AGRI MAGAZINE
(International E-Magazine for Agricultural Articles)
Volume: 02, Issue: 09 (September, 2025)
Available online at http://www.agrimagazine.in
©Agri Magazine, ISSN: 3048-8656

ICTs Driven Agricultural Extension Platforms: Transforming Farmer Advisory Service

*Abhishek Kumar Pal, Neha Singh, R.K. Doharey, Mukta Surya and Vikash Kumar
Department of Agricultural Extension Education, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, U.P., India
*Corresponding Author's email: ak2002pal@gmail.com

The global agricultural sector stands at a critical juncture, tasked with the unprecedented challenge of feeding a projected population of 9.7 billion by 2050 amidst the escalating threats of climate change, resource depletion, and unsustainable practices. This immense pressure exacerbates a long-standing bottleneck: the crippling inefficiency of traditional agricultural extension systems. These systems, often reliant on a limited cadre of extension agents using face-to-face, top-down methods, are hamstrung by limited reach, exorbitant costs, and critically slow information dissemination cycles. This paper argues that Information and Communication Technology (ICT), driven extension platforms are not merely an innovative supplement but are fundamentally transforming the paradigm of farmer advisory services. By leveraging the ubiquitous penetration of mobile technology from basic feature phones to sophisticated smartphones these platforms deliver timely, personalized, and geo-specific information directly to farmers, enabling a shift from a blanket, supply-driven approach to a decentralized, demand-driven, and participatory model. This article provides a detailed examination of the technological models powering this revolution, including SMS/IVR systems, interactive mobile applications, and integrated IoT-based platforms. It presents compelling empirical evidence of their impact on key metrics such as productivity, income, input efficiency, and risk mitigation. Furthermore, it offers a critical analysis of the persistent socio-technical challenges, including the digital divide, gender disparities, content relevance, and financial sustainability. The conclusion posits that for a resilient and food-secure future, the integration of ICT into national agricultural extension strategies is not optional but imperative, requiring multi-stakeholder collaboration to build inclusive, scalable, and impactful digital ecosystems for the world's farmers.

Keyword: ICT, Farmer Advisory Service, Digital Revolution, Mobile app

Introduction

Agriculture is more than an economic activity; it is the bedrock of global food security and a primary source of livelihood for over two-thirds of the world's poor living in rural areas. For decades, the bridge between agricultural research and farm-level practice has been the extension service. The conventional Transfer of Technology (ToT) model, characterized by government-employed extension agents conducting village visits and training sessions, has played a historically significant role. However, its inherent limitations have become starkly evident in the 21st century.

The system is plagued by a crippling shortage of personnel. In many parts of Sub-Saharan Africa and South Asia, the farmer-to-extension-worker ratio is a staggering 1:1000 or even 1:3000, a figure far removed from the recommended 1:400 (World Bank). This makes personalized, timely advice a logistical impossibility. Furthermore, the model is often top-down, with information flowing linearly from researcher to agent to farmer, leaving little room for feedback or the articulation of local needs. The information itself can become

generic, not accounting for hyper-local variations in soil, microclimate, or socio-economic conditions. The process is also slow; a new solution for an emerging pest may take months to trickle down to the farmers who need it immediately, by which time the damage is already done.

Concurrently, the challenges facing farmers are intensifying. Climate change is manifesting in increased weather volatility erratic rainfall, unseasonal frosts, and prolonged droughts—making traditional knowledge less reliable. Market dynamics are more complex, and post-harvest losses remain unacceptably high, often due to a simple lack of information on storage, processing, and fair market prices.

Paradoxically, the tool to address this information crisis has seen explosive growth even in the most remote rural areas: the mobile phone. With over 5.3 billion unique mobile subscribers globally and 75% of the world's population covered by a mobile network (GSMA Intelligence), the infrastructure for a digital revolution is already in place. In India, for instance, mobile penetration often exceeds access to clean sanitation or reliable electricity. This ubiquity has catalyzed the emergence of ICT-driven agricultural extension platforms, which leverage this connectivity to disrupt the antiquated ToT model. They promise to deliver the right information, to the right person, at the right time, and in the right format.

This article delves deep into this transformation. It moves beyond the hype to provide a structured analysis of how these platforms work, the evidence of their impact, and the significant hurdles that remain. It is a story of technological potential meeting agrarian reality, with profound implications for the future of how we grow our food.

The Technological Landscape: From Basic SMS to AI-Driven Insights

ICT-driven extension is not a monolith; it encompasses a spectrum of technologies tailored to different regions, resources, and farmer capabilities. They can be categorized into three evolving tiers:

Tier 1: Voice and SMS-Based Platforms (Reaching the Base of the Pyramid): This tier leverages the lowest common denominator basic feature phones to achieve massive scale.

