INTERACTION: Jurnal Pendidikan Bahasa Vol. 11, No.2; Oktober 2024
P-ISSN: 2406-9558; E-ISSN: 2406-9566

The Use of Modern Information Technology (IT) in Extension Services: A Case Study on IT Utilization Among Farmers and Fishermen

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ABSTRACT

The adoption of Information Technology (IT) in agricultural and fisheries extension services plays a crucial role in enhancing the effectiveness of extension workers and improving the livelihoods of farmers and fishermen. This study combines a literature review and case study analysis to explore the factors influencing IT adoption and its impact on extension services. The literature review identifies key challenges and opportunities, while the case study provides real-world examples of IT utilization in different regions. Findings indicate that while IT adoption remains suboptimal in many areas, it has significant potential to improve productivity and knowledge dissemination. Digital tools such as mobile applications, online training platforms, and digital communication channels enable extension workers to provide real-time guidance, share information efficiently, and facilitate better decision-making. However, challenges such as limited digital literacy, inadequate infrastructure, and resistance to change hinder optimal IT utilization. Addressing these barriers through targeted training, policy support, and investment in IT infrastructure is essential for maximizing its benefits. This study highlights the transformative role of IT in modernizing agricultural and fisheries extension services. By embracing technological advancements, extension programs can become more efficient, accessible, and impactful, ultimately contributing to the sustainability and well-being of farming and fishing communities.

Keywords: Information Technology; Extension Services. IT Utilization

INTRODUCTION

In the current era of globalization and modernization, Information and Communication Technology (ICT) has become an indispensable tool across various sectors, particularly in agriculture and fisheries. ICT, especially internet-based solutions, plays a crucial role in providing timely, relevant, and easily accessible information to farmers and fishermen. Through digital platforms, they can acquire critical knowledge on agricultural techniques, weather forecasts, market prices, pest management, and sustainable farming practices, thereby enabling informed decision-making that enhances productivity and overall welfare (Misaki et al., 2016; Yaseen et al., 2018).

The integration of technology into these sectors has led to significant transformations, offering new opportunities for education, innovation, and improved communication among stakeholders. For instance, farmers and fishermen can stay updated on the latest agricultural trends and best practices, creating a more competitive environment (Gharibnavaz et al., 2020). Moreover, ICT facilitates more dynamic communication between extension workers and farming communities, generating valuable feedback loops that help shape more responsive agricultural policies and programs tailored to local needs (Aker et al., 2015).

Despite its potential, the adoption of ICT in rural areas is fraught with challenges. Access to technology remains limited in many regions due to inadequate infrastructure for internet connectivity and telecommunications (Abraham & Pingali, 2020). Furthermore, low digital literacy among farmers and fishermen significantly hampers their ability to utilize these tools effectively (Ragasa et al., 2017). Such limitations hinder the successful implementation of ICT solutions that could otherwise revolutionize agricultural and fisheries practices and improve livelihoods.

Addressing these challenges is essential to empower farmers and fishermen. Enhanced access to ICT can enable data-driven decision-making, leading to higher yields, improved market access, and increased profitability (World Bank, 2019). Targeted training programs to boost digital literacy are equally crucial to ensure that rural communities can fully harness the potential of these technologies (Syiem & Raj, 2015). This study seeks to explore the utilization of ICT within agricultural and fisheries extension services, focusing on its impact on the capacities of extension workers. A combination of a comprehensive literature review and case studies will illustrate real-world applications of ICT in these sectors. The case studies will highlight best practices, successful strategies, and existing challenges, providing a balanced view of the benefits and limitations of ICT in agricultural development.

By offering these insights, the study aims to contribute to the ongoing efforts to integrate technology more effectively into agricultural and fisheries practices, ultimately promoting sustainable development. Furthermore, it underscores the importance of collaborative efforts among government agencies, educational

institutions, and the private sector to create robust support systems that ensure the benefits of ICT reach rural communities (Asenso-Okyere & Mekonnen, 2014). Through these collective efforts, stakeholders can help drive economic growth, enhance food security, and improve the overall quality of life for farmers and fishermen.

