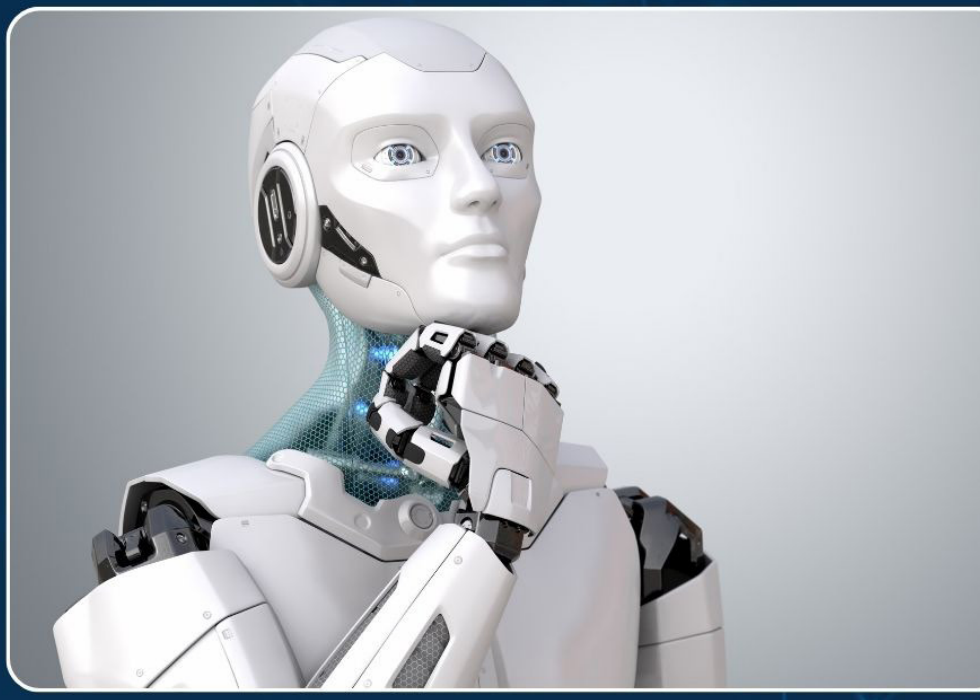
# MUHANDISLIK & IQTISODIYOT

№4

*ijtimoiy-iqtisodiy, innovatsion texnik,
fan va ta'limga oid ilmiy-amaliy jurnal*

2025
APREL



Milliy nashrlar

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*05.00.00 - Texnika fanlari*
*08.00.00 - Iqtisodiyot fanlar*

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*Elektron nashr,*
*79 sahifa, aprel, 2025-yil.*

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05.01.00 – Axborot texnologiyalari, boshqaruv va kompyuter grafikasi
05.01.01 – Muhandislik geometriyasi va kompyuter grafikasi. Audio va video texnologiyalari
05.01.02 – Tizimli tahlil, boshqaruv va axborotni qayta ishlash
05.01.03 – Informatikaning nazariy asoslari
05.01.04 – Hisoblash mashinalari, majmualari va kompyuter tarmoqlarining matematik va dasturiy ta'minoti
05.01.05 – Axborotlarni himoyalash usullari va tizimlari. Axborot xavfsizligi
05.01.06 – Hisoblash texnikasi va boshqaruv tizimlarining elementlari va qurilmalari
05.01.07 – Matematik modellashtirish
05.01.11 – Raqamli texnologiyalar va sun'iy intellekt
05.02.00 – Mashinasozlik va mashinashunoslik
05.02.08 – Yer usti majmualari va uchish apparatlari
05.03.02 – Metrologiya va metrologiya ta'minoti
05.04.01 – Telekommunikasiya va kompyuter tizimlari, telekommunikasiya tarmoqlari va qurilmalari. Axborotlarni taqsimlash
05.05.03 – Yorug'lik texnikasi. Maxsus yoritish texnologiyasi
05.05.05 – Issiqlik texnikasining nazariy asoslari
05.05.06 – Qayta tiklanadigan energiya turlari asosidagi energiya qurilmalari
05.06.01 – To'qimachilik va yengil sanoat ishlab chiqarishlari materialshunosligi
05.08.03 – Temir yo'l transportini ishlatish
05.09.01 – Qurilish konstruksiyalari, bino va inshootlar
05.09.04 – Suv ta'minoti. Kanalizatsiya. Suv havzalarini muhofazalovchi qurilish tizimlari
10.00.06 – Qiyosiy adabiyotshunoslik, chog'ishtirma tilshunoslik va tarjimashunoslik
10.00.04 – Yevropa, Amerika va Avstraliya xalqlari tili va adabiyoti


