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Agriculture in the Digital Age: Closing the Digital Divide and Looking at the Socio-Economic Factors Affecting ICT Adoption among Farmers in Uttar Pradesh

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Abstract

Information and Communication Technology (ICT) has become a powerful force in the Indian agricultural sector. It offers advancement to close knowledge gaps and improve the efficiency of agricultural value chains. Digital tools like messaging mobile advisory services, online portals and electronic markets are being integrated into agricultural extension systems. This integration delivers timely information and helps farmers make better decisions. This insights the current state of ICT use among farmers, especially in different agro-climatic zones of Uttar Pradesh. It also reviews key government and private efforts to digitize agricultural extension services. Despite platforms like the mKisan SMS Portal, Kisan Call Centres (KCC), and the National Agriculture Market (eNAM), various barriers still limit their effective use. Evidence from the Bundelkhand region indicates that more than 80 % of farmers see the lack of local language content as a major issue. Digital literacy limitations, poor infrastructure and financial constraints further obstruct ICT adoption. The study points out the need for an extension-focused approach to ICT deployment in relation to precision agriculture. The paper concludes that inclusive digital policies, infrastructure development, and collaboration among institutions are essential to creating resilient agricultural information ecosystem in India.

Keywords: Agriculture, Information and Communication Technology (ICT), Agricultural Extension, Digital Divide, ICT Adoption

Introduction

Agriculture plays a crucial role in India's socio-economic growth. The sector accounts for about 16-18 % of the national GDP and employs around 46% of the workforce. It thus supports the livelihoods of millions of rural families (Government of India, 2024). Recently, India has made significant strides in agricultural production, with food grain production reaching a record 3,577.3 lakh metric tonnes during the 2024-25 agricultural year. Related sectors like livestock and fisheries have also made important contributions; livestock's gross value added rose significantly between FY2015 and FY2024.

However, notable productivity gaps exist across different regions and sectors. Uttar Pradesh, for example, illustrates a contradiction in agricultural development. The state produced about 24.19 million tonnes of milk in 2013-14, ranking it as one of the largest milk-producing states in India, yet productivity per animal remains relatively low (BAH & FS, 2015). One major reason for this gap is limited access to reliable agricultural information and extension services. Information is seen as a key resource for agricultural development. Yet surveys show that nearly 60% of farmers do not access formal agricultural information sources. Less than 6% get information on animal husbandry practices (NSSO, 2014). This "adoption gap" underlines the need for effective methods to share research-based agricultural knowledge with farmers.

Information and Communication Technologies (ICTs) can help tackle these challenges. They facilitate quick sharing of agricultural information. ICTs include traditional media like radio and television, along with modern digital tools such as mobile phones, internet platforms, Geographic Information Systems (GIS), and sensor technologies (Kolhe *et al.*, 2009) [4]. These tools allow research institutions to share knowledge with farmers in a timely, cost-effective, and scalable way.

ICT Initiatives and Agricultural Value Chain Integration

Recognizing the potential of ICTs to boost agricultural productivity and market access, both the Government of India and private sector players have launched several initiatives to digitize agricultural extension and value chains. One key initiative is the mKisan SMS Portal, which started in 2013. It provides location-specific and timely advisories directly to farmers via mobile text messages. The platform allows agricultural departments, research institutions, and extension agencies to communicate with farmers in real time (mKisan, 2017). However, use has been limited. As of April 2016, only 16.4% of farmers in Uttar Pradesh were registered on the portal, showing a need for better awareness and access. Another major initiative is the Kisan Call Centre (KCC), set up in 2004 to give farmers real-time advisory services through a toll-free helpline.

Farmers can talk directly with agricultural experts and receive guidance in their local languages. In 2020-21, KCC handled over 5.47 million calls, highlighting its importance in meeting farmers' information needs (Yashavanth *et al.*, 2022) ^[17]. The National Agriculture Market (eNAM) is a significant digital reform in agricultural marketing. By linking Agricultural Produce Market Committee (APMC) mandis nationwide, eNAM enables transparent price discovery and reduces information gaps between buyers and farmers (Saravanan & Darekar, 2020) ^[14]. Alongside government initiatives, several digital knowledge platforms have been created to support agricultural extension. Agropedia, developed by the Indian Council of Agricultural

Research (ICAR), is a semantic-web-based knowledge repository that provides multilingual information on key crops and agricultural practices (Yadav & Yaduraju, 2011) ^[16]. Private sector innovations have also played a crucial role in the digitalization of agricultural value chains. Initiatives like e-Choupal have enabled direct procurement of agricultural products. Moreover, AKASGANGA has developed computerized milk collection systems to improve transparency and efficiency in dairy cooperatives. Agri-tech startups like AgroStar and Ninjacart are using mobile commerce and digital logistics platforms to enhance farmers' access to inputs and streamline supply chains from farm to market.

