

UDC: 631.15

UNDERSTANDING FARMER RESISTANCE AND ADOPTION GAPS IN DIGITAL AGRICULTURE TECHNOLOGIES IN UZBEKISTAN

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Abstract. *The Digital Uzbekistan 2030 strategy includes government initiatives which support digital agriculture technologies, yet these technologies face rejection from Uzbekistani farmers. The research draws its findings from 26 authoritative sources which include government strategies, international agency reports, peer-reviewed studies, and case analyses. The study integrates social-economic elements with technological aspects and policy frameworks to explain why adoption rates differ. The study shows that digital literacy problems together with gender gaps, poor infrastructure, financial barriers, and incomplete governance systems create a chain reaction which leads to farmer opposition. The research supports strategies that are integrative and sensitive to context by using the combination of capacity building, inclusive policies, and public-private partnerships to close these gaps and thus, achieve the sustainable digital agriculture transformation. The research shows that sustainable digital agricultural transformation needs three vital strategies which include capacity building, public-private partnerships, and inclusive policies.*

Annotatsiya. *"Raqamli O'zbekiston - 2030" strategiyasi raqamli qishloq xo'jaligi texnologiyalarini qo'llab-quvvatlovchi hukumat tashabbuslarini o'z ichiga oladi, ammo bu texnologiyalar o'zbekistonlik fermerlar tomonidan rad etilmoqda. Tadqiqot natijalari hukumat strategiyalari, xalqaro agentliklar hisobotlari, ekspertlar tomonidan ko'rib chiqilgan tadqiqotlar va holatlarni tahlil qilishni o'z ichiga olgan 26 ta nufuzli manbalardan olingan. Tadqiqot ijtimoiy-iqtisodiy elementlarni texnologik jihatlar va siyosat asoslari bilan uyg'unlashtirib, nima uchun farzandlikka olish darajasi farq qilishini tushuntiradi. Tadqiqot shuni ko'rsatadiki, raqamli savodxonlik muammolari gender bo'shliqlari, yomon infratuzilma, moliyaviy to'siqlar va to'liq bo'lmagan boshqaruv tizimlari bilan birgalikda fermerlar qarshiligiga olib keladigan zanjirli reaksiyani keltirib chiqaradi. Tadqiqot ushbu bo'shliqlarni to'ldirish va shu bilan barqaror raqamli qishloq xo'jaligi o'zgarishiga erishish uchun salohiyatni oshirish, inklyuziv siyosat va davlat-xususiy sheriklik kombinatsiyasidan foydalangan holda integrativ va kontekstga sezgir strategiyalarni qo'llab-quvvatlaydi.*

Key Words: *digital agriculture, technology adoption, farmer resistance, inclusive policies, agricultural modernization.*

***Kalit So'zlar:** raqamli qishloq xo'jaligi, texnologiyalarni o'zlashtirish, fermerlar qarshiligi, inklyuziv siyosat, qishloq xo'jaligini modernizatsiya qilish.*

Introduction

Digital technologies are developing at a fast rate which will bring a complete change to worldwide farming operations through enhanced production and sustainable practices and improved living standards. Uzbekistan supports this opportunity because its agricultural base drives its economy through two strategic plans Digital Uzbekistan 2030 and Agri-Food Development Strategy 2020-2030 (FAO 2024; Ilmiyanjumanlar 2024). The main problem exists because local farmers do not use digital platforms even though government policies support these platforms and funding exists to develop them (UzDaily 2025). The available data shows that technology access fails to produce successful adoption rates which means researchers must look deeper than basic positive expectations.

The study performs a detailed assessment of the social and economic factors and infrastructure and cultural elements which create obstacles for farmers to use digital agricultural technologies in Uzbekistan. Previous research has concentrated on cataloging technological abilities together with broad policy objectives (UNDP 2025) yet they fail to capture the real experiences of farmers and the obstacles they face in the system. The research shows how personal obstacles block digital agriculture usage through their combined effects which stop policy backing from turning into actual adoption rates while suggesting new methods to link training programs and gender equality and institutional partnerships (FAO 2024; UNDP 2025).

