DIGITAL TRANSFORMATION IN AGRICULTURAL EXTENSION: A PHENOMENOLOGICAL STUDY OF CYBER EXTENSION ADOPTION

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ABSTRACT

This study aims to explore the understanding, acceptance, benefits, and challenges faced by agricultural extension officers in Pangkajene and Kepulauan Regency in utilizing Cyber Extension. The research method used was interviews with 12 extension officers representing the mainland, mountainous, and island regions. The findings indicate that although the acceptance of Cyber Extension is relatively positive, significant challenges remain, particularly concerning technological infrastructure, digital skills, and resistance to shifting from conventional methods. Extension officers acknowledge the benefits of Cyber Extension in enhancing access to information, improving extension efficiency, and facilitating communication and coordination with farmers. However, challenges persist, including poor internet network quality, limited access to adequate devices, and a lack of digital skills among senior extension officers. Additionally, resistance to changing long-established traditional methods remains a barrier. Other factors affecting the successful implementation of Cyber Extension include limited policy support, budget constraints, and a lack of coordination among institutions. Overall, while Cyber Extension holds great potential for improving the effectiveness of agricultural extension services, enhancements in infrastructure, continuous training, and more supportive policies are needed to overcome these obstacles and maximize its benefits across all regions.

Keywords: Cyber Extension; agricultural extension officers; digital skills; technology adoption.

INTRODUCTION

The rapid advancement of Information and Communication Technology (ICT) has transformed various sectors, including agricultural extension services. Digital transformation in this field has become crucial in addressing future agricultural challenges, with cyber extension emerging as a modern solution to enhance farmers' capacity and performance through digital technology and online networks. This process utilizes computer communication and interactive multimedia to modernize extension methods and improve knowledge transfer effectiveness to farmers (Guntoro et al., 2022; Ledo et al., 2023; Mooventhan et al., 2017; Suswadi, 2023).

In the digital era, many countries have adopted applications and platforms such as WhatsApp, Zoom, websites, and YouTube as agricultural extension media. This adoption intensified during the pandemic, forcing many countries to switch to cyber extension to maintain services to farmers. Countries like India and several regions in Africa have enhanced their extension facilities by providing easily accessible Q&A platforms, enabling farmers to inquire directly and obtain relevant information (Prabasini et al., 2021). This digital transformation has become increasingly important in facing global agricultural challenges, such as climate change and food security. Mobile phones and internet access have significantly impacted the agricultural

sector, improving economic inclusion, efficiency, and market access for smallholder farmers in developing countries (Deichmann et al., 2016; Guntoro et al., 2022; Subejo et al., 2019).

The evolution of digital technologies, including Internet of Things (IoT), robotics, and smart farming, continues to influence agricultural efficiency and sustainability. The GRIN concept (Genomics, Robotics, Informatics, Nanotechnology) is driving digitalization in agricultural systems (Ahmad et al., 2024; Dayıoğlu & Türker, 2021; Guntoro et al., 2022; Madaswamy, 2020; Saiz-Rubio & Rovira-Más, 2020). Furthermore, changes in ICT have transformed agricultural extension models from one-way communication to et al., collaborative learning among farmers, enabling more dynamic and interactive exchanges (Khan et al., 2024a; Olayemi, 2019; Sirajuddin & Liskawati Kamba, 2021)

However, despite its significant potential, cyber extension implementation in developing countries faces various obstacles. These include inadequate infrastructure, digital divide, insufficient funding, lack of training, and limited incentives for extension workers, leading to poor technology adoption among farmers. Additionally, insufficient attention to equity and food sovereignty issues in digital agricultural training can hinder ethical and sustainable innovation (Abbasi et al., 2022; Dhaka & Chayal, 2010; Kabir et al., 2022; Khan et al., 2024a; Masere T.P., 2021; Visser et al., 2021)

In Indonesia, particularly in the Pangkajene and Kepulauan Regency of South Sulawesi, several major challenges persist, including technological access disparities, limited internet infrastructure, low digital literacy, and limited technological devices, especially in remote rural areas. These factors hamper the widespread adoption of cyber extension among farmers (Sabir et al., 2018; Subejo et al., 2019). Studies by (Kabir et al., 2022) supported by findings from (Adriyani, 2019) and (Syatir, 2017) indicate that ICT investments often fail to achieve desired impacts due to insufficient organizational support, such as inadequate internet funding and extension officer training.

