


# The Prospects for the Application of Artificial Intelligence and Data Science in Agriculture by the Ministry of Economy of the RA

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**UDC:** 330; **EDN:** YPUADF; **JEL:** O13, P32, Q1

**DOI:** 10.58587/18292437-2025.1-187

**Keywords & phrases:** Artificial Intelligence, Computer Science, Agriculture, Armenia, Ministry of Economy, Smart Agriculture, Data Analysis

## ՀՀ Էկոնոմիկայի նախարարության կողմից գյուղատնտեսության մեջ արհեստական բանականության եվ տվյալագիտության կիրառման հեռանկարները

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**Ամփոփագիր.** Գիտական հոդվածը ուսումնասիրում է, թե ինչպես կարող է ՀՀ Էկոնոմիկայի նախարարությունը օգտագործել արհեստական բանականությունը (ԱԲ) և տվյալների գիտությունը գյուղատնտեսության ոլորտում: Արհեստական բանականության և տվյալների վրա հիմնված տեխնոլոգիաների ներդրմամբ նախարարությունը կարող է բարձրացնել գյուղատնտեսության արտադրողականությունը, բարելավել որոշումների կայացման գործընթացները և օպտիմալացնել ռեսուրսների կառավարումը: Հոդվածում նշվում են տարբեր կիրառություններ, ինչպիսիք են բերքի մոնիտորինգը, հողի վերլուծությունը և վնասատուների կառավարումը, ցույց տալով, թե ինչպես են այս տեխնոլոգիաները նպաստում ավելի ճշգրիտ և արդյունավետ գյուղատնտեսական պրակտիկայի զարգացմանը: Այն նաև անդրադառնում է առավելություններին, ինչպիսիք են արդյունավետության բարձրացումը և ծախսերի խնայողությունը, ինչպես նաև այնպիսի մարտահրավերներին, ինչպիսիք են տեխնիկական փորձաքննության և համապատասխան ենթակառուցվածքների անհրաժեշտությունը:

Արհեստական բանականության կիրառությունները, ինչպիսիք են մշակարույսերի բերքատվության կանխատեսման վերլուծությունները, հողի առողջության մոնիտորինգի ավտոմատացված համակարգերը և ճշգրիտ գյուղատնտեսական տեխնիկան, կարևոր են որպես հիմնական գործիքներ, որոնք կարող են փոխակերպել ավանդական գյուղատնտեսական պրակտիկան:

Ուսումնասիրությունը ընդգծում է ԱԲ-ի և տվյալների գիտության փոխակերպման հնարավորությունները Հայաստանի գյուղատնտեսության ոլորտում՝ շեշտելով դրանց դերը կայուն զարգացման և տնտեսական աճի խթանման գործում:

Գիտական նորույթը կանխատեսող վերլուծության, ճշգրիտ գյուղատնտեսության և ավտոմատացված մոնիտորինգի համակարգերի ռազմավարական ինտեգրումն է, որը նպաստակ ունի բարելավել որոշումների կայացումը և ռեսուրսների կառավարումը:

Ընդհանուր առմամբ, հոդվածը ներկայացնում է համապարփակ ակնարկ Հայաստանի գյուղատնտեսության արհեստական բանականության և տվյալների գիտության ներկայիս վիճակի ու ապագա հեռանկարների մասին, ընդգծելով դրանց կարևորությունը ոլորտի զարգացման համար:

**Հանգուցաբառեր և բառակապակցություններ՝** արհեստական բանականություն, համակարգչային գիտություն, գյուղատնտեսություն, Հայաստան, Էկոնոմիկայի նախարարություն, խելացի գյուղատնտեսություն, տվյալների վերլուծություն

## Перспективы применения искусственного интеллекта и науки о данных в сельском хозяйстве со стороны Министерства экономики РА

