

Understanding Barriers in Agricultural Extension Communication and Its Influence on Farmers Adoption to Extension Services: A Systematic Review

John Arthur B. Bucane
J.H. Cerilles State College, Pagadian City, Zamboanga del Sur
School of Graduate Studies
johnarthurbucane@gmail.com

Date Submitted:
February 18, 2026

Date Accepted:
March 17, 2026

Date Published:
March 29, 2026

DOI:
10.5281/zenodo.19317283

ABSTRACT

This systematic review examined the barriers in agricultural extension communication and their influence on farmers' participation and adoption of extension services. Evidence from diverse contexts shows that limited funding, inadequate staffing, weak infrastructure, low digital literacy, and insufficient training of extension workers constrain effective knowledge transfer. These barriers reduce farmer engagement, weaken feedback systems, and lower adoption of recommended technologies. Digital and ICT-based tools offer potential to enhance access to information and real-time communication, yet poor connectivity and limited skills restrict their

effectiveness. Participatory approaches, capacity building, and institutional support are critical for improving communication, fostering trust, and increasing adoption rates. Strengthening coordination among local governments, research institutions, and farmer organizations further enhances extension outcomes. Addressing technical, institutional, and participatory gaps is essential for sustainable agricultural development and improved farmer livelihoods.

Keywords: *agricultural extension, communication barriers, farmer adoption, ICT in agriculture, participatory approaches, capacity building.*

INTRODUCTION

The global population is growing rapidly, creating significant pressure on the limited resources needed to feed people, while the availability of agricultural land continues to decline at a concerning pace [Food and Agriculture Organization] (FAO, 2017). Estimates suggest that the world population could reach around 11 billion by the end of the 21st century (UN, 2022). Additionally, the World Bank noted that nearly 75% of resource-poor rural populations in developing countries rely on agriculture for their livelihoods (World Bank, 2016). Meeting the food demands of this growing population requires farmers to increase production by up to 70% by 2100, which poses a major challenge (FAO, 2017). Achieving this growth depends on the adoption of modern techniques, improved farm management, access to current information,

and innovative ideas, which can be facilitated through agricultural extension services (Christoplos, 2010; Davis et al., 2014).

Agricultural extension services involve the delivery of agricultural knowledge and technology to farmers using various educational methods (Birner et al., 2009). Their primary objective is to enhance farming practices, boost productivity, and promote sustainable development. For sustainable agricultural progress, extension and advisory personnel need to regularly engage with rural farming communities and use diverse and effective communication channels (Abraham et al., 2022; Ekenta et al., 2013). Farmers also require exposure to multiple contact methods to interact effectively with extension staff (Tambo et al., 2023; Uddin et al., 2021).

The World Bank emphasizes that effective communication is critical to providing demand-driven advisory services, supporting participation, integration, decentralization, capacity building, policy advocacy, and sustainability, which are essential human dimensions (World Bank, 2016). Research shows that formal extension methods, particularly through training sessions and farm visits, remain among the most used and effective communication strategies employed by Agriculture Extension and Rural Advisory Service agents (Ekenta et al., 2013; Leeuwis, 2013).

Despite the presence of these services, many farmers encounter obstacles that limit their access to extension communication and affect their adoption of services (Hoa Sen, 2024). Research identifies barriers such as restricted access to communication technologies, low digital literacy, weak interaction between farmers and extension workers, and a lack of trust in advisory information (Sena et al., 2024). Poor communication links between farmers and extension personnel reduce access to agricultural knowledge, hinder participation in extension programs, and influence the adoption of recommended practices.

Improving agricultural extension communication supports several Sustainable Development Goals (SDGs). Effective extension services contribute to SDG 2 – Zero Hunger by enhancing food security and promoting climate-smart practices. They also advance SDG 1 – No Poverty by increasing farmers' productivity and income, and SDG 10 – Reduced Inequalities by providing marginalized farmers with access to advisory services. Addressing communication barriers is essential for extending the reach and effectiveness of extension systems.

While previous research has highlighted the role of agricultural extension in improving farm productivity, there is limited literature on how communication barriers affect farmers' participation and adoption of extension services at the local level. This case study explores the barriers in agricultural extension communication and examines their influence on farmers' adoption of services. Understanding these challenges offers insights into enhancing communication strategies employed by extension personnel and strengthening farmer engagement in agricultural programs.