The social and cultural implications of digital transformation in agricultural extension are equally significant. (Prayoga, 2018) identified both positive and negative impacts of cyber extension implementation on farmers' and extension workers' social capital. This transformation creates new "habitus" in society, altering how farmers interact and learn, resulting in social practices that differ from traditional face-to-face extension methods (Apriliani & Mada, 2024; Purwiyati et al., 2020)

This study aims to comprehensively understand the digital transformation process in agricultural extension, specifically focusing on cyber extension adoption in Pangkajene and Kepulauan Regency. Using a phenomenological approach, this research explores extension workers' subjective experiences in adopting and implementing cyber extension. This approach enables researchers to delve deeper into how extension workers consider and respond to existing challenges, such as the digital divide, infrastructure limitations, and resistance to change, while developing adaptation strategies in implementing cyber extension in the field.

CYBER EXTENSION

Conceptual Framework of Cyber Extension

The integration of Information and Communication Technology (ICT) in agricultural extension has given rise to cyber extension, a digital transformation aimed at facilitating knowledge transfer and agricultural innovation. This evolution has shifted the extension paradigm from a unidirectional communication model to an interactive learning system that enables two-

way knowledge exchange between farmers and extension workers (Subejo et al., 2019). Cyber extension has demonstrated significant potential in transforming conventional farming practices towards agripreneurship (Mooventhan et al., 2017), with electronic media, particularly television and mobile phones, becoming primary information sources for farmers accessing agricultural knowledge, market information, and weather forecasts (Ahmad et al., 2024).

Key Factors Influencing Cyber Extension Adoption

Recent research has identified several critical factors affecting successful cyber extension adoption. (Suswadi, 2023) highlight four primary components: individual motivation (IM), social capital (SC), cyber extension adoption (CEA), and knowledge sharing (KS). Additionally, (Khan et al., 2024b) found that smartphone ownership and membership in farming organizations significantly increase the likelihood of using mobile services for agricultural extension, emphasizing the importance of infrastructure and institutional support in digital technology adoption.

Implementation Challenges and Barriers

The implementation of cyber extension faces various complex challenges spanning technical, social, and structural aspects. (Kabir et al., 2022) identified several key barriers, including: limitations in existing extension approaches, internet infrastructure constraints, digital skills and knowledge gaps, supervisor resistance to change. Furthermore, (Nikander et al., 2020) highlighted critical digital security concerns often overlooked in implementation, particularly regarding network topology, malware protection, and data backup systems.

Social and Ethical Dimensions

(Soma & Nuckchady, 2021) emphasize the importance of social dimensions in digital agriculture development, advocating for critical social scientist engagement, responsible and ethical innovation, support for equitable and sustainable food systems, and integration of critical data studies in agricultural education

Climate Change Adaptation and Response

Cyber extension has played a crucial role in supporting farmers' climate change adaptation. (Khan et al., 2024a) documented various adaptation strategies facilitated through digital extension, including strategic tree planting, climate-smart seed adoption, planting schedule modifications, and crop diversification. This digital transformation has enabled farmers to access real-time climate information and adapt their agricultural practices accordingly.

