

Popular Article



Digital Extension Platforms for Farmer Empowerment

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Abstract

Digital extension platforms are transforming agricultural advisory services by providing farmers with timely, accessible, interactive, and personalized information. Mobile applications, websites, social media, messaging services, artificial intelligence, online learning platforms, Internet of Things devices, remote sensing, and digital marketplaces can connect farmers with extension professionals, researchers, markets, financial services, and fellow farmers. These platforms support crop management, weather forecasting, pest and disease diagnosis, input selection, farm record management, and marketing decisions. Personalized and location-specific advisories can improve farmers' decision-making capacity and resource-use efficiency. Digital communities also encourage peer learning and participation, while local-language and voice-based services can improve inclusiveness. Nevertheless, digital inequality, poor connectivity, limited digital literacy, affordability, misinformation, and data privacy remain important challenges. Integrating digital platforms with human expertise and participatory extension can strengthen farmer empowerment and sustainable rural livelihoods.

Keywords: Digital extension; Farmer empowerment; Mobile applications; Artificial intelligence; Digital advisory; E-agriculture; Rural development.

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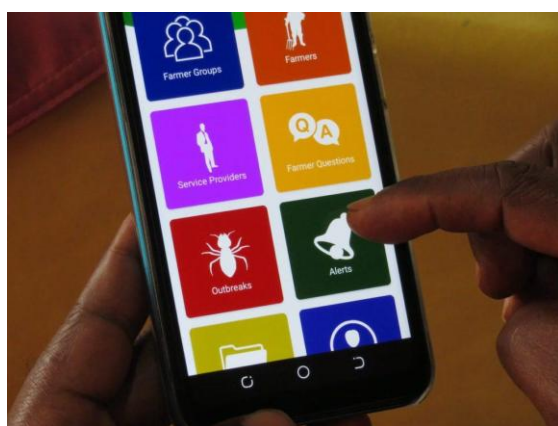
Introduction

Digital technologies are transforming agricultural extension by creating new pathways for farmers to access knowledge, advisory services, markets, financial information, and peer networks. Digital extension platforms bring multiple services together through mobile applications, websites, messaging systems, social media, online learning portals, artificial intelligence, cloud

computing, and data-driven decision-support systems. Traditional extension systems often depend on periodic field visits, meetings, demonstrations, printed materials, and telephone communication. These approaches remain valuable, but digital platforms can extend their reach beyond geographical and temporal limitations. Farmers can access information from their farms, communicate with experts, participate in online communities, and receive timely alerts related to weather, pests, diseases, markets, and crop management.

The concept of **farmer empowerment** goes beyond simply providing information. An empowered farmer is better able to access knowledge, evaluate alternatives, make informed decisions, participate in markets, negotiate with institutions, and influence agricultural-development processes. Digital platforms can support these capabilities by providing farmers with information and communication tools.

When designed around farmers' actual needs, digital extension platforms can shift agricultural extension from one-way technology transfer toward interactive, personalized, participatory, and demand-driven knowledge systems.



Concept of Digital Extension Platforms

A digital extension platform is an online or mobile-based system that connects farmers with agricultural information, advisory services, experts, institutions, markets, and other stakeholders.

A comprehensive platform may integrate:

- Agricultural advisory.
- Weather information.
- Pest and disease alerts.
- Market information.
- Input information.
- Digital training.
- Financial services.
- Farm records.

- Expert consultation.
- Farmer-to-farmer communication.

The central objective is to create a continuous knowledge connection between farmers and agricultural support systems.

From Extension Delivery to Farmer Empowerment

Traditional extension often focuses on delivering recommendations to farmers. Digital extension can go further by giving farmers access to information that supports independent decision-making.

Empowerment may involve:

1. Access to reliable information.
2. Ability to compare alternatives.
3. Improved technical knowledge.
4. Greater participation in decision-making.
5. Better market awareness.
6. Stronger communication with institutions.
7. Increased confidence in adopting innovations.

Digital platforms can therefore become tools for improving both agricultural knowledge and farmer agency.

Mobile-Based Digital Extension

Mobile phones are central to many digital extension systems because they are portable and increasingly accessible.