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**Аннотация.** Научная статья исследует, как Министерство экономики Республики Армения может применять искусственный интеллект (ИИ) и науку о данных в сфере сельского хозяйства. Внедрение технологий, основанных на ИИ и данных, предоставляет министерству возможность повысить производительность сельского хозяйства, улучшить процессы принятия решений и оптимизировать управление ресурсами. В статье акценти-

руется внимание на различных областях применения, таких как мониторинг урожая, анализ почвы и управление вредителями, показывая, как эти технологии способствуют более точным и эффективным сельскохозяйственным практикам. Также обсуждаются преимущества, включая повышение эффективности и снижение затрат, а также вызовы, такие как необходимость в технической экспертизе и соответствующей инфраструктуре.

Примеры использования искусственного интеллекта, такие как прогнозирование урожайности, автоматизированные системы мониторинга состояния почвы и технологии точного земледелия, выделяются как важные инструменты, способные изменить традиционные методы ведения сельского хозяйства.

Исследование подчеркивает преобразующий потенциал ИИ и науки о данных в аграрном секторе Армении, акцентируя их роль в поддержке устойчивого развития и экономического роста.

Научная новизна заключается в стратегической интеграции прогнозного анализа, технологий точного земледелия и автоматизированных систем мониторинга, что способствует улучшению принятия решений и управлению ресурсами.

В целом, статья предлагает всесторонний обзор текущего состояния и будущих перспектив применения ИИ и науки о данных в сельском хозяйстве Армении, подчеркивая их значимость для развития отрасли.

**Ключевые слова и словосочетания:** Искусственный интеллект, компьютерные науки, сельское хозяйство, Армения, Министерство экономики, умное сельское хозяйство, анализ данных

## Introduction

The agricultural sector is a vital part of Armenia's economy, significantly impacting the livelihoods of many people and contributing to the country's GDP. With global challenges like climate change, population growth, and resource scarcity, it has become essential to improve agricultural productivity and sustainability. In this light, the Ministry of Economy of the Republic of Armenia should look into innovative methods for modernizing agriculture, particularly focusing on the use of artificial intelligence and computer science.

AI and computer science have the potential to revolutionize agriculture by promoting more precise, efficient, and data-driven farming practices. They can enhance decision-making through predictive analytics, optimize resource use with precision agriculture technologies, and improve overall farm management with automated monitoring systems. By integrating these technologies, we can achieve higher crop yields, minimize environmental impact, and strengthen resilience against pests and diseases.

This article explores the efforts and plans of Armenia's Ministry of Economy to incorporate artificial intelligence and computer science into agriculture. It emphasizes the possible advantages, like enhanced productivity and sustainability, while also tackling current challenges such as the necessity for investments in technological infrastructure, educating farmers, and creating supportive regulatory frameworks. By utilizing advanced technologies, Armenia has the opportunity to become a leader in smart agriculture, promoting food security and driving economic growth in a complex global landscape.

## Theoretical Foundations

This article explores the efforts and plans of Armenia's Ministry of Economy to incorporate artificial intelligence and computer science into

agriculture. It emphasizes the possible advantages, like enhanced productivity and sustainability, while also tackling current challenges such as the necessity for investments in technological infrastructure, educating farmers, and creating supportive regulatory frameworks [9, pp. 55-80]. By utilizing advanced technologies, Armenia has the opportunity to become a leader in smart agriculture, promoting food security and driving economic growth in a complex global landscape [5].

The Ministry of Economy of the Republic of Armenia has the potential to launch several projects focused on integrating AI and data science into agriculture. These efforts are in line with global trends, as demonstrated by successful AI implementations in countries like the United States, Singapore, and the United Kingdom [8]. However, Armenia encounters specific challenges in this area, such as inadequate technological infrastructure and the necessity for regulatory frameworks that foster innovation.

In summary, although the incorporation of AI and data science presents significant opportunities for Armenia's agricultural sector, it is essential to address infrastructural and educational obstacles to guarantee the effective adoption and lasting benefits of these technologies.