LITERATURE REVIEW

Barriers to Agricultural Extension Communication

A study by Gumban and Baladjay (2025) found that Agricultural Extension Workers in Davao Oriental face significant barriers to effective communication. Limited resources, inadequate training, and logistical constraints reduce their ability to deliver timely and relevant information to farmers. Face-to-face interactions, technology demonstrations, and Farmers Field Schools are the main strategies used, while digital tools remain underutilized due to low literacy and access. Mobility challenges were reported by 58% of AEWs, funding gaps by 44%, and farmer resistance to innovation by 28%, reflecting similar global trends. These findings highlight the need for improved logistical and financial support, enhanced training, and stronger coordination between local government units and extension agencies to strengthen extension communication.

A study of farmers in Cambodia, the Philippines, and Vietnam highlighted that farmers' attitudes and actions significantly influence their adoption of digital extension services. The researchers found that subjective norms, perceived behavioral control, and farmers perceived usefulness positively affected uptake of digital tools, while perceived risks and household wealth also played a role. The study further noted that barriers and enablers vary across countries due to differences in culture, customs, norms, and socioeconomic conditions, pointing to the need for context specific approaches to agricultural extension communication (Hoa Sen, 2024).

(Ojo et al., 2024) in their study found that extension agents faced significant challenges in disseminating climate-smart agricultural practices to rice farmers. Most agents were middle-aged, male, married, and well-educated. They primarily used farm and home visits, result demonstrations, and methods demonstrations as dissemination pathways. The main constraints included an insufficient number of extension workers, lack of staff incentives, and inadequate transportation. Training was found to reduce both personal and institutional constraints, showing a significant negative correlation with these barriers. The study recommended periodic training and motivational incentives, such as awards, promotions, and recognition, to enhance extension agents' effectiveness in promoting climate-smart agricultural practices.

A study by Jimenez et al. (2025) identified key barriers to agricultural extension communication among rice farmers in Region II, Philippines. The research, involving 846 farmer-respondents across 60 municipalities, found that digital platforms, broadcast, and mobile-based strategies had limited reach and low adoption. Barriers included poor digital literacy, inadequate infrastructure, and unclear content. These constraints hindered the effectiveness of extension communication and limited the impact of newer technology-based strategies on farmer engagement and adoption.

Furthermore, Khwidzhilli, Ijatuyi, and Diko (2025) identified barriers to effective agricultural extension communication among smallholder farmers in the Ingquza Hill Local Municipality, Eastern Cape Province, South Africa. Despite widespread use of ICTs, farmers faced persistent constraints, including poor internet connectivity (39.4%), high data costs (38.5%), and limited digital literacy (18.3%), which limited the effective use of mobile phones and social media platforms for accessing extension information.

Impact of Communication Barriers on Farmer Participation

Sen et al. (2025) systematically reviewed interactive digital extension services globally. They found that lack of two-way interaction between farmers and service providers, absence of centralized information networks, poor internet connectivity, and low technical know-how hinder farmers' communication and engagement with extension platforms. These barriers reduce farmers' opportunities to participate meaningfully in extension communication and innovation exchange.

Moyo and Salawu (2018) found that discrepancies between the qualifications and experience of extension personnel reduced the quality of information delivered to resettled farmers, which weakened farmers' trust and willingness to participate. The study also reported that limited stakeholder analysis and the lack of a multimedia communication approach hindered farmers' access to relevant information and constrained their ability to adopt new agricultural innovations. These barriers contributed to reduced farmer participation in extension activities and lower agricultural productivity outcomes.

Systematic evidence shows that digital extension services encounter pervasive barriers that reduce farmers' capacity to engage with extension communication. Sen et al. (2025) identified institutional barriers such as a lack of two-way interaction and centralized information networks, which prevented farmers from providing feedback or influencing the content of extension messages. Resource shortages, including limited funding, inadequate infrastructure, and insufficient technical skills among both extension workers and farmers, reduced the effectiveness of communication and discouraged consistent farmer participation in DES programs. These structural constraints diminished farmers' confidence in digital platforms and limited their involvement in extension driven agricultural innovation.

