



FROM KRISHI BHAVAN TO CHATBOTS: HOW AI IS REDEFINING AGRICULTURAL EXTENSION IN RURAL INDIA

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Abstract

For many years, agricultural extension in India has helped farmers by linking them with agricultural research through Krishi Bhavans and extension workers. These services have supported farmers in learning new technologies and improving their farming skills. However, today this system faces several challenges. The number of farmers is increasing, extension staff are limited, climate conditions are uncertain, and farming practices are becoming more complex. At the same time, digital tools have reached rural areas because of smartphones, low-cost internet, and better connectivity. This has opened new ways to support farmers. In this situation, artificial intelligence (AI) is bringing important changes to agricultural extension. AI tools such as chatbots, voice-based advice, crop problem detection using images, weather alerts, and decision-support systems help farmers get timely and location-specific information. AI does not replace extension workers; instead, it helps them reach more farmers and make better decisions. This article examines the move toward AI-enabled extension, its uses, benefits, challenges, and the need to combine digital tools with human support.

Keywords: Agricultural extension; Artificial intelligence; Chatbots; Digital advisory services; Rural India; Smart agriculture; Decision support systems; Krishi Bhavan

Introduction: From Krishi Bhavan Lines to Instant Clicks and Chats

Agricultural extension has traditionally played a central role in promoting rural development in India. Over the years, Krishi Bhavans and extension personnel have functioned as the main communication channel linking agricultural research organizations with farming communities.

Through activities such as field visits, on-farm demonstrations, group meetings, and capacity building programmes, extension staff have supported farmers in adopting improved technologies and management practices (Rai *et al.*, 2023; Jadhav *et al.*, 2024). This approach relied heavily on direct interaction, mutual trust, and locally relevant guidance.

Nevertheless, the performance of the conventional extension system has been increasingly constrained by several structural challenges. Research evidence highlights issues such as insufficient manpower, rising workload per extension officer, delays in information delivery, and predominantly top down communication, which restrict the system's ability to respond promptly to farmers' needs (Khatri *et al.*, 2024; Ibrahim, 2023). As farming systems become more complex and vulnerable to risks, these limitations have become more pronounced.

At the same time, rural India is experiencing a rapid digital transition. Wider access to smartphones, affordable mobile data, and internet services has significantly altered the ways in which farmers seek and use information (Professor and Mullana, 2024). In this changing context, artificial intelligence (AI) - embedded in digital advisory platforms, chatbots, and decision support applications is gradually becoming part of the agricultural extension ecosystem.

Extension services are no longer limited to physical offices or fixed schedules; instead, AI is emerging as a quiet yet powerful extension support system that works alongside human expertise.



Fig 1. Image-based crop diagnosis using smartphone cameras

Why Agricultural Extension Needs a Digital Shift

The need for agricultural advisory services has expanded considerably due to the increase in farmer numbers, diversification of farming enterprises, and intensification of agricultural practices, while the availability of extension personnel has remained relatively stagnant (Rai *et al.*, 2023). This imbalance has resulted in significant advisory gaps, particularly in remote, rainfed, and resource poor regions.

In addition, contemporary agriculture is strongly influenced by climate uncertainty, erratic weather patterns, recurring pest and disease incidences, and unstable market conditions, all of which demand timely, location specific, and accurate guidance (Wadhe *et al.*, 2023; Alex *et al.*, 2023). Conventional extension mechanisms often lack the capacity to deliver such advice at the required speed and scale.

Farmers are also increasingly engaging with digital platforms such as WhatsApp groups, YouTube channels, mobile applications, and SMS based services, indicating a growing digital readiness within rural communities (Professor and Mullana, 2024). AI-enabled systems have the ability to process large volumes of data, provide customized recommendations, and reach large numbers of farmers simultaneously, making the transition towards digital extension both unavoidable and essential (Khatri *et al.*, 2024).

What Is AI in Agricultural Extension?

In the context of agricultural extension, artificial intelligence refers to computer based systems that can learn from data, identify

patterns, and generate recommendations to support farm level decision making (Ibrahim, 2023).

Unlike conventional ICT tools that mainly deliver standardized information, AI based applications are dynamic, interactive, and capable of responding to user specific queries.

AI enabled extension tools include:

- Chatbots that provide instant responses to farmer questions
- Voice based assistants that communicate through spoken language
- Image processing systems for identifying crop pests and diseases
- Decision support platforms that guide farm management choices

Together, these innovations shift extension from a supply driven, information push approach towards a more intelligent, farmer responsive advisory system (Patel *et al.*, 2024; Soujanya *et al.*, 2025).

Chatbots as the New Extension Assistant

Among various AI applications, agricultural chatbots have gained particular attention as effective extension tools. These systems allow farmers to interact via text or voice and obtain immediate advice related to crops, livestock, weather conditions, and market information (Sable, 2025; Sheikh *et al.*, 2025).