## Results

The 2023 Government AI Readiness Index [13] highlights the significant potential for AI transformation, as governments around the globe acknowledge its substantial impact. They are not only focused on promoting AI innovation and creating regulatory frameworks but are also working to incorporate these technologies into the delivery of public services. The main goal of the Government AI Readiness Index is to evaluate how ready a government is to use AI in providing services to its citizens.

The study examined 10 dimensions (vision, governance and ethics, digital capacity, adaptability,

maturity, innovation capabilities, human capital, infrastructure, data availability, and data representativeness), which are organized into three

key pillars: government, the technology sector, and the data and infrastructure sector. The research included 193 countries.

Global Ranking	Country	Overall Score	Government	Technology Sector	Data and Infrastructure
1	United States	84.80	86.04	81.02	87.32
2	Singapore	81.97	90.40	66.19	89.32
3	United Kingdom	78.57	82.50	68.80	84.42
47	Turkey	60.51	75.08	42.32	64.13
73	Azerbaijan	48.15	55.86	30.77	57.82
85	Armenia	45.22	43.50	33.58	58.57
94	Iran	42.07	31.56	38.77	55.88
99	Georgia	41.27	41.96	30.33	51.50

Table 1. Government AI Readiness Index, 2023 [3]

As shown in Table 1, the United States, Singapore, and the United Kingdom occupy the top three spots, each achieving impressively high overall scores. Looking at the rankings of Armenia

and its neighboring countries, Turkey is in 47th place, Azerbaijan is 73rd, Armenia is 85th, Iran is 94th, and Georgia is 99th.

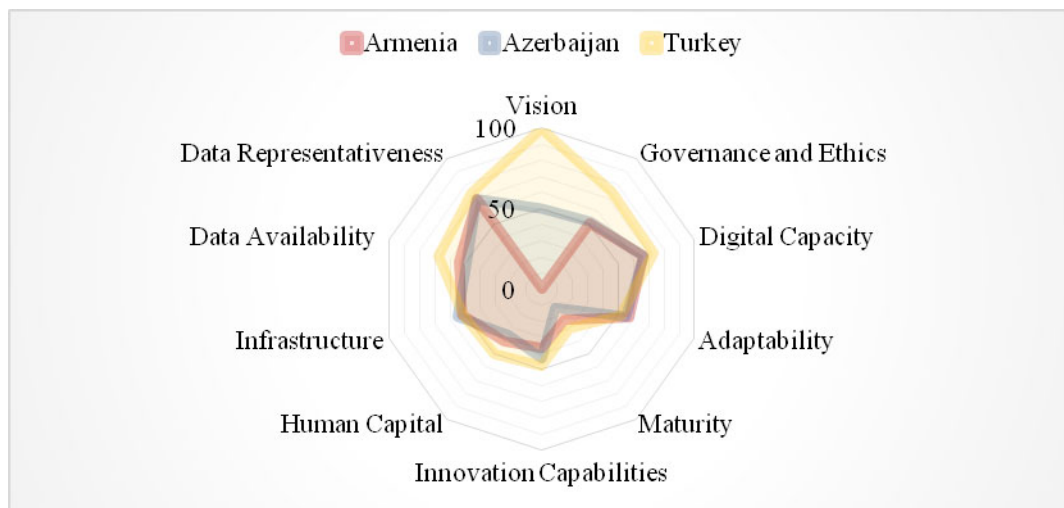


Figure 1. Indicators of the 2023 Study Across 10 Dimensions for Armenia, Azerbaijan, and Turkey [13]

Dimensions	Vision	Governance and Ethics	Digital Capacity	Adaptability	Maturity	Innovation Capabilities	Human Capital	Infrastructure	Data Availability	Data Representativeness
Armenia	0	50.37	66.48	57.13	23.72	36.75	40.27	52.37	54.46	68.88
Turkey	100	74.82	73.43	52.05	29.87	47.49	49.59	51.15	67.23	74.02
Azerbaijan	50	51.7	66.55	55.2	14.27	42.82	35.23	55.04	49.37	69.05