In South Africa, Khwidzhilli, Ijatuyi, and Diko (2025) documented digital communication barriers that affected farmers' engagement in extension services. Despite high mobile phone use, poor internet connectivity, high data costs, and limited digital literacy constrained farmers' ability to access and act on extension information through mobile and social media platforms. These barriers reduced farmers' opportunities to participate in extension communication activities delivered through digital tools, lowering the overall reach and impact of extension services on rural farmers.

Communication Content and Relevance Issues Affecting Farmer Participation

Communication content and relevance significantly influence farmer participation in extension programs. Studies show that when extension messages do not match farmers' needs, farmers are less likely to engage with extension services. In a study of smallholders in the Philippines, lack of tailored information reduced farmer interest and participation in training and advisory programs (Hoa Sen et al., 2024). Similarly, research in Southeast Asian farming communities found that generalized extension messages that fail to address local conditions lowered adoption rates of recommended practices (Dujali et al., 2025).

Khwidzhilli, Ijatuyi, and Diko (2025) stated that content that is overly technical without localization also limits comprehension, especially among farmers with low literacy or limited experience with formal extension systems. These communication content issues weaken the relevance of extension advisory

services for farmers, reducing their motivation to participate in extension events or implementing recommended technologies.

Solutions-Digital and ICT Based Communication Approaches

Barakabitze, Fue and Sanga's study highlight the need for participatory approaches in ICT development to improve adoption among rural farmers. The study found that ICT tools developed without farmer involvement are less adopted. Participatory approaches such as Participatory Communication, Participatory Video, Participatory Learning and Action Research, Farmer Participatory Research and Informal Mobile Learning Research helped bridge communication gaps. Among these, mobile and interactive learning approaches were more effective in increasing interest, participation and adoption of ICT-based solutions (Barakabitze, Fue & Sanga, 2017).

Reyes, Bautista, Villanueva, and Aquino (2024) compared digital extension channel preferences among young and older farmers in the Philippines. The study found that social media and video tutorials were the most preferred digital channels for agricultural extension, especially the younger farmers. Higher digital literacy correlated with greater adoption of ICT extension tools, suggesting that improving digital skills reduces barriers to information access.

ICT-based agricultural extension reduces communication barriers by providing farmers with real-time access to advisories, market information, and training programs. Digital tools, including mobile applications, SMS advisories, AI-powered crop monitoring, and online training, allow farmers in remote areas to receive timely information and guidance, improving engagement and participation in extension programs. In Davao Oriental, ICT integration enhanced yields, resource management, and farmer decision-making by enabling data-driven practices. These tools increase adoption of innovations by overcoming limitations of traditional farm visits and community training. Providing digital literacy support, reliable connectivity, and inclusive access ensures that ICT-based extension services can effectively reach farmers and increase participation in agricultural programs (Dujali et al., 2025).

Capacity Building and Training of Extension Workers

Training agricultural extension workers (AEWs) is critical for effective communication and promoting adoption of climate-smart agricultural practices (CSAPs). Ojo et al. (2025) found that over half of extension agents in North Central Nigeria had unfavorable attitudes toward CSAPs, while participation in their dissemination was moderate. Participation was particularly low for practices such as index-based weather insurance, water harvesting, drip irrigation, and integrated pest management. The study showed that training significantly influenced extension agents' attitudes and participation, while factors such as age, experience, and number of trainings also affected engagement levels. These findings indicate that targeted training and capacity-building initiatives are essential to strengthen AEWs' communication skills, improve farmer engagement, and increase the uptake of extension services.

Studies likewise showed that modernizing extension and advisory services should be taken to upgrade the competencies of extension personnel and their clients. These AEWs likewise need to be regularly updated to adapt to the ever-changing environmental conditions. As agricultural extension manpower serves as the most vital asset in extension services, strengthening their capacities, as to make them better leaders, entrepreneurs, and decision-makers, and helping them organize themselves into effective associations, institutions, and constituents is crucial and necessary. Thus, enough well-trained personnel are key to a successful extension system (Kante et al., 2016).

Research on extension communication skills highlighted the importance of interpersonal and non-verbal abilities in improving the delivery of agricultural information to farmers. The study reported that communication elements such as body language, tone of voice, and gestures improved farmers' understanding of extension messages and strengthened interaction between extension workers and farming communities. However, the findings indicated that limited training in these communication skills reduced the effectiveness of knowledge transfer between extension personnel and farmers, which negatively affected agricultural productivity and program outcomes. The authors emphasized that capacity building and skills development for extension personnel were necessary to strengthen communication with farmers and to improve the adoption of agricultural innovations and extension services (Abdel & Abdullah, 2025).