Ma'lumot uchun, OAK Rayosatining 2024-yil 28-avgustdagi 360/5-son qarori bilan "Dissertatsiyalar asosiy ilmiy natijalarini chop etishga tavsiya etilgan milliy ilmiy nashrlar ro'yxati"ga texnika va iqtisodiyot fanlari bo'yicha "Muhandislik va iqtisodiyot" jurnali ro'yxatga kiritilgan.

**Muassis:** "Tadbirkor va ishbilarmon" MChJ

**Hamkorlarimiz:**

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3. Toshkent irrigatsiya va qishloq xo'jaligini mexanizatsiyalash muhandislari instituti" milliy tadqiqot universiteti
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# MUNDARIJA

MUNDARIJA СОДЕРЖАНИЕ CONTENTS

# THE CURRENT STATE AND DEVELOPMENT TRENDS OF INNOVATIVE ACTIVITY IN AGRICULTURE

**Aytmuratova Miyrigul Zhalgasovna**
Independent researcher at Karakalpak State University

Abstract: This article explores the current state and development trends of innovative activity in agriculture. In the context of global challenges such as climate change, food security, and population growth, the agricultural sector faces the urgent need for technological modernization. The paper analyzes key indicators of innovation implementation in agriculture, evaluates the role of state and private investment, and identifies leading trends such as digital agriculture, biotechnology, and sustainable farming practices. The study concludes with recommendations for enhancing innovation diffusion and fostering a supportive ecosystem for agricultural transformation.

Keywords: agricultural innovation, digital farming, biotechnology, sustainability, agrotech, rural development.

Annotatsiya: Ushbu maqolada qishloq xo‘jaligidagi innovatsion faoliyatning hozirgi holati va rivojlanish tendensiyalari o‘rganiladi. Iqlim o‘zgarishi, oziq-ovqat xavfsizligi va aholining o‘sib borishi kabi global muammolar fonida qishloq xo‘jaligi sohasi texnologik modernizatsiyani jadal amalga oshirish zarurati bilan yuzma-yuz kelmoqda. Maqolada innovatsiyalarni qishloq xo‘jaligiga joriy etish bo‘yicha asosiy ko‘rsatkichlar tahlil qilinadi, davlat va xususiy investitsiyalarning roli baholanadi, shuningdek, raqamli dehqonchilik, biotexnologiyalar va barqaror qishloq xo‘jaligi amaliyotlari kabi yetakchi yo‘nalishlar aniqlanadi. Tadqiqot yakunida innovatsiyalarni kengroq tatbiq etish va qishloq xo‘jaligini transformatsiya qilishga ko‘maklashuvchi qulay ekotizimni shakllantirish bo‘yicha tavsiyalar beriladi.

Kalit so‘zlar: qishloq xo‘jaligi innovatsiyasi, raqamli dehqonchilik, biotexnologiya, barqarorlik, agrotexnologiya, qishloqni rivojlantirish.

Аннотация: В статье рассматриваются современное состояние и тенденции развития инновационной активности в сельском хозяйстве. В условиях глобальных вызовов, таких как изменение климата, продовольственная безопасность и рост численности населения, аграрный сектор сталкивается с острой необходимостью технологической модернизации. В работе анализируются ключевые показатели внедрения инноваций в сельском хозяйстве, оценивается роль государственных и частных инвестиций, а также выявляются ведущие направления, такие как цифровое земледелие, биотехнологии и устойчивые методы ведения сельского хозяйства. В заключение представлены рекомендации по активизации распространения инноваций и созданию благоприятной экосистемы для аграрной трансформации.

Ключевые слова: аграрные инновации, цифровое земледелие, биотехнологии, устойчивость, агротехнологии, сельское развитие.

## INTRODUCTION

The agricultural sector plays a fundamental role in ensuring global food security, sustaining livelihoods, and contributing to the economic stability of both developing and developed nations. As the global population continues to rise projected to reach nearly 10 billion by 2050—the demand for food, fiber, and fuel is expected

to grow exponentially. At the same time, the sector faces significant challenges, including limited arable land, water scarcity, climate change, biodiversity loss, and soil degradation. These issues pose a serious threat to agricultural productivity and long-term sustainability (figure 1).