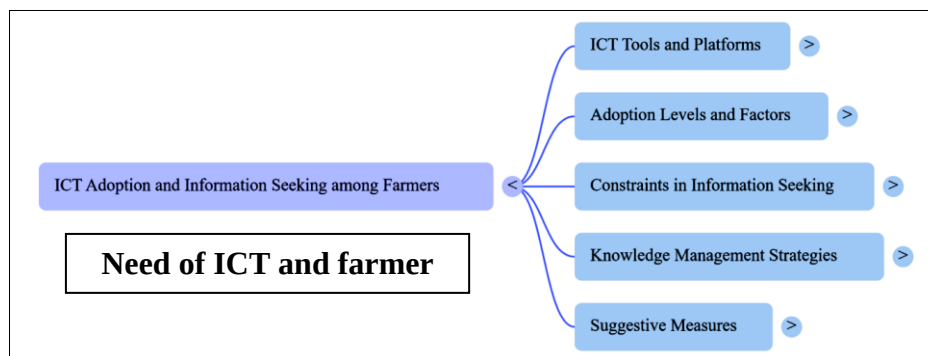


Fig 1: ICT Adoption and Information Seeking among Farmers".

ICT Adoption Levels and Farmers' Information Needs

Despite the growing number of digital platforms, many farmers still use ICT tools at low rates. A study in five agro-climatic zones of Uttar Pradesh found that about 74.67% of farmers are in the low category of ICT adoption (Singh *et al.*, 2018) ^[15]. Socio-economic factors significantly impact ICT adoption. Variables like education level, annual income, landholding size, and social involvement show strong positive relationships with farmers' use of digital technologies (Singh *et al.*, 2018) ^[15]. When it comes to communication device ownership, traditional media remain dominant in rural information systems. Around 69.33% of

farmers own radios, while 42.67% have televisions. In contrast, ownership of modern digital devices is low, with only 10.67% of farmers owning smartphones and 11.11% having access to computers. Farmers' information needs vary and are context-specific. Research in Mahoba district of Uttar Pradesh found that most farmers (86.37%) need information about seeds and planting techniques, followed by pest and disease management (64.96%) (Hariom & Singh, 2017) ^[4]. Information on weather forecasts, government schemes, and market prices is also among their top priorities.

Table 1: ICT Adoption and Information Seeking Initiatives in Indian Agriculture

Initiative and Type of ICT	Features	Key Constraints
mKisan Mobile (SMS), Telephone	Unified platform for information generation and delivery; provides need-based and timely agricultural SMS advisories; facilitates interaction between farmers and buyers.	Low registration rates; adoption hindered by low education levels, limited annual income, small land holdings, and lack of social participation
Agropedia Mobile (SMS) Telephone	Multi-lingual content aggregation for 24 crops; delivery via SMS and Voice KVK; features advanced semantic search capabilities Scientists, extension workers, farmers, ICAR,	Lack of adoption by the National Agricultural Research System (NARS); ownership disputes; limited bandwidth and erratic rural power supply.
Kisan Call Centres (KCC) Mobile (SMS) Telephone	Toll-free helpline (1800-180-1551) providing query resolution in native languages regarding agriculture, animal husbandry, and fisheries.	Software instability; slow internet during peak loads; use of complex scientific jargon; high call waiting times (2-3 minutes).
Radio Bundelkhand	Focuses on building resilient community ecosystems by promoting local talent, art, and culture in its broadcasts.	Rural community members and local artists.
AgriBazaar	Online Platform / Mobile App. Facilitates electronic trading and direct buyer-seller connections; includes e-wallet (AgriPay) and logistics support	Small farmers, merchants, banks, and enterprises.
Kishan Seva Kendra (Mahoba)	Physical Hub with ICT,	Rural farmers in Mahoba
TARA Kendra	Bundelkhand, Multipurpose Kiosks, Provides information, marketing	Local inhabitants and communities
AGMARK NET	Computer Networks / Web Portal. Database linking agricultural markets; broadcasts real-time commodity influx and price information.	Farmers, traders, policy makers, and the Directorate of Marketing and Inspection (DMI).
e-Choupal	Computer Networks / Internet. Established direct internet-based procurement links for crops (soybeans, wheat, coffee, prawns); ensures price transparency.	Rural farmers and ITC Limited. Fragmented digital agriculture ecosystem; slow geographic scale-out

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Stakeholder Constraints and Barriers

The shift toward a fully digitized agricultural extension system faces several socio-economic, infrastructure, and institutional obstacles.

One major barrier is the lack of local language content. Studies in the Bundelkhand region show that 93.81% of farmers said agricultural information is not available in their local language, limiting their understanding and practical use (Kumar *et al.*, 2025) ^[10].

Low digital literacy in rural communities also poses a significant challenge. About 83.33% of farmers highlighted the need for ongoing training in using ICT tools, stressing the importance of capacity-building programs (Kumar *et al.*, 2025) ^[10].

Financial limitations also restrict ICT use. The cost of smartphones, computers, and internet data plans affects more than 60% of farmers, especially small and marginal landholders.

Infrastructure issues make these challenges worse. Poor internet connectivity and unreliable electricity supply are common in rural areas. Some 45.24% of farmers report inadequate internet access, and 23.11% face inconsistent power supply.

Psychological factors influence technology adoption as well. Many farmers feel technologically inferior or lack confidence in using advanced digital tools, which discourages them from engaging with ICT-based extension services.

