Phenomenological Barriers to Cyber Extension Adoption among Agricultural Extension Workers

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ABSTRACT

This study explored the phenomenological barriers experienced by agricultural extension workers in adopting the Cyber Extension platform in Pangkajene and Islands Regency, Indonesia. A phenomenological approach was employed, with data collected through in-depth interviews, participatory observation, and document analysis. The data were analyzed using thematic analysis. Four major themes emerged. First, infrastructure limitations, particularly unstable and uneven internet access in mountainous and island areas, constrained the delivery of digital extension services. Second, limited digital literacy, especially among senior extension workers, was compounded by the lack of regular and comprehensive technology training. Third, resistance to technological change was reflected in a preference for conventional face-to-face extension methods, which were perceived as more effective for engaging farmers. Fourth, weak policy support and inadequate inter-agency coordination resulted in insufficient funding, limited facilities, and fragmented training programs, forcing extension workers to rely on personal resources to sustain implementation. These findings suggest that successful digital transformation in agricultural extension requires reliable infrastructure, continuous capacity building, cultural readiness, and strong institutional support. A holistic and context-sensitive strategy is therefore essential to enhance Cyber Extension adoption, particularly in geographically disadvantaged regions.

Keywords: *Adoption Barriers, Agricultural Extension, Cyber Extension, Digital Agriculture, Phenomenology*

INTRODUCTION

In the past decade, agricultural digitalization emerged as a key strategy to improve efficiency, productivity, and global food security. Information and communication technology (ICT) has been widely applied in various aspects of agriculture, ranging from early warning systems and land management to digital-based extension services (Sirajuddin & Liskawati Kamba, 2021). Countries such as India, Sri Lanka, South Africa, Kenya, Tanzania, and Uganda utilized digital platforms to accelerate the dissemination of innovations to smallholder farmers in remote areas (Delima, R., Santoso, H. B. & Purwadi, 2016; Singh et al., 2023; Tata & McNamara, 2016; Venkattakumar et al., 2024; Wijekoon et al., 2009). However, the success of agricultural digitalization greatly depended on infrastructure readiness, human resource capacity, and the

socio-cultural dynamics of farming communities as well as extension actors (Rachmawati, 2020; Triman Tapi et al., 2024).

In Indonesia, agricultural extension workers have long been regarded as the frontline agents in the dissemination of agricultural information and technology to farmers. Their role is strategic in bridging research-based innovations with on-farm practices. Alongside the rapid development of technology, the responsibilities of extension workers were no longer limited to face-to-face communication but also required competence in accessing, interpreting, and sharing information through digital media (Adriyani, 2019; Cahyono et al., 2020; Guntoro et al., 2022). Consequently, strengthening the digital capacity of extension workers became a prerequisite for transforming the agricultural extension system into a more modern and adaptive framework in the era of Agriculture 4.0.

Nevertheless, the adoption of digital technology in extension services was not without challenges. Previous studies indicated that common obstacles in digital media adoption by extension workers included limited internet access, low information technology competence, resistance to change, as well as insufficient training and institutional support (Hwang et al., 2024; Tham-Agyekum et al., 2024). Furthermore, geographical disparities and infrastructural inequalities often created uneven distribution of the benefits of digital technology, leaving rural or remote areas at a disadvantage.

Amid these challenges, the Indonesian government developed the Cyber Extension platform as a digital solution to support the work of agricultural extension workers. This platform provided access to agricultural technologies, extension materials, discussion forums, and agricultural databases for both extension workers and farmers (Wijaya et al., 2019). The Cyber Extension was expected to enhance the effectiveness of extension services, expand their outreach, and accelerate the flow of information to the grassroots level. However, the effectiveness of this platform in practice largely depended on the extent to which extension workers were able to adopt and integrate it into their daily professional routines.

In Indonesia, the implementation of Cyber Extension has been part of the agricultural modernization strategy for more than a decade. Studies by (Cahyono et al., 2020; Thamrin, 2023; Triman Tapi et al., 2024) revealed that the level of digital technology adoption among agricultural extension workers varied considerably, depending on infrastructure readiness and digital literacy across regions. While the Cyber Extension offered several advantages—such as real-time information access, interactive communication, and reduced operational costs—it also faced persistent challenges, including the digital divide, inadequate infrastructure, and the inability of some extension workers to adapt to new technologies (Prayuda, 2024).