Participatory Extension Model

(Madonna et al., 2022) developed a participatory extension concept integrating cyber extension as a solution to human resource limitations. This model emphasizes: multi-stakeholder collaboration, farmer empowerment as innovation co-creators, development of relevant local content and Integration of traditional knowledge with modern technology

Research Gaps and Future Directions

While existing literature has explored various aspects of cyber extension, several research gaps remain:
1. Understanding the interaction between technological, social, and cultural factors in local contexts
2. Developing effective strategies to bridge the digital divide in remote areas

3. Creating mechanisms to integrate traditional knowledge with digital innovations
4. Establishing comprehensive impact evaluation models for cyber extension programs

Further research is needed to develop a more holistic framework for cyber extension implementation, particularly in specific contexts like the Pangkajene and Kepulauan Regency, South Sulawesi. A deeper understanding of local dynamics and contextual factors will aid in designing more effective and sustainable implementation strategies

METHODS

This study employed a qualitative phenomenological approach to explore the lived experiences of agricultural extension workers in adopting and implementing cyber extension in Pangkajene and Kepulauan Regency, South Sulawesi, Indonesia. The phenomenological design was chosen as it enables an in-depth understanding of participants' subjective experiences and perspectives regarding digital transformation in agricultural extension services (W.Creswell, 2022). The study was conducted from September to Desember 2024, focusing on the diverse agricultural landscape of Pangkajene and Kepulauan Regency and its ongoing digital transformation initiatives in agricultural extension services.

Participant selection utilized purposive sampling to identify agricultural extension workers who met specific criteria: a minimum of three years of active service experience, direct involvement in cyber extension implementation, current service in Pangkajene and Kepulauan Regency, and willingness to participate in the study. Following phenomenological research principles, twelve agricultural extension workers were selected as participants to ensure data saturation (Guest et al., 2006). This sample size allowed for comprehensive exploration of the phenomenon while maintaining the depth of analysis characteristic of phenomenological research.

Data collection incorporated multiple methods to ensure a comprehensive understanding of the phenomenon. Primary data was gathered through in-depth, semi-structured interviews lasting 60-90 minutes, focusing on personal experiences, challenges, and adaptations in implementing cyber extension. These interviews were audio-recorded with participant consent and later transcribed for analysis. Participant observation was conducted during cyber extension activities, documenting interaction patterns and technological usage through detailed field notes. Additionally, document analysis included reviewing extension program reports, digital communication materials, and training documents to provide contextual understanding and triangulation of data.

The data analysis followed (Moustakas, 1994) phenomenological approach, beginning with epoché, where researchers documented and set aside personal biases and preconceptions about cyber extension adoption. Phenomenological reduction involved transcribing interviews, identifying significant statements, developing meaning units, and organizing themes. Through imaginative variation, researchers explored possible meanings and developed structural descriptions, leading to the integration of individual experiences into universal descriptions. The final synthesis integrated textural and structural descriptions to develop a composite description of the phenomenon.

To ensure research trustworthiness, several validation strategies were employed. Triangulation was achieved through multiple data sources, researcher perspectives, and theoretical frameworks. Member checking involved participants reviewing their interview transcripts and providing feedback on themes and interpretations. Regular peer debriefing sessions with the research team and external reviewers helped maintain analytical rigor and documentation of decisions.

The study adhered to ethical research principles through written informed consent, protecting participant confidentiality through pseudonyms and secure data storage, and maintaining reciprocity by sharing research findings with participants. This approach not only protected participant interests but also contributed to the development of extension services in the region. The research was conducted in three phases: preparation (September 2024), including literature review refinement and participant recruitment; field research (Oktober-November 2024), encompassing data collection and preliminary analysis; and analysis and writing (Desember 2024), focusing on in-depth analysis and report writing.

This methodological approach allowed for a systematic exploration of the digital transformation experience in agricultural extension while maintaining scientific rigor and ethical standards. The combination of multiple data collection methods, rigorous analysis procedures, and validation strategies ensured the credibility and transferability of the research findings, contributing to the understanding of cyber extension adoption in the context of rural agricultural development

RESULT AND DISCUSSION

This study explores how agricultural extension officers in Pangkajene and Kepulauan Regency interpret the use of Cyber Extension in supporting their extension activities. The research reveals their experiences in adapting to digital technology and the various factors contributing to the acceptance and effectiveness of Cyber Extension in their extension practices. The use of this digital platform not only enhances communication effectiveness between extension officers and farmers but also plays a crucial role in strengthening the learning process and adoption of agricultural technology, thereby supporting the development of a more modern and responsive extension system tailored to farmers' needs.