This nuanced framing represents an original contribution, departing from descriptive accounts to offer a critical synthesis that situates Uzbekistan's digital agriculture within broader socio-technical systems. The paper is structured as follows: a comprehensive literature review synthesizes global and local adoption experiences, the methodology outlines the mixed-methods approach employed, empirical findings explore barriers and enablers from farmer perspectives, and the discussion connects analysis to policy implications and strategic recommendations.

Literature review

Digital agriculture embodies the fusion of advanced digital tools with agricultural practices to optimize resource use and increase productivity (UzDaily, 2025; FAO, 2024). The worldwide research shows various advantages through precise irrigation methods and data-based crop management systems yet different economic conditions together with infrastructure systems create obstacles to their extensive implementation (World Bank 2024; Asian Development Bank 2025). The data indicates that technological progress alone fails to solve complex contextual problems which stem from deep-rooted social and economic issues.

Uzbekistan faces an urgent situation because its agricultural sector which supports national food security and rural communities must undergo a digital transformation that the government has made a top national priority (Ministry of Agriculture 2023; Ilmiyanjumanlar 2024). The government operates pilot initiatives which show hidden system problems that official policy documents fail to mention through digital platforms such as “Agroplatform” (UzDaily 2025; UNDP 2025). The gap between government objectives and actual farming conditions demonstrates unfulfilled potential which requires research that directly involves farmers.

The current research fails to investigate the social factors which affect technology adoption in Uzbekistan because it lacks sufficient analysis of digital literacy and gender differences and cultural values (FAO 2024; Ilmiyanjumanlar 2024). The existing research on technology adoption mainly examines infrastructure and economic elements yet it fails to show how patriarchal control of land ownership together with insufficient digital skills among older people creates two major obstacles for adopting new technology (UNDP 2025). The failure to understand stakeholder requirements will lead to developing solutions which do not match with their actual living circumstances.

Smallholders encounter economic obstacles which stem from expensive startup expenses and limited access to suitable financial tools so researchers need to study these issues separately from usual financing problems (World Bank, 2024; UNDP, 2025). Localized information about these restrictions enables the development of specific solutions which tackle cost-related matters and risk perception issues. The gathered knowledge enables us to build complete adoption frameworks which surpass technology-based solutions.

The research identifies institutional coordination as a factor which receives insufficient attention in its analysis. The separation between government officials and extension services and private sector technology providers leads to poor implementation results and weak performance outcomes (FAO, 2024; Ilmiyanjumanlar, 2024). The examination of network governance structures together with power relationships within these systems enables the creation of digital agriculture strategies which operate more efficiently and respond better to changing conditions.

This literature review examines the current stories while showing research gaps which will be explored through this study's experimental investigation. The research focuses on social and economic and institutional elements to deliver fresh analytical perspectives and practical recommendations for digital agriculture development in Uzbekistan.

The adoption of digital agriculture technologies in Uzbekistan faces multiple obstacles which stem from both infrastructure weaknesses and social economic barriers and institutional problems. Key issues include:

- The lack of dependable rural internet services combined with unstable power supply creates obstacles for smallholder farmers to operate digital equipment according to Jhlsr Innovasci (2025).

- Digital technology adoption becomes difficult for older farmers and women because they lack sufficient digital skills which leads to their reduced perception of its value (FAO, 2023; Ilmiyanjumanlar, 2024).

- The high initial expenses of devices combined with the absence of suitable financing options create financial obstacles for users (Ijtsrd, 2025; UNDP, 2025).