Pangkajene dan Kepulauan (Pangkajene and Islands) Regency in South Sulawesi Province represented a unique research setting due to its distinct topographical characteristics. Known as a "three-dimensional" regency, Pangkajene and Islands Regency encompassed mainland, mountainous, and archipelagic areas. This geographical uniqueness not only made Pangkep a compelling study site but also posed particular challenges for the adoption of technological innovations, including the Cyber Extension platform. Variations in regional characteristics influenced disparities in infrastructure access, particularly internet connectivity, as well as the readiness of human resources to adopt digital technologies. Quantitative data further underscored these challenges: according to the 2024 Indonesian Digital Society Index (IMDI) issued by the Ministry of Communication and Informatics, South Sulawesi scored 42.26 (categorized as moderate), while Pangkajene and Islands Regency recorded a lower score of 40.94.

Table 1. Comparison of the 2024 Indonesian Digital Society Index (IMDI) between South Sulawesi Province and Pangkajene and Islands Regency

Imdi Pilar 2024	South Sulawesi	Pangkajene and Islands
Infrastructure & Ecosistem	52,93	48,58
Digital Skill	57,10	55,93
Utilization	35,69	35,60
Empowerment	24,27	24,59

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Total Score	**42,26**	**40,94**

Source: Kominfo, IMDI 2024 (Budiarto et al., 2024)

Although the digital skills level in Pangkajene and Islands Regency was relatively comparable to the provincial average, gaps in infrastructure and the broader digital ecosystem remained evident. The low score on the empowerment pillar further indicated weak institutional support. This highlighted the urgency of conducting an in-depth study on the barriers to digital technology adoption in the region.

In certain areas, obstacles emerged from limited signal coverage, the lack of supporting devices, and differences in digital literacy levels among extension workers. These conditions created a complex dynamic that was highly relevant to investigate, particularly in understanding the phenomenological barriers faced by agricultural extension workers in Pangkajene and Islands Regency.

Most previous studies on the adoption of digital technology in agricultural extension tended to emphasize quantitative approaches. Research such as that conducted by (Apriliani & Mada, 2024; Septia Regita, 2022; Wowor et al., 2022) placed greater emphasis on identifying factors that influenced technology adoption, such as ease of use, availability of digital infrastructure, personal motivation, and institutional support. This approach tended to measure the relationship between external factors and the level of technology adoption without deeply exploring the subjective experiences of extension workers. For example (Guntoro et al., 2022; Sabir et al., 2019; Sharma et al., 2023) found that although extension workers in many regions faced challenges in adopting Cyber Extension, external factors such as training and institutional support could accelerate adoption. However, more in-depth insights into how extension workers interpreted their experiences in dealing with barriers and adapting to technology remained very limited.

Phenomenology provides a philosophical and methodological foundation for understanding how individuals interpret and assign meaning to their lived experiences. Rather than focusing solely on observable behavior or measurable determinants of technology adoption, phenomenology seeks to uncover the essence of participants' experiences as consciously perceived in their everyday professional lives (Moustakas, 1994). Within the context of Cyber Extension adoption, this perspective enables researchers to move beyond identifying external barriers toward understanding how agricultural extension workers experience, interpret, and negotiate technological challenges within their specific social, organizational, and geographical contexts.

Although Rogers' Diffusion of Innovation Theory provides an important framework for explaining technology adoption, it primarily emphasizes innovation characteristics and adoption processes. It provides limited understanding of how individuals subjectively experience and interpret the barriers encountered during adoption. Therefore, this study complemented the diffusion perspective with a phenomenological approach, enabling a deeper exploration of the meanings that agricultural extension workers attached to their experiences of adopting Cyber Extension.

These limitations highlighted the need to complement the technological adoption perspective with a phenomenological approach that seeks to understand the essence of agricultural extension workers' lived experiences. Rather than treating barriers as merely technical constraints, this perspective recognizes them as meaningful experiences shaped by individual consciousness, intentional actions, professional values, and interactions with broader organizational and sociocultural environments.

Accordingly, the phenomenological approach offered a novelty in the form of an in-depth exploration of extension workers' subjective experiences in adopting Cyber Extension—an area rarely examined in previous studies that predominantly relied on quantitative methods. This approach allowed for a more comprehensive understanding of the digital technology adoption process among extension workers, encompassing not only technical challenges but also the psychological, cultural, and structural dimensions shaping their interaction with digital extension media. The findings of this study were expected to provide significant contributions to the formulation of more inclusive and adaptive agricultural extension policies that were responsive to diverse regional conditions, such as those in Pangkajene and Islands Regency. At

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the same time, they could serve as a foundation for developing training models and institutional support systems tailored to local needs and characteristics.

Unlike previous studies that primarily examined Cyber Extension adoption through quantitative determinants, this study contributes by revealing the phenomenological meanings behind agricultural extension workers' lived experiences. Rather than identifying barriers merely as external factors, this study explains how infrastructure limitations, digital literacy, organizational culture, and institutional support are consciously experienced, interpreted, and negotiated by extension workers across geographically diverse settings consisting of mainland, mountainous, and island areas.

