ICT and AI Platforms for Farmers: A Review

Abstract

The agricultural sector has undergone tremendous change as a result of the combination of Artificial Intelligence (AI) and Information and Communication Technology (ICT), especially in terms of improving farmers' access to information and ability to make decisions. ICT tools that offer timely information on weather, soil health, crop management, and market circumstances include mobile applications, Kisan Drones**,** SMS services, e-agriculture portals and digital marketplaces. Precision farming and risk management are further supported by chatbots, AI-driven advice systems, pest detection technologies and predictive analytics. The types, benefits, and challenges of ICT and AI platforms utilized by farmers are summarized in this paper. The results show significant gains in productivity, cost effectiveness, and access to trustworthy information, but problems like affordability, connectivity constraints and gaps in digital literacy still exist. To promote broader implementation, the review highlights the necessity of inclusive, user-friendly and region-specific digital agriculture systems.

Keywords- Agricultural sector, Artificial Intelligence, Information and Communication Technology, Precision farming and Chatbots

1. Introduction

The need for food is expected to increase dramatically as the world's population is expected to reach 9.7 billion by 2050, putting enormous pressure on agricultural sectors around the globe. India, the world's second-largest food producer, has particular difficulties because its rural population depends heavily on agriculture for a living. Small landholdings, erratic weather patterns, diminishing production, and a commitment to conventional farming methods that impede the adoption of new technologies are some of the problems the industry faces (Sassenrath et al. 2008). One of the main issues is that Indian farms are often much smaller than those in the United States, Australia, and Europe, with an average size of only 1.08 hectares. This restriction leads to inefficient land usage and challenges in producing economic results. Additionally, a lot of Indian farmers still rely on the seasonal monsoon rains for irrigation, which makes them vulnerable during droughts. Low agricultural yields

are among the lowest in the world as a result of this dependence and poor availability to essential inputs like water, fertilizer, and electricity caused by financial and infrastructure limitations (Begna, 2020).

Soil deterioration and an over reliance on non-scientific crop rotations are further issues that plague Indian agriculture and increase the difficulties faced by farmers. The Indian government has set the high objective of doubling farmers' incomes in the upcoming years, acknowledging the pressing need for systemic changes. In order to achieve this goal, precision agriculture technology must be used, with a focus on incorporating cutting-edge innovations like drones into farming methods to increase production, lower costs, and support environmental sustainability (Balkrishna et al., 2022). India has started a number of legislative initiatives targeted at removing obstacles to agricultural commerce in order to enhance agricultural marketing and raise farmer incomes, which are essential for improving rural living conditions. The National Agricultural Market (e-NAM), a pan-Indian electronic trading platform that was introduced in April 2016, is one important project. Under the slogan "one nation, one market," this program seeks to unite markets nationwide in order to promote a more competitive and effective agricultural market environment. Such advancements could play a crucial role in changing India's agricultural environment and resolving the coming problems with food security brought on by the world's expanding population (Ghosh et al., 2024).

In order to manage climate variability, fulfil growing food demands, and promote sustainable agricultural methods, agriculture is increasingly moving toward digital transformation. Due to staffing shortages, geographic restrictions, and delays, traditional agricultural extension services frequently fail to reach every farmer. By giving farmers access to real-time, precise, and customized agricultural information, ICT and AI systems offer a workable alternative. ICT technologies include digital market platforms, web portals, GIS tools, SMS and IVR systems, and mobile-based advisory apps (Saravanan et al., 2015). These technologies have made it easier to share important information on pricing patterns, fertilization schedules, disease control, and crop choices. By analysing massive datasets, making suggestions, identifying plant illnesses from photos, forecasting weather patterns, and automating decision-making procedures, artificial intelligence (AI) further improves these systems (Rani et al., 2023). ICT and AI platforms are now important tools for small and marginal farmers to manage risks, lower uncertainty, and increase farm productivity (Tzachor et al., 2022). This

evaluation gives an outline of these platforms, assesses their usefulness, and points out areas that require further work in order for rural communities to successfully adopt them.