Use of Appropriate and Participatory Communication Channels

Research showed that integrating traditional extension approaches with digital communication tools improved the effectiveness of agricultural advisory services. Traditional methods such as farm visits, field demonstrations, and farmer training remained important for direct interaction and trust building between extension workers and farmers. However, the integration of ICT tools such as mobile applications, SMS advisories, and online platforms expanded the reach of extension services and enabled the delivery of timely agricultural information. The study reported that combining these approaches improved farmers' access to agricultural knowledge, strengthened communication between extension workers and farmers, and enhanced the adoption of improved farming practices. These findings indicate that a hybrid extension approach that integrates traditional extension activities with digital technologies improves knowledge dissemination and increases farmer participation in extension programs (Dujali et al., 2025; Dzanku & Osei, 2022).

Tegene et al., (2023) studied participatory extension and communication processes. Their findings show that when farmers are involved in designing extension activities and discussing problems with extension workers, communication becomes more effective and adoption of innovations increases. The study explains that traditional top-down communication often leads to resistance because farmers feel excluded from decision making. Participatory communication allows farmers to discuss their needs, co-develop solutions, and improve trust between farmers and extension workers. This approach leads to stronger farmer engagement and higher adoption of agricultural technologies.

Community participatory approaches have been shown to significantly improve farmer learning, confidence, and the application of agricultural technologies. Duna et al. (2018) demonstrated that using a Community Participatory Action Research (CPAR) approach in Libona, Bukidnon enabled farmers to adopt

Corn-Based Farming System (CBFS) technologies effectively. Through participatory consultation, planning, and problem-solving, farmers shifted from monocropping to diversified practices including crop relay, crop rotation, livestock integration, Integrated Nutrient Management, and Integrated Pest Management. This approach resulted in a 40% increase in yield, 111% increase in income, and high return on investment for crop relay and rotation systems. Importantly, 100% of farmer members and 85% of non-members adopted the technologies, indicating that participatory strategies enhance communication, understanding, and practical adoption of innovations in Philippine agricultural contexts. These results highlight the value of participatory methods in bridge the gap between extension services and farmer practices.

Institutional Support and Organizational Improvements

Effective coordination between agricultural extension workers (AEWs), local governments, and research institutions enhances extension communication and farmer adoption of services. Elago Carusos, Galero, and Sardido (2017) demonstrated that strategic partnerships in Bohol, Philippines, through the ACIAR Integrated Crop Management Project, facilitated the transfer of research-based knowledge to small rural farmers. Involving local governments allowed extension services to be tailored to community needs, improving access to non-formal education and practical information. The collaboration also strengthened AEWs' capacity to communicate innovations, integrate scientific recommendations with local practices, and support farmers in adopting improved agricultural methods. These experiences indicate that multi-stakeholder coordination is critical in bridging research and field practices, ultimately increasing productivity, income, and food security among rural communities.

Strengthening coordination between agricultural extension workers (AEWs), local governments, and research institutions is crucial for improving extension communication and increasing farmer adoption of services. Juan, Pascual, and Cumbe (2025) found that in Nueva Ecija, Philippines, farmers showed high acceptance of agricultural technologies when institutional roles were clearly defined and collaborative, with universities and government agencies leading knowledge dissemination, cooperatives facilitating community-level adoption, and private enterprises supporting commercialization. The study highlights that a Multi-Stakeholder Collaborative Framework, integrating the strengths of AEWs, local governments, research institutions, and cooperatives, enhances affordability, accessibility, and adoption of innovations, demonstrating that partnerships with multiple stakeholders improve communication channels and enable farmers to adopt recommended practices more efficiently.

An Evaluation of the Perceived Needs and Investment for the Implementation of the Philippine Agricultural and Fisheries Extension System (PAFES) in LGU-Guimaras reported that farmers and extension stakeholders identified the need for increased funding, additional agricultural technical personnel, and operational resources as critical for improving extension delivery and service outreach. The study found that investments in service vehicles, recruitment, training of agricultural personnel, and infrastructure were essential to support effective extension communication and enhance program implementation in rural communities. Because these investments address communication reach and operational barriers, they are directly linked to improving farmer participation and access to extension services (Vergara et al., 2025).