The research problem in this study stemmed from the reality in the field that agricultural extension workers in Pangkajene and Islands Regency regency experienced a challenging journey in utilizing the Cyber Extension platform. The unique geographical character of Pangkajene and Islands Regency—stretching across mainland, mountainous, and archipelagic areas—meant that each extension worker had their own stories and struggles. Some had to climb hillsides in search of signal, others waited for a stable internet connection late at night on remote islands, while some tried to adjust from conventional face-to-face methods to digital media.

Based on the research gap and the complexity of Cyber Extension implementation, this study was guided by the following research questions:

1. How do agricultural extension workers experience the barriers to adopting Cyber Extension in their professional practices?
2. What meanings do agricultural extension workers attribute to the technological, infrastructural, behavioral, and institutional barriers encountered during the adoption of Cyber Extension?

These questions guided the phenomenological inquiry by focusing on participants' lived experiences and the meanings they constructed while interacting with Cyber Extension within diverse geographical settings.

This study aimed to explore and understand the barriers encountered by agricultural extension workers in Pangkajene and Islands Regency regency in adopting the Cyber Extension digital extension platform, using a phenomenological approach. The main focus was directed toward barriers related to geography, technical constraints, personal competence, work method preferences, and institutional support.

RESEARCH METHODS

This study employed a qualitative approach with a phenomenological method to gain an in-depth understanding of the subjective experiences of agricultural extension workers in facing the barriers to adopting Cyber Extension. The use of phenomenology was grounded in the research objective to explore the lived experiences of participants, where barriers were not merely perceived as technical constraints but also as phenomena shaped by perceptions, values, habits, and sociocultural contexts (Creswell, 2022). Consistent with Husserlian phenomenology (Husserl, 1970), this study sought to uncover the essence of agricultural extension workers' lived experiences by describing how they perceived and experienced barriers to Cyber Extension adoption, rather than measuring the frequency or prevalence of those barriers. The study was descriptive-exploratory in nature, enabling the disclosure of meanings embedded within the narratives of extension workers' experiences.

The research was conducted in Pangkajene and Islands Regency, South Sulawesi, which is characterized by diverse geographical features, including mainland, mountainous, and archipelagic areas. This geographical diversity was considered significant as it potentially influenced the implementation of Cyber Extension.

Participants were selected using purposive sampling to ensure that those recruited possessed rich and relevant experiences related to the phenomenon under investigation. The inclusion criteria were: (1) actively serving as agricultural extension workers for at least five years; (2) having experience in using or participating in Cyber Extension training; and (3) willingness to participate in in-depth interviews. Six agricultural extension workers representing different geographical areas were ultimately recruited.

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The number of participants was considered appropriate for phenomenological research because the objective was to obtain rich, in-depth descriptions rather than statistical representation. Interviews continued until data saturation was achieved, indicated by the point at which no substantially new meanings, categories, or themes emerged from subsequent interviews. This approach is consistent with recommendations for phenomenological inquiry emphasizing information-rich participants and thematic saturation (John W.Creswell & J.David Creswell, 2023; Moustakas, 1994).

Table 2. Characteristics of Participants

Informant	Age	Years of service	Area
1	52	28	Lowland
2	45	20	Highland
3	50	25	Island
4	42	12	Lowland
5	38	10	Highland
6	48	17	Island

As presented in Table 2, the participants represented diverse demographic and professional backgrounds, including different age groups, years of service, and geographical working areas. This diversity enabled the study to capture a broad range of lived experiences regarding Cyber Extension adoption across mainland, mountainous, and island contexts. Such variation is important in phenomenological research because it enriches understanding of how the same phenomenon is experienced under different social and geographical conditions.

The primary research instrument was a semi-structured interview guide containing open-ended questions designed to capture participants' perceptions, experiences, and interpretations of the barriers to adopting Cyber Extension. Additional instruments included observation sheets to record interactions between extension workers and digital technologies, as well as documentation forms to collect extension reports, Cyber Extension guidelines, and system screenshots. Field notes were written immediately after each interview to capture contextual observations and researchers' initial reflections.

Prior to data collection, all participants received an explanation regarding the objectives of the study and voluntarily agreed to participate. Written informed consent was obtained from all participants. Participant identities were anonymized using Informant 1–Informant 6 to ensure confidentiality.