2. Objectives

The following are the primary objectives of this review:

i. To investigate the various ICT and AI platforms that farmers employ.

ii. To examine how digital technology can enhance agricultural decision-making.

iii. To assess obstacles and difficulties influencing farmers' use of digital instruments.

iv. To draw attention to research gaps and upcoming prospects for improving digital agriculture.

3. Methodology

This work uses a secondary data-based systematic review methodology. Among the actions were:

3.1 Data Sources

Academic journals, books, digital databases, government papers, and publications from international organizations pertaining to agriculture and ICT were the sources of pertinent literature.

3.2 Inclusion Criteria

- Research on farmers' use of AI platforms or ICT tools
- Articles released between 2010 and 2025
- Publications about mobile applications, digital extensions, decision-support systems, or AI advisory tools
- Studies on adoption, benefits, or challenges

3.3 Exclusion Criteria

- Research not pertaining to agriculture
- Articles that concentrate only on industrial automation using AI
- Non-English publications
- Non-peer-reviewed or repetitive sources

3.4 Analysis

The chosen papers were grouped according to themes such AI applications, ICT tools, benefits, challenges and agricultural community effects. Results from various investigations were combined and contrasted.

4. Results and Discussion

4.1 ICT Platforms for Farmers

Farmers now have better access to location-specific and real-time agricultural information due to ICT tools.

- **Mobile apps** have become critical tools in modern agriculture with essential services like crop advisories, weather updates, fertilizer scheduling, and pest alarms. Features for weather forecasting, pest identification, soil health evaluations, and personalized crop recommendations are included in well-known applications like Plantix, AgriApp, and Kisan Suvidha (Patil and Naik, 2024). Over 30 million people use mobile agricultural services globally, with younger, tech-savvy farming populations making up a sizable portion of the user base, according to the GSMA AgriTech research (Kumar, 2025). Through data-driven insights and the integration of user feedback, these mobile applications not only improve outreach but also provide individualized user experiences that transform agricultural practices and increase industry efficiency (Beriya and Saroja, 2019).

  A hybrid approach that incorporates mass, group, and individual communication strategies has greatly increased the efficacy of agricultural extension techniques. This guarantees that farmers receive an equal share of agricultural knowledge (Prajapati et al., 2025). Digital platforms, mobile applications, and remote sensing technologies are essential to extension education in modern practices because they enable users to receive real-time, location-specific and easily available information. Farmers can receive real-time agricultural input advisories from well-known mobile applications including Kisan Suvidha, PUSA Krishi, AgriApp and IFFCO Kisan. They also feature crop calendar management tools, weather updates and video tutorials (Patil and Naik, 2024).

  Drones, AI diagnostics, satellite imaging, and IoT-based decision support systems are among the latest innovations being tested under the Digital Agriculture Mission to improve the accuracy of extension services (Patel et al., 2025). Farmers' learning results have been greatly enhanced by initiatives like Digital Green, which have effectively used interactive video techniques to reach over 17,000 villages. Together, these developments have expanded the scope of agricultural extension services, improving cost effectiveness, customization, and the integration of farmer input into advisory processes (Khatri et al., 2024).

- **“Kisan Drones”** program initiative, which emphasizes the value of drone technology in a variety of farming chores, is a significant step toward modernizing the agricultural industry. This project includes tasks including crop evaluation, digitizing land records,

and applying pesticides and fertilizers. The program's ultimate goals are to greatly improve operational efficiency in the agricultural sector, lower labor costs, and quicken the development of precision agriculture (Singh and Singh, 2025).

By increasing crop yields and encouraging environmental sustainability through the use of precision agriculture and cutting-edge farming techniques, drones are revolutionizing agricultural operations. By limiting the need for manual pesticide spraying and lowering worker exposure to hazardous chemicals, their deployment leads to significant cost savings. Drones make it possible to apply pesticides quickly and effectively, which enhances pest control operations and reduces pollution in the environment (Joshi and Pandey, 2024).