Investment from local government units has shown a direct correlation with productivity in these sectors. For instance, fiscal policies that allocate sufficient funding to agriculture can result in increased gross regional domestic product (GRDP) from agricultural activities, positively impacting local economies (Salqaura et al., 2019). LGUs have a critical role in ensuring that financial resources are directed toward improving infrastructure, research, and development initiatives that can foster agricultural productivity and sustainability (Burlakoti & Nettle, 2024). Moreover, the establishment of web-based information systems aimed at facilitating coordinated governance in coastal and agricultural zones indicates LGUs' commitment to improving management capabilities through technology, resulting in better service delivery and stakeholder engagement (Balilo et al., 2020).

METHODS

Research Design

The study employs a systematic review approach to analyze existing literature on the barriers in agricultural extension communication and their influence on farmers' adoption of extension services. The systematic review method was chosen due to its ability to provide a structured and unbiased synthesis of studies across different contexts. The findings were synthesized to identify common barriers such as digital literacy, infrastructure, and extension worker training and to assess how digital and ICT-based tools help address these challenges. Overall, the study aimed to provide insights for improving communication strategies to increase farmer participation and technology adoption in extension programs.

Search Strategy

The search strategy for this systematic review focused on identifying relevant studies that examined the barriers in agricultural extension communication and their influence on farmers' adoption of extension services. The review included peer-reviewed journal articles, books, and grey literature. To retrieve studies, the following electronic databases were used: Google Scholar, Scopus, Web of Science, AGRIS (FAO), JSTOR, SpringerLink, Wiley, and PubMed. A combination of relevant keywords was searched using Boolean operators (AND, OR), such as "Barriers in Agricultural Extension Communication," "Farmer adoption of extension services," "Agricultural extension communication," "ICT in agricultural extension," "Barriers to ICT adoption in agriculture," "Extension service effectiveness," and "Farmers' adoption of technology." Only studies published in English between 2010 to 2025 were included to ensure the relevance and timeliness of the data.

Inclusion and Exclusion Criteria

The inclusion criteria for this review were:

1. Studies on barriers in agricultural extension communication and their influence on farmer participation and adoption of extension services or technologies.

2. Peer-reviewed journal articles, reports, books, and conference proceedings discussing communication strategies in agricultural extension.
3. Studies from developing countries or regions with smallholder farmers or those applicable globally or to similar context.
4. Both qualitative and quantitative studies. Qualitative studies should provide insights into farmer and extension worker experiences while quantitative studies should include data on adoption rates, participation, and communication strategy effectiveness.
5. Studies were published between 2010 and 2025.

The exclusion criteria for this review were:

1. Studies not addressing barriers in agricultural extension communication or farmer adoption of extension services.
2. Studies do not specifically address communication strategies or barriers in agricultural extension services.
3. Theoretical or opinion-based articles without empirical data or practical implications.
4. Studies from non-relevant regions or without insights for smallholder farming contexts.
5. Studies were published before 2010.

Data Analysis

The data gathered from the selected studies were analyzed using thematic content analysis. After the screening and selection process, the included literature was carefully reviewed and coded based on the objectives of the study: barriers in agricultural extension communication, effects on farmer participation, influence on farmers adoption of extension services and technologies, effectiveness of digital and ICT-based communication approaches, and the role of institutional support and capacity building. Similar findings were grouped into recurring themes such as limiting funding and staffing, weak infrastructure, low digital literacy, poor farmer-extension interaction, unclear or non-localized messages, training needs of extension workers, participatory communication approaches, and institutional coordination.

The findings of both qualitative and quantitative studies were then compared and synthesized narratively to identify common patterns, differences, and relationships across the reviewed literature. This process allowed the study to determine how communication barriers affected farmers' participation and adoption and to identify strategies that improved extension communication and service delivery.

RESULTS AND DISCUSSION

The review identified several barriers to agricultural extension communication. Limited access to communication technologies and low digital literacy were key constraints as reported in studies from the Philippines and South Africa where poor internet connectivity and high data costs hindered the use of digital tools (Khwidzhilli, Ijatuyi, & Diko, 2025). In Davao Oriental, insufficient resources and inadequate training were also significant barriers to effective communication (Gumban & Baladjay, 2025).

