SCIENTIFIC HORIZONS

Journal homepage: https://sciencehorizon.com.ua
Scientific Horizons, 28(6), 150-164

UDC 631.58:332.1
DOI: 10.48077/scihor6.2025.150

The role of investment in the development of smart agricultural technologies in megacities

Mehriban Aliyeva*
PhD in Economic Sciences, Associate Professor
Azerbaijan State University of Economics (UNEC)
AZ1001, 6 Istiqlaliyyat Str., Baku, Azerbaijan
https://orcid.org/0000-0003-4628-4873
Leyla Huseynova
PhD in Economic Sciences, Associate Professor
Azerbaijan State University of Economics (UNEC)
AZ1001, 6 Istiqlaliyyat Str., Baku, Azerbaijan
https://orcid.org/0000-0001-7367-4661
Gulnara Agabekova
PhD in Economic Sciences, Associate Professor
Azerbaijan State University of Economics (UNEC)
AZ1001, 6 Istiqlaliyyat Str., Baku, Azerbaijan
https://orcid.org/0000-0002-8534-523X

Article's History:
Received: 03.10.2024
Revised: 26.04.2025
Accepted: 28.05.2025

Abstract. The aim of the study was to analyse the role of investments in the development of smart agricultural technologies in the agro-industrial complex of various regions, with a focus on the implementation of these technologies in Azerbaijan. The study analysed current investment trends in smart agricultural technologies in North America, Europe, the Asia-Pacific region, Latin America, the Middle East and Africa for 2023-2024, and assessed their impact on the development of the agro-industrial complex in the period from 2023 to 2034. The investment analysis showed that North America accounted for the largest share of the smart agricultural technology market in 2023-2024 (43%), followed by the Asia-Pacific region (28%) and Europe (23%), while Latin America received only 4% and the Middle East and Africa 2%. Forecasts showed that the global smart agrotechnology market will grow from USD 20.87 billion in 2023 to USD 74.03 billion in 2034. The results also indicated that the main investments are directed towards process automation, precision farming, soil and livestock monitoring, and the use of artificial intelligence and big data to predict crop yields. At the same time, the biggest barriers to development were political and economic instability, limited access to financing for small agricultural enterprises, and uneven infrastructure development in different regions. On the other hand, the results showed that the

Suggested Citation:
Aliyeva, M., Huseynova, L., & Agabekova, G. (2025). The role of investment in the development of smart agricultural technologies in megacities. *Scientific Horizons*, 28(6), 150-164. doi: 10.48077/scihor6.2025.150.

*Corresponding author

introduction of smart agrotechnologies in Azerbaijan's agro-industrial complex increases production efficiency through precision farming, the use of drones and satellite technologies, digital platforms, innovations in supply chains, and agro-parks. These technologies optimise resources, improve monitoring and reduce costs, increasing the competitiveness of the agricultural sector. Projects such as "Agali Smart Village" and "Irrigation Control System" not only modernise technologies but also improve social conditions in rural areas. In addition, there has been a significant increase in funding for the agricultural sector, particularly in the state budget for 2025, where spending on agriculture has been increased by more than 30 million manats. The analysis also showed positive dynamics in the economic indicators of Azerbaijan's agricultural enterprises between 2018 and 2024. At the same time, challenges were identified, such as the need to modernise infrastructure, improve staff qualifications and improve legislation. Thus, the results obtained indicate the positive impact of investments in smart agrotechnologies on the efficiency of the agricultural sector both in Azerbaijan and in other regions of the world

Keywords: digitalisation of agriculture; automation of production processes; enterprise financing; global market forecasts and trends; improving production efficiency

INTRODUCTION

The digitisation of production processes has become a key factor in improving efficiency, reducing costs and promoting sustainable development in the context of global technological change. The integration of automated systems, artificial intelligence (AI), big data (BD) and cloud technologies can significantly improve resource management, increase productivity and optimise supply chains. At the same time, the large-scale implementation of digital technologies requires significant capital investment, which creates challenges, especially for countries with unstable economies or underdeveloped infrastructure. Despite the growth of global investment in digital transformation, its distribution remains uneven, slowing down the modernisation of certain sectors of the economy. Among the main problems are limited access to financing for small and medium-sized enterprises, high initial costs of technological upgrading, a shortage of skilled personnel, and the need to adapt the regulatory framework. This necessitates a comprehensive study of the mechanisms for attracting investment and their impact on the digitalisation of the manufacturing sector, which will make it possible to identify optimal financial models for accelerating technological development.

For example, A. Amirov *et al*. (2024) studied the impact of modern technologies on the productivity of Azerbaijan's agricultural sector, noting that the government is actively investing in the digitalisation of agriculture to increase yields and optimise costs. They also pointed to problems with access to finance for small agricultural producers and the need to improve mechanisms for supporting innovation. M. Manafli (2024) examined the role of Azerbaijan's agricultural sector, emphasising the importance of technological innovation and market integration to ensure sustainable development. He also identified key barriers slowing down the modernisation of the sector, including a lack of strategic policies and limited access to finance. In addition, S. Valiyeva (2024) explored the impact of AI on the agricultural sector, focusing on the use of expert systems, image analysis, machine learning and the Internet of Things (IoT) to optimise production processes. She emphasised that the application of AI contributes to increased productivity, improved resource management and reduced costs, which are important factors in the development of smart agricultural technologies.

Research by U.O. Matthew *et al*. (2023) confirmed that investments in IoT technologies contribute to increasing the efficiency of agricultural production, optimising supply chains and improving the market position of products. The authors emphasised that technological innovations are an important factor in ensuring food security and sustainable agricultural development. In turn, B.D. Pal *et al*. (2019) assessed the technical and economic feasibility of climate-smart agricultural technologies in different agroclimatic conditions in South Asia, analysing farmers' behaviour regarding their implementation. Using a climate-smart feasibility index and optimisation modelling, the authors proposed policy and investment strategies for scaling up these technologies. The work of F.C. Anosike *et al*. (2023) analyses the integration of climate-smart agricultural technologies and effective post-harvest operations to improve agriculture in the context of climate change. The authors proposed the use of technologies such as solar dryers, greenhouses, and sustainable storage to reduce post-harvest losses and improve food security. Meanwhile, L. Arenas-Calle *et al*. (2024) assessed the potential of agricultural technologies such as irrigation and new crop varieties to reduce climate risks in agriculture. The authors showed that improved agricultural technologies can significantly reduce the impact of climate extremes, in particular reducing crop losses by 64% through the use of irrigation and improved corn varieties.

On the other hand, the results of A. Bekbossinova and R. Doszhan (2025) showed that investments in fixed assets and digital technologies do not have a significant impact on agricultural production, indicating the need for policy measures to improve digital

literacy and technology adoption in the agricultural sector. C. Ding (2024) research demonstrated how blockchain technologies and smart contracts can promote investment in various areas of the economy by increasing transparency and reducing barriers to entry. The use of such technologies allows for the automation of investment processes, reducing the risk of fraud and ensuring more efficient capital management. In addition, A.Q. Al-Shetwi *et al.* (2025) examined the role of smart grid technologies in improving energy efficiency and integrating renewable energy sources, which can contribute to the development of smart agrotechnologies by optimising energy consumption in the agro-industrial sector. Investments in these technologies contribute to increased efficiency and reduced costs, which is important for the sustainable development of the agricultural sector.

Thus, the study aimed to investigate the impact of investment activity on the introduction of innovative agricultural technologies in agricultural production in different countries and regions, with a focus on the adaptation and practical application of these technologies in the agricultural sector of Azerbaijan. The study involved the following tasks: to analyse global trends in investment in smart agricultural technologies, to study the peculiarities of the introduction of these technologies in the agro-industrial complex of Azerbaijan, and to identify the main barriers and prospects for accelerating their integration by evaluating investment strategies and their impact on the efficiency of agricultural production.

MATERIALS AND METHODS

To investigate trends in smart agritechnology investment, a comprehensive set of methods was employed. These included statistical evaluation, time series analysis, forecasting modelling, comparative analysis, content analytics, and case studies. Comparative analysis was used to assess the distribution of investments in smart agritechnologies across global regions (North America, Europe, Asia-Pacific, Latin America, the Middle East, Africa), which helped to identify regional peculiarities in supporting agricultural innovations. Statistical evaluation processed data on the smart agriculture market share for 2023-2024, reflecting the scale and dynamics of technological changes in the secto. Forecasting modelling was applied to estimate the size of the global smart agritechnology market for 2023-2034, allowing for the determination of growth prospects for investments and demand for innovations (Smart agriculture market.., 2024).