- **Interactive Voice Response (IVR):** Systems like CGNET Swara in India or Farmers Friend in Bangladesh allow farmers to dial a number, listen to pre-recorded advisories in their local language on topics like weather and pests, and even record their own questions or observations, creating a participatory loop.
- **SMS/Alerts:** Simple, low-cost, and effective. Platforms like Kenya's M-Pesa (initially for payments but now used for alerts) and India's mKisan portal send targeted text messages on market prices, weather warnings, and government schemes. The a where platform analyzes satellite and weather data to send SMS alerts about potential disease outbreaks or drought stress specific to a farmer's registered location.
- **Impact:** The strength of this tier is its inclusivity, overcoming literacy barriers through voice and simple text. It is excellent for broadcasting urgent, time-sensitive information.

Tier 2: Smartphone Application-Based Platforms (Interactive and Multimedia): With rising smartphone adoption, a new generation of more interactive and rich-media apps has emerged.

- **Functionality:** These apps provide video tutorials (e.g., Digital Green's community-shared videos), image-based pest and disease diagnosis (e.g., Plantix), GPS-based market intelligence, and digital record-keeping.
- **Case Study - Digital Green:** Perhaps the most impactful model, Digital Green uses a participatory approach where videos are created by and for local farmers. This dramatically increases trust and adoption. Their research shows this method is 10 times more cost-effective per person reached and leads to 64% higher adoption rates of new practices compared to conventional extension.
- **Case Study - Esoko:** A comprehensive platform operating in multiple African countries, Esoko provides farmers with market prices via SMS or app, connects them with buyers, and allows for crowd-sourced surveys. Studies of Esoko's services in Ghana showed that

farmers who received price alerts saw an average 10-15% increase in income simply by being able to negotiate better deals and choose the most profitable markets.

Tier 3: Integrated and IoT-Driven Platforms (Precision Advisory): This represents the cutting edge, integrating multiple data streams for precision agriculture.

- **The Technology:** These systems combine satellite imagery, remote sensors placed in fields (measuring soil moisture, temperature, nutrient levels), drone photography, and weather station data. Artificial Intelligence (AI) and machine learning models process this vast dataset to generate highly precise, predictive advisories.
- **Functionality:** A farmer might receive an alert on their phone telling them exactly which plot of land needs irrigation today, or exactly how much fertilizer to apply to a specific area, minimizing waste and maximizing yield. Companies like CropIn and IBM's Watson Decision Platform for Agriculture are pioneers in this space.
- **Impact:** The primary benefits are radical efficiency and sustainability. Farmers can achieve yield increases of 15-20% while reducing water usage by 20-30% and fertilizer and pesticide use by 15-20%, as demonstrated by several pilot projects using precision agriculture technologies.

Documented Impact: Beyond Anecdotes to Empirical Evidence

The transformation driven by ICT platforms is measurable across several key performance indicators:

- **Productivity and Yield:** Access to timely information on improved seed varieties, sowing dates, and pest control directly translates to higher yields. A review of multiple studies by the World Bank found that farmers using digital advisories typically saw yield increases ranging from **4% to 18%**.
- **Income and Profitability:** The combination of higher yields and better market access significantly boosts incomes. As seen with Esoko, market information alone can increase incomes by over 10%. Reducing post-harvest losses through better storage and timing advice further adds to profitability.
- **Input Use Efficiency and Sustainability:** Precision agriculture platforms are at the forefront of promoting sustainable intensification. By enabling the judicious application of water, fertilizers, and pesticides, they reduce environmental runoff, lower production costs for farmers, and conserve vital resources. This is arguably one of the most critical long-term impacts of ICT-driven agriculture.
- **Risk Mitigation:** Early warning systems for droughts, floods, pests, and diseases are a game-changer. An SMS alert about an impending hailstorm allows a farmer to harvest early or cover crops, potentially saving an entire season's investment. Access to affordable crop insurance linked to these platforms (e.g., via index-based insurance) further de-risks farming.
- **Empowerment and Agency:** Perhaps the most profound change is the shift in power dynamics. Farmers are no longer passive recipients of knowledge. They can query systems, compare information, connect with experts and peers, and make informed choices. This strengthens their agency and decision-making capacity.

Navigating the Challenges: The Roadblocks to Inclusive Digitalization

Despite the promise, the path to universal digital extension is fraught with challenges that require deliberate policy and design interventions.

- **The Digital Divide:** Access to a network and a handset is not universal. Remote areas often have poor connectivity, and the cost of data and devices remains prohibitive for the poorest farmers. This risks creating a two-tier system where progressive, larger farmers benefit while marginal farmers are left further behind.
- **The Gender Gap:** The digital divide is acutely gendered. According to GSMA, women in low- and middle-income countries are 10% less likely to own a mobile phone and 23% less likely to use mobile internet than men. This disparity is driven by factors including

lower literacy rates, lack of technical confidence, socio-cultural norms, and unequal control over income. Designing for gender inclusivity with female-friendly content, interfaces, and community access points is non-negotiable.

- **Content Relevance and Localization:** A generic advisory is a useless advisory. Information must be hyper-localized, not just translated but contextualized for local soil types, prevalent crops, cultural practices, and dialects. Maintaining this relevance at scale requires robust backend systems and strong local partnerships.
- **Digital Literacy:** The assumption that all users can navigate complex app menus or even interpret an SMS is flawed. User interfaces must be intuitive, icon-based, and designed for low-literacy audiences. Training and support are essential components, not afterthoughts.
- **Financial Sustainability:** Many ICT-for-Ag initiatives start as donor-funded pilots but struggle to scale into self-sustaining businesses. viable business models are still evolving, ranging from freemium models (basic info free, premium advice paid) to B2B models where agribusiness companies pay for access to farmers, to government contracts.