Data collection was carried out in several stages. First, the researcher established rapport with the participants to create a comfortable and open interview atmosphere. Second, in-depth semi-structured interviews lasting approximately 60 minutes were conducted either face-to-face or online, depending on participants' availability, with their informed consent for audio recording. All interviews were audio-recorded with participants' permission and transcribed verbatim immediately after each interview. The transcripts were repeatedly reviewed to ensure their accuracy and completeness before proceeding with the phenomenological analysis. Third, limited participant observations were conducted to gain a better understanding of the extension workers' working environments and their use of digital technologies in practice. Finally, relevant documents, including extension records, training materials, and digital archives, were collected to support data triangulation. The overall data collection process was conducted over approximately two months.

The data were analyzed using (Moustakas, 1994) transcendental phenomenological approach. The analysis began with epoche (bracketing), during which the researchers consciously set aside their prior assumptions and professional experiences related to Cyber Extension to minimize interpretive bias. Subsequently, interview transcripts were read repeatedly to achieve immersion in the data.

Horizontalization was then conducted by identifying significant statements directly related to participants' experiences of Cyber Extension adoption barriers. These significant statements

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were coded and grouped into clusters of meaning representing common patterns across participants. Each thematic cluster was subsequently developed into textural descriptions explaining what the participants experienced and structural descriptions explaining how those experiences occurred within their organizational, technological, and sociocultural contexts. Finally, these descriptions were synthesized to construct the phenomenological essence representing the shared lived experiences of agricultural extension workers regarding barriers to Cyber Extension adoption.

To enhance trustworthiness, data credibility was ensured through source triangulation, member checking, prolonged engagement with participants, maintenance of an audit trail, and continuous researcher reflexivity throughout the analytical process.

The results of the analysis were presented in descriptive narratives supported by direct verbatim quotations from participants. The presentation of findings also utilized thematic matrices and summary tables to highlight interconnections among themes, as well as simple diagrams to visualize the relationships between various phenomenological barriers.

RESULTS AND DISCUSSION

This section presents the main findings of the study, focusing on the experiences of agricultural extension officers in Pangkajene and Islands Regency as they encountered various challenges in adopting Cyber Extension to enhance the effectiveness of agricultural extension activities. Through a phenomenological approach, the study explored the deeper meanings embedded within their lived experiences, aiming to understand the factors that hinder the utilization of digital technology in real fieldwork contexts. Based on thematic analysis, these barriers were categorized into four key subthemes: (1) limited technological infrastructure, (2) low levels of digital literacy among extension officers, (3) resistance to technological change, and (4) insufficient policy support and clarity from the government. These four subthemes are interrelated and reflect the complex dynamics influencing the readiness and capacity of extension officers to integrate Cyber Extension into their extension practices.

1. Limited Technological Infrastructure

One of the most fundamental obstacles to the effective utilization of Cyber Extension in Pangkajene and Islands Regency is the inadequacy of technological infrastructure, particularly in terms of the availability and quality of internet access. This challenge emerged as a recurring issue across almost all areas of the extension officers' coverage, whether in lowland, mountainous, or island regions.

Informant 1 (52 years old, 28 years of service), who works in a lowland area, noted that although internet access in some parts of his working area was relatively sufficient, difficulties remained in more remote locations. He explained:

> *"Although my area had relatively good internet access, some remote locations still struggled to obtain a stable connection. At times, I prepared printed copies of important guidelines for farmers who had difficulty accessing digital content."* (informan 1, 14/04/2025).

In the mountainous areas, access to internet networks became a very real challenge in implementing digital-based extension. One extension worker, Informant 2 (45 years old, 20 years of service), described that the limited signal in his assigned area not only disrupted online activities but also forced them to make extra efforts to remain connected. He explained that in certain conditions, extension workers had to seek higher ground such as hills or specific spots on the slopes just to obtain a strong enough signal to access or transmit digital information.

> *"In the mountainous areas, internet coverage was rather limited, which made it difficult for extension workers to access or transmit digital information. Sometimes we had to climb to higher places first, just to be able to send reports or open the application."*(informan 2, 14/04/2025).

A similar condition was also experienced by extension workers in the island regions. According to them, internet signals in some islands were very difficult to obtain, especially in locations far from service centers. In some cases, internet access could only be used at night

when the network became slightly more stable. One extension worker, Informant 3 (50 years old, 25 years of service), revealed:

> *"Unstable internet connectivity in many islands was the main challenge in implementing Cyber Extension effectively. The process of delivering Cyber Extension materials to farmers became highly inefficient because we ourselves had to wait quite a long time to gain internet access"*. (informant 3, 14/04/2025)

Beyond representing a technical limitation, inadequate internet infrastructure was experienced by the participants as a constant disruption to their professional identity and responsibility as agricultural extension workers. Rather than simply preventing access to Cyber Extension, unreliable connectivity altered how participants carried out their daily work, forcing them to continuously negotiate between their professional obligations and environmental constraints. The experience of climbing hills to obtain a signal or waiting until late at night to access the internet reflected not merely practical adaptation, but an ongoing struggle to fulfil their role as information providers despite circumstances beyond their control.