Farmers can use smartphones to:

- Receive crop advisories.
- View training videos.
- Ask experts questions.
- Upload crop photographs.
- Check weather forecasts.
- Access market prices.

- Record farm activities.
- Join farmer groups.

Mobile-based platforms can also send push notifications when important information becomes available.

Agricultural Mobile Applications

Agricultural applications can combine multiple services within a single interface.

A farmer-oriented application may provide:

- Crop calendars.
- Variety information.
- Fertilizer recommendations.
- Irrigation guidance.
- Pest identification.
- Disease diagnosis.
- Weather forecasts.
- Market prices.
- Farm records.

GPS-enabled applications can further provide location-specific information.

For example, a farmer in a particular district can receive crop recommendations based on local weather and agricultural conditions rather than receiving generalized information.

AI-Powered Agricultural Advisory

Artificial intelligence is increasingly being integrated into digital agricultural platforms.

AI can analyse large datasets and provide preliminary recommendations related to:

- Crop diseases.
- Insect pests.
- Irrigation.
- Nutrient management.
- Weather risks.
- Crop selection.

- Yield prediction.

AI chatbots can also provide conversational advisory services.

A farmer can ask a question in natural language, upload a photograph, and receive an initial response.

For example:

Farmer: “The leaves of my chilli plants have developed curling and yellowing. What should I check?”

An AI system can ask follow-up questions and analyse images before suggesting possible causes.

For critical crop-protection decisions, expert validation remains important because image-based or automated diagnoses can sometimes be uncertain.

Image-Based Farmer Advisory

Smartphones allow farmers to communicate agricultural problems visually.

Farmers can upload images of:

- Insect pests.
- Disease symptoms.
- Nutrient deficiencies.
- Weed species.
- Fruit damage.
- Irrigation problems.

Extension professionals or AI systems can analyse these images.



This reduces the need for farmers to physically transport samples to extension centres and can accelerate preliminary diagnosis.

Digital Weather Services

Weather information is one of the most valuable services that digital platforms can provide.

Platforms can deliver:

- Rainfall forecasts.
- Temperature alerts.
- Heat-wave warnings.
- Frost alerts.
- Wind information.
- Humidity forecasts.
- Extreme-weather notifications.

The information becomes more useful when combined with crop-specific recommendations.

For example, a rainfall forecast can be linked to advice regarding irrigation, fertilizer application, harvesting, or disease monitoring.

Pest and Disease Early Warning

Digital platforms can integrate farmer observations, weather data, pest-trap information, remote sensing, and historical records to identify disease or pest risks.

Farmers can receive alerts such as:

“Conditions are favourable for disease development. Monitor susceptible crops and follow locally recommended preventive measures.”

Such systems can encourage early monitoring and reduce unnecessary pesticide applications.

Digital Farmer Communities

Digital communities allow farmers to communicate directly with other farmers.

They can share:

- Production experiences.
- Successful technologies.

- Market information.
- Pest observations.
- Machinery information.
- Input recommendations.
- Local innovations.

Peer communication can strengthen social learning.

However, digital communities also create risks of misinformation. Platforms should therefore include mechanisms for expert moderation and information verification.

Farmer-to-Farmer Digital Learning

Digital platforms can expand farmer-to-farmer extension beyond geographical boundaries.

Experienced farmers can share:

- Short videos.
- Photographs.
- Farm-management experiences.
- Demonstration results.
- Cost information.

Such content may be particularly convincing because it is generated by people working under similar conditions.

Video-Based Digital Extension

Video is highly effective for communicating practical agricultural practices.

Digital extension platforms can provide videos on:

- Nursery preparation.
- Seed treatment.
- Grafting.
- Pruning.
- Fertigation.
- Pest monitoring.
- Biological control.

- Harvesting.
- Post-harvest management.

Farmers can watch videos repeatedly and share them with other members of their communities.

Interactive Voice-Based Services

Digital extension should not depend entirely on text and internet connectivity.

Interactive Voice Response systems allow farmers to access information through telephone calls.

Voice-based services are especially useful for:

- Farmers with limited literacy.
- Users without smartphones.
- Local-language communication.
- Remote areas with limited internet connectivity.

Combining voice, SMS, and smartphone services can make digital extension more inclusive.