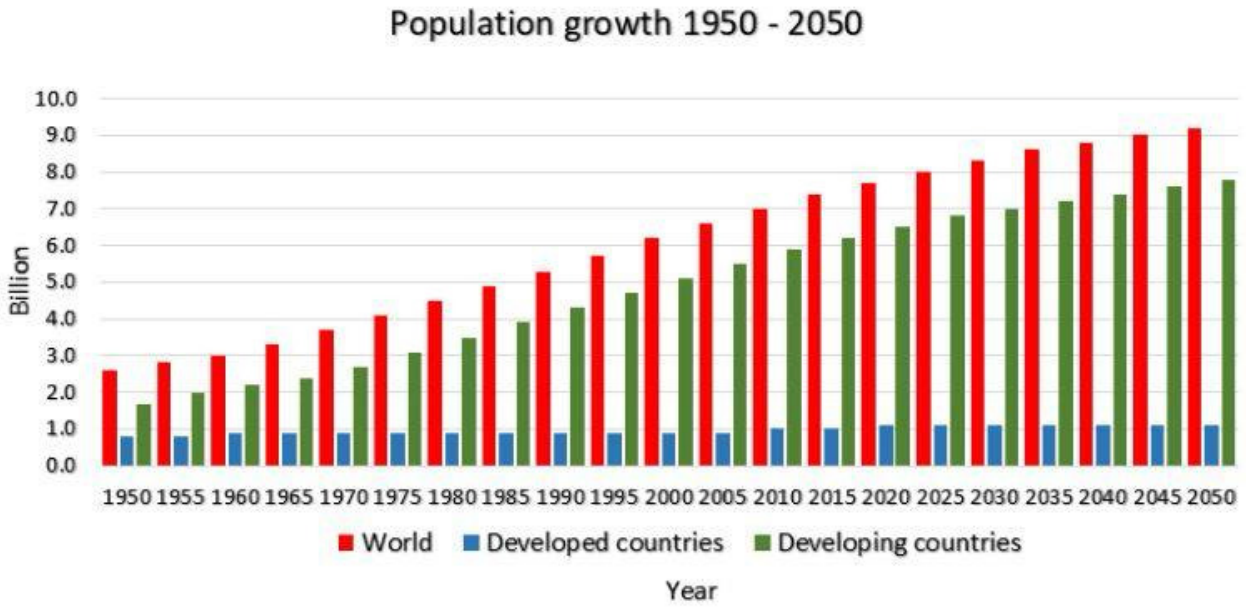


Figure 1. Population growth 1950-2050, billion.

Traditional farming methods, while historically effective, are increasingly inadequate in addressing today's complex and interconnected challenges. Reliance on outdated technologies, inefficient resource use, and environmentally harmful practices has underscored the urgent need for transformation within agricultural systems. In this context, innovation emerges as a critical driver of change. It introduces new approaches and technologies that enhance productivity, minimize environmental impact, and strengthen resilience against external shocks such as climate variability and market fluctuations.

Innovative activity in agriculture spans a wide array of domains, including biotechnology, precision farming, automation, digital agriculture, sustainable resource management, and supply chain optimization. The integration of advanced technologies such as artificial intelligence, the Internet of Things (IoT), big data analytics, and renewable energy has created unprecedented opportunities to improve efficiency and sustainability across the entire agricultural value chain.

This study aims to assess the current state of innovative activity within the agricultural sector, examining both its technological and institutional dimensions. It seeks to identify the key drivers, barriers, and enablers of innovation, as well as to highlight emerging trends likely to shape the future of agriculture. By understanding these dynamics, stakeholders including policymakers, researchers, agribusinesses, and farmers can better position themselves to foster innovation that not only meets the growing global demand for food but also promotes environmental stewardship and economic inclusiveness.

## REVIEW OF LITERATURE ON THE SUBJECT

The current state and development trends of innovative activity in agriculture have become a focal point of research within the global scientific community. Scholars emphasize that agricultural innovation is not merely a tool for boosting productivity, but a strategic instrument for ensuring food security, environmental sustainability, and long-term economic development.