Communication barriers negatively impacted farmer participation in extension services. A lack of two-way interaction and centralized information networks limited farmers' engagement with extension activities (Sen et al., 2025). Poor communication content, often too technical or generalized further reduced participation and adoption (Khwidzhilli, Ijatuyi, & Diko, 2025).

To address these issues, digital tools like SMS advisories and mobile applications combined with traditional methods such as farm visits were found to improve communication and farmer participation (Dujali et al., 2025). Participatory approaches in ICT development involving farmers in the process also enhanced adoption of these tools (Barakabitze, Fue & Sanga, 2017). Training for Agricultural Extension Workers (AEWs) was crucial for improving communication. Studies showed that targeted training in interpersonal communication enhanced farmer trust and engagement (Abdel & Abdullah, 2025). Additionally, institutional support and multi-stakeholder coordination improved the reach and effectiveness of extension services increasing farmer adoption of technologies (Elago-Carusos et al., 2025).

CONCLUSION

This review synthesized existing literature on barriers in agricultural extension communication and their influence on farmers' participation and adoption of extension services. The evidence shows that communication barriers remain a major constraint across different contexts. Common barriers include limited funding, inadequate staffing, weak infrastructure, low digital literacy, and insufficient training of extension workers. These factors reduce the effectiveness of information delivery and limit farmers' access to extension services. Studies consistently show that communication barriers negatively affect farmer participation. Limited interaction, weak feedback systems, and lack of trust between farmers and extension workers reduce engagement in extension activities. As participation declines, farmers have fewer opportunities to access knowledge, share experiences, and engage in innovation processes. The literature also confirms that communication challenges influence farmers' adoption of agricultural technologies. Extension messages that are unclear, too technical, or not adapted to local conditions result in low adoption rates. Farmers are more likely to adopt technologies when information is relevant, practical, and responsive to their needs.

Digital and ICT-based communication approaches offer opportunities to improve delivery extension. Studies show that these tools expand access to information and support real-time communication. However, their impact remains constrained by poor connectivity, high data costs, and low digital skills among farmers. Without addressing these issues, the potential of ICT in extension systems remains limited. The review further highlights the importance of institutional support and capacity building. Strengthening the skills of extension workers, improving coordination among stakeholders, and increasing investments in extension systems enhance communication effectiveness. These factors contribute to improved farmer participation and higher adoption of extension services.

Overall, the literature indicates that addressing communication barriers requires a combination of technical, institutional, and participatory approaches to improve extension outcomes.

RECOMMENDATIONS

Based on the findings of the review, the following recommendations are proposed to address barriers in agricultural extension communication and improve farmers' participation and adoption of extension services:

1. Increase funding, staffing, and logistical support for extension services to address key communication barriers and ensure regular farm visits across all target areas.
2. Strengthen two-way communication by conducting regular farmer meetings, farm visits, and establishing clear feedback systems to improve farmer participation in extension activities.
3. Localize and simplify extension messages using practical demonstrations, farmer field schools, and crop-specific materials to improve understanding and increase adoption of technologies.
4. Expand the use of ICT tools such as SMS advisories, social media, and video tutorials, supported by digital literacy training and improved internet access in rural communities.
5. Enhance capacity building and institutional coordination by providing continuous training for extension workers and strengthening collaboration among local government units, research institutions, and farmer organizations.