This study also highlights the various challenges faced by extension officers in adopting this technology and the strategies they use to overcome these obstacles. Three main themes emerged from the interviews, revealing the experiences of extension officers in using Cyber Extension: (1) Extension Officers' Understanding and Acceptance of Cyber Extension, (2) Benefits and Impacts of Using Cyber Extension in Agricultural Extension, and (3) Barriers and Challenges in Using Cyber Extension.

The third theme, concerning the barriers to using Cyber Extension, is closely related to the first theme on the acceptance of extension officers. However, these barriers are discussed separately as they encompass more complex challenges, both technical and non-technical. These barriers are further explained in four sub-themes: (a) Technological infrastructure limitations, (b) Lack of digital skills among extension officers, (c) Resistance to technological change, and (d) Government support and policies.

Extension Workers' Understanding and Acceptance of Cyber Extension
a. Understanding Cyber Extension in Extension
The results of interviews with extension workers in Pangkajene and Kepulauan Regency showed that their understanding of Cyber Extension was greatly influenced by personal experience and the training they received. Extension workers understood Cyber Extension as a technological tool that facilitates the delivery of agricultural information. E1 (52, extension worker for 25 years) from the mainland said:

> Cyber Extension helps me access the latest agricultural information such as agricultural innovations, weather, and market prices. In the past, we had to travel far to deliver the material, now farmers can directly access the guides we share.

In the mountainous and island regions, E2 (55, extension worker for 28 years) and E3 (40, extension worker for 17 years) also saw the great potential of Cyber Extension in improving communication with farmers in remote areas. E3 added:

> With Cyber Extension, communication becomes easier. We can provide information on the latest agricultural practices in real-time without having to go directly to the location. This is very helpful, especially when there are urgent obstacles in the field that require a quick response from us.

These findings underscore the importance of technology access in bridging the information gap between extension workers and farmers across locations (Abbasi et al., 2022; Davis & Addom, 2010; Ratnadila et al., 2019; Singh et al., 2023).

b. Sources of Extension Workers' Information on Cyber Extension

Most extension workers learned about Cyber Extension through official training and interactions with colleagues. E4 (42, extension worker for 17 years) stated:

> I first learned about Cyber Extension through training organized by the agricultural office. After the training, I started to actively use it and share this information with the farmers I mentor. We often exchange experiences in utilizing Cyber Extension, so that we can be more effective in assisting farmers.

Meanwhile, E5 (45, extension worker for 18 years) from the mountainous region obtained additional information from technical guidance and discussions with fellow extension workers who had already used the platform. E2 added that discussion groups on social media and WhatsApp forums also helped accelerate understanding, especially in island regions where routine training sessions were rare.

Previous studies have shown that structured training and outreach efforts play a significant role in accelerating the adoption of new technology by extension workers (Fadillah et al., 2024; Ferroni & Zhou, 2012; Marg et al., 2018; Sidharta et al., 2021). Furthermore, extension workers' efforts to deepen their knowledge through informal discussions, digital media, and self-learning indicate that technology adaptation is not solely dependent on formal training but also on individual initiatives and the availability of supporting resources.

c. Understanding the Features and Main Functions of Cyber Extension

Based on interviews, extension workers' understanding of the features and main functions of Cyber Extension varied. An extension worker from the mainland, E6 (38, extension worker for 15 years), recognized various features such as material search, discussion forums, and access to commodity price information. He stated:

> Cyber Extension is very helpful in enriching extension materials. The search feature allows me to access the latest information relevant to farmers' needs in the field. Sometimes, I have to wait until I get a stable signal before I can download materials or respond to farmers' questions.

However, extension workers from mountainous areas, such as E3, admitted that they had not fully utilized interactive features due to internet access limitations. Similarly, E2 from the island region often faced signal issues. These findings align with previous studies (Holzinger et al., 2011;

Olayemi, 2019; Pratiwi & Suzuki, 2017; Sewell et al., 2017; Yu et al., 2017), which indicate that understanding new technological features is influenced by accessibility and training.