Market Information and Farmer Empowerment

Access to reliable market information is an important dimension of farmer empowerment.

Digital platforms can provide:

- Market prices.
- Buyer contacts.
- Demand information.
- Transportation options.
- Storage facilities.
- Processing opportunities.
- Online marketplaces.

When farmers have better information about prices and buyers, they may be better positioned to compare selling options and negotiate transactions.

Digital Financial Services

Digital platforms can connect farmers with financial services.

Potential services include:

- Digital payments.
- Agricultural loans.
- Crop insurance information.
- Savings services.
- Credit assessment.
- Government benefit information.

Integration of financial services with agricultural advisory can create a more comprehensive digital agricultural ecosystem.

Digital Farm Records

Digital platforms can help farmers maintain records of:

- Seed purchases.
- Fertilizer use.
- Pesticide applications.
- Irrigation.
- Labour.
- Production.
- Sales.
- Expenses.

Farm records can support better planning and profitability analysis.

Over time, these records may also support personalized advisory services.

Internet of Things and Smart Advisory

IoT sensors can provide real-time information to digital extension platforms.

Sensors can monitor:

- Soil moisture.
- Temperature.
- Humidity.
- Water level.

- Soil electrical conductivity.
- Greenhouse conditions.

Data can be transmitted to a digital platform, where algorithms interpret it.

For example:

**Sensor → Cloud platform → Data analysis
→ Alert → Farmer**

This creates continuous communication between the farm and the advisory system.

Remote Sensing and Digital Platforms

Satellite imagery and drones can provide information about crop conditions.

Digital extension platforms can use these data to identify:

- Crop stress.
- Drought.
- Flooding.
- Vegetation changes.
- Water stress.
- Possible disease hotspots.

This can help extension agencies prioritize areas requiring field-level investigation.

Personalized Advisory

Digital platforms can move agricultural extension from generalized recommendations toward personalized advisory.

Recommendations can be based on:

- Farmer location.
- Crop.
- Variety.
- Soil condition.
- Weather.
- Crop growth stage.
- Farm history.
- Pest incidence.

For example, two farmers growing the same crop may receive different irrigation recommendations because their soil moisture levels and weather conditions differ.

Multilingual Digital Extension

Language accessibility is essential for farmer empowerment.

Digital platforms should provide information in local languages and, where possible, local dialects.

Technologies such as speech recognition, machine translation, text-to-speech, and AI-based conversational interfaces can improve accessibility.

Local-language content can make complex technical information easier to understand and apply.

Empowering Women Farmers

Women contribute significantly to agricultural production and rural livelihoods but may face barriers to accessing formal extension services.

Digital platforms can provide flexible access to:

- Crop information.
- Livestock advisory.
- Market information.
- Training.
- Financial services.
- Women's farmer communities.

Women-focused digital groups can also encourage peer learning and collective action.

However, digital gender gaps involving phone ownership, connectivity, affordability, and digital literacy must be addressed.

Empowering Rural Youth

Young people can become important users and providers of digital agricultural services.

Digital extension can create opportunities in:

- Agri-entrepreneurship.

- Drone services.
- Precision agriculture.
- Digital marketing.
- Farm data management.
- Agricultural machinery.
- E-commerce.
- Agritech enterprises.

Youth can also serve as digital facilitators for older farmers who need support using new technologies.

Digital Literacy

Access to technology alone does not guarantee empowerment.

Farmers need the ability to:

- Navigate digital platforms.
- Search for reliable information.
- Interpret advisories.
- Upload useful images.
- Recognize misinformation.
- Protect passwords.
- Understand digital payments.
- Manage personal data.

Digital-literacy programmes should therefore be integrated into extension systems.

Data Privacy and Farmer Rights

Digital platforms collect substantial information about farmers.

This may include:

- Farm location.
- Crop details.
- Production records.
- Financial information.
- Input use.
- Market transactions.

Farmers should understand how their data are collected, stored, used, and shared.

Digital extension systems should prioritize transparency, consent, security, and responsible data management.

Role of Extension Professionals

Digital platforms do not eliminate the need for extension personnel.

