

Digital Extension and ICTs in Agriculture: Transforming Agricultural Advisory Services

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Digital Extension is not merely a technological advancement; it is a transformative approach that empowers farmers with knowledge, connects them with opportunities and drives the future of smart agriculture.

Abstract

Agricultural extension has traditionally served as a bridge between research institutions and farmers by facilitating the transfer of knowledge, technologies, and innovations. However, the increasing complexity of agricultural systems, climate change, globalization and the growing demand for food security have challenged conventional extension approaches. The emergence of Information and Communication Technologies (ICTs) has transformed agricultural extension services into a more dynamic, interactive and farmer-centric system known as Digital Extension. Digital extension utilizes mobile phones, internet services and other digital technologies to provide timely and location-specific agricultural information to farmers. This article examines the concept, evolution, tools, applications, benefits, challenges, government initiatives, and future prospects of digital extension and ICTs in agriculture.

Introduction

Agriculture remains the primary source of livelihood for approximately 45–50% of India's workforce, despite contributing around 15–18% to the country's Gross Domestic Product (GDP). The sector faces numerous challenges, including climate variability, declining farm sizes, pest outbreaks, market uncertainties, labour shortages and natural resource degradation. Agriculture is the backbone of many developing economies, including India, where nearly half of the population depends on farming for their livelihood. Traditional agricultural extension services have played a crucial role in transferring knowledge, technologies and innovations from research institutions to farmers. However, challenges such as limited extension personnel, geographical barriers, and increasing information needs have necessitated the adoption of digital technologies.



Digital Extension, supported by Information and Communication Technologies (ICTs), has emerged as a powerful approach to improve agricultural advisory services. It enables timely dissemination of information, enhances farmer engagement and promotes sustainable agricultural development.

What is Digital Extension?

Digital Extension refers to the use of digital technologies and communication tools to deliver agricultural information, advisory services, training and support to farmers. It integrates modern ICT tools such as:

Information and Communication Technologies (ICTs)

ICTs encompass technologies used for collecting, storing, processing, transmitting and sharing information electronically.

Components of ICTs

Component	Examples
Hardware	Computers, Smartphones, Tablets
Software	Mobile Apps, Management Systems
Communication Networks	Internet, Wi-Fi, Mobile Networks
Digital Platforms	Portals, Websites, Social Media
Data Systems	Cloud Computing, Big Data Analytics

Evolution of Agricultural Extension

Traditional Extension	Digital Extension
Face-to-face communication	Real-time communication
Demonstrations and field visits	Mobile-based advisories
Printed materials	Online training
Farmer meetings	Data-driven decision making

Table : Major ICT Tools Used in Agriculture

S. No.	ICT Tool	Description	Major Applications	Examples/Benefits
1	Mobile Phones	Most widely used ICT tool among farmers for accessing agricultural information and advisory services.	Weather forecasts; Market price information; Crop advisory services; Pest and disease alerts.	The Government of India's mKisan Portal sends SMS advisories to millions of farmers.
2	Mobile Application	Agricultural mobile applications provide personalized recommendations and real-time information to farmers.	Farm management; Advisory services; Information access; Decision support.	Instant access to information; Multilingual support; Easy usability.
3	Internet and Web Portals	Agricultural websites and portals provide comprehensive information related to farming and rural development.	Crop production; Input management; Pest control; Government schemes.	Digital Agriculture Mission; ICAR Portals; State Agricultural Department Websites.
4	Social Media Platforms	Social media serves as an effective extension and communication tool for farmers and stakeholders.	Information exchange; Farmer networking; Extension communication; Community interaction.	Peer learning; Knowledge sharing; Rapid dissemination of innovations.

5	Artificial Intelligence (AI)	AI supports data-driven agricultural decision-making through predictive analytics and automation.	Disease diagnosis; Yield prediction; Precision farming; Crop monitoring.	AI-powered pest surveillance systems can identify disease outbreaks before severe damage occurs.
6	Geographic Information System (GIS)	GIS provides location-specific agricultural information for planning and resource management.	Soil mapping; Land-use planning; Irrigation management; Crop suitability analysis.	Improved spatial planning and efficient resource utilization.
7	Remote Sensing and Satellite Technology	Satellite imagery and remote sensing technologies help monitor crops and environmental conditions.	Crop health assessment; Drought monitoring; Flood prediction; Yield estimation.	Large-scale monitoring, early warning systems, and improved decision-making.
8	Drones	Agricultural drones are increasingly used for precision agriculture and field surveillance.	Crop monitoring; Precision spraying; Field mapping; Nutrient management.	Reduced labour costs; Improved efficiency; Better resource utilization.

Importance of Digital Extension

- 1. Wider Outreach**-Digital tools can reach millions of farmers simultaneously.
- 2. Timely Information**-Farmers receive real-time advisories and alerts.
- 3. Cost Effectiveness**-Reduces the need for frequent physical visits.
- 4. Improved Decision Making**-Data-driven recommendations enhance farm productivity.
- 5. Inclusiveness**-Provides access to information for remote and marginalized communities.

Government Initiatives in India

1. Digital Agriculture Mission

Launched to modernize agriculture through digital technologies.

