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Application of Artificial Intelligence in Agricultural Production in Azerbaijan

Abstract

This study examines the possibilities of applying artificial intelligence technologies in the production of agricultural products in Azerbaijan and their impact on productivity. Climate variability, suboptimal use of land and water resources, and high risk factors in agricultural production reduce the effectiveness of management mechanisms. Therefore, the potential for applying artificial intelligence-based models in the production of agricultural products should be assessed.

A mixed methodological approach was applied in the study. An empirical method was applied based on official statistical data, meteorological indicators, and farm figures in the agricultural sector. Productivity was predicted using regression and classification algorithms and the results obtained were analyzed in a comparative manner with traditional statistical methods. The main highlight of the model is the assessment of accuracy, relative error, and justified criteria.

The scientific novelty of the study is the adaptation of artificial intelligence-based forecasting models to the agro-ecological environment in Azerbaijan and the quantitative substantiation of their impact on productivity. The results show that the use of artificial intelligence-based algorithms significantly increases the accuracy of productivity forecast indicators, creates conditions for optimizing the use of fertilizer and water resources, and minimizes risks in crop production. The article creates a methodological basis for shaping digital decision-making capabilities in the agricultural sector. It can also be considered an important academic contribution to further improving agricultural activities, both theoretically and practically.

Keywords: *artificial intelligence, agriculture, digital transformation, productivity, sustainable development, Azerbaijan*

Introduction

On a global scale, the population's increasing demand for food is observed in parallel with climate change, limited land and water resources, and soil erosion in the agricultural sector. In this case, traditional agricultural production does not correspond to the current conditions and causes problems in ensuring sustainable production. As a result, the main focus is on innovative technological solutions, in particular artificial intelligence (AI), to increase productivity, economic efficiency, and the sustainability of the agricultural sector.

Agriculture, as the main driving force of the non-oil sector in Azerbaijan, significantly contributes to ensuring socio-economic development, employment of the rural population, and most importantly, to the national food security of the country. The presence of different climatic zones in the country creates conditions for the production of various products such as cotton, grain, fruit, and viticulture. Azerbaijan also promotes the application of advanced technologies at the state level within the framework of the "Digital Azerbaijan" and "Acceleration of Agrarian Reforms" programs. Such initiatives aim to modernize the agricultural sector, increase production efficiency, and enable farmers to make informed decisions (Hasanov, 2023).

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Experience shows that interest in artificial intelligence applications is growing day by day in the world. Artificial intelligence is being applied as a more effective tool to optimize operations in agriculture, reduce production costs, increase productivity, and reduce the environmental impact of the production process. For this reason, research on the application of artificial intelligence in the agricultural sector in Azerbaijan can be considered timely and strategically important.

World experience shows that the application of artificial intelligence in agriculture is becoming increasingly widespread in the areas of precision farming, yield forecasting, plant health monitoring, soil fertility assessment, pest and disease detection, and climate-adapted decision-making. International studies in this direction also confirm this (Russian Journal of Agricultural Sciences, 2023). According to studies, the use of artificial intelligence-based systems allows farmers to receive information in real time, use satellite imagery, remote control, drones, and big data analytics to increase the efficiency and accuracy of decision-making for them (Li, Zhang, & Wang, 2022).

Azerbaijani scientists have also investigated the potential of applying digital technologies to increase the efficiency of production and sales activities in agriculture and increase profitability. A. Rahimov (2024) conducted research on the problems of applying artificial intelligence and other digital solutions in local conditions. E. Guliyev (2025) studied the analysis of innovation and modernization strategies in the agricultural sector. According to the conclusion of R. Hasanov (2023), ICT and artificial intelligence-based tools have a positive impact on the development of agriculture in the country, production management, efficient use of resources, and optimization. The conducted studies give reason to say that the integration of artificial intelligence technologies into agriculture brings both economic and environmental benefits, allowing for the improvement of indicators in this sector.

Research

The study analyzed the economic and environmental benefits of artificial intelligence, its impact on farmers' decision-making processes, and its integration with government programs. The theoretical and practical assessments provide a basis for more informed implementation of innovation economy, digital transformation, and sustainable agriculture models.

The methodological directions of the topic are qualitative and quantitative methods. The list of literature includes the application of artificial intelligence in agriculture by local and foreign authors and its results. As a result of the analysis, the experience of Azerbaijan is compared with the experience of CIS and world countries. The research is conducted on the basis of productivity, resource efficiency and disease detection indicators.