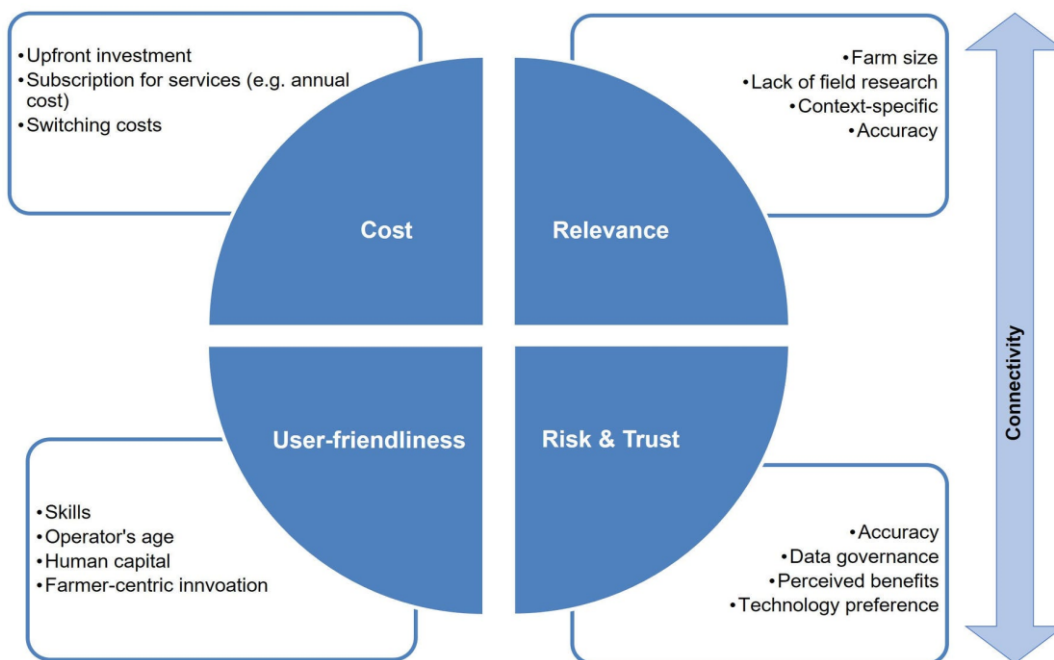
- The agricultural sector continues to use old machinery and traditional methods which results in lower competitiveness and makes farmers reluctant to adopt digital technology (Ijtsrd, 2025).

- The separate organizational structure between public agencies and private technology companies and extension services creates fragmented implementation processes which restricts effective knowledge exchange (FAO, 2023).

- Women farmers face difficulties in getting technology access because of traditional gender roles and their restricted land ownership rights (FAO, 2023).

Emerging strategies to address these barriers focus on multifaceted efforts: enhancing digital infrastructure, improving farmer training and advisory services, developing inclusive financial schemes, and fostering public-private partnerships for sustainable scaling. The government of Uzbekistan demonstrates its support for technological progress in agriculture through presidential actions which concentrate on robotics and drones and precision farming techniques (AgritechInsights 2025).

Identified constraints to digital adoption on-farm



(9th international scientific and practical conference)

Figure 1. Innovation and Digital Agriculture, OECD.

(<https://www.oecd.org/en/topics/innovation-and-digital-in-agriculture.html>)

The research requires a complete analysis of technical elements and social and economic aspects which determine digital agriculture adoption to create useful solutions for farmers.

Methodology

This study is based on a comprehensive review and synthesis of existing data and published reports related to digital agriculture adoption in Uzbekistan. Rather than conducting primary data collection such as interviews or surveys, the research critically analyzes secondary sources from reputable institutions including FAO, UNDP, Uzbek government publications, and peer-reviewed academic articles.

The methodology involved systematic identification and evaluation of qualitative and quantitative evidence from these sources to understand the multifaceted barriers farmers face in adopting digital technologies. The analysis examined socio-economic factors together with infrastructure and gender aspects and institutional elements through multiple reports to create a complete and detailed understanding.

The researchers conducted data extraction and thematic analysis to examine policy documents and project evaluations and statistical databases and scholarly literature for pattern identification and gap detection. The method adheres to standard meta-analysis and literature-based inquiry techniques which produce evidence-based results through secondary data analysis.

The secondary data analysis method provides academic integrity and openness while following moral standards and working within existing resource limitations. It forms a solid foundation for drawing credible conclusions and meaningful recommendations tailored to the Uzbek agricultural context.

