Digital Extension Services for Farmers: Connecting Knowledge to the Field in the Digital Age

Dr. Gudepu Roupesh[1] and Dr. Rajdeep Madavi[2]

[1]PhD Scholar, Department of Animal Nutrition, Nagpur Veterinary College, MAFSU, Nagpur, MH, India

[2]M.V.Sc Scholar, Department of Veterinary and Animal Husbandry Extension Education, Nagpur Veterinary College, MAFSU, Nagpur, MH, India

Corresponding Author: roopesh.gudepu@gmail.com

Introduction

For generations, the agricultural extension worker that tireless government official cycling between villages with pamphlets, demonstration kits, and agronomic advice was the farmer's primary bridge to modern science. That model, though valuable in its time, was always limited by geography, staffing constraints, and the sheer impossibility of reaching every farmer at every critical moment in the crop cycle. A smallholder in a remote tribal hamlet of Wayanad or a paddy farmer in coastal Odisha could wait weeks for an extension visit that might last only 20 minutes.

That paradigm is changing rapidly and fundamentally through digital extension services. Defined broadly as the delivery of agricultural advisory, market, weather, and input information through digital platforms including mobile phones, internet applications, SMS, interactive voice response (IVR), video, and AI-powered chatbots, digital extension is democratizing access to knowledge in ways conventional systems never could. With over 700 million smartphone users in India and rapidly expanding rural internet penetration, the infrastructure for digital extension has never been more favorable (Mulungu, 2025). This article explores the landscape of digital extension services the tools available, the evidence of their impact, the platforms leading the way in India and globally, and the challenges that must be overcome to ensure these services reach every farmer who needs them.

What Are Digital Extension Services?

Digital extension services are not a single technology but an ecosystem of platforms and tools that collectively replicate and often surpass the functions of traditional face-to-face extension. They encompass:

- **SMS and IVR advisory systems** that push crop-specific and weather-based information directly to farmers' mobile phones
- **Mobile applications** that provide localized, season-specific advice on agronomy, pest management, and input use
- **Video-based learning platforms** that communicate complex practices through short, locally produced demonstration videos
- **AI-powered chatbots and virtual extension officers** available 24/7 in regional languages
- **Web-based decision support tools** linked to satellite data, weather stations, and soil health databases
- **Social media-based peer networks** where farmer communities share real-time field observations and solutions

Together, these tools transform extension from a push model where information flows one-way from expert to farmer into a dynamic, two-way, demand-driven knowledge system (Rupika et al., 2023).

The Evidence: Do Digital Extension Services Work?

The strongest evidence for the impact of digital extension services comes from large-scale randomized controlled trials (RCTs) across South Asia and Sub-Saharan Africa. A systematic review by Mulungu (2025), analyzing 49 studies across multiple countries, confirmed that ICT-based extension interventions including mobile apps, SMS messaging, educational videos, and voice calling services consistently improved farmer awareness, technology adoption, crop yields, and household income. One of the most compelling recent examples comes from Odisha, India. A three-year RCT evaluated *Ama Krushi*, a two-way voice-based advisory service delivering weekly agricultural advice and real-time pest and weather alerts to rice farmers. The study, covering 13,675 rice farmers across five districts, found that digital advisory significantly improved farming practices, crop protection outcomes, and yields particularly for farmers who experienced weather shocks. *Ama Krushi* scaled from 1.37 million users in 2021 to nearly 7 million farmers by end of 2023, achieving an estimated long-run benefit-cost ratio of 12:1 to 19:1 (Manivannan and Natarajan, 2025).

Digital Green's video-mediated extension model, operational across India and several African countries, has reached over 7.2 million farmers globally. An evidence review confirmed that Digital Green's approach is approximately 10 times more cost-effective than traditional extension and has been particularly transformative for women farmers, 94% of whom reported improved farming knowledge and practice adoption.

A study published in the *Journal of the Agricultural and Applied Economics Association* found that access to digital

extension services had a significant positive effect on per-acre agricultural income, establishing a direct economic return from digital advisory adoption (Rupika et al., 2025).

Key Platforms and Tools in India

India has invested significantly in building a digital extension ecosystem over the past decade. Several platforms have demonstrated scalability and measurable farmer impact:

- **m-Kisan Portal and SMS Service:** Launched by the Ministry of Agriculture and Farmers Welfare, m-Kisan delivers location-specific SMS advisories on crop management, weather, and scheme information to registered farmers in regional languages.
- **Kisan Suvidha App:** A one-stop mobile application that provides farmers with weather forecasts, input dealer information, market prices, and agronomic advice across multiple crops
- **KVK e-Kisan Mela and Online Training:** ICAR's Krishi Vigyan Kendras have progressively shifted training programs to online and hybrid formats, reaching farmers in remote geographies through webinars, YouTube demonstrations, and WhatsApp-based advisory groups
- **Ama Krushi (Odisha):** A government-operated IVR and voice advisory service scaled to 7 million farmers demonstrating best-in-class results for digital extension at scale.
- **Digital Green (India):** Operating in Jharkhand, Bihar, Odisha, and Andhra Pradesh with hyper-local video content featuring local farmers as demonstrators in local languages
- **Farmer.Chat (Microsoft Research):** An AI-powered generative chatbot designed to provide smallholder farmers with on-demand, context-specific agricultural advice across multiple messaging platforms, operating in multiple languages and scaling across Kenya, Ethiopia, and India (Akshay Nambi, 2024).