Time series analysis was used to examine the volume of agricultural production in Central Asian countries (Azerbaijan, Kazakhstan, Kyrgyzstan, and Uzbekistan) from 2018-2024 to assess the regional context of technology implementation. These data were provided in millions (mln) of Azerbaijani manats, trillions (trn) of Kazakh tenge and Uzbek soums, and billions (bn) of Kyrgyz som, allowing for consideration of differences in national currencies and economic scales. This method was also applied to evaluate the dynamics of economic indicators (in thousands (ths) of manats) for agricultural enterprises in Azerbaijan over the same period, revealing trends in the agro-sector's development under the influence of smart agritechnologies (Ismayilova & Hajiyeva, 2024). Content analytics was employed to systematise global (Food and Agriculture Organization (FAO), European Bank for Reconstruction and Development (EBRD), Global Environment Facility (GEF) programmes, international microfinance, carbon markets) and regional (tax incentives, grants, public-private partnerships, agritech parks, incubators) mechanisms for financing innovations. This contributed to forming a holistic understanding of investment attraction strategies in Central Asian countries (Investment opportunities for..., 2022; Precision agriculture trends, 2025).

To assess the role of investments in the development of smart agritechnologies in Azerbaijan, a country characterised by intensive urbanisation and growing demand for food security in megacities, both quantitative and qualitative methods were applied. Statistical evaluation analysed data on agricultural expenditure in Azerbaijan's state budget for 2025 (Ashirov, 2024). A comparative analysis systematised key smart agritechnologies in Azerbaijan for 2024, including digital platforms (Electronic Agricultural Information System, n.d.), drones and satellite technologies (Farmonaut), precision agriculture (Idrak Agrorobot) (IDRAK Technology Transfer MM, n.d.), IoT systems in supply chains (Narrow Band IoT (NB-IoT) and Long-Term Evolution (LTE)), and agroparks (Dost Agropark), evaluating their contribution to enhancing the agro-sector's efficiency (Dost Agropark phase..., 2022; Vision for the future..., n.d.; Wireless solutions..., n.d.).

Case studies were used to provide a detailed examination of Azercell Business's IoT solution for irrigation systems ("Irrigation Control System") and the "Agali Smart Village" project as an example of integrating smart technologies for the development of rural areas that supply produce to megacities ("Smart villages" will..., 2022; Azercell Business integrates..., 2023). Azerbaijan was chosen due to its strategic location, rapid urbanisation, and active implementation of smart agritechnologies, making the country a illustrative example for studying investment strategies in megacities. Time series analysis was used to assess the volume of investments in fixed capital in Azerbaijan's agricultural sector from 2018-2024, revealing the economic effect of implementing smart agritechnologies (State Statistical Committee of the Republic of Azerbaijan, 2024). These data, expressed in million manats, reflect the dynamics of capital investment in the sector, demonstrating increased funding and a correlation with the integration of digital technologies.

RESULTS

Analysis of investments in smart agrotechnologies: General overview and global trends. The development of the agro-industrial complex largely depends on the level of implementation of innovative technologies and the volume of investments in their development and application. The use of smart agricultural technologies makes it possible to increase the efficiency of agricultural production, reduce resource consumption and minimise negative impacts on the environment. Key areas include process automation, precision farming, soil and crop monitoring using sensors, and the use of AI and BD for yield forecasting. Investments in these technologies determine the pace of their development and dissemination. Smart agricultural technologies are financed both at the state level through support programmes and through private and venture capital investments. International institutions that support the development of innovative agriculture in various countries play a special role. However, the level of investment in this area varies significantly depending on the region (Fig. 1).

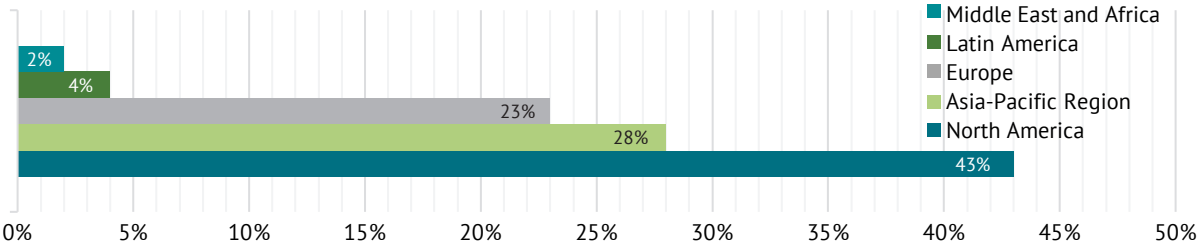

Figure 1. *Smart agriculture market share by region, 2023-2024*
Source: *compiled by the authors based on Smart agriculture market size. Share and trends 2024 to 2034 (2024)*

Thus, the distribution of investments in smart agrotechnologies indicates uneven funding in this area across different regions. North America attracts the largest share, largely due to active venture capital involvement, the development of digital agricultural solutions, and government programmes supporting innovation. Significant investment is also observed in the Asia-Pacific region and Europe, where technological progress in the agricultural sector is stimulated by both government initiatives and private capital. At the same time, Latin America, the Middle East and Africa are characterised by significantly lower levels of investment, due to both limited financial resources and insufficient infrastructure development for the implementation of smart solutions. This situation determines further trends in the development of the agro-industrial complex, affecting the speed of innovation adaptation and its effectiveness in different countries.

North America's leading position in smart agrotechnologies is due to a number of interrelated factors. Firstly, this region has a strong scientific and technological environment that promotes the creation of innovative solutions for the agricultural sector. In particular, agrotech start-ups (Indigo Ag, Plenty, FarmWise) are actively working in Silicon Valley and other development centres, quickly attracting venture capital investments. Secondly, agricultural enterprises in the United States and Canada have a high level of mechanisation and digitalisation, which simplifies the integration of the latest technologies into production processes. Government policy also plays a key role: governments fund research, provide tax incentives for innovative farming, and promote the spread of technology among farmers through support programmes. In addition, most of the agricultural land in North America belongs to large farms that have the financial capacity to invest in expensive digital solutions, unlike small-scale farming in many other regions. As a result of this comprehensive approach, North America not only maintains its leadership position in the implementation of agricultural innovations, but also sets an example for other regions of the world in the effective implementation of smart technologies in the agricultural sector.

Against this backdrop, it is clear that growing investment in smart agrotechnologies is driving the gradual expansion of the smart agriculture market. Funding for precision farming technologies, automated management systems, monitoring solutions and other digital innovations is helping to increase their share in the global agricultural sector (Kharchenko *et al.*, 2017). High levels of investment, combined with technological progress, are driving positive market dynamics. The smart agriculture market is expected to show steady growth between 2023 and 2034 (Fig. 2).

The projected market growth indicates a steady increase in demand for smart agricultural technologies, supported by both private investment and government incentives. The expected growth from USD 20.87 billion in 2023 to USD 74.03 billion in 2034, with an average annual growth rate of 12.2%, confirms the strengthening role of innovation in the future of the agro-industrial complex. North America is making the largest contribution to market development, while the main areas of application for smart technologies remain software, precision farming and livestock monitoring.