Benefits and Impacts of Cyber Extension Use in Agricultural Extension
a. Enhancing Access to Information and References in Providing Agricultural Extension
Cyber Extension has had a positive impact on improving extension workers' access to agricultural information. E7 (55, extension worker for 26 years) stated:

> One of the greatest benefits of Cyber Extension is the ease of accessing the latest information on agriculture and government policies. In the past, we relied heavily on printed materials or direct meetings, which took time. Now, we can quickly retrieve and share crucial updates.

Meanwhile, E8 (48, extension worker for 23 years) from the mountainous region added that the platform makes it easier for them to obtain references that were previously difficult to access due to physical and distance limitations. He said that if farmers have specific questions, we can quickly consult with specialists through the platform and relay the information back to them. These findings align with previous studies (Deichmann et al., 2016; Li et al., 2022; Tzounis et al., 2017), which indicate that digital platforms enable extension workers to access fast and relevant information, ultimately improving the quality of agricultural extension services.

b. Facilitating Communication and Coordination with Farmers and Fellow Extension Workers
Effective communication and coordination between extension workers and farmers, as well as among extension workers themselves, are crucial in agricultural extension processes. Interview results revealed that Cyber Extension significantly facilitates this process. E1 stated:

> I can communicate directly with farmers through instant messaging features or discussion forums, making communication faster and unrestricted by time or distance. "If a farmer encounters an issue, they can send a message or post in the forum, and I can respond immediately without having to visit the field.

E1 further added that communication among extension workers has also become smoother, allowing them to share experiences and information more easily, especially in addressing farmers' challenges. E2, from the island region, noted that using Cyber Extension enables them to stay connected with other extension workers despite being in different locations. These findings align with studies by (Antwi-Agyei & Stringer, 2021; Ayisi Nyarko & Kozári, 2021; Singh et al., 2023), which indicate that improved communication between extension workers and farmers, as well as among extension workers, enhances the effectiveness of agricultural extension.

c. Efficiency in Delivering Extension Materials Through Digital Media
Cyber Extension also offers significant efficiency in delivering extension materials. Extension workers can distribute materials in various digital formats, such as videos, infographics, or presentations, making it easier for farmers to understand. E4 stated:

> By using tutorial videos and infographics, the materials become more engaging and easier for farmers to understand, especially in areas with lower literacy levels. Instead of just reading text, they can watch step-by-step demonstrations, which makes learning more practical.

E8 added that extension workers in mountainous regions often face limitations in conducting face-to-face extension activities. However, with Cyber Extension, extension materials can be

disseminated more effectively despite geographical barriers. E9 (50, extension worker for 25 years) from the island region shared a similar view:

> Although internet access is often limited, using digital media is still more efficient than conventional methods that require long-distance travel. This way, they can still benefit from digital resources without being completely dependent on real-time internet access.

These findings align with previous studies oleh (Fu & Akter, 2016; Sousa et al., 2016; Suswadi, 2023; Wang et al., 2020), which indicate that using digital media in extension services improves time and cost efficiency.

Enhancing Extension Workers' Professionalism in Performing Their Duties

The use of Cyber Extension has also positively impacted the professionalism of extension workers. They now have broader access to various training programs and information that support their competency development. E5 stated:

> This platform has helped me improve my technical skills and knowledge of the latest agricultural technologies. With online training and webinars, I can enhance my skills without having to travel for workshops. We can easily exchange insights with experts and colleagues from different regions, which helps us refine our approaches in assisting farmers.

E10 (50, extension worker for 22 years) also expressed increased confidence in providing extension services, as Cyber Extension allows them to access a wider and more up-to-date range of references. E2 added that despite infrastructure challenges in the island region, Cyber Extension helps them continue learning and growing professionally.

These findings align with research by (Rogers et al., 2014), which states that adopting technology in the agricultural sector improves the quality and effectiveness of extension workers. This is also supported by (Cole & Fernando, 2020), who highlight that modern technology helps extension workers disseminate agricultural information more efficiently.