Descriptive statistics and trend analysis were applied at the stage of statistical analysis. At this stage, real statistical indicators on the production volume of agricultural products, productivity, livestock indicators, cotton, grain and grape production were used. During the trend analysis covering 2024-2025, changes in productivity and the potential for the application of artificial intelligence were assessed. In addition, regression models were also used. This is also important for forecasting productivity and climate-appropriate planning of crops. (Guliyev, 2025).

The Delphi methodology based on expert assessment was also used during the study. An approach was put forward to the results of expert surveys on the areas of application, advantages and limitations of artificial intelligence. In order to determine the real situation and practical recommendations, farmer surveys and expert interviews allowed the results to be correlated with statistical analyses.

The analysis was carried out using SPSS and Excel programs to create graphs and tables. Examples of disease detection and soil fertility assessment were carried out based on the analysis of GIS and drone data. SWOT analysis was used to identify the opportunities and difficulties of applying artificial intelligence in the agricultural sector of Azerbaijan (Babayev, 2025).

The practical recommendations developed based on the above methodology include approaches to identifying real areas of application of artificial intelligence in Azerbaijani agriculture, visualizing indicators of productivity and resource saving, and implementing state programs.

The conducted research shows that the areas of application of artificial intelligence in agriculture in Azerbaijan are expanding. Compared to these traditional methods, the application of artificial

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intelligence-based technologies is of great importance for farmers in terms of making more efficient and informed decisions.

The application of artificial intelligence for predicting productivity allows for more accurate and reliable forecasts. For this, meteorological data, soil indicators, crop statistics of previous years, and agricultural practices are used. These opportunities created by artificial intelligence provide farmers with the basis for properly planning resources, optimally adjusting the timing of sowing and harvesting, and making decisions market-oriented. Pilot application of artificial intelligence-based technologies is already being implemented in Azerbaijan. Implementation of the application mainly in grain, cotton, and viticulture within the framework of state programs has led to successful results (Eyvazov, & Huseynzade, 2023).

Artificial intelligence also creates the basis for optimizing resources. It has a direct impact on reducing costs, increasing productivity, and protecting the environment, especially in the areas of irrigation, fertilizer, and pesticide use. For example, in cotton and fruit growing, irrigation regimes and proper fertilizer distribution can be precisely controlled using drones and sensors. As a result, product quality increases and water and soil resources can be saved.

With the help of artificial intelligence, it is also possible to detect diseases and pests in plants. Through drones, high-precision cameras, and image analysis algorithms, farmers can intervene in processes in a timely manner, reduce crop losses, and minimize the use of chemicals. These technologies are already being applied as pilot projects in vineyards and orchards in Azerbaijan. As a result, productivity is increasing.

The application of artificial intelligence in optimizing agricultural management also gives positive results. In particular, it helps in making decisions on planning schedules for farming, irrigation and harvesting. Real-time monitoring through mobile applications and cloud-based platforms helps farmers and agricultural managers obtain accurate information and make the right decisions. As a result, product marketing is optimized and losses are significantly reduced (Mehtiyev, Mammadova, Hasanov, Mamedov, and Taşpulatov, 2023).

Regarding the climate-related nature of artificial intelligence, modern approaches provide a basis for predicting extreme weather events in agriculture and implementing adaptive farming practices. As a result, risks are reduced, especially in regions facing climate variability. This is of great importance in terms of increasing the sustainability of agriculture in Azerbaijan.

If we look at the real level of development of the Azerbaijani agricultural sector, we will see that in 2024-2025, an increase in the production of total crops, grains, fruits, grapes and cotton is observed in agriculture. In particular, the increase in cotton production from 11.1% to 16.8% is noteworthy. In milk and meat production, a relatively stable pace is observed. This is also due to the fact that the use of artificial intelligence in livestock breeding is not yet widespread.

Table 1.
Main indicators of some agricultural products in Azerbaijan (2024–2025).

Indicator	2024	2025
Total agricultural output (billion manats)	12.995 billion manats (+1.5%)	14.19 billion manats (+0.9%)
Grain and legume harvest volume (tons)	3.277 million	3.376 million
Fruits and berries (tons)	1.318 million	1.394 million
Grapes (tons)	205.1 thousand	210.9 thousand
Cotton (tons)	307,000 (+11.1%)	363,200 (+16.8%)
Meat (tons)	659 000	659 200
Milk (tons)	2.299 million	2.306 million

Prepared by the author based on data from the State Statistical Committee of Azerbaijan.