Leading international research identifies three major drivers of innovation in agriculture: digital technologies, biotechnologies, and sustainability. Philip G. Pardey and Julian M. Alston have demonstrated that investments in agricultural research and development (R&D) generate high returns and significantly influence economic growth and food price stability. Their work highlights the necessity of sustained support for innovation to maintain global food system resilience.

Robert Evenson analyzed the impact of innovation on agricultural systems in developing countries, particularly in Asia and Africa. His research shows that modern plant breeding, improved seed varieties, biopesticides, and advanced irrigation techniques play a crucial role in enhancing agricultural productivity and adapting to environmental challenges.

In recent years, digital technologies such as precision farming, AI-based monitoring systems, the Internet of Things (IoT), and drone surveillance have reshaped the operational landscape of agriculture. David Rose and Jason Chilvers have explored how social factors and digital literacy influence the adoption of these technologies by farmers. According to their findings, innovation must be integrated into the social and institutional context to be effective and sustainable.

Biotechnological breakthroughs have also contributed significantly by increasing crop resilience, reducing chemical input reliance, and mitigating environmental impact. Paul Heisey and Keith Fuglie have conducted empirical studies in the United States and Europe, underscoring the critical role of biotechnology in driving agricultural efficiency and sustainability.

In the context of Uzbekistan, researchers such as S. Khojaev, B. Qodirov, and N. Madrahimov have examined the local implementation of agro-technological innovations. Their work explores issues related to the adaptation of global innovations to regional contexts, the development of infrastructure to support innovation, and the role of human capital and financing mechanisms in fostering innovation in the agricultural sector.

In conclusion, innovative activity in agriculture is increasingly viewed as a multidimensional process. It encompasses not only technological advancements but also environmental, institutional, and social innovations. Evidence-based research and international experiences serve as critical foundations for shaping effective innovation strategies in agriculture worldwide.

## RESEARCH METHODOLOGY

This research employs a mixed-methods approach that integrates quantitative and qualitative analyses to assess trends and dynamics in agricultural innovation over the past decade. The study draws upon both national and international datasets and publications (Table 1, 2, 3):

Table 1. Data Sources.

| Source | Type of Data | Scope |
|---|---|---|
| FAO (Food and Agriculture Organization) | Agricultural innovation indicators | Global |
| World Bank | Economic and agricultural statistics | Global and country-specific |
| OECD Reports | R&D expenditure, policy evaluations | OECD member countries |
| National Statistical Services | Country-level data on innovation inputs/outputs | Selected countries (2020–2024) |
| Scientific Publications | Peer-reviewed research on innovation trends | International |
| Policy Documents | National agricultural strategies | National level |

Table 2. Methodological Approach

| Method | Description |
|---|---|
| Comparative Analysis | Comparison of innovation indicators across countries and regions |
| Trend Analysis | Examination of innovation activity dynamics from 2010 to 2024 |
| Document Analysis | Review of scientific articles and official policy documents |
| Descriptive Statistics | Summary metrics such as mean, median, and growth rates |
| Index Construction (if used) | Development of composite indices for innovation activity (optional) |

Table 3. Indicators Analyzed.

| Indicator | Unit of Measurement | Source |
|---|---|---|
| R&D expenditure in agriculture | % of agricultural GDP | OECD, WB |
| Number of agricultural patents | Count per year | WIPO, FAO |
| of digital technologies in farming | % of farms using ICT | National surveys |
| Number of scientific publications in AgTech | Articles per year | Scopus, WoS |
| Innovation policy implementation timelines | Years, milestones | Policy docs |

## ANALYSIS AND RESULTS

The analysis reveals that while innovation adoption in agriculture is growing, it remains uneven across countries and regions. High-income countries lead in implementing digital technologies and precision farming, whereas developing nations often lack infrastructure and funding. Investment in agri-tech startups has increased globally, signaling strong market interest (figure 2).