Instead, extension professionals can become:

- Digital facilitators.
- Online advisors.
- Content developers.
- Information validators.
- Community moderators.
- Technology trainers.
- Data interpreters.

Human expertise remains essential for complex problems and for building trust with rural communities.

Participatory Digital Extension

Farmer empowerment is stronger when farmers participate in platform development.

Farmers can contribute to:

- Identifying information needs.
- Testing applications.
- Evaluating advisory messages.
- Developing local-language content.
- Reporting platform problems.
- Suggesting new services.

This ensures that digital extension responds to actual user needs rather than being designed exclusively by technology providers.

Challenges of Digital Extension Platforms

Several challenges can limit effectiveness.

Digital Divide

Farmers without smartphones, internet access, or reliable electricity may be excluded.

Digital Literacy

Some users may require training before using advanced platforms.

Connectivity

Poor network coverage can restrict access in remote areas.

Affordability

Smartphones, data plans, and digital subscriptions may create financial barriers.

Information Reliability

Incorrect information can cause poor management decisions.

Language Barriers

Platforms may not adequately support local languages.

Trust

Farmers may be hesitant to rely on unfamiliar digital systems.

Data Security

Weak data protection can expose farmers to privacy and financial risks.

Integrated Digital Extension Ecosystem

An effective digital extension platform should connect multiple services.

A possible model is:

Farmer → Mobile Platform → Weather + Soil + Crop Data → AI Analysis → Extension Expert → Personalized Advisory → Farmer Feedback

This creates a continuous learning cycle rather than one-time information delivery.

Practical Framework

Digital component	Function	Empowerment benefit
Mobile app	Advisory	Easy information access

SMS	Alerts	Timely communication
IVR	Voice advisory	Greater inclusion
Video	Demonstration	Practical learning
AI chatbot	Question answering	Rapid support
Image diagnosis	Problem identification	Faster response
IoT sensors	Field monitoring	Real-time decisions
Remote sensing	Crop assessment	Early warning
Digital marketplace	Market access	Better selling opportunities
Digital records	Farm management	Improved planning
Online communities	Peer learning	Social empowerment

Measuring Farmer Empowerment

The success of digital extension should not be measured only by the number of users or application downloads.

Important indicators include:

- Improvement in agricultural knowledge.
- Increased confidence in decision-making.
- Adoption of appropriate technologies.
- Improved access to markets.
- Increased income.
- Reduced production risks.
- Greater participation of women and youth.
- Increased interaction with extension institutions.
- Improved resource-use efficiency.

These indicators provide a more meaningful assessment of whether digital platforms actually empower farmers.

The future of digital extension will involve greater integration of artificial intelligence, IoT, satellite imagery, mobile applications, voice technology, digital financial services, and online communities.

AI-based systems may provide multilingual conversational advisory services, while sensors and remote sensing can supply real-time farm information.

Digital platforms may eventually create individual **farmer knowledge profiles** that combine farm history, crop conditions, weather, soil information, and market information to generate highly personalized recommendations.

Conclusion

Digital extension platforms provide powerful opportunities to strengthen farmer empowerment by improving access to agricultural knowledge, advisory services, markets, financial information, and peer networks. Mobile applications, AI-based advisory, digital communities, video learning, IoT sensors, remote sensing, online marketplaces, and digital farm records can make extension services more accessible, timely, personalized, and interactive.