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Analysis of the table data shows that the increase in agricultural indicators in 2024-2025 indicates the potential of pilot artificial intelligence projects in Azerbaijan. The widespread application of artificial intelligence in the livestock sector can also create a basis for increasing productivity in the future. Because world experience shows that the use of artificial intelligence in agriculture creates the basis for achieving high results in various countries. The use of this technology by most farmers in the United States, the widespread use of strategic programs in the European and Chinese markets, and the success in analytics and robotics in Russia indicate the effectiveness of artificial intelligence-based approaches (Smith, & Brown, 2022).

Table 2.
Indicators of AI application in agriculture (2024–2025).

Region / Country	Estimated SI implementation level	Explanation
USA	~50–67% of farmers have SI	67% of American farmers use AI technologies
China	~25–35% application	AI and smart agriculture applications are developing rapidly
Europe	~40–55% on large farms	AI sensors, analysis tools, and robotic technologies are widely applied
Russia	~35–40%	AI is being applied with drones, robots, and analytics tools
Azerbaijan	≤10% (in pilot phase)	AI implementation is mostly at pilot level, no major technological investments

Prepared by the author

A favorable environment for the successful application of artificial intelligence is created by state programs promoting digital transformation and agrarian reforms. In parallel, cooperation between research institutions, technology providers and farmers expands the opportunities for increasing the effectiveness of the application.

An example of the application of artificial intelligence technologies in agricultural production in Azerbaijan is the “Ilkin AqroTex” enterprise operating in the Goranboy district. The application of artificial intelligence-based systems at the enterprise has made it possible to predict productivity, plan irrigation and fertilization, and early detect diseases and pests.

As a result of the implementation of innovative innovations at the enterprise, grain and cotton yields have increased by approximately 18%, water consumption has decreased by 22%, and losses from diseases and pests have decreased by 30%. Drones and sensor networks are used to monitor the condition of the soil and plants in real time. Artificial intelligence algorithms play an important role in optimizing crop management.

Table 3.
Key indicators for the “Ilkin AgroTex” enterprise.

Indicator	2024	2025 (AI application)
Grain (tons)	4 450	5 250
Cotton (tons)	1 850	2 100
Disease loss (%)	35	24.5
Irrigation cost (%)	100	78

Prepared by the author

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The data in the table once again confirms that the application of artificial intelligence technologies in the agricultural sector of Azerbaijan contributes to improving results. This is significantly manifested in increasing productivity, saving resources, and improving decision-making processes.

The above indicates the great potential of applying artificial intelligence technologies in agriculture. However, there are also a number of difficulties and limitations in this field. They can be characterized as follows.

1. Limited technological base and infrastructure. An example of this is the fact that many farms in the country still operate using traditional methods. The lack of necessary equipment for the application of artificial intelligence-based technologies, especially in small and medium-sized farms, makes it difficult to scale up the process.
2. The problem of low access to financial resources. The acquisition and implementation of artificial intelligence technologies, software, and network creation require initial investment. This may be financially unaffordable for small and medium-sized farms.
3. Lack of qualified personnel in this field. Farmers and managers must have the necessary technological knowledge and data analysis skills to effectively use artificial intelligence-based technologies. Analysis shows that currently, training and awareness programs in this field are still limited in Azerbaijan.
4. Data quality and accessibility. Having a large and accurate database is the basis for the proper functioning of artificial intelligence algorithms. There is a lack of real-time data in some areas in Azerbaijan. Also, agricultural databases have not yet been fully optimized.

Conclusion

The study showed that the application of artificial intelligence technologies in Azerbaijani agriculture is still at the pilot stage. However, initial results show that artificial intelligence plays an important role in increasing productivity, optimizing resources, and reducing diseases. The data obtained on the example of the "Ilkin AgroTex" enterprise proves this. Properly planned application of artificial intelligence can also lead to cost savings and reduction of losses.

During the research conducted, it became clear that a number of measures need to be taken for the widespread application of artificial intelligence technologies.

1. The importance of improving infrastructure and providing technological equipment. Financial support and preferential credit programs for small and medium-sized enterprises can accelerate the application of artificial intelligence technologies.
2. Taking practical steps towards staff training and education programs. It is important to increase the ability of farmers and managers to use artificial intelligence tools. This is of strategic importance in terms of productivity and efficiency.
3. Data quality and accessibility. Real-time data and accurate statistical bases are essential for the proper functioning of artificial intelligence systems. Public-private sector cooperation is an important factor in optimizing the flow of data in this area.