Institutional partners also encounter challenges, such as limited funding for new technology research and complex administrative processes that hinder the rollout of digital extension programs.

Emerging Technologies and Digital Disruption

Digital disruption in Extension and Advisory Services (EAS) marks a change from traditional ways of sharing knowledge to using data-driven, personalized advisory systems (Meera, 2017) ^[11]. Emerging technologies like Big Data analytics allow for the integration of large datasets related to soil health, weather, crop performance, and market prices. Analyzing these datasets can produce tailored agricultural advice for specific locations.

The Internet of Things (IoT) is another key technology in digital agriculture. Sensors connected through IoT can track soil moisture, crop health, and environmental conditions in real time. This helps farmers make better decisions about irrigation, fertilization, and pest control. Likewise, precision agriculture technologies, which include drones and remote sensing systems, enable large-scale crop monitoring. To achieve inclusive and sustainable digital transformation in Indian agriculture, several strategic actions are needed. First, agricultural advice should be tailored and delivered in regional languages to ensure it is accessible and relevant. Local content can greatly enhance farmers' understanding and use of recommended practices. Second, broad capacity-building programs should be established to improve digital skills among farmers and extension workers. Third, significant investment is needed in rural digital infrastructure such as broadband internet, mobile network coverage, and reliable electricity supply. Fourth, collaboration between public extension agencies, private tech firms, and research bodies should be strengthened to

create integrated digital advisory systems. Finally, policies should focus on small and marginal farmers, ensuring that digital technologies help close, not widen, the existing rural digital gap.

Conclusion

The digital transformation of agricultural extension in India presents an important chance to tackle ongoing challenges in knowledge sharing, improving productivity, and enhancing market access. However, the use of ICT-based extension services remains inconsistent due to socio-economic, linguistic, infrastructural, and institutional hurdles. The evidence in this study shows that the digital divide in regions like Uttar Pradesh is not just a tech issue, but a socio-technical challenge. Solving this problem requires a comprehensive approach that combines technological progress with local economic realities. By promoting localized content, improving rural infrastructure, and boosting institutional collaborations, policymakers can build a resilient and inclusive agricultural information network. These efforts will help farmers fully leverage digital innovations and support the sustainable transformation of Indian agriculture.

References

1. Adoption of ICT among the Farmers of Different Agro Climatic Zones of Uttar Pradesh. *Journal of Agricultural Informatics*. 2023;14(3):145-150.
2. Application of Information and Communication Technology (ICT) in Agriculture Value Chains in India. *Agricultural Research Journal*. 2023;40(2):210-220.
3. BAH & FS. Basic Animal Husbandry and Fishery Statistics. Department of Animal Husbandry, Dairying and Fisheries, Government of India; 2015.
4. Hariom, Singh MP. Information needs and gathering habits among farmers in rural areas of Mahoba district, Uttar Pradesh. *Int J Lib Inf Stud*. 2017;7(1):10-19.
5. Information and Communication Technology: Emerging Tool for Agricultural Extension. *Research Journal of Agricultural Extension*. 2023;15(4):98-105.
6. Information And Communication Technology for Extension. *Journal of Agri Extension & Rural Development*. 2022;8(2):123-130.
7. Information Needs and Gathering Habits among Farmers in Rural Areas of Mahoba District, Uttar Pradesh: A Study. *Indian Journal of Rural Development*. 2023;12(5):112-118.
8. Kisan Call Centres - NAARM. *Indian Journal of Agricultural Communications*. 2023;22(1):55-60.
9. Kolhe PR, Kolhe PP, Tharkar MH. Information and communication technology: Emerging tool for agricultural extension. *Asian Sci*. 2009;4(1-2):85-90.
10. Kumar A, Mishra D, Mishra BP, Ojha PK, Shukla G, Kalia A, Gupta BK, Verma AP, Chandra N. Constraints faced by stakeholders of agricultural innovation system in Bundelkhand region of Uttar Pradesh, India. *J Extension Systems*. 2025;39(2):29-33.
11. Meera SN. A treatise on navigating extension and advisory services through digital disruption. *AESA Blog*. 2017;62(176):176-217.
12. NSSO. Key Indicators of Situation of Agricultural Households in India. *National Sample Survey*

- Organisation, Government of India; 2014.
13. Saravanan R. ICTs for agricultural extension in India: Policy implications for developing countries. AFITA Proceedings. 2012;1:45-50.
 14. Saravanan R, Darekar A. Farming 2.0: Digital agri value chain. Kurukshetra. 2020;69(2):33-37.
 15. Singh PK, Tiwari R, Dutt T, Joshi P. Adoption of ICT among farmers of different agro-climatic zones of Uttar Pradesh. Int J Curr Microbiol Appl Sci. 2018;Special Issue-7:5250-5255.
 16. Yadav K, Yaduraju NT. Co-developed content through Agropedia: Experience so far. AESA Blog. 2011;65:245-257.
 17. Yashavanth BS, Sontakki BS, Soam SK, Venkateshwarlu G, Srinivasa Rao C. Strengthening Kisan Call Centres in India. ICAR-National Academy of Agricultural Research Management; 2022.