In general, a slight improvement in the investment climate is related to rising prices for agricultural products.

Capital investments in the agricultural sector of the national economy in 2021 were estimated at USD 2.3 billion. According to analysts' forecasts, in 2022, the sector was expected to show even higher results (Zakharchuk, 2022b). However, the military actions on the territory of Ukraine leveled this forecast.

According to research conducted by the European Business Association, the integral indicator of the Investment Attractiveness Index of Ukraine in the first half of 2022 was 2.17 points out of 5, which corre-

sponds to the indicators of 2012-2013. For comparison, at the beginning of 2022, the indicator was 2.73 points, and during the "The Revolution of Dignity" – 1.8 points, with a rapid increase soon after, which is promising for similar dynamics in the post-war period (Kotsky, 2022).

Military operations are a significant obstacle to the realization of financial investments in the Ukrainian economy. However, already in 2022, a pilot project funded by the Multilateral Investment Guarantee Agency (MIGA), a member of the World Bank Group, was launched as part of the war risk insurance initiative, under which Ukraine received USD 30 million. In general, the country's investment potential is estimated at USD 43 billion, including USD 34 billion in the investment potential of the agricultural sector (Advantage Ukraine, n.d.).

Global experience and business practice indicate that the most important feature of a market economy is the presence and effective interaction of large, medium and small enterprises, as well as their optimal ratio (Table 1).

Table 1. Number of large, medium, small and micro enterprises

Year	Total, thousand units					Agriculture, forestry and fisheries				
	units	percent			small incl. micro enterprises	units	percent			small incl. micro enterprises
		large	medium	small			large	medium	small	
2010	378.88	0.2	5.5	94.3	79.3	50666	0.0	6.8	93.2	84.8
2015	343.44	0.1	4.4	95.5	82.8	46744	0.1	5.4	94.5	83.9
2017	338.25	0.1	4.4	95.5	82.2	50115	0.0	4.8	95.2	84.8
2018	355.87	0.1	4.5	95.4	82.3	50504	0.0	4.6	95.4	85.0
2019	380.59	0.1	4.7	95.2	82.3	50239	0.1	4.5	95.4	84.9
2020	373.81	0.1	4.7	95.2	82.4	49492	0.1	4.3	95.6	85.0
2021	370.83	0.2	4.7	95.1	82.2	47753	0.1	4.4	95.5	84.2
In % to 2010	97.8	100	85.5	101	103.6	94.2	-	64.7	102.5	99.3

Source: developed by the authors based on State Statistics Service of Ukraine (n.d.)

The data in Table 1 show that the proportion of small enterprises is overwhelming and tends to grow, including agricultural enterprises. It has also been established and repeatedly proved (Pilevych, 2021; Babyna & Babyn, 2021) that small business is a driving force behind the development of the economy and economic relations. This is also evidenced by the increase in the volume of products sold from 2015 to 2021 by UAH 1639258.6 million, which in turn accounts for 18.9% of the total volume of sales of products (goods, services) by all enterprises in the country. But the fact that only profit and depreciation deductions are the main internal source of investment for small and medium-sized enter-

prises is, of course, insufficient for capital reproduction. And attracting external sources of investment is risky due to high credit rates, so government support is very important. The experience of European countries in attracting investments in high-tech agriculture is also important (Vasilevska et al., 2019; Kiropoulos et al., 2021).

Although Ukraine has created regulatory and legal regulation of small and medium-sized businesses, it is insufficient for successful innovative functioning, especially in the investment part, since funds are not distributed in favor of agricultural small and medium-sized enterprises, which introduces a certain economic imbalance of organizational and legal forms.

According to statistics, in 2020, the amount of support for the agro-industrial complex amounted to UAH 3.97 billion, and in 2022 – UAH 4.6 billion (Neuter *et al.*, 2022). That is, since 2020, state support has become more substantial and targeted, and other programs such as compensation for lost crops due to an emergency and others began to appear in 2021, but all this does not allow us to say that it is stable in terms of volume and structure, and the corruption factor is still in action. Thus, the reasons for the low investment attractiveness of the agricultural sector and credit risks are not only

the size of enterprises and seasonal characteristics of the industry, but also the further worsening of the financial situation caused by the war in the country, the absence of liquid loans from debtors, and the disparity between the needs of agricultural enterprises for credit resources and the needs and opportunities of banks and investors (Pisarenko *et al.*, 2021).