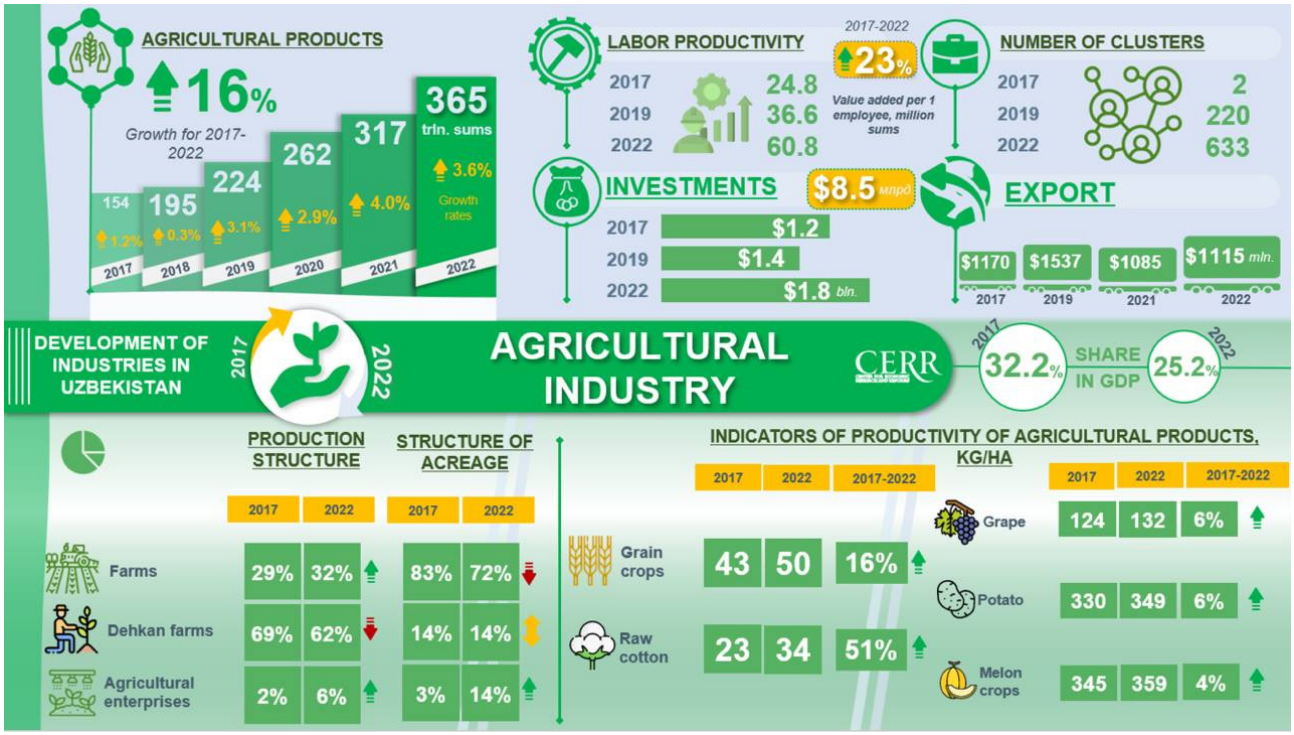


Figure 2. Development Indicators of the Agricultural Industry in Uzbekistan (2017–2022).

Key drivers of innovation include government subsidies, private investment, and the increasing availability of digital platforms. However, barriers such as limited access to capital, lack of technical knowledge among farmers, and regulatory hurdles continue to impede progress.

*Key development trends:*

• Digitalization of agriculture: The use of AI, IoT, and big data is transforming farming operations.

• Biotechnological advancements: Genetically modified crops and bioengineering are contributing to higher yields and resilience.

• Sustainable practices: Emphasis on organic farming, reduced chemical use, and climate-smart agriculture is growing.

• Agri-education and training: Farmer education and skill development are becoming central to innovation diffusion.

The agricultural sector stands at a turning point, where integrating technologies like precision farming, biotechnology, and digital platforms can significantly boost productivity and sustainability. These tools help optimize inputs, increase yields, reduce waste, and counteract climate impacts. Yet, adoption is uneven due to barriers such as inadequate infrastructure, financing gaps, limited training, and fragmented policies.

To harness innovation inclusively, policies must be tailored to diverse agro-ecological and socio-economic contexts. Special attention should be given to smallholder farmers, ensuring equitable access to technologies, knowledge transfer, and capacity building (figure 3).