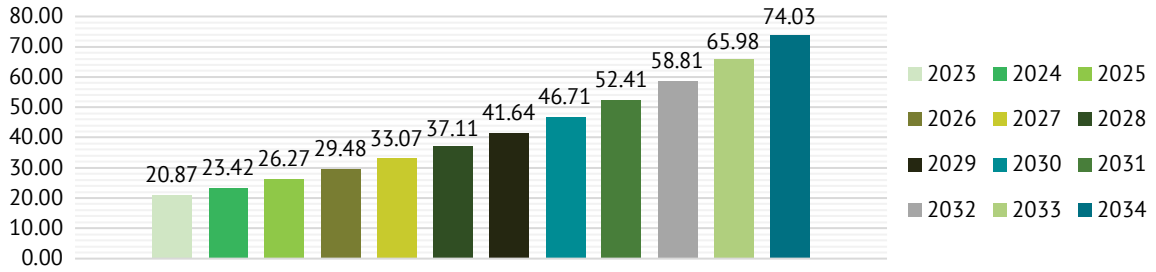

***Figure 2**. Global smart agriculture market size from 2023 to 2034 (USD billion)*
***Source:** Global smart agriculture market size from 2023 to 2034 (USD billion)*

Overall, investments in smart agrotechnologies are contributing to the emergence of new innovative solutions at the global level, particularly in 2024. For example, in August 2024, Sri Lanka launched the development of an Investment Plan for Climate-Smart Agriculture with the support of the FAO and the Green Climate Fund. This project aims to increase the resilience of the agricultural sector to climate change. In April 2024, Cropin, supported by Google, introduced the first open micro-language model for climate-smart agriculture, "aksara" which was designed to meet global nutritional needs. In particular, in the same month, Centre for Development of Advanced Computing (C-DAC) launched the SMART FARM system, which helps farmers optimise irrigation and fertilisation, significantly increasing crop yields (Smart agriculture market..., 2024). Other innovations, such as the GFX-350 display by Trimble, which controls the autopilot, or improvements in agricultural equipment management technologies by AG Leader Technology, contribute to the growth of agricultural process efficiency. Thus, these developments underscore the importance of investing in innovations that are actively transforming the agro-industrial complex, making it more efficient and sustainable. This technological development highlights the importance of funding innovative technologies in agriculture, as they can significantly increase the efficiency and sustainability of the agro-industrial complex. Global examples of innovation in agriculture underscore the need for financial support for technological modernisation in the agricultural sector. In this context, it is worth considering how agricultural production is developing in Central Asia, a region that is also actively pursuing innovation (Fig. 3).

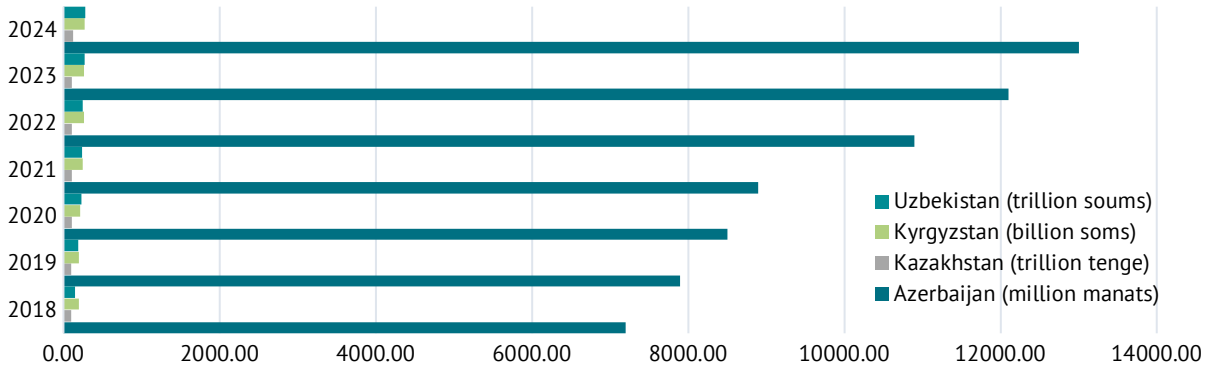

***Figure 3**. Agricultural production in Central Asia from 2018 to 2024*
***Source:** compiled by the authors based on H. Ismayilova and S. Hajiyeva (2024)*

The figure shows the nominal volume of agricultural production in the national currencies of Azerbaijan (million manats), Kazakhstan (trillion tenge), Kyrgyzstan (billion soms) and Uzbekistan (trillion soums) in 2018-2024. During this period, Azerbaijan demonstrates stable growth in production indicators. At the same time, Kazakhstan, Kyrgyzstan and Uzbekistan show less pronounced dynamics or moderate growth, with relatively stable but lower values in their respective currencies. Given the above production indicators, it is advisable to consider what mechanisms are used in the respective countries to attract investment in smart agrotechnologies (Table 1). In other words, Azerbaijan is demonstrating relative leadership among Central Asian countries in the implementation of smart agricultural technologies. Unlike other countries in the region, Azerbaijan is seeing concrete, measurable results from the use of digital solutions: water savings of up to 30-50% thanks to precision irrigation, a 10-30% increase in crop yields through the use of AI recommendations, and a 35% reduction in greenhouse gas emissions through optimised soil management. This level of integration of high technologies, in particular AI, satellite monitoring and blockchain, indicates

a deeper penetration of digital tools into agriculture compared to other countries in the region. Countries such as Kazakhstan, Kyrgyzstan and Uzbekistan are also actively working to modernise their agricultural sectors, but the focus is mainly on traditional or physical solutions: drip irrigation, conservation agriculture, pasture improvement, rotational grazing, etc. For example, Kazakhstan is investing in climate-smart agricultural technologies with the support of international organisations (Kerimkhulle *et al.*, 2023). Kyrgyzstan is actively supporting small producers, while Uzbekistan is demonstrating a desire to attract foreign investment, creating technology parks and simplifying the regulatory environment.

***Table 1**. Main methods of attracting investment in smart agricultural technologies in Central Asia*

Country	Main methods of attracting investmens
Azerbaijan	Promoting the introduction of precision agriculture using satellite monitoring, AI and blockchain technologies, which provide up to 30-50% water savings (precision irrigation); 10-30% increase in yields (due to AI recommendations and precise fertilisation); 35% reduction in greenhouse gas emissions (due to optimised soil and resource management)
	Increasing the climate resilience of rural communities through digital tools (risk analysis, monitoring, income diversification)
	Opportunity to participate in carbon markets through emissions tracking and soil carbon storage
	Building partnerships with government, research institutions, and agribusiness to integrate technologies into national agricultural policy
Kazakhstan	Investments in climate-smart agricultural technologies (conservation agriculture, drip irrigation, pasture improvement, precision agriculture)
	Financial support through the private sector
	State participation in research funding
	Promoting innovation through FAO, EBRD and GEF programmes
Kyrgyzstan	Attracting investment in low-cost climate technologies (rotational grazing, livestock efficiency, conservation agriculture)
	Grant support and soft loans for small and medium-sized producers
	Participation of international programmes of FAO, EBRD and GEF in the development of agricultural practices with the potential for adaptation and mitigation of climate change
	State support for innovation and financing of the agricultural sector
Uzbekistan	Attracting foreign investment through cooperation with international financial organisations, funds and development banks
	Introduce tax incentives and simplified procedures for private investment in digital and smart agricultural solutions
	Development of innovative infrastructure, including agro-technoparks, start-up incubators and educational programmes for farmers
	Supporting small and medium-sized agricultural producers through microfinance and access to technology

***Source:** compiled by the authors based on Investment opportunities for climate-smart agrifood tech in Kazakhstan and the Kyrgyz Republic (2022), Precision agriculture trends: 2025 yield innovations (2025)*

Thus, Azerbaijan stands out for its systematic approach, where digital technologies have already had a noticeable effect on the efficiency of agricultural production, resource conservation, and environmental sustainability. This emphasises its lead over other countries in the region in terms of both the level of innovation implementation and the results achieved. Other countries are currently laying the groundwork for further digitalisation, but have not yet demonstrated a similar level of impact of smart agricultural solutions on specific production or environmental indicators. In summary, investment in smart agricultural technologies is key to the transformation of the agro-industrial complex, increasing its efficiency and sustainability. Despite significant growth in investment, there are significant differences in the levels of funding and technology development depending on the region, which affects the speed of innovation adoption. Important factors for further development are access to financing, political and economic stability, and infrastructure development. At the same time, technologies aimed at conserving resources and reducing environmental impact have great potential for attracting investment in the future.

Implementation of smart agricultural technologies in the agricultural sector of Azerbaijan. The development of the agro-industrial complex in modern conditions is impossible without the introduction of innovative solutions that contribute to increasing productivity, optimising resource use and reducing negative impact on the environment. In global practice, smart agricultural technologies based on the use of digital systems, process automation, BD and AI analysis are a key factor in improving the efficiency of agricultural production (Puyu *et al.*, 2025). These technologies enable precision farming, monitoring of soil and crop conditions, effective water resource management, and the introduction of robotic systems into production processes.

