A Pratibha Spandan's Journal

CONFLUENCE OF KNOWLEDGE
(A Multidisciplinary International Peer-Reviewed/Refereed Journal)
ISSN 2320–5237 | Volume 13, Issue 02, February 2026 (Special Issue)
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ROLE OF INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) IN AGRICULTURE: POLICY IMPLICATIONS FOR INDIA

P. SADANANDAM
ASSISTANT LIBRARIAN (CONTRACT), P.V NARSIMHA RAO TELANGANA VETERINARY UNIVERSITY, COLLEGE OF VETERINARY SCIENCE, MAMNOOR, WARANGAL, E-MAIL: SADHU0307@GMAIL.COM, MOBILE NO: 9550765376

ABSTRACT

Agriculture remains a cornerstone of the Indian economy, contributing nearly 17 percent to the national Gross Domestic Product (GDP) and providing livelihoods to more than 60 percent of the population. Despite its economic and social significance, the sector continues to face persistent challenges such as fragmented markets, inadequate access to timely and reliable information, small and marginal landholdings, and low adoption of modern agricultural technologies. In this context, Information and Communication Technology (ICT) has emerged as a transformative tool for improving agricultural productivity, sustainability, and farmers' incomes. ICT-enabled platforms facilitate timely dissemination of localized, personalized, and actionable information related to weather, crop management, pest and disease control, input availability, and market prices. This paper reviews the role of ICT in Indian agriculture, examines major ICT initiatives, analyzes the prevailing frameworks for information dissemination, and proposes an advanced ICT framework incorporating emerging technologies such as big data analytics, artificial intelligence, remote sensing, and decision-support systems. The study highlights key policy implications for strengthening digital agriculture in India.

Keywords: *ICT, Agriculture, Digital agriculture, Information dissemination, India, Farmers*

Introduction

Agriculture plays a vital role in India's socio-economic development, accounting for approximately 17 percent of GDP and employing over two-thirds of the rural population. The growing demand for food grains, coupled with climate variability and resource constraints, necessitates substantial improvements in agricultural productivity and efficiency. However, Indian agriculture is constrained by structural and systemic issues including poor market integration, delayed and unreliable information flows, small landholdings, limited extension services, and uneven adoption of improved technologies.

The rapid advancement of information and communication technologies has opened new avenues for addressing these challenges. ICT has the potential to modernize traditional agricultural practices by enabling faster communication, real-time decision-making, and enhanced access to knowledge and markets. Empowering farmers with the right information at the right time is particularly critical for small and marginal farmers, who are most vulnerable to production and market risks. Consequently, ICT-based agricultural services—often referred to as e-agriculture—have gained prominence as an essential component of agricultural development strategies.

Concept and Importance of ICT in Agriculture

Information and communication have always been integral to agriculture. Historically, farmers relied on interpersonal communication and indigenous knowledge systems to make farming decisions. ICT extends this process by using electronic means to collect, store, process, and disseminate information efficiently and at scale. ICT in agriculture encompasses tools such as mobile phones, web portals, mobile applications, SMS and voice-based advisories, information kiosks, video-based learning, and satellite-based technologies.

The integration of ICT in agriculture facilitates precision farming, improves resource-use efficiency, reduces information asymmetry, and strengthens farmers' capacity to respond to climatic and market uncertainties. By enabling two-way communication between farmers and experts, ICT also enhances the effectiveness of agricultural extension systems.

Role of ICT in Agricultural Development

ICT as a Decision Support System

One of the most significant contributions of ICT in agriculture is its role as a decision support system. ICT platforms provide farmers with real-time and location-specific information on weather forecasts, crop varieties, nutrient management, pest and disease outbreaks, and recommended agricultural practices. Such information enables farmers to plan cropping patterns, optimize input use, and improve productivity and quality.

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The dissemination of tailored technologies suited to specific agro-climatic zones, soil types, and farm sizes remains a major policy challenge in India. ICT-based advisory services help bridge this gap by offering personalized solutions, often through question-and-answer services, which have been widely perceived as highly effective by farmers.