Conclusion

The evidence presented throughout this article underscores a singular, powerful narrative: ICT-driven platforms are fundamentally and irreversibly transforming agricultural extension. This is not a marginal change but a paradigm shift, moving the sector from a slow, monolithic, and supply-driven system to a dynamic, personalized, and demand-oriented knowledge ecosystem. The digital thread, woven through mobile networks, satellites, and sensors, is now an integral part of the fabric of modern agriculture, connecting the isolated farmer to a global wealth of information and opportunity.

The transformation is multi-faceted. Technologically, we have witnessed an evolution from simple, broadcast-style SMS systems to interactive, AI-powered platforms that offer predictive, precision advisories. Economically, the impact is clear and measurable, with documented increases in productivity, income, and input efficiency, directly contributing to poverty reduction and economic resilience in rural communities. Socially, these platforms have begun to democratize knowledge, empowering farmers with the agency to make informed decisions and strengthening their position within the agricultural value chain.

However, this digital sunrise casts long shadows. The challenges of the digital divide, the persistent gender gap, and the questions of content relevance and financial sustainability are significant. They serve as a crucial reminder that technology is a tool, not a panacea. Its benefits are not automatic; they must be consciously engineered through inclusive design and proactive policy.

Therefore, the future of ICT in agriculture cannot be left to market forces or tech innovation alone. It requires a concerted, collaborative effort. Governments must prioritize digital infrastructure as critical rural infrastructure and foster policies that encourage innovation while protecting farmers. The private sector must commit to sustainable business models that value inclusivity as much as profitability. NGOs and research institutions must continue to act as bridges, ensuring that solutions are grounded in the real needs of farmers and that their voices shape the technology meant to serve them.

References

1. Aker, J. C. (2011). *Dial "A" for Agriculture: A Review of Information and Communication Technologies for Agricultural Extension in Developing Countries*. Agricultural Economics, 42(6), 631–647.
2. Baumüller, H. (2018). *The Little We Know: An Exploratory Literature Review on the Utility of Mobile Phone-Enabled Services for Smallholder Farmers*. Journal of International Development, 30(1), 134-154.
3. CGIAR. (2020). *Digital Agriculture: Pathways to Development*. Report from the CGIAR Research Program on Policies, Institutions, and Markets (PIM).

4. Digital Green. (2022). *Annual Impact Report 2021*. Retrieved from https://www.digitalgreen.org/impact/
5. Fabregas, R., Kremer, M., & Schilbach, F. (2019). *Realizing the Potential of Digital Development: The Case of Agricultural Advice*. Science, 366(6471), eaay3038.
6. GSMA Intelligence. (2023). *The Mobile Economy 2023*. GSM Association. Retrieved from https://www.gsmaintelligence.com/economy/
7. Krell, N. T., Giroux, S. A., Guido, Z., Hannah, C., Lopus, S. E., Caylor, K. K., & Evans, T. P. (2021). *Smallholder Farmers' Use of Mobile Phone Services in Central Kenya*. Climate and Development, 13(3), 215-227.
8. Nakasone, E., Torero, M., & Minten, B. (2014). *The Power of Information: The ICT Revolution in Agricultural Development*. Annual Review of Resource Economics, 6(1), 533-550.
9. Qaim, M. (2020). *Role of New Plant Breeding Technologies for Food Security and Sustainable Agricultural Development*. Applied Economic Perspectives and Policy, 42(2), 129-150.
10. The World Bank. (2019). *ICT in Agriculture: Connecting Smallholders to Knowledge, Networks, and Institutions* (Updated Edition). World Bank Report No. 12605.
11. Tadesse, G., & Bahiigwa, G. (2015). *Mobile Phones and Farmers' Marketing Decisions in Ethiopia*. World Development, 68, 296-307.
12. Van Campenhout, B., Vandevelde, S., Walukano, W., & Van Asten, P. (2017). *Agricultural Extension Messages Using Video on Mobile Phones Increase Knowledge and Learning of Best Practices among Smallholder Farmers in Uganda*. PLoS ONE, 12(4), e0175366.
13. Zossou, E., Van Mele, P., Vodouhe, S. D., & Wanvoeke, J. (2009). *The Power of Video to Trigger Innovation: Rice Processing in Central Benin*. International Journal of Agricultural Sustainability, 7(2), 119-129.
14. aWhere Inc. (2021). *The Business Case for Precision Agriculture: ROI Studies*. [White Paper]. Retrieved from https://www.awhere.com/resources
15. Food and Agriculture Organization of the United Nations (FAO). (2021). *The State of Food and Agriculture 2021*. Making agri-food systems more resilient to shocks and stresses. Rome. https://www.fao.org/documents/card/en/c/cb4476en
16. GSMA. (2020). *The Mobile Gender Gap Report 2020*. GSM Association. Retrieved from https://www.gsma.com/r/gender-gap/