There are also certain problems with foreign investment, primarily low returns on investment and their inefficient distribution by type of economic activity (Fig. 2).

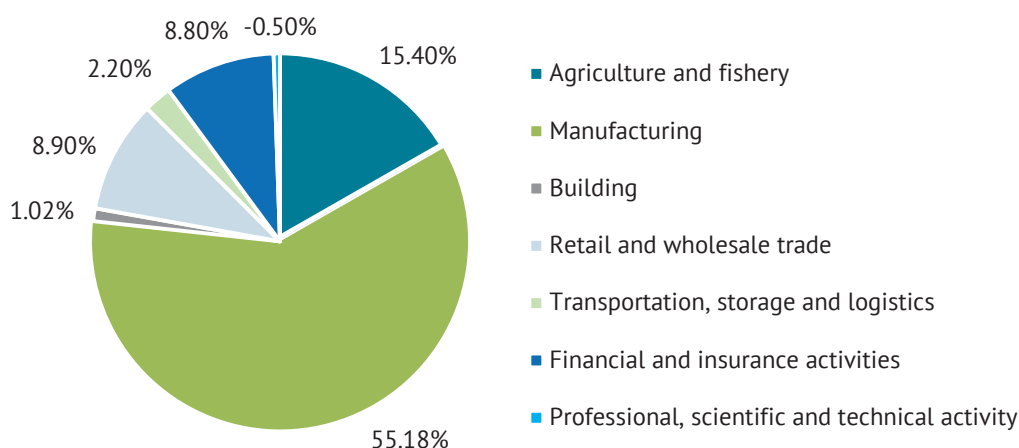


Figure 2. Structure of foreign direct investment in Ukraine by type of economic activity in 2021

Source: developed by the authors based on State Statistics Service of Ukraine (2020)

Thus, as can be seen from the Figure 2, the largest proportion in the structure of foreign investment in Ukraine is taken by industry (55.18%), the second place is occupied by agriculture (15.40%), and the third place is divided between financial and insurance activities and wholesale and retail trade (8.8% and 8.9%, respectively). It is worth noting that foreign investments is directed only to developed sectors.

And as mentioned above, one of the problems of attracting foreign investments is outdated equipment and technologies, therefore it is necessary to introduce innovations in agriculture. After all, technological renewal and development of the agro-industrial complex is a strategically priority direction of innovative activity of the state, and in 2020, the largest number of technologies was transferred in this direction, namely 55.6%, respectively, and the largest share of revenues was received – 77.2% (Pisarenko *et al.*, 2021). The foundation of innovative competitiveness is human capital, higher education, as well as knowledge and results of scientific research (Burkynskyi *et al.*, 2022; Lee & Keunhwan, 2022). Currently, there are many definitions of innovation, but the concept of agricultural innovation has not been sufficiently investigated.

The authors share the interpretation of the Food and Agriculture Organization of the United Nations (FAO) on agricultural innovations (FAO, 2018) as a process in which individuals or organizations use new or existing products, processes or methods of organization for the first time in a particular context to improve efficiency, competitiveness, resilience to stress or environmental sustainability and thus contribute to food security and nutrition, economic development or sustainable management of natural resources.

The need to implement resource-saving innovations based on the rational use of resources in the activities of agricultural enterprises is objectively determined by the constant growth of prices for oil and gas, fertilizers, plant protection products, and seed. Ensuring the optimal level of costs for commodity and material resources included in the cost of production, while maximizing the growth of crop yields, allows to increase the profitability per 1 hectare of crop production. The use of such precision agriculture, which involves the optimal management of available land resources, opens up real opportunities for agricultural producers to grow quality products and preserve the environment (Koutsos & Menexes, 2019; Poertner *et al.*, 2022).

However, the effective implementation of innovative precision agriculture technologies and the solution of socio-economic tasks is impossible with the use of traditional mechanical equipment. Every year, the number of progressive agricultural market participants who recognize the need to actively involve the latest scientific and technological solutions in their production processes is growing. According to analytical data (The market..., 2022), the global precision agriculture market is poised to register a compound annual growth rate (CAGR) of 13% over the next ten years and reach USD 20.36 billion in 2032. Such forecasts are due to the increased demand for precision agricultural equipment caused by the lack of resources together with unpredictable weather conditions.