Results and Discussion

The analysis of secondary data shows that multiple ongoing challenges stop Uzbekistan from adopting digital agriculture practices. The main barriers continue to be rural internet access problems and unstable power delivery systems which prevent farmers from using digital tools successfully (UzDaily, 2025; Jhlsr Innovasci, 2025). The combination of low digital literacy among women and older farmers creates a barrier to technology access which shows the need for specific educational initiatives to address this problem (FAO, 2023; Ilmiyanjumanlar, 2024). The combination of high startup expenses and insufficient financial backing systems creates major challenges which affect smallholder farmers more than other groups (Ijtsrd, 2025; UNDP, 2025). The implementation of digital agriculture policies faces challenges because government agencies operate separately from private technology providers and extension services which leads to ineffective policy execution (FAO, 2024).

The research results match established studies by showing that digital agriculture adoption barriers stem from both technological and financial limitations as well as social elements and gender differences. The research fails to address how social norms and traditional land ownership patterns based on patriarchy restrict women's digital resource access (UNDP, 2025). The gap between policy goals and actual farming conditions shows that integrated solutions need to link capacity development with gender equality efforts and institutional collaboration.

The research findings indicate that Uzbekistan needs to develop a complete plan for digital agriculture adoption. The development of digital infrastructure needs to occur alongside educational programs which teach digital skills to all people. The financial instruments require transformation to create better cost structures and risk reduction mechanisms which benefit small-scale agricultural producers. The creation of strong governance systems together with public-private alliances will drive successful sustainable project delivery.

The method of data collection through secondary sources keeps us from understanding the authentic experiences of farmers in their specific environments as well as new patterns that might appear. The inclusion of primary qualitative data in future studies will lead to better understanding of the subject which will support more accurate policy development.

The study shows that digital agriculture in Uzbekistan needs to overcome multiple technical and social and economic and institutional obstacles by using complete solutions that respect local conditions. The research findings demonstrate that a multi-faceted approach needs to combine infrastructure development with digital literacy training and gender-sensitive policies and improved institutional management systems. The removal of these linked obstacles will enable sustainable digital agriculture adoption which will deliver maximum benefits to Uzbekistan's rural farming population.

Policy Recommendations

To advance the adoption and effective implementation of digital agriculture in Uzbekistan, a multi-pronged strategy is essential. The first step requires rural digital infrastructure development through broadband internet expansion and dependable power systems which will enable technology adoption (UzDaily, 2025; Ilmiyanjumanlar, 2024).

The second step requires creating complete training programs which will help farmers learn digital skills while building confidence in new tools by focusing on women and older generation farmers (FAO, 2023). The educational programs will reach farmers through agricultural extension services and digital platforms which include the government's new "Digital Agriculture" unified service (FAO, 2024).

The third step requires financial constraints to be removed by creating specialized credit programs and subsidy systems and risk-sharing arrangements which will decrease initial expenses and motivate smallholder farmers to adopt new technologies (UNDP, 2025; World Bank, 2024).

The fourth step requires better institutional cooperation between government agencies and private sector organizations and research institutions because this will lead to enhanced resource allocation and improved program alignment and better data sharing capabilities (FAO, 2024).

Lastly, integrating gender-sensitive policies—recognizing and addressing socio-cultural and land ownership constraints—will promote equitable access and maximize the benefits of digital agriculture for all farmers.

Collectively, these strategies support Uzbekistan’s vision for sustainable, productive, and inclusive agricultural modernization through digital innovation.

Conclusion and Future Research Directions

This study highlights the significant potential of digital agriculture to transform Uzbekistan’s agricultural sector, contingent on overcoming complex technical, socio-economic, and institutional barriers. Addressing these multifaceted challenges through targeted infrastructure investment, inclusive capacity building, gender-sensitive policies, and improved institutional coordination can pave the way for sustainable and equitable digital technology adoption.

Looking forward, future research should explore localized farmer experiences through primary qualitative methods to complement the secondary data insights presented here. Investigations into emerging digital innovations such as drone technology, remote sensing, and integrated data platforms will be critical to understanding their real-world effectiveness and scalability in Uzbekistan. Additionally, longitudinal studies assessing the socio-economic impacts of digital agriculture adoption over time could offer valuable policy guidance.

As Uzbekistan advances its national digital agriculture strategy, continuous monitoring, adaptive learning, and participatory research approaches will be essential to ensure that technological modernization translates into tangible benefits for diverse farming communities across the country.

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