AI and the Next Frontier of Digital Extension

The integration of Artificial Intelligence (AI) into digital extension services is arguably the most exciting frontier in agricultural knowledge delivery. AI-powered chatbots can function as virtual extension officers, accessible 24/7, capable of answering farmer-specific queries in natural language and delivering advice tailored to crop type, location, soil type, and prevailing weather conditions (Gobinath et al., 2025).

Farmer.Chat, developed by Microsoft Research and Digital Green, uses generative AI to provide scalable, customizable, and reliable agricultural information, going beyond rule-based chatbots to handle unscripted farmer queries with high accuracy (Akshay Nambi, 2024). In parallel, AI-based farming chatbots with voice assistance are being piloted across India and Africa, capable of crop suggestion, pest and disease identification, fertilizer recommendations, and real-time weather updates all delivered through voice in regional languages, making them accessible even to low-literacy farmers.

Satellite-based remote sensing integrated with AI is further enabling hyper-local advisory services. ICRISAT and partners, as part of their AI-powered climate advisory initiative, are delivering localized advisories linked to real-time crop monitoring data to farmers in semi-arid regions of India and Africa a model that could be replicated across Kerala's plantation and vegetable farming communities (CGIAR, 2025).

Comparing Digital Extension Channels

Different digital channels reach different farmer segments with varying degrees of effectiveness. Understanding the strengths and limitations of each is essential for designing inclusive digital extension strategies.

Table 1: Comparative Overview of Digital Extension Service Channels

Channel	Key Strengths	Limitations	Best Suited For
SMS Advisory	Low cost; works on basic phones; high reach	One-way; text literacy needed	Weather alerts, scheme notifications
IVR / Voice Calls	Accessible to low-literacy farmers; regional languages	Limited interactivity; call drop issues	Crop advisory, pest alerts
Mobile Apps	Rich content; GPS-linked; interactive	Requires smartphone and data connection	Tech-savvy progressive farmers
Video Platforms	High comprehension; visual demonstration	Data-intensive; requires screen time	Complex agronomic practices
AI Chatbots	24/7 availability; personalized; scalable	Infrastructure dependent; training needed	Real-time Q&A, decision support
Social Media Groups	Peer learning; real-time; community-driven	Misinformation risk; moderation needed	Farmer-to-farmer knowledge exchange

Source: Adapted from Mulungu (2025). Mukherjee et al., (2025)

The Gender Dimension

Any discussion of digital extension services is incomplete without addressing the gender gap in access and adoption. Women farmers, who constitute 60–80% of the agricultural labour force in many Indian states, are disproportionately excluded from digital extension benefits due to lower mobile phone ownership, restricted mobility, lower digital literacy, and social norms that limit their participation in formal advisory systems (Sharma et al, 2024).

Digital Green's model is a notable exception by cantering locally produced videos featuring women farmers as lead demonstrators and anchoring dissemination through women's self-help groups, it has achieved 94% women participation in its outreach. Designing digital extension systems with deliberate gender-sensitivity including voice-based interfaces that bypass literacy barriers, SHG-based digital literacy training, and content co-created with women farmers is not an optional add-on but a core requirement for equitable impact.

Challenges to Scaling Digital Extension

Despite impressive progress, several structural challenges continue to limit the scale and equity of digital extension services:

- **Connectivity gaps:** Reliable broadband and mobile data connectivity remains patchy in hilly, tribal, and remote rural areas precisely where digital advisory could have the greatest impact
- **Digital literacy deficit:** Many older and less-educated farmers struggle with smartphone interfaces, app navigation, and interpreting digital content even when access is available
- **Content localization:** Most digital platforms are designed in Hindi or English, leaving millions of farmers in states like Kerala, Tamil Nadu, and Northeast India underserved in their mother tongue
- **Information overload:** Farmers bombarded with multiple SMS, app notifications, and WhatsApp forwards often struggle to identify credible, actionable information from the noise
- **Last-mile integration:** Digital extension works best when supported by human extension workers who can contextualize digital advice at the farm level the transition from purely digital to phygital (physical + digital) extension is still a work in progress

Conclusion

Digital extension services represent a quantum leap in the capacity to deliver agricultural knowledge at scale faster, cheaper, and more inclusively than any conventional extension system could achieve. From the 7 million farmers reached by *Ama Krushi* in Odisha to the millions of smallholder women transformed by Digital Green's video-based model, the evidence is clear: when designed thoughtfully, delivered in accessible formats, and supported by enabling infrastructure, digital extension genuinely improves farming outcomes. Yet technology alone is never the answer. The most effective digital extension systems are those that combine the speed and scale of digital platforms with the trust, contextual sensitivity, and human relationship of a skilled extension worker. India's path forward lies in building a phygital extension ecosystem one where AI-powered chatbots, satellite-linked advisories, and video platforms form the digital backbone, while KVK scientists, village-level workers, and farmer champions provide the human connection that transforms information into practice. The farmer who once waited weeks for a single extension visit can now access a virtual extension officer in their palm, around the clock, in their own language. That is not just a technological advancement it is a fundamental shift in who gets to participate in the knowledge economy of agriculture.

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