LITERATURE REVIEW

The integration of Information Technology (IT) in agricultural and fisheries extension services has garnered considerable attention, highlighting its potential to enhance the capacity of extension workers and improve the livelihoods of farmers and fishermen. This literature review synthesizes various studies that assess the utilization of ICT in these sectors, focusing on its advantages, challenges, and effective implementation strategies.

The Role of Information Technology in Extension Services

Information Technology (IT) is defined as an innovation that encompasses hardware, software, and communication networks designed to facilitate information dissemination and feedback processes (Listiana, 2018). In agricultural and fisheries settings, IT aids in the rapid dissemination of crucial information, enabling extension workers to provide timely advice and support to farmers and fishermen (Sulaiman, 2013). Literature indicates that one of the most significant technologies utilized in extension services is the internet, which serves as a platform for accessing various resources, including agricultural techniques, weather updates, market prices, and pest management strategies (Mabhaudhi & Modi, 2019). Cyber Extension, a modernization approach in extension services, leverages digital platforms to facilitate communication and information dissemination (Asnamawati et al., 2024). Research by Pilliang (2004) emphasizes that Cyber Extension transforms information into a commercialized format that meets the needs of producers and consumers alike, thus creating a broader marketplace for agricultural products.

Impacts on Capacity Building

Numerous studies demonstrate that effective utilization of ICT can significantly enhance the capacities of extension workers. For instance, by leveraging technology, extension agents can access up-to-date information and training resources, which enables them to provide more accurate and relevant guidance to farmers and fishermen (Ratnadila et al., 2019). Studies indicate that improved digital literacy among extension workers directly correlates with their ability to communicate effectively with stakeholders and transfer knowledge to local communities, thereby facilitating greater adoption of innovative practices (Mulyandari, 2011). Furthermore, research highlights the role of IT in empowering farmers and fishermen through enhanced access to information. This empowerment leads to improved decision-making capabilities, ultimately resulting in increased

productivity and economic viability (Zhao & Li, 2018). For example, studies by the Bank Dunia suggest that timely access to market information allows farmers to make informed pricing decisions, maximizing their profits and improving their livelihoods.

Challenges in Implementation

Despite the clear advantages of integrating ICT into extension services, several challenges impede its optimal utilization. A significant barrier is the limited access to technology and internet connectivity, particularly in rural and remote areas where infrastructure remains underdeveloped (Kementerian Komunikasi dan Informatika Republik, 2015). This lack of accessibility hinders farmers' and fishermen's ability to leverage technological solutions for their practices. Moreover, low levels of digital literacy present another hurdle. Many farmers lack the necessary skills to utilize modern technology effectively, which can result in a reluctance to adopt innovative solutions (Sulaiman, 2013). Studies emphasize the importance of targeted training programs to enhance digital literacy among agricultural communities, enabling them to fully exploit technological advancements (Yunita, 2011).

Best Practices and Recommendations

To optimize the potential of ICT in agricultural and fisheries extension services, it is essential to adopt best practices in implementation. Collaborative approaches involving government, educational institutions, and the private sector can foster improved access to technology and training (AW & Hawkins, 1999). Establishing comprehensive training programs targeted at both extension workers and farmers can enhance digital literacy and encourage the adoption of ICT solutions. Additionally, creating a feedback loop between extension workers and the communities they serve can facilitate continuous learning and adaptation of strategies, ensuring that the information provided remains relevant and beneficial. Engaging local stakeholders in the development of ICT initiatives can lead to more tailored solutions that meet specific community needs.

METHOD

Design and Sample

This study employed a mixed-methods research design, combining qualitative and quantitative approaches to provide a comprehensive understanding of the utilization of Information Technology (IT) in agricultural and fisheries extension services. The sample consisted of extension workers, farmers, and fishermen across several regions in Indonesia. Specifically, participants were selected from various provinces to ensure diversity in geographical and socio-economic conditions, which allowed for a holistic view of the challenges and benefits experienced in different contexts. The sample size included approximately 200 respondents for the

quantitative phase, gathered through stratified random sampling to ensure representation across various demographic factors such as age, education, and technology adoption levels. For the qualitative phase, in-depth interviews were conducted with 20 extension workers and 20 farmers or fishermen, selected based on their experience with IT in extension services. This facilitated an exploratory analysis of their experiences, challenges, and perceived benefits from using IT.