Barriers and Challenges in the Use of Cyber Extension

a. Technological Infrastructure Limitations

　1. *Unequal Internet Network Availability in Extension Workers' Service Areas*

One of the main barriers to using Cyber Extension is the limitation of technological infrastructure, particularly internet access. E11 (32, extension worker for 7 years) from the lowland region stated:

> Although my area has relatively good internet access, some remote locations still struggle to obtain a stable internet connection. Sometimes, I prepare printed copies of important guidelines for farmers who have difficulty accessing digital content.

E12 (45, extension worker for 15 years) from the mountainous region added that in highland areas, internet coverage is very limited, making it difficult for extension workers to access or transmit digital information. Similarly, E9 from the island region expressed:

> Unstable internet connectivity across many islands is the main challenge in effectively implementing Cyber Extension. Although it's not as fast as online sharing, it allows us to ensure farmers still have access to necessary information.

This finding supports previous research, which indicates that infrastructure gaps, particularly in internet access, are a limiting factor in utilizing digital technology in remote areas. Improving

internet networks in hard-to-reach regions is crucial for maximizing Cyber Extension's benefits (Naika et al., 2021; Wang et al., 2020).

2. Limited Access to Adequate Technological Devices

Besides internet access issues, limited access to technological devices is also a challenge. Extension workers in remote areas often struggle to obtain the necessary devices to use Cyber Extension. P4 stated:

> Although my device is quite sufficient, some colleagues in other regions lack adequate devices to attend training or access digital information. In some cases, colleagues have to rely on shared devices, which limits their ability to fully engage with the platform. Without the right equipment, even the best digital resources become less effective.

E10 and E2 also noted that in mountainous and island regions, the devices available to extension workers do not always support the Cyber Extension application. This highlights that a lack of access to technology can further exacerbate disparities in technology adoption across different areas (Bhat et al., 2024; Deichmann et al., 2016; Singh et al., 2023). A potential solution is to enhance access to more affordable and suitable devices for extension workers' needs.

Lack of Digital Skills Among Extension Workers
1. The Need for Continuous Technology Training

Apart from infrastructure constraints, the digital skills of extension workers also pose a significant challenge in using Cyber Extension. E1 revealed:

> Although I am quite familiar with technology, many of my senior colleagues struggle to use digital platforms to access information or communicate with farmers. Some are hesitant to use the platform because they're not comfortable with digital tools. For some of us, there's a steep learning curve, but with proper training and patience, it becomes easier over time," he explained.

E12 also highlighted the lack of adequate technology training as a major obstacle. E2 added that very limited training is a significant challenge in improving the digital skills of extension workers in island regions. These findings align with studies (Arowosegbe et al., 2024; Naika et al., 2021; Salsabella et al., 2024; Singh et al., 2023), which emphasize that continuous training is essential to enhance extension workers' digital skills and ensure optimal use of Cyber Extension.

2. Differences in Technology Proficiency Between Young and Senior Extension Workers

Interviews revealed differences in technology proficiency between younger and senior extension workers. E7 noted:

> Younger extension workers adapt more quickly to Cyber Extension features, while senior workers often struggle to operate the devices. Younger workers often take the lead in showing their senior colleagues how to use the platform, but it takes time for everyone to become equally proficient. It's just a matter of getting comfortable with the technology, and once they understand its benefits, they're more inclined to use it.

E8 also observed that younger extension workers in mountainous areas adapt to technology more easily, whereas older ones require more time. E9 added:

> Young extension workers in the island region are more proactive in using Cyber Extension for extension activities. They don't hesitate to experiment with the platform, and their enthusiasm often motivates the older colleagues to catch up.

These findings align with studies by (Rogers et al., 2014) dan (Fonna, 2019), which indicate that younger generations adopt technology more quickly, whereas older individuals often face barriers due to skill gaps or reluctance. Thus, training programs tailored to age and experience levels are essential to maximize Cyber Extension's benefits for all extension workers.