References

1. Aker, J. C. (2011). Dial "A" for agriculture: Using information and communication technologies for agricultural extension in developing countries. *Agricultural Economics*, 42(6), 631–647. <https://doi.org/10.1111/j.1574-0862.2011.00545.x>
2. Nakasone, E., Torero, M., & Minten, B. (2014). The power of information: The ICT revolution in agricultural development. *Annual Review of Resource Economics*, 6, 533–550. <https://doi.org/10.1146/annurev-resource-100913-012714>
3. Aker, J. C., Ghosh, I., & Burrell, J. (2016). The promise (and pitfalls) of ICT for agriculture initiatives. *Agricultural Economics*, 47(S1), 35–48. <https://doi.org/10.1111/agec.12301>
4. Fabregas, R., Kremer, M., & Schilbach, F. (2019). Realizing the potential of digital development: The case of agricultural advice. *Science*, 366(6471), eaay3038. <https://doi.org/10.1126/science.aay3038>
5. Rajkhowa, P., & Qaim, M. (2021). Personalized digital extension services and agricultural performance: Evidence from smallholder farmers in India. *PLOS ONE*, 16(10), e0259319. <https://doi.org/10.1371/journal.pone.0259319> (PLOS)
6. Spielman, D. J., Lecoutere, E., Makhija, S., & Van Campenhout, B. (2021). Information and communications technology (ICT) and agricultural extension in developing countries. *Annual Review of Resource Economics*, 13, 177–201. <https://doi.org/10.1146/annurev-resource-101520-080657>
7. Coggins, S., McCampbell, M., Sharma, A., Sharma, R., Haeefe, S. M., Karki, E., Hetherington, J., Smith, J., & Brown, B. (2022). How have smallholder farmers used digital extension tools? Developer and user voices from Sub-Saharan Africa, South Asia and Southeast Asia. *Global Food Security*, 32, 100577. <https://doi.org/10.1016/j.gfs.2021.100577> (PubMed)
8. Khan, R. P., Daum, T., Ruthenberg, H., Birner, R., & Ringler, C. (2025). Levelling the field: A review of the ICT revolution and agricultural extension in the Global South. *Journal of International Development*. <https://doi.org/10.1002/jid.3949> (Wiley Online Library)
9. Maurya, A. S., Yadav, B., Patel, S., Kumar, R., & Kumar, A. (2026). Assessing the role of digital platforms in strengthening agricultural extension services: Advisory to empowerment. *Indian Journal of Extension Education*, 62(2), 47–53.

<https://doi.org/10.48165/IJEE.2026.62208>
(Indian Agricultural Research Journals)

10. Paliwal, H., Singh, A. K., Singh, S. K., & Singh, P. (2026). Scale to measure farmers' attitude towards ICT-based agro-advisory services. *Indian Journal of Extension Education*, 62(1), 166–170.
<https://doi.org/10.48165/IJEE.2026.621RT05> (Indian Agricultural Research Journals)
11. Challa, L. N., Naik, R., & Meera, S. N. (2025). Evaluating factors influencing farm women's utilization of digital extension services. *Gujarat Journal of Extension Education*, 39(2).
<https://doi.org/10.56572/gjoe.2025.39.2.0010> (Gujarat Journal of Extension Education)
12. Challa, L. N. (2024). Constraints faced by farm women in accessing and utilisation of digital extension services. *Gujarat Journal of Extension Education*, 38(1).
<https://doi.org/10.56572/gjoe.2024.38.1.0026> (Gujarat Journal of Extension Education)
13. Mishra, A., Yadav, O. P., Yadav, V., Mishra, S., & Kumar, N. (2020). Benefits of the use of ICT services perceived by farmers for acquiring agricultural information in Central U.P. *Indian Journal of Extension Education*, 56(1), 86–89.
<https://doi.org/10.48165/IJEE.2020.56118> (Indian Agricultural Research Journals)
14. *Digital extension service: Quick way to deliver agricultural information to the farmers.* (2021). In *Food Technology Disruptions*, 285–323.
<https://doi.org/10.1016/B978-0-12-821470-1.00006-9> (ScienceDirect)
15. Njoroge, B., Fisher, M., & Mpande, B. (2026). Pricing inclusive digital extension services: Gender, delivery design, and farmers' willingness to pay in Zambia. *Development in Practice*, 55(2).
<https://doi.org/10.1177/00307270261436518> (DOI)
16. Abbas, I. R., Ramakrishnan, K., Velusamy, R., Selvarani, G., & Sivasankari, B. (2024). Usage of mobile phone technologies of agricultural extension services utilized by farmers. *Journal of Experimental Agriculture International*, 46(8), 565–569.
<https://doi.org/10.9734/jeai/2024/v46i82736>
17. Khatri, A., Lallawmkimi, M. C., Rana, P., Panigrahi, C. K., Minj, A., Koushal, S., & Ali, M. U. (2024). Integration of ICT in agricultural extension services: A review. *Journal of Experimental Agriculture International*, 46(12), 394–410.
<https://doi.org/10.9734/jeai/2024/v46i123146>