REFERENCES

- Abdel, A. M., & Abdullah, A. S. (2025). Non-verbal communication skills of employees at the guidance center, Salah al-Din Agriculture Directorates in Iraq. *International Journal of Agriculture Extension and Social Development*, 8(3), 56–64. <https://doi.org/10.33545/26180723.2025.v8.i3a.1680>
- Abraham, O. A., Merianchris, E. E., Oludare, O. O., Olayemi, S. S., & Mongalaku, B. T. (2022). Effect of social media in enhancing agricultural extension services among farmers in Gwagwalada Area Council, Abuja, Nigeria. *Journal of Research in Science and Technology*, 3(4), 24–32.
- Balilo, B. B., Vibar, J. C. N., Balmadrid, D., Dioneda, R. R., Maraña, H. L., & Sy, D. J. (2020). Implementation of fishcoral-PRSA web-based information system for the Asid Gulf project. *Bicol University Research and Development Journal*. <https://doi.org/10.47789/burdj.mbtcbbgs.20182103.1>
- Barakabitze, A. A., Fue, K. G., & Sanga, C. A. (2017). The use of participatory approaches in developing ICT-based systems for disseminating agricultural knowledge and information for farmers in developing countries: The case of Tanzania. *The Electronic Journal of Information Systems in Developing Countries*, 78(1), 1–23. <https://doi.org/10.1002/j.1681-4835.2017.tb00576.x>
- Burlakoti, M., & Nettle, R. (2024). *International Journal of Agricultural Extension and Rural Development Studies*, 11(1). <https://doi.org/10.37745/ijaerds.15/vol11n4>
- Christoplos, I. (2010). Mobilizing the potential of rural and agricultural extension. Food and Agriculture Organization. <https://www.fao.org/docrep/012/i1444e/i1444e.pdf>
- Davis, K., Babu, S. C., & Blom, S. (2014). The role of extension and advisory services in building resilience of smallholder farmers. International Food Policy Research Institute.
- Dujali, I. L., Inutan, S. M. B., Bacus, M. S., Quijano Pagutayao, A. S., & Sarita, V. B. (2025). Transforming agricultural extension in the digital age: A review of ICT based approaches and innovations. *International Journal of Research and Scientific Innovation*, 12(3), 840–851. <https://doi.org/10.51244/IJRSI.2025.12030064>
- Duna, L. V., Salvani, J. B., Paday, M. L., Daproza, J. O., & Pitchay, C. (2018). Community participatory action research approach as an effective tool towards adoption of corn-based farming system technologies by Libona, Bukidnon farmers. *Philippine Journal of Crop Science*, 43(1), 1–12.
- Ekenta, C., Ayanlere, A., Afolabi, K., Adebayo, C., & Owolagba, E. (2013). Effective extension information dissemination methods used in disseminating organic agricultural practices as a mitigating strategy for climate change in Kogi State, Nigeria. *Journal of Biology, Agriculture and Healthcare*, 4(20), 189–195.
- Elago Carusos, E., Galero, W., & Sardido, E. (2017). Engaging the local government in research & extension: The ACIAR-ICM-Landcare experience. *Annals of Tropical Research*, 39(Supplement B), 208–220. <https://doi.org/10.32945/atr39sb17.2017>
- Food and Agriculture Organization. (2017). *World agriculture: Towards 2015/2030: An FAO perspective*. Routledge. <https://doi.org/10.4324/9781315083858>
-