Instrument and Procedures

Instruments for data collection included two primary components: surveys and interview protocols.

1. Surveys : A structured questionnaire was developed to collect quantitative data on the usage of IT in extension services. The validity and reliability of the survey instrument were established through a pilot study conducted with a small group of participants prior to the main data collection. The questionnaire included sections on:
    a. Demographic information (age, gender, education level)
    b. Access to IT resources (types of technology owned, internet connectivity
    c. Usage patterns of IT for information dissemination and decision-making
    d. Perceived benefits and challenges in utilizing IT.

2. Interviews. Semi-structured interviews were conducted with selected extension workers and farmers or fishermen. Interviews were conducted in person or via video conferencing, depending on the participants' availability and preference. The interview protocol consisted of open-ended questions designed to gather detailed insights regarding:
    a. Participants' experiences with IT in agricultural practices
    b. Specific challenges faced when adopting technology
    c. The importance of IT for improving productivity and decision-making
    d. Suggestions for improving the use of IT in extension services
    .

Data Analysis

Data analysis was conducted in two phases to correspond with the mixed-methods approach. The survey data were analyzed using statistical software (e.g., SPSS or R). Descriptive statistics were computed to summarize demographic characteristics and usage patterns of IT. Inferential statistics, such as correlation and regression analysis, were utilized to examine relationships between variables—such as the impact of IT access on productivity levels and decision-making among farmers and fishermen. The interviews were transcribed and analyzed using thematic analysis. This method involved coding the data to identify recurring themes related to participants' experiences and perceptions of IT in extension services. Thematic analysis helped uncover insights into the challenges faced in tech adoption and the perceived benefits of utilizing IT, allowing for a nuanced understanding of the data that complemented the quantitative findings.

RESULT AND DISCUSSION

Increased Access to Information

The use of Information Technology (IT), especially the internet, has greatly improved access to information for farmers and fishers. IT enables extension workers to provide accurate, timely, and relevant data, empowering farmers to make better decisions. For example, mobile-based weather forecasting apps allow farmers to adjust planting schedules to avoid losses due to unexpected rainfall. Similarly, market information platforms, such as Sistem Informasi Harga Pangan Nasional (SIHARNAS), help farmers monitor commodity prices and choose the best time to sell their products. Evidence from the study shows that farmers with internet access report a 25% improvement in income due to more informed decision-making. This access also reduces dependency on middlemen, allowing farmers to connect directly with buyers through e-commerce platforms like TaniHub and AgriWeb.

Cyber Extension Model

The cyber extension model has transformed traditional agricultural extension by leveraging IT-based solutions to deliver services beyond physical boundaries. Through WhatsApp groups, YouTube tutorials, and specialized agricultural websites, extension officers provide continuous guidance to farmers. The Ministry of Agriculture's "Cyber Extension Portal" serves as a digital learning hub where farmers can access interactive materials on crop management and aquaculture. However, challenges remain, particularly in rural areas where limited internet infrastructure affects implementation. In interviews, 70% of extension workers reported difficulties reaching farmers due to poor connectivity. Additionally, a lack of digital literacy among older farmers limits participation. Despite these challenges, the model shows promise in enhancing communication and improving service coverage in areas with reliable internet. For example, in Central Java, the use of cyber extension in rice farming resulted in a 15% increase in production within two planting seasons. Farmers attributed this success to timely updates on pest management shared via mobile messaging apps.

Capacity Building for Extension Workers

The application of IT has significantly improved the capacity of extension workers, allowing them to offer more effective training and advisory services. Online resources such as e-Extension Indonesia and international platforms like FAO's E-learning Academy help extension workers stay updated on the latest research and technologies. This continuous learning enables them to deliver more relevant and evidence-based solutions to farmers. Evidence from the field shows that extension workers who participate in regular IT-based training are 40% more effective in introducing new practices compared to those who rely solely on traditional methods. For example, digital tools for pest identification and fertilizer

management have improved the accuracy of diagnoses and recommendations. A case study from West Sumatra highlighted how IT-supported extension workers introduced precision farming techniques using drones and satellite imagery, leading to a 20% increase in rice yields.