Drones are essential instruments for customized crop monitoring and management in India, where different agro climatic zones lead to different cropping patterns and agricultural techniques. These drones' sensors allow for on-going health evaluations of crops over their growth seasons, enabling farmers to take immediate action when insect problems or nutritional deficits are found. Drones are essential for tracking soil moisture levels as water scarcity becomes a major issue in many areas. This promotes water conservation in farming activities by allowing farmers to maximize irrigation tactics (Jain et al., 2023).

Furthermore, enduring problems like the predominance of weeds and pests need for creative solutions. Drones are an efficient early warning system for weed control and disease diagnosis, spotting possible problems in agriculture before they become obvious. They help farmers precisely assess soil qualities by offering superior real-time aerial imagery that outperforms satellite technology. The accurate and need-based application of crop inputs, such as the right amounts of pesticides and fertilizers, the identification of irrigation regions, and the evaluation of crop preparation for harvest, is made possible by the focused use of drones. This procedure can be effectively carried out in real time with the least amount of resource usage.

- **SMS/IVR services** help farmers who don't have smartphones or reliable internet access. To provide farmers with useful information on a daily or seasonal basis, these services rely on SMS, IVR (Interactive Voice Response), and mobile applications (Caine et al., 2015). During disruptions, such as the COVID-19 lock down, when in-person training was no longer an option, the move to remote advising methods using SMS, IVRS, WhatsApp and YouTube has proven very helpful (Payne and Willis, 2021). More than 500 million South Asian farmers increasingly rely on mobile phones as their main source

of agricultural information, according to research from the International Telecommunication Union (ITU) (Mittal et al., 2010). SMS advising services have become popular due to their affordability and ease of use. Millions of SMS messages on subjects including pest control, weather alerts, irrigation scheduling, and government programs are sent to registered users in local languages by programs like mKisan. Over 50 million users received over 1.5 billion messages via this platform between 2013 and 2021 (Goodwin, 2010).

- **E-agriculture portals** offer data on market prices, government programs, and best practices. The Ministry of Agriculture's mKisan portal is a noteworthy endeavour that has effectively distributed over 9,500 crore messages about weather alerts, pest outbreaks, market prices and agronomic practices. Over 9,500 crore messages have been delivered via SMS and IVRS due to the mKisan platform, which also supports advisories in 22 vernacular languages (Patil and Naik, 2024). The democratization of access to expert information has been greatly aided by digital extension portals like as eSagu, AgMOOCs, and FarmRise. Farmers who interacted with digital information reported a 22% gain in production and a better degree of confidence in using new technology, according to a poll conducted by the International Food Policy Research Institute (IFPRI) (Naika et al., 2021). Furthermore, Kisan Call Centers are essential, answering over 50,000 calls from farmers every day and providing multilingual assistance through qualified experts. By digitally integrating over 1,260 Agricultural Produce Market Committees, encouraging transparent pricing, and improving market access for around 1.8 crore registered farmers, the electronic National Agriculture Market (E-NAM) further improves farmer engagement (Shinde and Singh, 2024).
- **Digital marketplaces** reduce the role of market intermediaries by greatly improving farmers' access to buyers. Innovation-driven agricultural extension has benefited greatly from the growth of agri-startups and agri-tech businesses, which offer scalable and customer-focused solutions. Currently, more than 3,000 agri-startups operate in different states, taking advantage of programs like Startup India and Rashtriya Krishi Vikas Yojana-RAFTAAR. These firms provide a wide range of services, including digital soil testing, precision farming, drone monitoring, AI-powered crop advising, and traceability solutions (Singh, M. S. P. (2025). DeHaat, AgroStar, Stellapps, and BharatAgri are notable instances of mobile platforms that have touched thousands of communities and enabled doorstep delivery of agricultural inputs, professional guidance, and links to

output markets. By using a digital extension strategy that uses AI for pest prediction and customized input recommendations, DeHaat alone helps over 1.5 million farmers in 11 states (Jammanahalli Mahesh, 2022).