Azerbaijan, with its significant agro-industrial potential, is gradually integrating smart agricultural technologies into agriculture. The state pays special attention to the modernisation of this sector, which is strategically important for the country's economy. There has also been an increase in investment in digital solutions for the agricultural sector, the development of precision farming technologies, and the creation of infrastructure for their effective implementation. Both state support and the involvement of international financial institutions and private capital play an important role in this process. For example, an analysis of investments in agricultural technologies in Azerbaijan shows a significant increase in funding for the agricultural sector. In particular, in the state budget for 2025, expenditures on agriculture were increased by more than 30 million manats, reaching a total of more than 1.2 billion manats (Ashirov, 2024). This indicates growing state support for the agricultural sector, which includes investments in technological innovation and production modernisation. Overall, the introduction of smart agricultural technologies in Azerbaijan's agro-industrial complex is a key factor in improving the efficiency of agricultural production (Table 2).

***Table 2**. The most common smart agricultural technologies in Azerbaijan in 2024*

Technology	Description	Examples
Digital farm management platforms	Tools for crop planning, crop monitoring and resource management	Electronic Agricultural Information System – an electronic agricultural information system that combines data on land use, crops, subsidies and allows farmers to manage resources and receive government services
Drones and satellite technologies	Use of unmanned aerial vehicles and satellite imagery to monitor crop conditions, detect diseases and assess soil moisture	Farmonaut – a platform for monitoring the condition of crops using satellite images, AI and recommendations for agricultural management
Precision farming	Individual approach to field management, including precise application of fertilisers, pesticides and water	Idrak Agrorobot – a robot that automates processes in agriculture, such as irrigation, spraying with chemical fertilisers, pesticides, insecticides, weed removal, etc.
Innovations in supply chain and logistics	Supply chain management and IoT systems to optimise the storage, transport and distribution of agricultural products	IoT systems (NB-IoT and LTE) - technologies for optimising the processes of storage, transportation and distribution of agricultural products, reducing losses and increasing competitiveness
Agro parks	Integrated agro-industrial complexes that combine land plots with processing enterprises	Dost Agropark – a joint agricultural project between Turkey and Azerbaijan, including smart agriculture, renewable energy and sustainable development

***Source:** compiled by the authors based on K.P. Kumawat (2023), S. Alizade (2024), Vision for the future: Transition to digital agriculture international conference (n.d.)*

The Electronic Agricultural Information System (n.d.) platform is an important tool for the development of Azerbaijan's agro-industrial sector, promoting the integration of digital technologies into agriculture (Vision for the future..., n.d.). Launched by the country's government in 2019, it allows farmers to access a wide range of agricultural services, including information on land use, crops and subsidies. By creating a single electronic database, the system improves resource management, increases the transparency of service delivery and ensures more effective monitoring of agricultural processes (Potryvaieva *et al.*, 2024). This initiative also responds to the global challenges of digitalisation in the agricultural sector, in particular by reducing information, transaction and oversight costs. The Farmonaut platform demonstrates high efficiency, confirming the feasibility of investing in digital solutions even in urbanised regions (Kumawat, 2023). This technology helps reduce crop losses by 10-35% through timely detection of crop problems and rapid intervention. A significant advantage is time savings – up to 95% compared to traditional methods of assessing crop condition. In other words, Farmonaut not only increases agricultural productivity, but also creates conditions for the sustainable development of the agricultural sector in the context of urbanisation and increasing pressure on resources.

In turn, Idrak Agrorobot is an important innovation in Azerbaijan's agro-industrial complex, demonstrating the effectiveness of automation in agricultural processes (IDRAK Technology Transfer MM, n.d.). Using advanced technologies, such a robot can perform a number of important functions, including irrigation, spraying, weed control, and automated harvesting. One of the main advantages is the high accuracy of the operations performed, in particular, the accuracy of movement up to 1 centimetre. Overall, the use of Idrak Agrorobot saves up to 30% of the time spent on traditional tasks, reduces the need for human resources, and significantly improves the overall results of economic activity. IoT systems are also actively used in Azerbaijan to optimise agricultural processes (Wireless solutions..., n.d.). One of the examples is solutions from Azcom Technology, which provide wireless connectivity via NB-IoT and LTE technologies. These systems allow for effective monitoring of the condition of agricultural products and resource management, reducing the costs of storage and transportation of products.

For its part, Dost Agropark, launched in October 2021, is an important project being implemented in three phases (Dost Agropark phase..., 2022). Upon completion of all phases, it is planned to commission agroparks covering an area of 6,000 hectares, build product processing complexes, and large storage warehouses. Investments in the project amount to over USD 100 million, and it will contribute to ensuring food security in Azerbaijan and Turkey, creating over 500 jobs. Thus, smart agricultural technologies contribute to the optimisation of agro-industrial production by improving resource management, crop cultivation efficiency and reducing costs, which overall increases the competitiveness of the country's agricultural sector. In this regard, Azerbaijan is actively investing in the development of smart agricultural technologies, seeking to increase the efficiency of agriculture and ensure food security. For example, Azercell Business has introduced an innovative IoT solution for irrigation systems – the "Irrigation Control System" (Azercell Business integrates..., 2023). This technology allows remote control of the irrigation process for large areas in automatic mode, which helps to increase productivity. As of 2025, the company continues to implement this solution for irrigation systems in Azerbaijan, providing monitoring and control of the irrigation process, while the availability of this technology via web and mobile applications ensures ease of use and management efficiency.

It should also be noted that in June 2022, the "Agali Smart Village" project was presented in Azerbaijan, which aimed to transform rural life through the introduction of modern technologies and infrastructure ("Smart villages" will..., 2022). For this project, villages were equipped with high-speed internet to support e-health and e-learning. Particular attention was paid to environmental and alternative energy sources, using solar and wind installations, as well as heat pumps to meet energy needs. As of 2025, the "Agali Smart Village" project in Azerbaijan continues to develop, becoming a model for regional revitalisation. Moreover, Azerbaijan is actively negotiating with international organisations (FAO, World Bank, International Fund for Agricultural Development, etc.) to attract financial support for the agricultural sector, in particular to improve water supply and introduce modern agricultural technologies. This is aimed at increasing the resilience of agriculture to climate change and improving production processes. However, despite the active integration of smart agricultural technologies into Azerbaijan's agro-industrial complex, their large-scale implementation faces a number of challenges (Fig. 4).

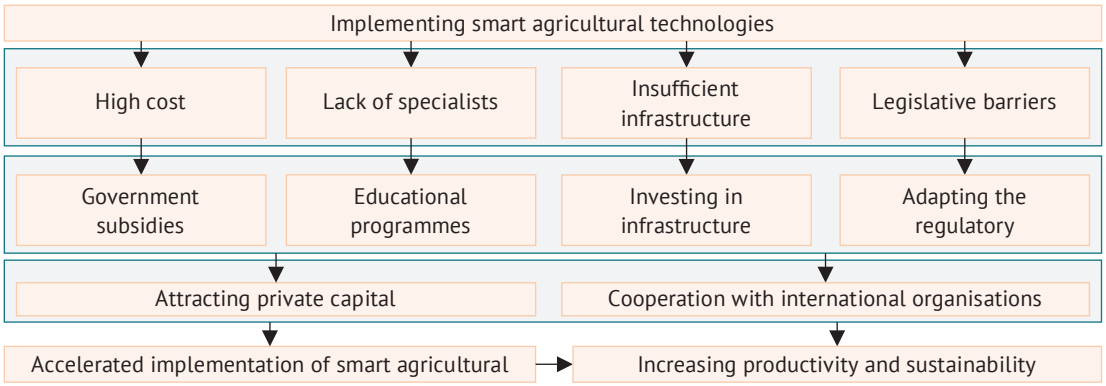

***Figure 4**. Main challenges of implementing smart agricultural technologies in Azerbaijan*
***Source:** compiled by the authors*

To overcome existing challenges and effectively develop smart agricultural technologies in Azerbaijan's agro-industrial complex, it is necessary to develop a comprehensive approach that includes financial, educational, infrastructural, and regulatory initiatives. One of the key areas is financial support, in particular the creation of state grant programmes to stimulate the introduction of smart agricultural technologies among small and medium-sized farms. An important aspect is the involvement of international financial organisations, such as the European Bank for Reconstruction and Development and the World Bank, to co-finance innovative agricultural projects. The private sector can be stimulated through tax incentives for companies investing in digital agricultural technologies. An additional effective mechanism is public-private partnerships, which allow for the implementation of large-scale projects using modern agricultural technologies.