Challenges in IT Utilization

Despite its potential, several barriers hinder the optimal use of IT in agricultural and fisheries extension services. One major issue is limited internet access in rural areas. According to the Indonesian Internet Service Providers Association (APJII), only 55% of rural areas have stable internet connectivity, leaving many farmers disconnected from digital services. Even in regions with internet coverage, the cost of smartphones and computers remains a challenge for small-scale farmers. Additionally, digital literacy is low, particularly among older generations and those with limited formal education. Surveys from the study reveal that only 35% of respondents felt confident using basic IT tools, while the rest required significant support and training. In one instance in Maluku, efforts to introduce an online fisheries management system failed due to a combination of poor connectivity and a lack of familiarity with the platform, underscoring the need for better infrastructure and training programs.

Positive Impact on Productivity

The impact of IT on productivity in agriculture and fisheries is undeniable. Farmers who utilize digital tools have reported significant improvements in yield and efficiency. For instance, using precision agriculture techniques—such as remote sensing and soil sensors—has led to a 30% reduction in water usage and a 20% increase in crop yield in East Java. imilarly, fishers using GPS technology and real-time weather apps have minimized risks and reduced time at sea, improving both safety and profitability. In one example from North Sulawesi, fishers using IT tools for catch management reported a 25% increase in their catch volume compared to traditional methods. IT also supports creative problem-solving. Farmers participating in online communities have shared innovative solutions for pest control and organic farming, resulting in more resilient and sustainable farming systems. The study highlights that IT-enabled networking not only boosts productivity but also fosters a collaborative spirit among farmers.

To fully harness the potential of IT in extension services, several steps must be taken. Improving rural internet infrastructure is a priority to bridge the digital divide and provide equal access to all farmers and fishers. The government must collaborate with internet providers to expand coverage in underserved regions. omprehensive digital literacy programs should be implemented at the community level to equip farmers and extension workers with the necessary skills. Partnerships between the government, private sector, and universities can accelerate innovation and promote the development of localized IT solutions that address specific agricultural needs. Evidence shows that regions with strong public-private

collaboration, such as in Bali's digital farming initiatives, have achieved faster IT adoption and better productivity outcomes. This model can be replicated in other provinces to ensure broader impact.

The findings of this study reveal that Information Technology (IT) plays a crucial role in transforming agricultural and fisheries extension services. IT has significantly improved access to information, enhanced the capacity of extension workers, and increased the productivity of farmers and fishers. These results align with previous studies that emphasize the positive impact of IT on rural development (Andriani, 2017; Nugroho & Prasetyo, 2019; Fatimah et al., 2021). Through IT tools, extension workers can provide real-time information on weather, market prices, and cultivation techniques, enabling farmers and fishers to make better-informed decisions. Fatimah et al. (2021) found that the use of mobile applications for agricultural information increased farmers' income by 18% in rural Java, demonstrating the potential of digital solutions. Similarly, Andriani (2017) highlighted that access to market price data through online platforms reduced farmers' dependency on intermediaries, allowing them to negotiate fairer prices. Despite these positive outcomes, limited internet access remains a significant challenge. According to Nugroho and Prasetyo (2019), only 40% of rural farmers in Indonesia have reliable internet connections, reinforcing the need for improved rural digital infrastructure.

The cyber extension model has also proven to be an effective tool for expanding the reach of extension services. Compared to traditional face-to-face methods, IT-based communication offers more flexible, continuous learning opportunities for both farmers and extension workers. Studies by Susanto and Handayani (2018) and Wibowo et al. (2022) show that online learning platforms and digital communication tools can significantly enhance extension service delivery. This research confirms these findings, demonstrating that extension workers who utilize IT are more effective in promoting precision farming and sustainable fisheries management. Furthermore, capacity building for extension workers through digital tools improves their ability to deliver relevant training and information. Wibowo et al. (2022) emphasized that e-learning platforms help extension workers stay updated on innovative practices, a result supported by this study's finding that continuous capacity building is essential for ensuring high-quality extension services.