Table 2. Indicators of the 2023 Study Across 10 Dimensions for Armenia, Azerbaijan, and Turkey [13]

Figure 1 and Table 2 show the results of the 2023 study across 10 dimensions for the AI readiness index of the governments of Armenia, Azerbaijan, and Turkey. It is evident that Armenia ranks lower than Turkey in 9 out of 10 indicators and lower than Azerbaijan in 6 out of 10 indicators. Specifically, the scores for the AI implementation vision indicator [12] are 0 for Armenia, 50 for Azerbaijan, and 100 for Turkey. This clearly indicates that Armenia does not prioritize AI sufficiently.

Now, let's discuss the importance of implementing AI in various sectors of agriculture.

### **Autonomous Machinery for Agriculture in Armenia**

The use of autonomous agricultural machinery has the potential to greatly improve the efficiency of farming in Armenia. Tractors, harvesters, and other equipment that utilize AI and machine learning can carry out tasks like planting, weeding, and harvesting with little need for human involvement. This is particularly beneficial in Armenia, where labor shortages can be a significant issue, making these machines a game changer [11]. Autonomous tractors can maneuver through the rugged landscapes of areas like Tavush, ensuring accurate planting and harvesting. AI-driven harvesters can tell the difference between ripe and unripe crops, ensuring that only the best quality produce is collected. This technology lowers labor costs, reduces the chances of human error, and enhances overall productivity.

If Armenia concentrates on high-value crops like pomegranates and apricots, using autonomous machinery can help ensure that these crops are handled and harvested with care, which is crucial for meeting the quality standards required in export markets.

### **Crop Yield Predictive Analytics in Armenia**

Predictive analytics driven by artificial intelligence and data science can accurately forecast crop yields, offering Armenian farmers essential insights. By examining historical data, weather trends, soil conditions, and crop management techniques, AI models can estimate crop productivity, enabling farmers to plan their planting schedules and optimize resource use.

For example, AI systems can evaluate weather information and yield data to foresee potential droughts in the Ararat Valley, suggesting drought-resistant crop varieties or modified irrigation plans. These predictive insights empower farmers to reduce risks and boost productivity.

In Armenia, where weather conditions can be unpredictable, having access to reliable yield predictions can greatly lessen uncertainties and help farmers make well-informed choices. This

ultimately leads to better crop management and increased profitability.

### **Smart Irrigation Systems in Armenian Agriculture**

Water management is a vital concern in Armenia, especially in areas that face water shortages. Smart irrigation systems that leverage AI and data science can enhance water efficiency by tracking soil moisture, weather patterns, and the water needs of crops. These systems rely on data from sensors placed in the soil to accurately assess the water requirements for various sections of a field.

For instance, in the Ararat Valley, where water is scarce, AI-driven irrigation systems can pinpoint regions that receive less rainfall and automatically modify irrigation schedules to make up for the deficit. This approach ensures that crops get the right amount of water without excessive irrigation, helping to conserve water resources while boosting crop health and yield [2].

Incorporating smart irrigation systems into the agricultural lands of Armenia can lead to substantial water conservation, improved crop yields, and the encouragement of sustainable farming practices, all of which are vital for the long-term resilience of the country's agriculture.

### **Disease and Pest Detection for Armenian Crops**

Artificial intelligence and data science are essential for the early detection and management of crop diseases and pests. By using machine learning algorithms, we can analyze images of crops taken by drones or ground-based cameras to spot signs of disease or pest problems. These systems can distinguish between different diseases and pests, offering farmers accurate diagnoses and treatment suggestions [7].

In the Lori region, drones equipped with AI technology can monitor wheat fields and identify early signs of fungal infections. The system can recommend targeted fungicides and application techniques, allowing farmers to tackle the problem quickly and avoid extensive damage.