Resistance to Technological Change
1. Skepticism About the Effectiveness of Cyber Extension Compared to Conventional Methods
One of the challenges in implementing Cyber Extension is resistance to change, particularly skepticism among some extension workers. E4 stated:

> Although I recognize Cyber Extension's potential, some colleagues prefer conventional methods because they feel more familiar and believe face-to-face interaction is more effective. They are more comfortable with what they know and may doubt the reliability of digital platforms.

E10 from the mountainous region added that extension workers in his area doubt whether digital information can be well received by farmers who are more accustomed to direct extension services. E2 from the island region also mentioned that direct interaction is perceived as more effective in providing immediate solutions to farmers. These findings are consistent with studies (Fadeyi et al., 2022; Kalle Hirvonen, Elia Machado, 2024), which indicate that adopting new technology is often hindered by perceptions that traditional methods are superior. To overcome this skepticism, it is essential to provide evidence of Cyber Extension's success in improving agricultural outcomes and access to information.

2. Difficulty in Changing Long-Standing Extension Practices
Long-standing extension practices, especially face-to-face interactions, pose a barrier to adopting Cyber Extension. E6 explained:

> Many extension workers feel more comfortable with traditional methods of providing agricultural extension services. There's a strong bond that develops through these in-person meetings, and some believe that digital methods can't replicate that connection.

E12 added that these habits are difficult to change, especially among experienced extension workers who have relied on conventional methods for a long time. E2 also noted that extension workers in island regions struggle to shift away from traditional approaches that have been considered effective. These findings align with (Rogers et al., 2014) diffusion of innovation theory, which states that adopting new technology is often hindered by long-established habits. Therefore, it is crucial to provide practical evidence of Cyber Extension's benefits in enhancing extension effectiveness.

4. Government Support and Policy
1. Availability of Budget and Policies Supporting Cyber Extension Implementation
Government support, both in terms of budget and policy, is crucial for the successful implementation of Cyber Extension. E1 mentioned:

> Budget constraints often hinder the procurement of necessary devices and training programs. Even if the technology is available, the lack of budget for training and maintenance means some workers are left behind

E3 added that although there is encouragement to use technology, budget limitations remain a challenge. E9 also noted that in island regions, limited funding hampers the optimal use of Cyber

Extension. These findings align with studies (Sabir et al., 2019; Singh et al., 2023), which emphasize the importance of adequate budget allocations and policies to support the implementation of digital technology in agriculture. Policies ensuring sufficient funding for Cyber Extension development are necessary.

2. Coordination with Relevant Institutions for More Effective Implementation
Coordination between agricultural agencies and relevant institutions is vital for the effective implementation of Cyber Extension. Extension workers like E1 emphasized:

> Collaboration between the agricultural department and educational or technology institutions is necessary for the proper implementation of Cyber Extension. By working with educational and technology institutions, we can ensure that the platform is continuously improved and tailored to the needs of farmers.

Extension workers also highlighted the importance of synergy to provide adequate training and access to technology. Without proper coordination, extension workers struggle to maximize Cyber Extension's benefits. These findings align with research by (Rogers et al., 2014), which underscores the importance of inter-institutional coordination for successful technology adoption.

CONCLUSION

This study examines the understanding, acceptance, benefits, and challenges of using Cyber Extension among agricultural extension workers in Pangkajene and Kepulauan Regency. Based on interviews with 12 extension workers, the findings indicate that although Cyber Extension is generally well accepted, the main challenges lie in infrastructure, digital skills, and attitudes toward technological change. Extension workers recognize its benefits, such as improved access to information and increased efficiency in extension activities, but some remain skeptical about its effectiveness compared to traditional methods.

Key obstacles include limited technological infrastructure, inadequate access to suitable devices, digital skill gaps among senior extension workers, and resistance to change. Additionally, budget constraints and a lack of coordination among institutions further hinder implementation. To maximize the utilization of Cyber Extension, improvements in infrastructure, continuous training, and stronger policy support from the government and related institutions are essential. Overall, Cyber Extension holds significant potential to enhance the effectiveness of agricultural extension services in Pangkep Regency. However, these challenges must be addressed through collaborative efforts from various stakeholders.

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