Objectives:

- ❖ Farmer database creation
- ❖ Digital services delivery
- ❖ Data-driven agriculture

2. mKisan Portal

❖ What it is:

A central government platform (Ministry of Agriculture) that sends real-time farming advisories directly to farmers' mobile phones.

❖ How it works:

It uses standard SMS and voice messages—meaning it works on basic feature phones without requiring an internet connection.

❖ What it covers:

Weather alerts, crop cultivation tips, pest control, Mandi (market) prices and government subsidy schemes.

❖ How to join:

Farmers can register for free online by sending an SMS to 51969 or by calling the toll-free Kisan Call Centre at 1800-180-1551.

3. Kisan Call Centres

The Kisan Call Centre (KCC) is a flagship initiative by the Ministry of Agriculture and Farmers Welfare, designed to provide instant, expert solutions to farmers over a simple phone call.

- **Toll-Free Number:** 1800-180-1551
- **Timings:** 6:00 AM to 10:00 PM, all 7 days a week.

- **Languages:** Available in 22 local languages and regional dialect.

4. e-NAM (National Agriculture Market)

The e-NAM (National Agriculture Market) is a pan-India electronic trading portal launched by the Government of India to create a unified, digital market for agricultural commodities. It essentially removes geographical barriers by linking physical APMC (Agricultural Produce Market Committee) mandis across different states into a single network.

- **Concept:** "One Nation, One Market" for agricultural produce.
- **Implementing Agency:** Small Farmers Agribusiness Consortium (SFAC) under the Ministry of Agriculture and Farmers Welfare.
- **Network Scale:** Over 1,650 mandis integrated across India, serving millions of registered farmers, traders and Farmer Producer Organizations (FPOs)

5. Agri Stack

Agri Stack is a foundational Digital Public Infrastructure (DPI) created by the Government of India (under the Digital Agriculture Mission) to modernize the agricultural sector.

Agri Stack is designed to answer three basic questions: *Who is the farmer? Where is the land? What is growing on it?* It achieves this through three databases:

1. **State Farmers Registry (The "Who"):** Every landowning farmer (including women, livestock, and fisheries farmers) is given a unique, verified digital identity called a Farmer ID. Over 9 crore Farmer IDs have already been generated.
2. **Geo-Referenced Village Maps (The "Where"):** Digitized land records linked directly to GIS/satellite data to pinpoint exact farm plot borders.
3. **Crop Sown Registry (The "What"):** Driven by an annual Digital Crop Survey (DCS) this logs exactly what crop is planted on each plot every season using smartphone images and satellite data.

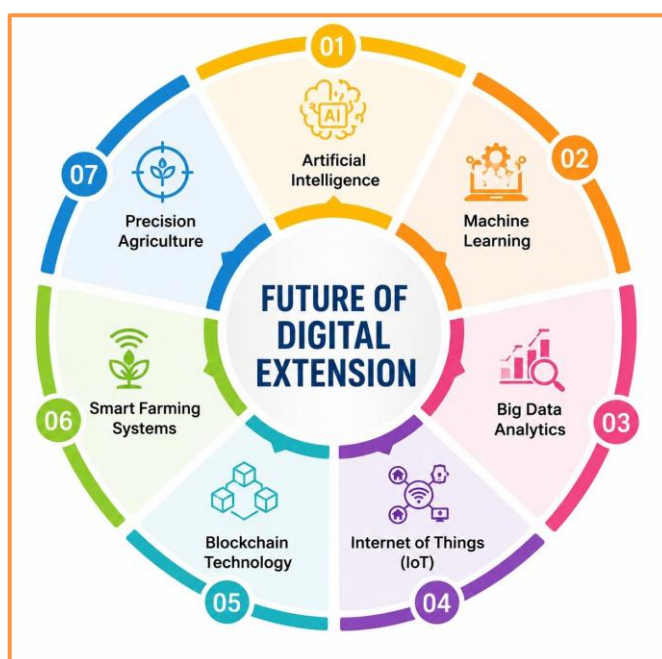
Impact of Digital Extension

- **Productivity Enhancement:-** Farmers adopting digital advisories often achieve higher yields due to improved management practices.
- **Improved Market Access** -Digital platforms connect farmers directly with buyers.
- **Risk Reduction** -Weather and pest alerts help farmers mitigate losses.
- **Knowledge Empowerment**- Farmers gain access to scientific and updated agricultural information.

Challenges of Digital Extension

- **Digital Divide** - Many rural areas still face poor internet connectivity.
- **Digital Literacy**- Limited technological skills among farmers hinder adoption.
- **Infrastructure Constraints** - Lack of smartphones and electricity affects accessibility.
- **Language Barriers** - Content availability in local languages remains inadequate.
- **Data Privacy Concerns** - Protection of farmer data is becoming increasingly important.

These technologies will further enhance efficiency, sustainability and profitability in agriculture.



Conclusion

Digital Extension and ICTs are revolutionizing agricultural advisory services by making information more accessible, timely, and personalized. They bridge the gap between agricultural research and farmers, improving productivity, income, and resilience. While challenges such as digital literacy and infrastructure limitations remain, continued investments in technology, connectivity and capacity building can ensure that digital extension becomes a cornerstone of sustainable agricultural development.