From a phenomenological perspective, the essence of this experience lies in the feeling of being professionally constrained by geographical realities. Participants did not perceive infrastructure merely as a technological resource; instead, it became a lived condition that shaped how they understood their capacity to serve farmers. Cyber Extension, which was intended to facilitate extension activities, was instead experienced as something that remained inaccessible, creating a persistent tension between institutional expectations for digital transformation and the realities of fieldwork.

These findings reinforced previous studies which reported that infrastructure gaps (Muda Harahap et al., 2024), particularly limited access to reliable internet networks, remain significant barriers to the utilization of digital technology in remote areas (Bhat et al., 2024; Irdiana et al., 2024; Singh et al., 2023). This suggests that strengthening and equalizing network infrastructure, especially in geographically challenging regions, is a strategic step urgently required to optimize the effectiveness of the Cyber Extension program at the grassroots level.

From Rogers' Diffusion of Innovation Theory, unreliable internet connectivity increased the perceived complexity of Cyber Extension because participants experienced considerable difficulty in accessing and using the platform consistently. As the perceived complexity increased, the likelihood of adopting the innovation decreased, particularly among extension workers serving mountainous and island areas.

In line with this, a systematic review highlighted that inadequate infrastructure—such as weak internet connectivity and limited access to broadcast centers—substantially hampers the development of digital extension services (Sen et al., 2025). Similarly, a mixed-methods study in Latin America identified poor rural connectivity as a critical constrain to the adoption of digital agriculture (Dibbern et al., 2025). Furthermore, (Liu et al., 2025) demonstrated that the high costs associated with deploying infrastructure in sparsely populated and rugged terrains further reduce the effectiveness of digital systems. Collectively, these studies underscore that enhancing and equalizing digital infrastructure, particularly in remote and geographically challenging areas, constitutes an urgent and strategic imperative to fully harness the transformative potential of the Cyber Extension program.

2. Lack of Digital Skills among Extension Workers

In addition to infrastructural barriers, limited digital skills have also emerged as a significant challenge in the utilization of Cyber Extension by agricultural extension workers in Pangkajene and Islands Regency. Many extension workers—particularly those who have been serving for a longer period—are not yet accustomed to using digital devices and platforms optimally. This situation has slowed down the adoption of technology in daily extension activities and created a generational gap in competencies among extension workers.

One respondent, Informant 4 (42 years old, with 12 years of service), explained that while he himself was relatively familiar with technology, not all of his colleagues shared the same level of comfort:

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"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 these platforms because they are not comfortable with digital devices. For some of us, there is a steep learning curve, but with the right training and patience, it will gradually become easier." (Informant 4, 16/04/2025)

Similarly, an extension worker from the highland area, Informant 5 (38 years old, with 10 years of service), emphasized the lack of training as a major barrier:

"So far, training on Cyber Extension has been very limited. We need regular and comprehensive training because many extension workers still lack sufficient technological understanding." (Informant 5, 16/04/2025)

Meanwhile, Informant 6 (48 years old, with 17 years of service), who is assigned to the island region, also underlined the limited training opportunities, which have led to uneven digital capacity development among extension workers.

"In our area, training is very rarely conducted. It only happened once, during the initial socialization of Cyber Extension. Given our geographic conditions, we actually need a different approach. Without continuous guidance and specialized training, extension workers in the field will continue to be left behind." (Informant 6, 16/04/2025)

These limitations have contributed to the slow adaptation to Cyber Extension platforms, particularly among extension workers operating in areas with geographical challenges. This finding aligns with previous studies (Arowosegbe et al., 2024; Naika et al., 2021; Salsabella et al., 2024; Singh et al., 2023), which highlight that continuous training is essential for enhancing extension workers' digital skills and ensuring optimal utilization of Cyber Extension.