The development of human capital plays an important role. It is necessary to integrate digital agriculture training programmes into educational institutions, in particular agricultural universities and vocational schools. It is advisable to organise training for farmers on the use of smart agricultural technologies, agricultural data management and the automation of production processes. It is also worth expanding international cooperation with agricultural educational and

scientific institutions to exchange experience in the field of agricultural innovation. Infrastructure modernisation is an integral part of the successful implementation of smart agricultural technologies (Boiko *et al.*, 2025). The primary task is to develop digital infrastructure in rural areas, including access to high-speed internet and satellite communications. In addition, it is necessary to expand the network of agroparks, integrating IoT solutions for managing production processes, logistics, and product storage. A separate area is the modernisation of irrigation systems, which will enable the introduction of "smart" water use, optimising the use of water resources in agriculture (Hussain *et al.*, 2022).

The effective development of smart agricultural technologies also requires improvements to the regulatory framework. The development of legislation to stimulate digital agricultural solutions and regulate their application will contribute to more active integration of innovations (Syrov, 2024). In addition, it is important to create legal mechanisms for the protection of intellectual property, which will motivate local enterprises to develop their own technological solutions. The introduction of environmental standards will make it possible to assess the effectiveness of smart agricultural technologies in terms of sustainable development and minimising negative impacts on the environment (Konovalyuk *et al.*, 2023). In addition, international cooperation should be strengthened by developing strategic partnerships with countries that are leaders in smart agricultural innovation, such as the Netherlands, Israel and the United States. Joint research and development centres will enable the adaptation of advanced technologies to Azerbaijan's specific conditions, which will facilitate the faster implementation of modern solutions in agricultural production. Furthermore, attracting international grants will provide funding for the development and adoption of cutting-edge technologies in precision agriculture, agroecology, and biotechnology. In turn, the dynamic economic indicators of agricultural enterprises in Azerbaijan demonstrate the industry's increasing financial stability. This is a crucial factor for further investment attraction and the development of innovative technologies within the agro-industrial sector (Fig. 5).

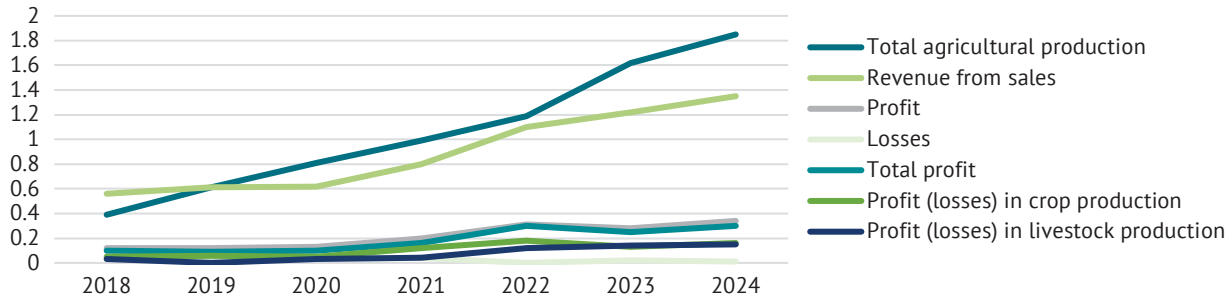

Figure 5. *Dynamics of economic indicators of agricultural enterprises in Azerbaijan, 2018-2024 (thousand manats)*
Source: *compiled by the authors based on H. Ismayilova and S. Hajiyeva (2024)*

The total volume of agricultural production in Azerbaijan shows positive dynamics, which indicates the effectiveness of state policy and investments in the development of the industry. Increased revenues of agricultural enterprises, profit growth and a stable financial position contribute to the further implementation of smart agricultural technologies. These factors indicate the prospects for further investment in the digitalisation of the agricultural sector, which will ensure increased productivity, resource optimisation and sustainable growth of Azerbaijan's agro-industrial complex. For a better understanding of the dynamics of investment processes in the agricultural sector, it is advisable to analyse the volume of capital investments in this sector in Azerbaijan (Table 3). The figures provided reflect financial activity in the industry for 2018-2024, which is important for assessing the investment environment in which innovative technologies are being implemented.

Table 3. *The volume of investments in fixed assets in the agricultural sector of Azerbaijan in 2018-2024 (million manats)*

Year	Volume of investments
2018	764.4
2019	769.5
2020	520.6
2021	341.9
2022	408.0
2023	578.3
2024	625.0

Source: *compiled by the authors based on State Statistical Committee of the Republic of Azerbaijan (2024)*

In other words, there are fluctuations in investment volumes, with certain increases and decreases, reflecting changes in economic conditions and financing of the agricultural sector. The overall trend shows a gradual increase in investment, confirming interest in the development of the agro-industrial complex and the potential for further implementation of innovative technologies. Thus, the large-scale introduction of smart agricultural technologies in Azerbaijan's agro-industrial complex is a necessary condition for ensuring its competitiveness and sustainable development. Effective digitalisation of agriculture requires not only investment in technological solutions, but also modernisation of infrastructure, training of qualified personnel and improvement of the regulatory framework. Creating favourable conditions for the integration of innovations will optimise production processes, improve resource management and minimise the environmental impact of agricultural activities. State support and the involvement of international experience will be key factors determining the further dynamics of the agricultural sector's development. The successful implementation of these measures will contribute to increased productivity, financial stability of enterprises, and the formation of a modern agricultural ecosystem capable of effectively adapting to global challenges.

DISCUSSION

This study showed that investments in smart agrotechnologies contribute to increased productivity, resource optimisation and food security, in particular through the introduction of precision farming, digital platforms and IoT solutions. Similarly, R. Choudhary *et al*. (2024) looked at the use of smart agri-tech, like AI and data science in the agri-sector to predict crop yields, manage resources, and deal with climate and scarcity challenges. In other words, both studies emphasise the importance of technology in transforming the agricultural sector, but the current study focuses on investment aspects, while the one under review focuses on technological approaches to process optimisation. The current analysis shows that the global smart agrotechnology market will grow from USD 20.87 billion in 2023 to USD 74.03 billion in 2034, with the main investments going towards automation, precision farming and AI solutions. Similarly, K. Selwe and C. Hofisi (2024) investigated the role of innovative technologies in the development of smart cities, emphasising their potential to improve the efficiency of urban systems. However, unlike the agricultural sector, urban initiatives face increased cybersecurity and data protection challenges, which require additional regulatory measures.

This study also showed that funding for smart agrotechnologies is growing, particularly in Azerbaijan, where budget expenditures for the agricultural sector in 2025 have been increased by more than 30 million manats, which contributes to the implementation of innovative solutions in agriculture. Similarly, T. Mandičák *et al*. (2021) looked at the assessment of investments in smart technologies, but for the construction industry, emphasising the need for effective methods of analysing their economic feasibility. Although both areas require significant capital investment, in the agricultural sector they are aimed at automating and digitising production, while in construction they are aimed at creating intelligent infrastructures and improving project efficiency.

The results showed that investments in smart agrotechnologies in Azerbaijan contribute to the implementation of digital farm management platforms, drones and satellite technologies, precision farming, IoT systems for supply chains and agropark, which increases productivity and optimises resources. To this end, the following platforms and technologies were analysed: Electronic Agricultural Information System, Farmonaut, Idrak Agrorobot, NB-IoT, LTE and Dost Agropark. In turn, S. Yusupov *et al*. (2025) found a positive effect of using modern agricultural technologies, such as drip irrigation and organic fertilisers, on increasing yields and conserving resources. Although both studies emphasise the importance of technology, the current results focus on investment aspects, while the aforementioned study focuses on the techniques used in agriculture. The work carried out confirmed the importance of investing in smart agricultural technologies to improve agricultural efficiency, in particular through the introduction of precision farming and digital platforms, which in Azerbaijan has resulted in 30-50% water savings, 10-30% yield increases and 35% reductions in greenhouse gas emissions through satellite monitoring, AI and blockchain technologies. Similarly, S. Giannelos *et al*. (2024) demonstrated the impact of investments in smart grids, focusing on the economic aspects of technology implementation in the energy sector. Both studies emphasise the importance of investment for resource optimisation, but in the agricultural sector the focus is on production, while in the energy sector it is on reducing costs and increasing grid flexibility.