According to statistics, 70% of German farmers and more than 80% of US farmers use various elements of precision agriculture in their production process. In Europe, their use is noted even on areas of 0.5 hectares due to their high efficiency, which is due to a significant reduction in time and labor costs, which in turn reduces the investment payback period and contributes to the gradual expansion of the list of elements implemented (Zakharchuk, 2022a). As of the beginning of 2022, only 15% of Ukraine's agricultural land was covered by precision agriculture, mostly those used by agricultural holdings. The volume of the precision agriculture market in Ukraine, which includes equipment that comes with machinery, additional equipment, equipment sheds, services, software products, and drones, is estimated at more than USD 60 million. Currently, management systems that help ensure high vigilance in the implementation of production processes in agriculture, including safety, maintenance and prevention, account for more than 41% of the total market revenue. The complex implementation of precision agricultural systems has been realized on 5% of Ukraine's cultivated land, and on 20% of its individual elements (Zakharchuk, 2022a).

For Ukrainian producers, the use of resource-saving crop cultivation technologies that can increase production efficiency is becoming increasingly important. Such agricultural systems include, in particular, no-till, mini-till, strip-till, and verti-till, each of which has both advantages and disadvantages. When choosing the best technology for practical application in farming, it is necessary to take into account the field characteristics (mechanical composition and humus level; natural soil density, level of soil structure; relief; rainfall and annual temperature), availability of technical equipment; intensity of production technologies; existing crop rotations; and varietal characteristics of crops. The use of variable seeding rate technology (differentiated seeding), which is based on an precise calculation of plant

growth density across the field, taking into account soil fertility, moisture reserves and topography, is highly effective, especially in heterogeneous fields. Spot spraying systems are widely used in Ukrainian agricultural enterprises. At the heart of these innovative products are modern optics and electronic computing systems that allow effective detection of weeds and their treatment with herbicides. Such spot use of herbicides provides savings of up to 90% (Zakharchuk, 2022a).

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P. Sabluk & I. Khomin (2020) substantiated the concept of reorientation of non-refundable budget allocations to revolving, but preferential crediting of commodity producers in the agricultural sector of Ukraine, which should encourage commodity producers to search for internal reserves, which is especially relevant for small and medium-sized agricultural enterprises in the post-war period. Such internal reserves, according to the authors, can become capital investments in technologies of precision agriculture, in particular. At the same time, the authors agree with the opinion of K.B. Voloshchuk *et al.* (2020), which emphasize the possibilities of achieving high productivity of agricultural producers in case of coordination and unification of efforts of business structures with state and local self-government bodies, solving problems and determining investment priorities according to the nature of strategic direction. V. Klochan & I. Klochan (2018) the improvement of the mechanism of state regulation of investments in innovative activities aimed at the development of the agricultural sector of the country is considered, in particular, due to the close integration of production and science, which fully allows to solve the task of finding internal reserves of agro-producing enterprises – through the application science-based management methods, innovative agricultural technologies, etc.

The latest achievements are the basis of various cultivation systems that provide cost savings. For example, the use of moldboardless technology saves about 27%, minimal tillage – 43%, and no-till technology –

86% of total fuel and lubricants costs for crop preparation. Improvements in the structure of the machine and tractor park, the optimal combination of tillage units during sowing, fertilization and pesticide application, etc. have a significant impact on the efficiency of crop production. The operation of combined units in combination with resource-saving technologies reduces total production costs by 15% compared to traditional technologies, and the introduction of precision agriculture and minimum tillage technologies reduces them by almost 20% (Taran *et al.*, 2020).

The implementation of resource-saving innovations, such as precision agriculture, is necessary for agricultural enterprises due to increasing costs for key resources and the need to maximize crop yields and profitability. It is critical to explore the internal reserves of agro-producers through innovative agricultural technologies, improved mechanisms for state regulation of investments, and closer integration of production and science; such strategies not only enhance the efficiency of crop production but also significantly reduce production costs.