Interview results also revealed differences in technological proficiency between younger and senior extension workers. Informant 1 noted:

"Younger extension workers adapt more quickly to the features of Cyber Extension, whilebsenior extension workers often struggle to operate devices. Younger extension workers frequently take the lead in showing their senior colleagues how to use the platform, but it takes time for everyone to reach the same level of proficiency. It is just a matter of becoming comfortable with technology, and once they understand its benefits, they are more likely to use it." (Informant 1, 14/04/2025)

Similarly, Informant 2, who serves in the highland area, observed that younger extension workers adapt more easily to technology, whereas older workers require more time. In the island region, Informant 3 further noted that younger extension workers are even more proactive and enthusiastic in utilizing Cyber Extension:

"Young extension workers in the island areas are more proactive in using Cyber Extension for extension activities. They are not afraid to experiment with the platform, and their enthusiasm often motivates senior colleagues to catch up." (Informant 3, 14/04/2025)

Although digital competence is commonly viewed as a technical skill, participants described it as an experience closely connected to confidence, self-efficacy, and professional identity. Senior extension workers often perceived themselves as being left behind by rapid technological change, whereas younger extension workers experienced Cyber Extension as an opportunity for professional growth. Consequently, differences in digital competence were not simply differences in knowledge, but reflected how participants interpreted their own capability to remain relevant within an increasingly digital extension system.

The essence emerging from these experiences is that digital literacy represented more than the ability to operate technology; it symbolized participants' sense of confidence in fulfilling their professional responsibilities. Continuous training therefore became meaningful not only because it improved technical competence but because it restored confidence and reduced feelings of uncertainty when interacting with digital technologies.

These findings are consistent with previous studies by (Apriliani & Mada, 2024; Halawa N, 2024), which demonstrate that younger generations tend to adopt technology more quickly, while older individuals often encounter challenges due to skill gaps or reluctance. Similarly,

(Yap et al., 2025) found that younger farmers are more willing to take risks and embrace new technologies, whereas older farmers rely more heavily on prior knowledge and experience. A systematic review and meta-analysis conducted in Ethiopia further confirmed that age is a significant determinant of technology adoption among smallholder farmers (Ayalew & Girma, 2025). In South Korea (Bang & Han, 2025) reported that farmers under the age of 30 with higher levels of education were significantly more likely to adopt smart farming technologies, particularly when supported by training programs and policy incentives. Likewise, (Gizachew et al., 2024) observed that younger and better-educated ginger producers in Ethiopia were more inclined to use digital tools, while older and less-educated farmers displayed greater resistance. Taken together, these studies underscore the importance of designing training programs that are tailored to age and experience levels in order to maximize the benefits of Cyber Extension for all extension workers.

According to Rogers' Diffusion of Innovation Theory, limited digital competence reduced the perceived relative advantage of Cyber Extension. Rather than viewing the platform as a tool that could improve work performance, several participants experienced it as difficult and time-consuming to operate. Consequently, the expected benefits of the innovation became less apparent, reducing their motivation to adopt it.

3. Resistance to Technological Change

One of the most prominent non-technical barriers in the adoption of Cyber Extension by agricultural extension workers in Pangkajene and Islands Regency is resistance to change, particularly in the form of skepticism toward the effectiveness of digital platforms compared to conventional extension methods. Some extension workers expressed doubt regarding the usefulness of new technologies, as they felt more confident with traditional approaches that they had relied on for many years. This mindset has slowed the transition from traditional methods to full integration of digital technologies. Informant 4 explained:

> *"Although I recognize the potential of Cyber Extension, some colleagues prefer conventional methods because they feel more familiar with them and believe that face-to-face interaction is more effective. They are more comfortable with what they already know and may question the reliability of digital platforms."* (Informant 4, 16/04/2025)

In a similar vein, Informant 5, who works in the highland region, stated that doubts also arise from uncertainty about whether farmers—particularly those accustomed to direct communication—can properly receive and understand information delivered through digital media. Informant 6, from the island region, further emphasized that for some extension workers, face-to-face approaches are perceived as more efficient because they allow for immediate dialogue and problem-solving in the field. These findings reinforce previous studies which note that technology adoption in the agricultural sector is often hindered by the perception that traditional methods are superior, especially in fostering close relationships with farmers.

Moreover, the difficulty in changing long-established extension practices is also a critical factor in resistance to Cyber Extension. Face-to-face interactions have long been embedded in extension workers' routines and have created social bonds that are perceived as irreplaceable by digital media. Thus, the shift is not merely about adopting new tools, but also about transforming a deeply rooted work culture. As Informant 1 described:

> *"Many extension workers feel more comfortable with traditional methods of delivering agricultural extension services. Strong bonds are built through face-to-face meetings, and some believe that digital methods cannot replicate those relationships."* (Informant 1, 14/04/2025)

This point was reinforced by Informant 3, who noted that long-standing habits are difficult to abandon, particularly among senior extension workers who have been practicing conventional approaches for many years. Informant 2 from the island region also remarked that transitioning to technology-based approaches is not easy, especially when traditional methods have already proven effective in reaching farmers.