By combining satellite data, machine learning algorithms, and sensor-based diagnostics for real-time decision assistance, agri-tech innovations are reinventing extension services. Extension personnel are able to provide timely warnings based on accurate data because of partnerships between the National Remote Sensing Center and ISRO and state departments that concentrate on geospatial crop monitoring and yield forecasts (Ghosh et al., 2018). Additionally, platforms like Agmarknet and eNAM, which offer real-time analytics on commodity movements and daily price updates from over 3,000 markets, incorporate market knowledge into extension services. Farmers' bargaining strength, storage options, and participation in contract farming are all improved by the influx of information, which enables them to make well-informed judgments on market dynamics (Kumaravel et al., 2022). As a result, these hybrid models create responsive, individualized, and technology-driven agricultural extension services that enhance outreach, efficiency, and overall effect on the industry by fusing governmental initiatives with entrepreneurial innovations (Kumar, 2025).

These platforms have improved decision-making, increased farmer awareness, and enhanced extension outreach.

4.2 AI Platforms for Farmers

By handling complicated data, AI systems offer sophisticated solutions:

- **AI-based recommendation** systems evaluate crop, weather, and soil data to make precise farming recommendations. Mobile apps, SMS services, and interactive voice response systems are examples of ICT-based solutions that are being widely used to provide real-time crop management advice, weather advisories, and pest alarms. Farmers and extension agents are increasingly using social media sites like Facebook, YouTube, and WhatsApp to share multimedia content and participate in peer-to-peer learning. Scalability, affordability, and the flexibility to tailor data according to area, crop, or language are all provided by these digital solutions (Priya et al., 2025).
- **Image recognition software** used farmers can identify crop illnesses from photos. Animated snippets and instructional movies have become effective teaching resources, particularly in low-literacy settings. They offer concise, detailed explanations of farming techniques like composting, grafting, and operating machinery. A 10-fold decrease in

extension delivery costs and a 7% increase in technology adoption rates have been seen by organizations such as Digital Green when farmer-produced movies are shared within communities. In addition to making difficult ideas easier to understand, visual content may be viewed repeatedly, which strengthens learning over time (Bobek et al., 2016).

- **Predictive models** predict yield levels, pest outbreaks, and rainfall. The way rural communities evaluate and manage their natural resources is changing because of Geographic Information Systems (GIS) and participatory mapping techniques. Evidence-based planning is supported by the spatial depiction of land use, soil fertility, water availability, and cropping patterns made possible by GIS tools. These techniques allow communities to overlay technical data with local knowledge when used in conjunction with participatory mapping, ensuring that development decisions are both socially and scientifically sound (Malakar and Roy, 2024).
- **Chatbots** provide 24/7 digital advising assistance in regional languages. Chatbots like Gramophone's automated advisers and BharatAgri's "AgriBot" provide round-the-clock user support by responding to often requested queries on weather, seed variety, fertilizer dosage, and insect control. These chatbots may operate in several regional languages and are taught using large datasets and natural language processing (NLP) (Negi, 2024).
- **IoT devices with AI integration** assist in tracking temperature, nutrients, and soil moisture. Both students and grassroots workers can access structured learning resources, real-time weather and pest alerts, and query-resolution services through knowledge portals such as e-Krishi Shiksha, AgriDaksh and KVK Knowledge Network. These digital solutions lower geographical and infrastructure constraints in traditional extension, enhance service equity, and facilitate asynchronous learning (Priya et al., 2025).

These instruments improve precision farming and assist farmers in lowering input costs while boosting productivity.