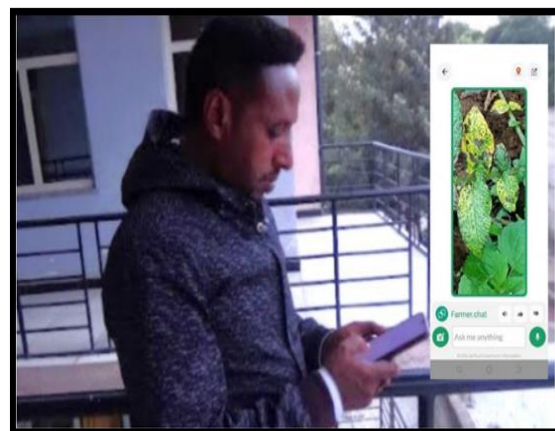


Fig 2. Increasing smartphone use among farmers is transforming access to agricultural information

Major strengths of chatbots include round-the-clock availability, support for multiple languages, affordability, and scalability. Platforms such as CropCare Companion and AgroBuddy illustrate how AI driven chatbots can deliver localized and timely guidance without requiring the physical presence of extension personnel (Sable, 2025; Sheikh *et al.*, 2025).

For instance, when a farmer encounters a sudden pest problem, a chatbot can provide instant recommendations in the farmer's local language - an option that may not always be possible through traditional extension channels.

AI Beyond Chatbots: Emerging Extension Tools

The application of AI in extension extends well beyond conversational interfaces. Image based plant disease detection systems enable farmers to diagnose crop problems using smartphone photographs, often with support for vernacular languages (Kurre *et al.*, 2025). Similarly, AI driven weather advisory services combine climatic data to assist farmers in making informed decisions related to sowing, irrigation, and harvesting operations (Alex *et al.*, 2023).

In addition, decision support systems integrate crop, soil, and climate information to recommend appropriate management practices, thereby contributing to sustainable agriculture and food security objectives (Soujanya *et al.*, 2025). Voice enabled AI applications further promote inclusiveness by allowing illiterate and semi-literate farmers to access advisory services with ease (Akash *et al.*, 2025; Mehra and Anitha, 2025).

How AI is Changing the Role of Extension Officers

Rather than replacing extension professionals, AI is gradually transforming the nature of their work. Extension officers are increasingly shifting from the role of primary information providers to that of facilitators, mentors, and evaluators of AI based recommendations (Patel *et al.*, 2024).



Fig 3. Extension professionals using digital tools to enhance advisory efficiency

AI tools support extension staff by enabling better identification of farmer needs, prioritization of urgent issues, reduction of repetitive advisory tasks, and expansion of outreach coverage (Jadhav *et al.*, 2024). This partnership between human expertise and AI technologies strengthens the overall effectiveness of extension services (Ibrahim, 2023).

Benefits of AI-Based Extension for Rural Farmers

The adoption of AI enabled extension systems offers several advantages, including:

- Timely and customized advisory support
- Cost effective and scalable service delivery
- Improved access for farmers in remote and underserved areas
- Rapid response during climate-related and pest emergencies
- Enhanced farm decision making and income potential

Such benefits have been documented across crop and livestock advisory platforms, precision farming applications, and multilingual AI based systems (Jini *et al.*, 2025; Sheikh *et al.*, 2025).

Challenges and Ground Realities

Despite its promise, AI based extension is constrained by challenges such as the digital divide in internet connectivity, smartphone ownership, and digital skills (Professor and Mullana, 2024).

Additional concerns include linguistic diversity, farmers' trust in machine-generated advice, and issues related to data privacy and reliability (Nyagatare and Kumar, 2025).

Scholars therefore emphasize the need for expert oversight, institutional backing, and ethical data governance frameworks to ensure that AI driven advisory services remain accurate, transparent, and farmer oriented (Patel *et al.*, 2024; Ibrahim, 2023).

The Way Forward: Blending Human Touch with AI

The future of agricultural extension is best envisioned as a hybrid system, in which AI technologies complement rather than replace human expertise. Investments in rural digital infrastructure, capacity building of farmers and extension personnel, and localization of AI tools are crucial for long term sustainability (Khatri *et al.*, 2024; Professor and Mullana, 2024).

In addition, collaboration among government agencies, private technology providers, and research institutions can further improve the reach, reliability, and credibility of AI based extension services.

Conclusion: The Future Extension Officer May Be Digital-but Human at Heart

The integration of Krishi Bhavans with AI enabled advisory tools represents a significant shift in the evolution of agricultural extension. By expanding access to information and supporting timely decision making, AI has the potential to foster a more inclusive, responsive, and farmer-centric extension system. While digital technologies will increasingly support extension activities, the human dimensions of trust, empathy, and contextual understanding remain indispensable. The combined strength of AI and extension professionals can therefore reshape agricultural extension to meet the emerging challenges of Indian agriculture.

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