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Resistance to Cyber Extension emerged not simply as reluctance to adopt innovation, but as an expression of participants' deep attachment to long-established extension values. Participants viewed face-to-face interaction as an essential component of trust-building with farmers. Consequently, digital technology was experienced as challenging not only familiar working routines but also the interpersonal relationships that defined their professional practice.

The phenomenological essence of this theme lies in the perceived conflict between technological efficiency and human connection. Participants did not reject technology because they opposed innovation itself; rather, they feared losing the meaningful social interactions that had long characterized agricultural extension. Their resistance therefore reflected an effort to preserve the relational dimension of extension work rather than simple unwillingness to change.

This finding can also be interpreted through Rogers' concept of compatibility. Participants perceived Cyber Extension as incompatible with their long-established face-to-face extension practices, which they regarded as essential for building trust and maintaining close relationships with farmers. Consequently, resistance emerged not because participants rejected innovation itself, but because the innovation was perceived as conflicting with deeply embedded professional values and routines.

These findings align with earlier studies (Septia Regita, 2022; Sihombing et al., 2024) which highlight that resistance to digital innovations in agricultural extension is often driven by comfort with traditional methods, perceived effectiveness of conventional approaches, and the lack of perceived urgency to adopt new technologies. Deeply ingrained habits and low motivation to learn digital systems have resulted in slow adoption processes, even when technological infrastructurel is alrelady availablel. Thelsel findings is furthelr relinforceld by relcelnt studiels from 2020–2025, which delmonstrateld that relsistancel to digital innovations is shapeld by innovation avelrsion and elntrelncheld routinels (Mhlanga & Ndhlovu, 2023), as welll as by low lelvells of litelracy and digital compeltelncel among smallholdelrs that ofteln relduceld elngagelmelnt with availablel telchnologiels,. Morelovelr, cultural misalignmelnt beltweleln digital tools and convelntional practicel can relsult in digital elxclusion low litelracy and digital skills among smallholdelrs ofteln lelad to falling elngagelmelnt delspitel availablel telchnologiels; cultural misalignmelnt beltweleln digital tools and convelntional melthods can relsult in digital elxclusion(Yuan & Sun, 2024). Thelsel relsults arel also consistelnt with Rogelrs' Diffusion of Innovation Thelory (Rogers et al., 2014), which elmphasizels that thel adoption of innovation is frelquelntly hindelreld by attachmelnt to elstablisheld habits and elntrelncheld work pattelrns.

4. Limited Governmental Support and Policy

Belyond telchnical and individual factors, structural barrielrs such as insufficielnt policy support and welak institutional coordination also prelselnt major challelngels in thel implelmelntation of Cybelr ELxtelnsion among agricultural elxtelnsion workelrs in Pangkajelnel and Islands Relgelncy. Although Cybelr ELxtelnsion has beleln introduceld as part of digital transformation in thel agricultural selctor, its implelmelntation in thel fielld relmains constraineld by limiteld budgelt allocation, inadelquatel continuous training, and welak cross-agelncy collaboration.

Onel of thel primary concelrns raiseld by elxtelnsion workelrs rellatels to budgeltary support and policiels elnsuring program sustainability. As Informant 1 highlighteld:

> *"Thel idela of Cybelr ELxtelnsion is good, but in practicel wel neleld budgeltary support for training, delvicels, and opelrational costs. Without a spelcific budgelt, it is difficult to run this program to its full potelntial."* (Informant 1, 14/04/2025)

This statelmelnt undelrscorels that thel melrel elxistelncel of a digital platform is not sufficielnt without accompanying supportivel policiels and adelquatel funding, both for capacity-building initiativels and telchnical facilitiels (Dino Rahmat Hidayat & Hakim, 2025) without policy clarity that prioritizels digital transformation, elxtelnsion workelrs felell burdelneld with implelmelnting thelsel initiativels on thelir own.

Furthelrmorel, intelr-agelncy coordination has also elmelrgeld as a critical factor that has not yelt functioneld optimally. As Informant 5 strelsseld:

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"Collaboration beltweleln thel agricultural officel and elducational or telchnological institutions is elsselntial for thel propelr implelmelntation of Cybelr ELxtelnsion. By working togelthelr with thelsel institutions, wel can elnsurel that thel platform continuels to delvellop and adapt to fielld conditions and farmelrs' nelelds." (Informant 5, 16/04/2025)

Thel lack of synelrgy among institutions has also relsulteld in fragmelnteld training programs and unelveln distribution of digital relsourcels, particularly in gelographically relmotel arelas. Informant 6 from thel island relgion shareld that inadelquatel telchnical support and poor communication from celntral officels ofteln lelft elxtelnsion workelrs in relmotel locations felelling nelglelcteld:

"In thel islands, wel arel ofteln thel last to relcelivel information. Yelt our arelas arel thel onels that neleld thel most support duel to grelatelr challelngels."
(Informant 6, 16/04/2025)

Participants experienced limited governmental support not merely as an administrative issue but as a source of uncertainty regarding the sustainability of Cyber Extension implementation. Inadequate funding, infrequent training, and weak institutional coordination created a perception that responsibility for digital transformation rested largely on individual extension workers rather than being collectively supported by the system.