Contrary to current results, which show that in 2023-2024, investments in smart agrotechnologies were unevenly distributed (North America – 43%, Asia-Pacific – 28%, Europe – 23%, Latin America – 4%, Middle East and Africa – 2%) due to infrastructure and economic constraints, as well as their impact on the economic performance of the agricultural sector, G.S. Reddy *et al*. (2025) focused on analysing the environmental sustainability of digital technologies in agriculture, urban development and energy. Thus, both works pointed to the importance of innovation for resource optimisation, but the former focused on the financing structure and economic effects, while the latter focused on the overall impact of technologies on sustainable development. Similar to the results obtained, which confirmed the importance of investments in smart agricultural

technologies for increasing productivity and optimising resources, in particular through the stable growth of agricultural production in Azerbaijan compared to the less pronounced dynamics in Kazakhstan, Kyrgyzstan and Uzbekistan for 2018-2024, the results of Y. Chen *et al.* (2024) emphasised the importance of precision farming in reducing negative environmental impacts and improving the efficiency of the agricultural sector. However, the current study focused on financial aspects and investment strategies, while the one under review focused on technological approaches to agrosystem management and their impact on agricultural sustainability.

The study showed that investments in smart agrotechnologies contribute to productivity and resource optimisation through the digitalisation and automation of processes, in particular through the introduction of precision farming using satellite monitoring, AI and blockchain technologies, the creation of partnerships with the government and agribusiness, and participating in carbon markets to track emissions. Similar conclusions were made by W. Febiyanti and A.P. Subriadi (2024), who studied the economic impact of investments in smart cities, emphasising their importance for gross domestic product growth, economic benefits and efficient use of resources. However, unlike the current study, which considers investments in the agricultural sector, the study focused on the need to develop methodologies for assessing the economic impact of innovations in urban development. The conclusions of this study emphasised the importance of investing in smart technologies in the agricultural sector, in particular AI and BD for monitoring crop yields and managing production. This is consistent with the findings of T. Al-Rimawi and M. Nadler (2025), who found that AI and BD are key to the development of smart real estate, as they facilitate market analysis, location selection and optimisation of construction processes. Both studies indicated that these technologies are suitable for practical use, although in the smart agricultural sector they are used to improve the efficiency of agricultural processes, while in real estate they are used to manage the urban environment and plan development.

The study focused on analysing investment trends in smart technologies and their impact on the agro-industrial complex, complementing the research by S. Khan *et al.* (2025), which confirmed the current findings regarding significant growth in investment in such technologies, particularly in automation, precision farming, and the use of BD for yield forecasting. Both studies noted the importance of financial support and overcoming barriers such as economic instability and uneven infrastructure development for the effective development of these technologies. At the same time, the current study expands the analysis of investment trends, focusing on specific regional aspects and financial mechanisms to support the implementation of smart technologies. The results of this study align with the conclusions of T.D. Viet *et al.* (2025), as both studies emphasise the importance of applying modern technologies, such as AI and IoT, for the development of smart agricultural production. The current study expands the focus on investment aspects, the impact of these technologies on the economic efficiency of the agricultural sector, and the need to overcome barriers through financial support, in particular through government grant programmes, the involvement of international financial organisations, tax incentives for the private sector, and public-private partnerships for the implementation of innovative agricultural projects. Although the aforementioned study focuses on the overall development of smart agricultural technologies and their integration to achieve sustainable agricultural development, both studies confirm the importance of technologies for optimising resources and increasing productivity in the agricultural sector.

Moreover, the results of the study by M. Shalamberidze and T. Gugeshashvili (2025) agree with the current analysis in recognising investment as a key factor in economic development, particularly through promoting modernisation, technology adoption and productivity growth. The current study details these processes in the context of smart agrotechnologies, demonstrating the growth in investment in fixed capital in Azerbaijan's agricultural sector in 2024, which contributed to an increase in the profits of agricultural enterprises. Meanwhile, the aforementioned source considers investment as a tool for overall economic growth and attracting foreign capital. The study found that one of the key factors in improving the efficiency of agricultural production is the combination of investment in digital infrastructure with the development of educational programmes for farmers and agricultural specialists. This approach not only promotes innovation but also helps to create a sustainable knowledge ecosystem necessary for adaptation to modern technological changes. In turn, M. Elhussiny (2025) study focuses on the implementation of smart technologies in port infrastructure, demonstrating the environmental and energy benefits of such solutions in the field of maritime logistics. Despite the differences between the industries, both approaches demonstrate the importance of innovation as a tool for achieving sustainable development. This study also showed that investments in smart agrotechnologies in Azerbaijan contribute to increased productivity, efficient use of resources and digitalisation of the agricultural sector. At the same time, S.T. Hajiyeva (2025) study focuses on the development of small and medium-sized businesses in the agro-industrial sector, barriers and investment dynamics in Azerbaijan. The results obtained generally confirm the conclusions of the aforementioned work regarding the importance of investment and structural modernisation for the development of the country's agricultural sector.

Thus, the study confirmed that investments in smart agrotechnologies play a key role in the transformation of the agro-industrial complex, ensuring increased productivity, resource optimisation and enhanced food security both globally and regionally, particularly in Azerbaijan. A comparison with other studies showed common conclusions regarding the importance of modern technologies for sustainable development, but revealed different emphases – from financing and institutional support to direct technological implementation, which indicates the need for a comprehensive approach to the digitalisation of the agricultural sector.

CONCLUSIONS

An analysis of investments in smart agrotechnologies has revealed key trends and their impact on the transformation of the agro-industrial complex, particularly in Azerbaijan. The global smart agrotechnology market has shown significant growth, with a projected increase from USD 20.87 billion in 2023 to USD 74.03 billion by 2034, with an annual growth rate of 12.2%. In 2023-2024, the main share of investments fell on North America (43%), the Asia-Pacific region (28%) and Europe (23%), while Latin America (4%) and the Middle East and Africa (2%) remained limited due to infrastructure and economic barriers. North America's leading position is due to its developed scientific and technological environment, venture capital, high level of digitalisation and government support. The main areas of funding include automation, precision farming, soil and crop monitoring using sensors, and AI and BD for yield forecasting. Global innovations, such as the microlanguage model "Aksara" by Cropin, the SMART FARM system by C-DAC, and the GFX-350 display by Trimble, illustrate the transformation of the agricultural sector through technology.

An analysis of the implementation of smart agricultural technologies in Azerbaijan's agro-industrial complex showed positive dynamics and demonstrated growth in agricultural production in Central Asian countries for 2018-2024. The results emphasised that technologies and platforms such as Electronic Agricultural Information System, Farmonaut, Idrak Agrorobot, NB-IoT, LTE and Dost Agropark increase productivity and optimise resources. In general, technologies such as precision farming, the use of drones and satellite technologies significantly increase production efficiency in the country. At the same time, Azerbaijan demonstrates relative leadership in the implementation of smart agricultural technologies among countries such as Kazakhstan, Kyrgyzstan and Uzbekistan. Compared to other countries in the region, Azerbaijan achieves water savings of 30-50% through precision irrigation, increases yields by 10-30% through AI recommendations, and reduces greenhouse gas emissions by 35% through optimised soil management. However, the following problems have been identified in the implementation of smart agricultural technologies in Azerbaijan: high cost, lack of specialists, inadequate infrastructure and legislative barriers. In addition, the implementation of projects such as the "Agali Smart Village" and the irrigation control system has not only modernised agricultural technologies but also improved social conditions in agriculture. This has increased the competitiveness of the agricultural sector, reduced costs and optimised resources. Progress in agricultural investment, in particular the increase in budget expenditure on agriculture by 30 million manats in 2025, confirms the importance of state support in this area.

However, the study is limited by insufficient access to complete data on investment flows and partial consideration of the socio-economic aspects of the implementation of smart agricultural technologies. Further research should focus on developing financial mechanisms to support small and medium-sized businesses, including microcredit and subsidies, analysing the long-term impact of innovation on the socio-economic structure of rural communities, and assessing the impact of geopolitical and foreign policy factors, such as trade restrictions or sanctions, on investment flows. It is recommended to develop grant programmes, expand digital infrastructure, improve legislation to stimulate innovation, and strengthen cooperation with leading countries such as the Netherlands and Israel to adapt advanced technologies.