Expanding Market Access
Limited market information and long marketing chains significantly reduce farmers' share in consumer prices. ICT platforms enable farmers to access real-time market prices, identify suitable markets, and connect directly with buyers, thereby reducing dependence on intermediaries. Improved market transparency empowers farmers to make informed decisions regarding crop selection, timing of sales, and choice of marketing channels, ultimately enhancing farm incomes.

Strengthening and Empowering Farming Communities
ICT facilitates networking and collaboration among farmers, research institutions, government agencies, non-governmental organizations, and private sector stakeholders. Exposure to scientific knowledge, peer learning, and success stories strengthens farmers' capacities and fosters collective action. Digital platforms also support farmer producer organizations (FPOs) by improving coordination, aggregation, and market linkages.

Major ICT Initiatives in Indian Agriculture

India hosts one of the largest numbers of ICT initiatives in agriculture globally. However, their distribution has been uneven, with greater concentration in socio-economically advanced regions. Some notable initiatives include:

- AGRISNET: A government-funded portal providing information on inputs, soil health, government schemes, and improved technologies.
- Digital Green: A participatory video-based extension model that promotes peer-to-peer learning among farmers.
- eSagu: A personalized advisory system delivering expert recommendations based on farm-specific data and images.
- Warana Wired Village Project: An early initiative offering localized agricultural and government information through village kiosks.
- IFFCO Kisan Sanchar Limited (IKSL): A mobile-based advisory service delivering voice messages and expert interactions.
- AGMARKNET: A nationwide agricultural marketing information system providing price and arrival data.
- mKisan Portal: An SMS-based platform delivering advisories and services in local languages.
- Kisan Call Centers (KCCs): Toll-free helplines providing expert advice in regional languages.
- Village Knowledge Centers (VKCs): Community-based information hubs established by MS Swaminathan Research Foundation.

These initiatives demonstrate the diverse applications of ICT across production, marketing, fisheries, and dairy sectors.

ICT Components and Tools Used in Agriculture

The primary ICT components used in Indian agriculture include web portals, mobile applications, SMS and voice services, information kiosks, video-based learning modules, and expert video conferencing. Among these, mobile phones have emerged as the most accessible and widely used tool for agricultural communication, particularly for market-related information.

Empirical studies indicate that farmers using ICT-based information systems make significantly better production and marketing decisions and incur lower transaction costs compared to non-users. ICT-based livestock and crop advisory services have also contributed to improved farm management practices across several Indian states.

Framework of ICT in Agriculture

Existing ICT initiatives in India primarily focus on information dissemination, often mediated by field coordinators who act as intermediaries between farmers and experts. This model is necessary due to varying levels of digital literacy and access among farmers. While effective, the current framework remains limited in its integration of advanced technologies and data-driven decision-making.

Proposed Advanced ICT Framework

The proposed framework extends beyond agricultural advisories to include education, health, e-governance, and employment information for rural communities. It emphasizes the integration of advanced technologies such as:

- Big Data Analytics: For predictive insights on weather, markets, and crop performance.

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- Artificial Intelligence and Cognitive Computing: For crop selection, yield forecasting, and risk assessment.
- Remote Sensing, GIS, and GPS: For precision agriculture, land-use mapping, and resource monitoring.
- Image Processing: For early detection of pests, diseases, and nutrient deficiencies.
- Simulation and Modelling: For mechanization planning and climate adaptation strategies.

Incorporating trust, data security, and infrastructure development into technology acceptance models is essential for wider adoption.

Conclusion and Policy Implications

ICT has immense potential to transform Indian agriculture by improving access to information, enhancing productivity, reducing risks, and increasing farmers' incomes. However, despite numerous initiatives, ICT has yet to achieve a decisive breakthrough at scale. Greater emphasis is needed on systematic evaluation, inclusivity, infrastructure development, and integration of advanced digital technologies.

Policy Recommendations

- Rigorous evaluation of existing ICT initiatives based on feedback from grassroots extension workers and farmers.
- Transition towards comprehensive digital agriculture systems.
- Enhancing digital literacy and access among small and marginal farmers.
- Promoting adoption of advanced ICT tools such as AI, GIS, remote sensing, and IoT.
- Strengthening big data governance and analytics for evidence-based agricultural policymaking.

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