CONCLUSIONS

The need for investment support for the technological growth of the agro-industrial sector of Ukraine's economy during the wartime period is critical, as the agro-industrial complex is one of the key sectors of the country's economy and plays an important role in providing food for the population and export potential. One of the most promising areas is attracting foreign investment, as Ukraine has great potential for this in the agri-food sector, in particular due to its natural resources, location on international transportation routes, the presence of a domestic market and growing demand for agricultural products. However, there is a need to provide financial support to small and medium-sized agribusinesses. This may include creating favorable conditions for access to loans and other financial resources, developing support programs aimed at developing technologies and innovations in the agri-food sector.

For example, today there are more and more problems related to the rational use of natural resources and environmental safety, lack of investment, especially

in the context of rising costs of environmental protection measures and production expansion. In this regard, the state can no longer solve these problems on its own and needs a new approach to interacting with business in this area. One possible approach is to develop a new type of interaction between the state and business based on the principles of partnership and cooperation. This means that the state and business should cooperate on an equal footing, increasing mutual responsibility and equality, in order to achieve common goals of rational environmental management and environmental safety. This new type of interaction can be based on the following principles:

➤ Dialogue and consultation. The state and business should interact on the basis of open dialogue and consultation with the opinion of users and the views of all stakeholders, including public organizations and scientists.

➤ Joint decision-making. The state and business should jointly make decisions on environmental management, taking into account economic, social and environmental aspects. The decision must be balanced and not harm the interests of all stakeholders.

The authors see the study of the potential of innovative technologies that can be implemented in the agri-food sector, the study of financial instruments and investment mechanisms, and the study of the effectiveness of investment projects as promising directions for further research on the mentioned topic. Also in research, it would be advisable to conduct a more in-depth analysis of the prospects of attracting investments in terms of agricultural enterprises of different sizes, specialization, location, etc.

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CONFLICT OF INTEREST

None.

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Перспективи формування інвестиційного забезпечення технологічного зростання агропродовольчого сектора економіки України в повоєнний період

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Анотація. В період війни і після її завершення Україна потребує відновлення своєї економіки, зокрема агропродовольчого сектора, який є одним із ключових галузей національної економіки. Інвестиційне забезпечення технологічного зростання агропродовольчого сектора може мати вирішальне значення для цього, адже дозволяє досягти високої продуктивності, конкурентоспроможності та сталого розвитку цієї галузі, що в свою чергу сприятиме забезпеченню продовольчої безпеки країни, підвищенню життєвого рівня населення та зменшенню відтоку робочої сили за кордон. Метою статті було проаналізувати та визначити перспективні шляхи залучення інвестицій для підтримки технологічного розвитку агропродовольчого сектора в умовах післявоєнного періоду в Україні. Використовуючи аналіз літературних джерел та статистичних даних, розглянуто та проаналізовано стан галузі сільського господарства України в довоєнний і повоєнний період. Досліджено структуру і інвестиційну привабливість українських підприємств. Проаналізовано стан господарюючих суб'єктів в галузі сільського господарства і за допомогою експертних оцінок, встановлено, що саме мале підприємництво є рушійною силою розвитку економіки і економічних відносин, хоча і ризикованим для інвестування. За допомогою статистичного аналізу досліджено структуру іноземних інвестицій і встановлено, що основною проблемою залучення іноземних інвестицій є застаріла техніка і технології, тому є необхідним запроваджувати інновації в сільське господарство. Отже, проаналізувавши сильні й слабкі сторони, можливості і загрози, встановлено, що відповідне фінансування може допомогти впроваджувати сучасні ресурсощадні технології в агропродовольчому виробництві, сприяти впровадженню інноваційних підходів, а саме – впровадження сучасних методів обробки ґрунту, використання раціонального водокористування, впровадження автоматизації та механізації процесів виробництва, використання дронів та сучасних систем моніторингу, а також впровадження сучасних методів зберігання, переробки та збуту продукції, що забезпечить підвищення ефективності виробництва, зниження екологічних наслідків та підвищення конкурентоспроможності українських аграрних підприємств на міжнародному ринку. Практична цінність дослідження полягає у можливості надати рекомендації щодо створення сприятливого інвестиційного клімату, удосконалення законодавства, забезпечення захисту прав інвесторів, а також розвитку інфраструктури і підтримки науково-дослідних проектів у сфері агропродовольчого виробництва

Ключові слова: ресурсощадні технології; поступальний розвиток; мале підприємництво; інновації; сільське господарство