ACKNOWLEDGEMENTS

None.

FUNDING

None.

CONFLICT OF INTEREST

None.

REFERENCES

[1] "Smart villages" will transform rural life in Azerbaijan. (2022). Retrieved from https://surl.li/nofnxz.
[2] Alizade, S. (2024). *How Azerbaijan adapts to new technologies in agriculture*. Retrieved from https://news.az/news/-how-azerbaijan-adapts-to-new-technologies-in-agriculture.
[3] Al-Rimawi, T., & Nadler, M. (2025). Leveraging smart city technologies for enhanced real estate development: An integrative review. *Smart Cities*, 8(1), article number 10. doi: 10.3390/smartcities8010010.
[4] Al-Shetwi, A.Q., Hannan, M.A., Al-Masri, H.K., & Sujod, M.Z. (2025). Latest advancements in smart grid technologies and their transformative role in shaping the power systems of tomorrow: An overview. *Progress in Energy*, 7, article number 012004. doi: 10.1088/2516-1083/ada198.

[5] Amirov, A., Rzayeva, T., Mammadli, G., Ismayilova, M., & Mammadova, E. (2024). The modern development of the agricultural sector in Azerbaijan: Analysis and evaluation. In *Scientific collection "InterConf", (186): With the proceedingsof the 3rd international scientific and practical conference "Innovative development in the global science"* (pp. 394-397). Boston: Independently Published.
[6] Anosike, F.C., Obasi, I.O., Nwachukwu, E.U., Obi, J.N., Orji, J.E., Inyang, P., Chinaka, I.C., Osang, E.A., Iroegbu, C.S., Nzeakor, F.C., & Onu, S.E. (2023). Integration of climate smart agro-technologies and efficient post-harvest operations in changing weather conditions in Nigeria. *Journal of Agriculture and Crops*, 9(3), 281-292. doi: 10.32861/jac.93.281.292.
[7] Arenas-Calle, L., Jennings, S., & Challinor, A.J. (2024). Agro-Technology for climate-smart agriculture and resilience to climate extremes in Sub-Saharan Africa. *IOP Publishing, Environmental Research: Food Systems*, 1, article number 021001. doi: 10.1088/2976-601X/ad50d9.
[8] Ashirov, Q. (2024). *Parliament approves significant funding boost for agriculture in 2025*. Retrieved from https://www.azernews.az/business/235209.html.
[9] Azercell Business integrates cutting-edge technologies in the agricultural industry. (2023). Retrieved from https://www.azercell.com/en/about-us/press-releases/news/azercell-biznes-elknin-knd-tsrrefati-sahsin-measir-texnologiyalar-gtirir.html.
[10] Bekbossinova, A., & Doszhan, R. (2025). The impact of digitalization and investment on agricultural development in Kazakhstan. *Eurasian Journal of Economic and Business Studies*, 69(1), 81-96. doi: 10.47703/ejebs.v69i1.474.
[11] Boiko, R., Baran, R., Boiko, V., Vasyltsiv, T., Mahas, N., & Berezivskyi, Y. (2025). Empirics of investment – social and economic development causal nexus in Ukraine (case study of the Lviv region of Ukraine). *Investment Management and Financial Innovations*, 22(2), 365-384. doi: 10.21511/imfi.22(2).2025.29.
[12] Chen, Y., Sun, Z., Zhou, Y., Yang, W., & Ma, Y. (2024). The future of sustainable farming: An evolutionary game framework for the promotion of agricultural green production technologies. *Journal of Cleaner Production*, 460, article number 142606. doi: 10.1016/j.jclepro.2024.142606.
[13] Choudhary, R., Mantri, S.P., Barse, V.A., & Chitnis, S. (2024). Leveraging AI in smart agro-informatics: A review of data science applications. *International Research Journal on Advanced Engineering and Management*, 2(6), 1964-1975. doi: 10.47392/IRJAEM.2024.0291.
[14] Ding, C. (2024). The role of blockchain technology and smart contracts in enhancing the transparency of fragmented investments in overseas real estate. *World Journal of Advanced Engineering Technology and Sciences*, 13(1), 448-458. doi: 10.30574/wjaets.2024.13.1.0442.
[15] Dost Agropark phase 1 opening ceremony was conducted. (2022). Retrieved from https://www.dostziraat.com/en/dost-agropark-faz-1-acilis-toreni-gerceklesti/.
[16] Electronic Agricultural Information System. (n.d.). Retrieved from https://www.eagro.az/.
[17] Elhussiny, M. (2025). Smart green ports: A sustainable solution for the maritime industry in a changing climate. *Journal of Multidisciplinary Adaptive Climate Insights*, 2(1). doi: 10.21622/MACI.2025.02.1.1162.
[18] Febiyanti, W., & Subriadi, A.P. (2024). Exploring the economic impact of smart city investment: A literature review. *Journal of the Independent Pillars of Nusa Mandiri*, 20(2), 87-93. doi: 10.33480/pilar.v20i2.5047.
[19] Giannelos, S., Borozan, S., Konstantelos, I., & Strbac, G. (2024). Option value, investment costs and deployment levels of smart grid technologies. *Sustainable Energy Research*, 11, article number 47. doi: 10.1186/s40807-024-00143-x.
[20] Hajiyeva, S.T. (2025). Current aspects of small and medium entrepreneurship development in the agro-industrial sector of Azerbaijan. *Science Education and Innovations in the Context of Modern Problems*, 8(2), 144-167. doi: 10.5281/zenodo.15108392.
[21] Hussain, K., Khan, N.A., Vambol, V., Vambol, S., Yeremenko, S., & Sydorenko, V. (2022). Advancement in Ozone base wastewater treatment technologies: Brief review. *Ecological Questions*, 33(2), 7-19. doi: 10.12775/EQ.2022.010.
[22] IDRAK Technology Transfer MM. (n.d.). *Product*. Retrieved from https://idrak.com/products/robotic-platform-1/.
[23] Investment opportunities for climate-smart agrifood tech in Kazakhstan and the Kyrgyz Republic. (2022). Retrieved from https://www.fao.org/europe/news/detail/Investment-opportunities-for-climate-smart-agrifood-tech-in-Kazakhstan-and-the-Kyrgyz-Republic/en.
[24] Ismayilova, H., & Hajiyeva, S. (2024). Agro-economic synergy: Enhancing food security through innovative agricultural practices in Azerbaijan. *AGORA International Journal of Economical Sciences*, 18(2), 134-147. doi: 10.15837/aijes.v18i2.6947.
[25] Kerimkhulle, S., Kerimkulov, Z., Aitkozha, Z., Saliyeva, A., Taberkhan, R., & Adalbek, A. (2023). The classification of vegetations based on share reflectance at spectral bands. In R. Silhavy & P. Silhavy (Eds.) *Artificial intelligence application in networks and systems. CSOC 2023. Lecture notes in networks and systems* (pp. 95-100). Cham: Springer. doi: 10.1007/978-3-031-35314-7_8.