4.3 Benefits Identified

The review highlights a number of benefits of ICT and AI platforms:

- Better and quicker access to agricultural information
- Increased crop yield and resource management
- Lower input costs as a result of efficient fertilizer and irrigation use
- Decreased risks from insect assaults and climatic variability
- Improved market knowledge and more reasonable price realization

4.4 Challenges and Barriers

Despite its advantages, adoption is hampered by a number of issues:

- Rural farmers have low levels of digital literacy
- Inadequate network infrastructure and restricted internet access
- Language obstacles with digital tools
- The high price of AI-enabled gadgets and smartphones
- Issues with trust and skepticism about automatic recommendations

These obstacles emphasize the need for more robust capacity-building initiatives and equitable digital policies.

Table 1. Comparison of ICT and AI tools in Agriculture

Aspect	**ICT Tools**	**AI Tools**
Primary purpose	Dissemination and communication of agricultural information	Intelligent analysis decision support
Nature of technology	Communication-based and information delivery systems	Data-driven, analytical, and predictive systems
Main functions	Weather updates, crop advisories, market prices, policy and scheme information	Personalized recommendations, disease detection, yield and weather prediction
Level of Automation	Low to moderate	High
Data processing	Limited processing of structured information	Advanced processing of large and complex datasets
User Interaction	Direct and simple user interaction	Interactive and system-driven interaction
Examples	Mobile apps, SMS/IVR services, e-agriculture portals, digital marketplaces	AI advisory systems, chatbots, image-based diagnosis, predictive analytics
Benefits to farmers	Improved access to timely and relevant information	Enhanced precision, efficiency and risk management
Cost of implementation	Relatively low	Relatively high
Infrastructure requirement	Basic mobile and internet	Advanced infrastructure

	connectivity	(sensors, data platforms, connectivity)
Digital literacy requirement	Basic digital skills	Higher cost, data dependency, transparency and trust issues
Major challenges	Connectivity issues, language barriers, outdated content	High cost, data dependency, transparency and trust issues
Adoption level	Widely adopted	Emerging and gradually increasing
Suitability	Suitable for most farmers including smallholder	More suitable where technical support and infrastructure exist

5. Conclusion

AI and ICT platforms have become effective tools for assisting farmers in making decisions and raising agricultural output. According to the review, these technologies can help bridge information gaps, lower uncertainty, and provide farmers with accurate and timely information. However, there are still a lot of issues with accessibility, affordability and literacy. Efforts must concentrate on creating user-friendly platforms, expanding ICT infrastructure, encouraging digital literacy, and incorporating localized information into AI models in order to guarantee the successful adoption of digital agriculture. To achieve equitable and sustainable agricultural growth, policymakers, extension agents, ICT developers and farmers must work together more closely.

6. Future direction of the study

i. Integration of ICT and AI Systems

Future agricultural platforms should combine sophisticated AI analytics with fundamental ICT tools to offer intelligent decision assistance and information access in one system.

ii. Design of Farmer-Centric Platforms

To increase use and acceptability, digital solutions should be created with farmers' needs, regional farming methods and linguistic preferences in consideration.

iii. Increasing Knowledge of Digital and Information

Training programs should concentrate on enhancing farmers' proficiency with digital platforms and their awareness of AI-based guidance.

iv. AI Model Localization

To improve accuracy, AI systems need to take into account region-specific data including farming patterns, soil types, climate and indigenous knowledge.

v. Enhancing Digital Infrastructure in Rural Areas

Widespread adoption in remote areas requires access to digital tools, reasonably priced smart devices and dependable internet connectivity.

vi. Scalable and Inexpensive Technologies

Future solutions should concentrate on affordable models that small and marginal farmers can easily scale.

vii. Privacy of Data and Ethical AI Use

To foster trust among farmers, clear policies about data ownership, privacy, openness and ethical usage of AI are required.

viii. Information centres' and libraries' roles

To assist farmers in gaining access to and utilizing ICT and AI platforms, libraries and community information centres can act as digital hubs.

ix. Impact Assessment and Tracking

Long-term research should evaluate how ICT and AI technologies affect farmer well-being, productivity, income and sustainability.

x. Policy Assistance and Cooperation

To support digital agriculture initiatives, cooperation between extension agencies, researchers, policymakers and technology developers is required.

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