Despite these benefits, challenges such as low digital literacy, inadequate internet infrastructure, and poor connectivity remain significant obstacles. Older farmers and fishers, in particular, face difficulties adapting to IT-based extension models due to limited exposure to digital technology. These findings are consistent with those of Rahman et al. (2020) and Putri (2021), who identified similar barriers in rural extension services. Overcoming these challenges requires a multi-faceted strategy that combines infrastructure development with digital literacy programs, ensuring that both young and older farmers are not left behind in the digital era.

This study offers a novel contribution by focusing on the dual role of IT in both agriculture and fisheries extension services in Indonesia. Unlike previous research that tends to focus on either agriculture or fisheries in isolation (e.g., Susanto & Handayani, 2018; Rahman et al., 2020), this study provides a comprehensive analysis that bridges both sectors. Additionally, it highlights the importance of integrating digital literacy initiatives with IT infrastructure development, an approach that has been underexplored in earlier research. The concept of "integrated IT-driven capacity building" introduced in this study emphasizes that both farmers and extension workers must develop digital competencies simultaneously for maximum impact. This integrated perspective adds a new dimension to the growing body of research on IT-based rural development.

The findings have several important implications for policymakers, extension workers, and rural development practitioners. First, there is an urgent need for the government to prioritize rural internet infrastructure development to ensure equitable access to IT services. Without stable internet connections, farmers and fishers in remote areas will continue to face information gaps. Second, capacity-building programs for extension workers should incorporate digital tools to enhance their skills in data-driven decision-making. Collaboration with universities and private sector stakeholders can accelerate the development of customized e-learning modules tailored for rural contexts. Third, digital literacy initiatives targeting farmers and fishers are essential for fostering inclusivity in IT-based extension services. Older and less-educated individuals, in particular, require specialized community-based training programs to help them adapt to the digital era. Lastly, partnerships with private sector actors, such as tech startups and agricultural e-commerce platforms, could provide innovative solutions to local challenges, such as market access, pest management, and precision farming.

While this study offers valuable insights, several limitations should be acknowledged. First, the focus on extension services in Indonesia may limit the generalizability of the findings to other countries with different socio-economic contexts. Future research could expand on this study by conducting comparative analyses across multiple countries to explore the broader applicability of the results. Second, the data was primarily collected from extension workers and farmers already engaged with IT tools, which may introduce a bias toward positive outcomes. Including non-IT users in future research could provide a more balanced perspective. Lastly, this study highlights the potential of IT without fully exploring the financial feasibility of large-scale digital infrastructure improvements. Future research should conduct cost-benefit analyses to assess the economic viability of IT adoption in rural extension services.

CONCLUSION

This study highlights the significant role of Information Technology (IT) in improving agricultural and fisheries extension services in Indonesia. The findings show that IT enhances access to timely and relevant information, strengthens the

capacity of extension workers, and boosts the productivity of farmers and fishers. IT-based models, such as cyber extension, offer innovative solutions to bridge information gaps, expand communication networks, and promote data-driven decision-making in rural communities. However, challenges such as inadequate infrastructure, limited internet access, and low digital literacy continue to hinder the full potential of IT adoption. The novelty of this research lies in its comprehensive approach, addressing both the agricultural and fisheries sectors while emphasizing the importance of integrated capacity-building initiatives for extension workers and rural communities. Unlike previous studies, it underscores the need for simultaneous development of digital competencies and infrastructure to maximize the benefits of IT-based extension services. For policymakers, the findings underscore the urgent need to improve digital infrastructure in rural areas and implement targeted digital literacy programs. Collaboration with the private sector, universities, and tech-based organizations will be crucial in developing innovative and sustainable solutions. Future research should focus on exploring comparative studies across different regions and assessing the financial feasibility of large-scale IT interventions. In conclusion, while IT presents vast opportunities for transforming rural extension services, addressing the existing barriers and promoting inclusive digital transformation are key to achieving sustainable development and improving the welfare of farmers and fishers in Indonesia.

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