[26] Khan, S., Sachan, H.K., & Krishna, D. (2025). The role of smart farming technologies in mitigating climate change and enhancing agricultural sustainability. *International Journal of Environment and Climate Change*, 15(2), 138-159. doi: 10.9734/ijecc/2025/v15i24718.
[27] Kharchenko, V., Ponochovnyi, Y., Qahtan, A.-S.M., & Boyarchuk, A. (2017). Security and availability models for smart building automation systems. *International Journal of Computing*, 16(4), 194-202. doi: 10.47839/ijc.16.4.907.
[28] Konovalyuk, I., Brych, V., Borysiak, O., Mucha-Kus, K., Pavlenchyk, N., Pavlenchyk, A., Moskvyak, Y., & Kinelsk, G. (2023). Monitoring the integration of environmentally friendly technologies in business structures in the context of climate security. *Forum Scientiae Oeconomia*, 11(2), 161-174. doi: 10.23762/FSO_VOL11_NO2_8.
[29] Kumawat, K.P. (2023). Study of designing technology-driven solutions for holistic environmental protection in agriculture. *Journal for ReAttach Therapy and Developmental Diversities*, 6(1), 1389-1394.
[30] Manafli, M. (2024). *Leveraging Azerbaijan's agricultural sector for economic diversification: Strategies for sustainable development and resilience*. doi: 10.2139/ssrn.4933972.
[31] Mandičák, T., Mésároš, P., Behúnová, A., Behún, M., & Tkáč, M. (2021). Evaluation methods of investments to mobile applications and smart technology in construction projects. In D. Perakovic & L. Knapcikova (Eds.), *5th EAI international conference: Future access enablers for ubiquitous and intelligent infrastructures* (pp. 374-385). Cham: Springer. doi: 10.1007/978-3-030-78459-1_28.
[32] Matthew, U.O., Kazaure, J.S., Ebong, G.N., Ndukwu, C.C., Nwanakwaugwu, A.C., & Ubochi, C.N. (2023). Smart IoT rural agricultural innovations for food security through digital technology transfer: Agro-industrial sector reform. *Global Research in Environment and Sustainability*, 1(7), 30-50.
[33] Pal, B.D., Kishore, A., Joshi, P.K., & Tyagi, N.K. (2019). *Climate smart agriculture in South Asia: Technologies, policies and institutions: Technologies, policies and institutions*. Singapore: Springer. doi: 10.1007/978-981-10-8171-2.
[34] Potryvaieva, N., Dubinina, M., Cheban, Yu., Syrtseva, S., & Luhova, O. (2024). Digitalisation of accounting of agricultural enterprises: National and international experience. *Ukrainian Black Sea Region Agrarian Science*, 28(4), 41-53. doi: 10.56407/bs.agrarian/4.2024.41.
[35] Precision agriculture trends: 2025 Yield innovations. (2025). Retrieved from https://farmonaut.com/asia/climate-smart-farming-5-ways-farmonaut-transforms-azerbaijan.
[36] Puyu, V., Ponichtera, P., Havriliuk, V., Sheiko, I., & Kozyrsky, D. (2025). Smart farming models in urbanised regions: Prospects for economic efficiency and sustainability. *Ekonomika APK*, 32(2), 76-86. doi: 10.32317/ekon.apk/2.2025.76.
[37] Reddy, G.S., Reddy, M., Chaitanya, K., & Joshi, A. (2025). Environmental sustainability in the digital age: The role of smart technologies in agriculture, urban development, and energy management. *International Journal of Environment and Climate Change*, 15(1), 12-24. doi: 10.9734/ijecc/2025/v15i14669.
[38] Selwe, K., & Hofisi, C. (2024). Exploring the role of innovative technologies in smart cities. *Journal of Education and Learning Technology*, 5(10), 568-582. doi: 10.38159/jelt.202451015.
[39] Shalamberidze, M., & Gugeshashvili, T. (2025). The role of investments in the development of the agri-food sector. *Georgian Scientists*, 7(1), 224-228. doi: 10.52340/gs.2025.07.01.21.
[40] Smart agriculture market size. Share and trends 2024 to 2034. (2024). Retrieved from https://www.precedenceresearch.com/smart-agriculture-market.
[41] State Statistical Committee of the Republic of Azerbaijan. (2024). *The agriculture of Azerbaijan*. Retrieved from https://www.stat.gov.az/menu/6/statistical_yearbooks/source/agriculture_2024.pdf.
[42] Syrov, O. (2024). Administrative legal regulation of the agro-industrial complex in the context of the "green" transition. *Law. Human. Environment*, 15(4), 84-102. doi: 10.31548/law/4.2024.84.
[43] Valiyeva, S. (2024). Agricultural field management problems: From classic agro-technologies to artificial intelligence. *Global Sustainable Development*, 2(1), 12-19. doi: 10.69471/gsd-8.
[44] Viet, T.D., Anh, L.H., Keiji, S., & Xuan, T.D. (2025). *The modern technology in developing smart agriculture*. doi: 10.20944/preprints202503.2174.v1.
[45] Vision for the future: Transition to digital agriculture international conference. (n.d.). Retrieved from https://agro.gov.az/digital-agriculture-en.html.
[46] Wireless solutions: Accelerating your CU, DU, RU development programs. (n.d.). Retrieved from https://www.azcomtech.com/wireless-solutions/.
[47] Yusupov, S., Azizov, I., Khaydarov, R., Inadullaeva, S., & Kholmirzayev, S. (2025). Optimisation of agro-technologies for sustainable development of agriculture in Uzbekistan. *BIO Web of Conferences*, 161, article number 00047. doi: 10.1051/bioconf/202516100047.

Роль інвестицій у розвитку розумних сільськогосподарських технологій у мегаполісах

Мехрібан Алієва
Кандидат економічних наук, доцент
Азербайджанський державний економічний університет (UNEC)
AZ1001, вул. Істіклляліят, 6, м. Баку, Азербайджан
https://orcid.org/0000-0003-4628-4873
Лейла Гусейнова
Кандидат економічних наук, доцент
Азербайджанський державний економічний університет (UNEC)
AZ1001, вул. Істіклляліят, 6, м. Баку, Азербайджан
https://orcid.org/0000-0001-7367-4661
Гульнара Агабекова
Кандидат економічних наук, доцент
Азербайджанський державний економічний університет (UNEC)
AZ1001, вул. Істіклляліят, 6, м. Баку, Азербайджан
https://orcid.org/0000-0002-8534-523X

Анотація. Метою дослідження був аналіз ролі інвестицій у розвитку інтелектуальних сільськогосподарських технологій в агропромисловому комплексі різних регіонів, з акцентом на впровадження цих технологій в Азербайджані. У дослідженні проаналізовано поточні інвестиційні тенденції в інтелектуальні сільськогосподарські технології в Північній Америці, Європі, Азіатсько-Тихоокеанському регіоні, Латинській Америці, Близькому Сході та Африці за 2023-2024 роки, а також оцінено їх вплив на розвиток агропромислового комплексу в період з 2023 по 2034 рік. Аналіз інвестицій показав, що Північна Америка займала найбільшу частку ринку інтелектуальних сільськогосподарських технологій у 2023-2024 роках (43 %), далі йдуть Азіатсько-Тихоокеанський регіон (28 %) та Європа (23 %), тоді як Латинська Америка отримала лише 4 %, а Близький Схід та Африка – 2 %. Прогнози показали, що світовий ринок розумних агротехнологій зросте з 20,87 млрд доларів США у 2023 році до 74,03 млрд доларів США у 2034 році. Результати також показали, що основні інвестиції спрямовані на автоматизацію процесів, точне землеробство, моніторинг ґрунтів та худоби, а також використання штучного інтелекту та великих даних для прогнозування врожайності сільськогосподарських культур. Водночас найбільшими перешкодами для розвитку були політична та економічна нестабільність, обмежений доступ до фінансування для малих сільськогосподарських підприємств та нерівномірний розвиток інфраструктури в різних регіонах. З іншого боку, результати показали, що впровадження розумних агротехнологій в агропромисловому комплексі Азербайджану підвищує ефективність виробництва завдяки точному землеробству, використанню дронів та супутникових технологій, цифровим платформам, інноваціям у ланцюгах поставок та агропаркам. Ці технології оптимізують ресурси, покращують моніторинг та знижують витрати, підвищуючи конкурентоспроможність сільськогосподарського сектору. Такі проекти, як «Розумне село Агалі» та «Система контролю зрошення», не лише модернізують технології, але й покращують соціальні умови в сільській місцевості. Крім того, спостерігається значне збільшення фінансування сільськогосподарського сектору, зокрема в державному бюджеті на 2025 рік, де витрати на сільське господарство збільшено на понад 30 мільйонів манатів. Аналіз також показав позитивну динаміку економічних показників сільськогосподарських підприємств Азербайджану між 2018 і 2024 роками. Водночас були визначені проблеми, такі як необхідність модернізації інфраструктури, підвищення кваліфікації персоналу та вдосконалення законодавства. Таким чином, отримані результати свідчать про позитивний вплив інвестицій у розумні агротехнології на ефективність сільськогосподарського сектору як в Азербайджані, так і в інших регіонах світу

Ключові слова: цифровізація сільського господарства; автоматизація виробничих процесів; фінансування підприємств; прогнози та тенденції світового ринку; підвищення ефективності виробництва