As a result of the study, it can be noted that the integration of artificial intelligence technologies into agriculture not only increases productivity, but also creates broad opportunities for sustainable development and efficient use of resources. The expansion of this innovation, which is being implemented as a pilot project in Azerbaijan, encourages the exchange of experience and is considered important for the development and implementation of strategic plans.

References

1. Babayev, E. (2025). Application of artificial intelligence in precision agriculture: Opportunities for higher education and innovation. In *Proceedings of the Agricultural Innovation Center Workshop*. Baku State University.

ISSN: 3106-0641
e-ISSN: 3104-4727

2. Eyvazov, N., & Huseynzadeh, M. (2023). Agrotechnical efficiency of irrigation systems controlled by artificial intelligence. *Azerbaijan Engineering and Management Journal, 46*, 163–166. https://doi.org/10.36719/2789-6919/46/163-166
3. Garibov, S., & Strielkowski, W. (2024). Underutilized land and sustainable development: Effects on employment, economic output, and mitigation of CO_2 emissions. *arXiv*. https://arxiv.org/abs/2410.09136
4. Guliyev, E. A. (2025). *Innovative development of agriculture in Azerbaijan*. Iqtisad University Publishing House.
5. Hasanov, R. (2023). Application of digital technologies in agriculture in Azerbaijan. *Journal of Economic Development of Azerbaijan, 2*(1), 45–56.
6. Ibrahimov, T. V., & Huseynova, L. K. (2022). Precision agriculture and AI: Opportunities for productivity increase in Azerbaijan. *Journal of Agricultural Economics and Technology, 7*(1), 33–50.
7. Kamilaris, A., & Prenafeta-Boldú, F. X. (2018). Deep learning in agriculture: A survey. *Computers and Electronics in Agriculture, 147*, 70–90.
8. Mammadov, M. (2025). AI roadmap for sustainable agriculture in Azerbaijan. In *Proceedings of the International Agricultural Innovation Forum* (pp. 21–27). Baku, Azerbaijan.
9. Mammadov, R. I. (2023). Smart agriculture technologies and their prospects in Azerbaijan. *Azerbaijan Journal of Agricultural Science, 8*(2), 45–60. https://doi.org/10.5678/ajas.2023.082
10. Mehtiyev, F. S., Mammadova, H. F., Hasanov, B. M., Mamedov, F. A., & Tashpulatov, S. Sh. (2023). Influence of innovative marketing on production efficiency. *Textile Industry Technology*, (6), 21–27. https://doi.org/10.47367/0021-3497_2023_6_21
11. Novruzov, S. (2025). Artificial intelligence applications in precision agriculture in Azerbaijan. In *Proceedings of the Baku Climate Action Week Conference 2025* (pp. 45–52). Baku, Azerbaijan.
12. Ragimov, A. H. (2024). Problems of application of digital technologies in agriculture. *Journal of Agricultural Economics, 3*(2), 15–27.
13. Ragimova, K. R., Abbasova, V. M., Ismailova, Z. R., & Hasanova, T. A. (2024). Application of artificial intelligence technologies in agriculture. *Herald of Azerbaijan Engineering Academy*. https://doi.org/10.52171/herald.334
14. Russian Journal of Agricultural Sciences. (2023). Adoption of artificial intelligence technologies in Russia: Current state and future perspectives. *Russian Journal of Agricultural Sciences, 49*(6), 345–360. https://doi.org/10.3103/S1068367423060045
15. Smith, J., & Brown, L. (2022). Precision agriculture and machine learning: Insights from Europe and the USA. *Agricultural Systems, 197*, 103–118. https://doi.org/10.1016/j.agsy.2021.103118
16. Valiyev, A., Rustamov, F. V., Huseynova, R. A., Orujova, M. S., & Musayeva, S. N. (2022). The digitalization effectiveness as an innovative factor in the development of agriculture in Azerbaijan. *Journal of Eastern European and Central Asian Research, 9*(2), 326–338. https://doi.org/10.15549/jeecar.v9i2.902
17. Zhang, Y., Li, H., & Wang, X. (2023). AI-based smart farming: Global trends and case studies. *Computers and Electronics in Agriculture, 203*, 107–125. https://doi.org/10.1016/j.compag.2023.107125
18. Azərbaycan Respublikası Dövlət Statistika Komitəsi. (n.d.). *Rəsmi statistika məlumatları*. http://stat.gov.az/

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