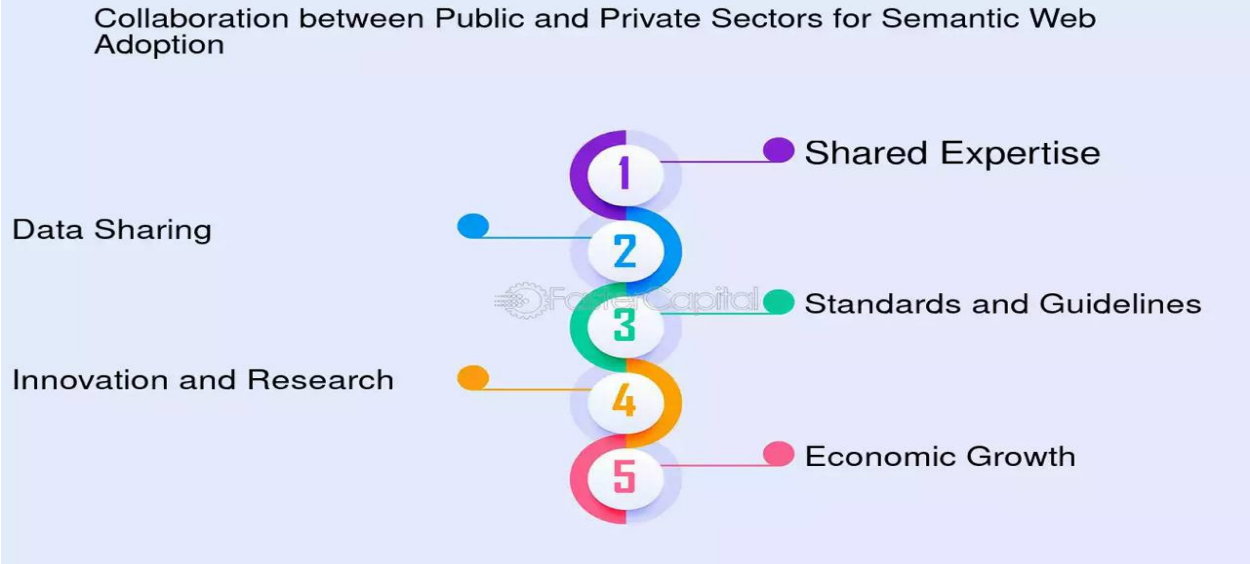


Figure 3. Key Areas of Collaboration Between Public and Private Sectors for Semantic Web Adoption.

Robust institutional frameworks are vital. Governments must set clear regulations, invest in R&D, and support inclusive innovation ecosystems. Public-private partnerships, aligned with community needs and sustainability goals, can accelerate change.

Cross-sector collaboration among governments, businesses, researchers, NGOs, and farmers—is key to scaling effective solutions. Embedding monitoring and evaluation mechanisms into innovation strategies will ensure adaptive learning and long-term impact on food security, environmental health, and rural livelihoods.

## CONCLUSION AND SUGGESTIONS

Innovative activity in agriculture is steadily advancing, driven by rapid developments in digital technologies, biotechnology, and a growing emphasis on sustainability. These core trends are transforming agricultural practices, increasing productivity, and enabling more efficient resource management. Digital tools such as precision farming, AI-powered monitoring systems, and data-driven decision-making are becoming increasingly accessible, while biotechnological innovations contribute to crop resilience, yield enhancement, and reduced environmental impact. Sustainability, now a central pillar of agricultural development, is pushing innovation toward eco-friendly practices and circular economy models.

However, significant disparities remain in terms of access to and implementation of these innovations. Many rural and underdeveloped regions still face challenges such as limited infrastructure, lack of funding, insufficient education, and weak policy support. These gaps hinder the widespread adoption of advanced agricultural technologies and perpetuate inequalities in agricultural productivity and resilience.

To ensure that innovation benefits all stakeholders in the agricultural sector, future efforts must focus on building a more inclusive and enabling environment. This includes strengthening rural infrastructure, improving access to digital tools, investing in education and training for farmers, and supporting smallholder farmers through targeted policies and financing. Furthermore, fostering international cooperation and knowledge-sharing will be essential in addressing global challenges such as climate change, food security, and biodiversity loss.

In conclusion, the future of agriculture lies in the successful integration of innovation across all regions and scales. By addressing current disparities and promoting inclusive development, the agricultural sector can become more resilient, sustainable, and capable of feeding a growing global population.

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**Ingliz tili muharriri:** Feruz Hakimov

**Musahhih:** Zokir Alibekov

**Sahifalovchi va dizayner:** Oloviddin Sobir o'g'li

**2025. № 4**



"Muhandislik va iqtisodiyot" jurnali 26.06.2023-yildan
O'zbekiston Respublikasi Prezidenti Adminstratsiyasi huzuridagi
Axborot va ommaviy kommunikatsiyalar agentligi tomonidan
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