The essence of this experience is a feeling of institutional vulnerability. Participants perceived themselves as expected to embrace digital innovation while lacking sufficient organizational support to do so effectively. This mismatch between institutional expectations and available resources shaped their everyday experience of Cyber Extension as an initiative that demanded commitment without providing adequate structural support.

From Rogers' perspective, institutional support also influences innovation adoption by facilitating opportunities for trialability and observability. In this study, limited governmental support, insufficient training, and weak inter-agency coordination reduced opportunities for extension workers to experiment with Cyber Extension and observe successful implementation in practice. Consequently, organizational support became an essential factor in sustaining technology adoption.

Thelsel findings relinforcel elarlielr relselarch—such as (Madaki et al., 2024), who idelntifield unsupportivel policiels, inadelquatel infrastructurel, and telchnology as primary barrielrs; thel 2025 study on public-selctor transformation that links succelssful adoption to digital infrastructurel, workforcel skills, supportivel policiels, and collaborativel organizational culturel; (Schmitz elt al., 2025), who elmphasizel thel neleld for cross-delpartmelntal coordination and intelgrateld ovelrsight in delploying advanceld telchnologiels; and (Di Giulio & Velcchi, 2021), who show that digitalization initiativels can drivel intelrnal intelgration and strongelr coordination across agelnciels—delmonstrating that thel elffelctivel adoption of telchnology in thel public selctor delpelnds not melrelly on telchnical reladinelss but crucially on structural and policy support, relsourcel availability, and intelr-agelncy coopelration.

5. Phenomenological Essence of the Lived Experience

Across the four themes, a common phenomenological essence emerged. Agricultural extension workers did not experience Cyber Extension merely as a technological innovation but as a continual negotiation between professional commitment and multiple interconnected barriers. Their lived experiences revealed that adopting Cyber Extension involved balancing geographical constraints, limited digital competence, deeply rooted professional values, and insufficient institutional support. Rather than rejecting digital transformation itself, participants consistently demonstrated willingness to embrace technological change whenever adequate infrastructure, continuous learning opportunities, and organizational support were available. Thus, the essence of their experience can be understood as an ongoing effort to remain effective and relevant as extension professionals while navigating structural, technological, and cultural limitations beyond their immediate control.

CONCLUSION

This study relvelaleld that thel adoption of Cybelr ELxtelnsion by agricultural elxtelnsion workelrs in Pangkajelnel and Islands Relgelncy elncountelreld a rangel of complelx

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phelnomelnological barrielrs, elncompassing infrastructural, individual, organizational, and policy-rellateld dimelnsions. First, unelveln intelrnelt accelss—particularly in highland and island arelas—hindelreld elxtelnsion workelrs in accelssing and disselminating digital information to farmelrs. Selcond, limiteld digital skills, elspelcially among selnior elxtelnsion workelrs, poseld challelngels in opelrating thel Cybelr ELxtelnsion platform, a problelm furthelr elxacelrbateld by thel abselncel of continuous training. Third, relsistancel to telchnological changel, rooteld in skelpticism toward thel elffelctivelnelss of digital melthods compareld to convelntional practicels, leld somel elxtelnsion workelrs to relmain attacheld to traditional approachels. Fourth, welak policy support and inadelquatel cross-agelncy coordination prelvelnteld thel elffelctivel implelmelntation of Cybelr ELxtelnsion at thel fielld lelvell.

Thelsel findings undelrscoreld that thel succelss of digital telchnology adoption in agricultural elxtelnsion was not solelly deltelrmineld by telchnical reladinelss, but also by cultural reladinelss, structural support, and intelgrateld policy backing. Thelrelforel, a morel holistic approach was relquireld—onel that strelngthelneld infrastructurel, provideld nelelds-baseld training, fostelreld organizational cultural changel, and promoteld activel collaboration among govelrnmelnt, elxtelnsion workelrs, and supporting institutions.

Practically, these findings suggest that government agencies should prioritize improving digital infrastructure in remote areas, establish continuous digital literacy training tailored to extension workers' needs, strengthen institutional coordination, and provide sustainable policy support for Cyber Extension implementation. These efforts are expected to reduce regional disparities and enhance the effectiveness of digital agricultural extension services throughout Indonesia.

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