- Gumban, L. M., & Baladjay, A. A. (2025). Extension delivery strategies, challenges, and best practices of agricultural extension workers (AEWs) in Davao Oriental, Philippines. *Davao Research Journal*, 16(4), 47–53. <https://doi.org/10.59120/drj.v16i4.474>
- Hoa Sen, L., Chou, P., Dacuyan, F. B., Nyberg, Y., & Wetterlind, J. (2024). Barriers and enablers of digital extension services' adoption among smallholder farmers: the case of Cambodia, the Philippines and Vietnam. *International Journal of Agricultural Sustainability*, 22(1). <https://doi.org/10.1080/14735903.2024.2368351>
- Jimenez, C., Tabbun, H., Bayucan, R., Gaspar, L., Edillo, N., Olivas, K., & Aquino, R. M. (2025). Quad Media Integration in Agricultural Extension Services: Its Impact on Rice Production Outcomes in Region 02, Philippines. *Linker (The Journal of Emerging Research in Agriculture, Fisheries and Forestry)*, 5(1), 79–92. <https://doi.org/10.65141/jeraff.v5i1.n5>
- Juan, J. G., Pascual, R., & Cumbe, M. M. (2025). Institutional roles and farmer acceptance in agricultural technology transfer: A multi-stakeholder framework in Nueva Ecija, Philippines. *International Journal of Innovative Science and Research Technology*, 10(7), 2895–2901. <https://doi.org/10.38124/ijisrt/25jul1798>
- Kante, A., Moore, A., Akeredolu, M., Edwards, M., Annor-Frempong, F., & Moriba, S. (2016). Human resource development for extension and advisory services: Training, adult learning, and field methods. MEAS Discussion Paper. <https://meas.illinois.edu/wp-content/uploads/2017/02/Kante-et-al-2016-HRD-AES-Training-Adult-Learning-and-Field-Methods-MEAS-Discussion-Paper.pdf>
- Khwidzhilli, R. H., Ijatuyi, E. J., & Diko, P. (2025). The role of information and communication technologies in enhancing farmers' access to extension services: Evidence from Ingquza Hill Local Municipality. *Frontiers in Sustainable Food Systems*, 9, 1704550. <https://doi.org/10.3389/fsufs.2025.1704550>
- Leeuwis, C. (2013). *Communication for rural innovation: Rethinking agricultural extension* (3rd ed.). John Wiley & Sons.
- Moyo, R., & Salawu, A. (2018). A survey of communication effectiveness by agricultural extension in the Gweru district of Zimbabwe. *Journal of Rural Studies*, 60, 32–42. <https://doi.org/10.1016/j.jrurstud.2018.03.002>
- Ojo, I. E., Akangbe, J. A., Kolawole, E. A., Owolabi, A. O., Obaniyi, K. S., Ayeni, M. D., Adeniyi, V. A., & Awe, T. E. (2024). Constraints limiting the effectiveness of extension agents in disseminating climate-smart agricultural practices among rice farmers in north-Central Nigeria. *Frontiers in Climate*, 6, 1297225. <https://doi.org/10.3389/fclim.2024.1297225>
- Reyes, M. C. S., Bautista, J. A. C., Villanueva, A. L. M., & Aquino, R. I. T. (2024). Young farmer innovation adoption and digital extension channel preferences: A pilot assessment in the Philippines. *International Journal of Agricultural Extension and Social Development*, 7(6), 239–242. <https://doi.org/10.33545/26180723.2024.v7.i6c.3185>
- Salqaura, S. S., Mulyo, J. H., & Darwanto, D. H. (2019). The influence of fiscal policy on the agriculture sector in Java Island. *Agro Ekonomi*, 29(2), 173. <https://doi.org/10.22146/ae.35044>

- Sen, L. T. H., Phuong, L. T. H., Chou, P., Dacuyan, F. B., Nyberg, Y., & Wetterlind, J. (2025). The opportunities and barriers in developing interactive digital extension services for smallholder farmers as a pathway to sustainable agriculture: A systematic review. *Sustainability*, 17(7), 3007. <https://doi.org/10.3390/su17073007>
- Sena, L. T. H., Choub, P., Dacuyanc, F. B., Nyberg, Y., & Wetterlind, J. (2024). Barriers and enablers of digital extension services adoption among smallholder farmers: The case of Cambodia, the Philippines and Vietnam. *Journal of Agricultural Education and Extension*. <https://doi.org/10.1080/14735903.2024.2368351>
- Tambo, J. A., Mugambi, I., Onyango, D. O., Uzayisenga, B., & Romney, D. (2023). Using mass media campaigns to change pesticide use behaviour among smallholder farmers in East Africa. *Journal of Rural Studies*, 99, 79–91. <https://doi.org/10.1016/j.jrurstud.2023.03.001>
- Tegene, T., Wims, P., Gebeyehu, D., & Abdo, T. (2023). Analysis of communication approaches used in agricultural extension: Case of Wolaita Zonw, Southern Ethiopia. *Local Development & Society*, 4(2), 348-369. <https://doi.org/10.1080/26883957.2023.2173635>
- Uddin, E., Gao, Q., & Mamun-Ur-Rashid, M. (2016). Crop farmers' willingness to pay for agricultural extension services in Bangladesh: Cases of selected villages in two important agro-ecological zones. *Journal of Agricultural Education and Extension*, 22(1), 43–60. <https://doi.org/10.1080/1389224X.2014.971826>
- United Nations, Department of Economic and Social Affairs, Population Division. (2022). *World population prospects 2022: Summary of results*.
- Vergara, J. T., Junco, E. P., Ibieza, D. B., & Morada, N. G. (2025). An evaluation of the perceived needs and investment for the implementation of the Philippine Agricultural and Fisheries Extension System (PAFES) in LGU-Guimaras. *International Journal of Research in Innovative Science and Social Technology*, 10(7), 714–719. <https://dx.doi.org/10.47772/IJRISS.2025.90700058>
- World Bank. (2016). *World development report 2016: Digital dividends*. World Bank Publications.