This innovation has the potential to greatly minimize crop losses while improving the overall health and productivity of Armenian agriculture, thereby supporting the country's food security and agricultural economy.

### **Supply Chain Optimization**

Artificial intelligence and data science have the potential to improve agricultural supply chains in Armenia, minimizing inefficiencies and boosting profitability. By examining data related to crop yields, market demand, transportation logistics, and storage conditions, AI systems can enhance the entire supply chain from farm to market.

For example, an AI-driven platform might forecast an increase in demand for Armenian apricots and suggest that farmers modify their harvest schedules in response [4]. It can also improve transportation routes to make sure that products arrive at markets swiftly and in the best condition, minimizing spoilage and boosting profits.

Supply chain optimization is especially important for Armenia, where agriculture is a key part of the economy. By enhancing supply chain efficiency, artificial intelligence and data science can assist Armenian farmers in maximizing their profits and strengthening their competitiveness in both domestic and international markets.

#### **Precision Livestock Farming in Armenia**

Precision livestock farming utilizes artificial intelligence and data science to oversee and enhance animal health and productivity. Sensors and wearable devices gather data on animal behavior, health, and environmental conditions, which AI algorithms then analyze to offer insights and recommendations. For example, AI systems can track the body temperature, movement, and feeding habits of cattle in the Syunik region to identify early signs of illness. This allows farmers to take timely action, minimizing the spread of diseases and promoting better animal welfare [10].

AI-based systems can optimize feeding schedules and nutrition plans, which can enhance livestock productivity and profitability. Implementing precision livestock farming in Armenia can lead to healthier animals, greater productivity, and more efficient use of resources, ultimately benefiting both farmers and the agricultural economy [1].

#### **Conclusion**

The use of artificial intelligence (AI) and data science in agriculture offers a significant opportunity for transformation in the sector, aligning with the strategic goals of the Ministry of Economy. By integrating these advanced technologies, we can boost productivity, optimize resource use, and promote sustainable agricultural practices. This academic article has examined the various benefits and potential challenges that come with adopting AI and data science in Armenia's agricultural landscape.

One of the main benefits of AI in agriculture is its capacity to deliver precise, data-driven insights that enhance decision-making. From predictive analytics that estimate crop yields and weather conditions to automated monitoring systems that maintain optimal soil and plant health, AI technologies are set to change traditional farming methods. The Ministry of Economy's focus on these innovations underscores a strong dedication to

modernizing agriculture, ensuring food security, and fostering economic development.

Additionally, data science in agriculture supports the effective management of resources like water, fertilizers, and pesticides. Precision farming techniques driven by AI allow farmers to apply inputs more accurately, which helps reduce waste and lessen environmental impact [6]. This method not only boosts crop yields but also encourages sustainable farming practices, which are crucial for the long-term health of agriculture.

The successful implementation of AI and data science in agriculture does come with its challenges. Major hurdles include the need for significant investments in technological infrastructure, fostering data literacy among farmers, and creating supportive regulatory frameworks. To tackle these issues, a collaborative effort is essential among the government, private sector, and educational institutions to provide the necessary resources, training, and policy support.

In conclusion, the potential for applying AI and data science in Armenia's agriculture through the Ministry of Economy's initiatives is encouraging, with the ability to greatly enhance the sector. The Ministry's proactive stance on exploring and integrating these technologies demonstrates a forward-thinking vision that aligns with global trends in agricultural innovation. By addressing existing challenges and harnessing the advantages of AI and data science, Armenia can establish itself as a leader in smart agriculture, ensuring a resilient and prosperous future for its agricultural community.

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*Сдана/Հանձնվել է՝ 03.12.2024*  
*Рецензирована/Գրախոսվել է՝ 10.12.2024*  
*Принята/Ընդունվել է՝ 17.12.2024*