



ICT-Driven Extension Models for Marginalized Farming Communities

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Agricultural extension services are being revolutionized by information and communication technology (ICT), particularly for underserved farming communities that have historically encountered obstacles because of caste, location, literacy, gender, and economic isolation. ICT-driven extension approaches are bridging the knowledge gap between disadvantaged rural farmers and research institutions via the use of digital video, radio, mobile phones, community information centers, and AI-powered technologies. The development, varieties, and efficacy of ICT-enabled extension programs designed for underserved populations are critically examined in this research. The study emphasizes inclusive tactics including voice-based advisory, women-centric platforms, participatory content production, and vernacular digital media, drawing on current research and international case studies. In addition, it examines issues including societal opposition, infrastructural deficiencies, and digital literacy while providing a path for future innovation in inclusive extension services. In order to create agricultural systems that are fair, climate resilient, and economically successful, ICT must be integrated with participatory development.

Overview

Mainstream extension programs often do not reach marginalized farmers, who are disadvantaged because of their gender, caste, ethnicity, land ownership, rural location, or poor literacy. These people make up a significant share of the agricultural population in South Asia and Sub-Saharan Africa, but they get little institutional assistance (Anderson & Feder, 2007). Because of structural constraints, traditional extension techniques like field trips and group meetings are insufficient for these communities. However, ICT-driven models have the ability to provide inclusive, timely, and individualized agricultural guidance, which makes them essential for fostering resilience and sustainable development among these populations (Aker, 2011; Tsan et al., 2019).

Obstacles Marginalized Farming Communities Face

Social and Economic Obstacles

- Lack of ownership and homelessness have an impact on institutional credit and service accessibility.
- According to Beauchelt and Badstue (2013), participation in text-based extension formats is restricted by illiteracy and gender-based exclusions.

Isolation by Geography: Knowledge asymmetries are exacerbated in remote locations, which often lack sufficient infrastructure and extension staff (Swanson & Rajalahti, 2010).

Restrictions Due to Culture: Women's movement and information access are restricted by patriarchal standards. Advisories in the majority language exclude minority ethnic or linguistic groups (Chowdhury et al., 2020).

The Development of ICT for Extension in Agriculture

The Age Before Digital

The main media were written materials, radio, and television, although interaction was restricted by one-way communication.

The Digital Revolution

Farmers started using SMS, IVR (Interactive Voice Response), mobile applications, and video to receive location-specific alerts as a result of growing cellphone usage and digital infrastructure.

Toward Inclusive ICT

Modern models focus on:

- Two-way communication
- Language customization
- Voice/text hybridity
- Participatory content creation

ICT-Driven Extension Models for Marginalized Farmers

Model Type	Key Examples	Inclusive Features
Voice-based IVR	Avaaj Otalo, Lifeline Agriculture	Local dialect support, no literacy required
Community Video	Digital Green, Access Agriculture	Participatory content, led by local women or farmers
SMS/Text Alerts	M-Kisan, Reuters Market Light	Multilingual messaging, weather and market alerts
Mobile Apps	Krishi Network, Plantix	Image diagnosis, offline capability, tailored to smallholders
Radio + ICT Fusion	Farm Radio International	Combines local radio with call-ins, SMS for feedback
Community Info Centers	e-Choupal, Village Knowledge Centers	Walk-in centers with mediated advisory for those without devices

Case Studies

India's Digital Green

Tribal farmers adopted more best practices as a result of women-led participatory video production on nutrition and agriculture, and the gender gap in access to advisory services was closed.

Lifeline Agriculture in Africa

Developed to reach over 300,000 farmers in Ghana, Kenya, and Uganda; farmers submit recorded questions via IVR and get knowledgeable responses; very useful in low-literacy populations (FAO, 2020)

Telangana, India's e-Sagu

- Farmers use kiosks to submit crop photos, and experts respond with suggested treatments.
- Dryland farmers in underserved areas benefited.

Farm Radio International

Radio shows combined with SMS/IVR feedback loops; emphasis on indigenous knowledge and women farmers; shown to increase yield and retention of knowledge (Chapota et al., 2014).

Women's Contribution to ICT Extension

- Despite making up roughly 43% of the world's agricultural workforce, women only get 20% of extension services (World Bank, 2021).

This gap is filled by gender-sensitive ICT platforms such as Shakti SMS and SEWA Bharat's mobile outreach; including women as ICT intermediates increases adoption and trustworthiness.

Localization, Dialect, and Language

- Adapting advising materials to local languages improves understanding and confidence.
- Multilingual voice-based outreach is made possible by tools like Gram Vaani and Awaaz.De. Localization include context-specific agricultural methods, insect profiles, and religious calendars.

Hybrid and Offline Models

- In areas with poor internet penetration, offline ICT is crucial.
- Offline-first applications, like Plantix offline mode, sync and save data when connected.
- Hybrid strategies blend digital reinforcement (Digital Green) with in-person facilitation.

Conclusion

In order to eliminate historical disparities in access to agricultural consulting services, ICT-driven extension programs are essential. Effective design, language, facilitation, and feedback loops may make the difference between underrepresented populations being excluded and empowered. ICT has the potential to be a cornerstone of resilient, sustainable, and equitable rural development with inclusive innovation, participatory content, and ethical digital behaviors.

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