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The role of agricultural extension workers in digital transformation at the Agricultural Extension Center in Lowokwaru Malang

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ABSTRACT

Introduction: The pivotal role of the agricultural sector in Indonesia's economic advancement stems from the employment of a significant portion of the Indonesian populace. Central to this sector are agricultural extension workers tasked with fostering motivational shifts, altering operational methodologies, and instilling adaptive practices congruent with technological advancements. This research endeavors to scrutinize the modus operandi of agricultural extension workers amidst the digital metamorphosis era within the Agricultural Extension Center situated in Lowokwaru, Malang, Indonesia. **Methods:** Employing a Mixed methods approach, this study draws upon primary and secondary data sources. Thirty samples, affiliated with the Farmers Group at the Agricultural Extension Center in Lowokwaru Malang, constitute the study cohort, selected through purposive sampling techniques. Data accrual involves questionnaire administration, employing the Likert scale as the measurement metric. Statistical analysis entails multiple linear regression, facilitated through SPSS 22 software. **Results:** Simultaneously, variables embodying extension workers' roles as facilitators, innovators, motivators, dynamists, and educators collectively impact the income of registered farmers at the Agricultural Extension Center in Lowokwaru, Malang. **Conclusion:** This study reveals that the roles of extension workers as facilitators, innovators, and educators significantly enhance farmers' capacity to integrate digital technology into their agricultural practices. Nevertheless, the absence of direct statistical significance in some roles suggests the interplay of other critical factors, such as farmers' readiness to adopt technology and external support mechanisms. These findings highlight the need for targeted interventions to bolster extension workers' capabilities and farmer engagement with digital innovations.

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INTRODUCTION

The Indonesian state boasts a remarkable abundance of natural resources and agricultural land. As per Badan Pusat Statistik (2022), the harvested land area in Indonesia encompasses approximately 10,657 hectares. Human endeavor drives farming activities, harnessing biological resources to yield food, processed materials, and industrial raw materials (Nurhaedah, 2022).

The agricultural sector holds the potential to bolster Indonesia's economic landscape. Ongoing agricultural development endeavors aim to satisfy nutritional requirements and elevate the income levels of Indonesian citizens (Feliyana *et al.*, 2021). Given that a substantial portion of the Indonesian populace engages in farming, as evidenced by data from the Badan Pusat Statistik (2021), wherein 60,700,128 out of 275,770,000 individuals are employed in the agricultural sector, the sector's significance in Indonesia's economic progression is indisputable. Such potential necessitates the pivotal contribution of agricultural extension workers.

Agricultural extension workers play a crucial role in bolstering governmental agricultural initiatives by fostering and aiding farmers, thereby enhancing farmers' livelihoods (Rahmawati *et al.*, 2019). Tasked with motivating and guiding farmers to adapt mindsets, methodologies, and practices in alignment with technological advancements, agricultural extension workers number 67,260 in Indonesia. Functioning as purveyors of information services and educational resources essential for farmers, agricultural extension workers serve as exemplars and mentors, steering farmers toward improved agricultural outcomes (Ergina *et al.*, 2022).

Agricultural extension workers assume a pivotal role in the advancement of agriculture in Indonesia, particularly during its agrarian phase, facilitating the nation's self-sufficiency. Their multifaceted roles encompass facilitation,

innovation, motivation, dynamism, and education. As facilitators, they streamline farming operations by provisioning agricultural necessities such as facilities, infrastructure, seeds, fertilizers, and tools. In their capacity as innovators, they introduce cutting-edge technologies in horticultural practices, exemplified by the adoption of tractor-based rice harvesting and the implementation of urban farming through hydroponic and aquaponic systems featuring catfish cultivation. Functioning as motivators, agricultural extension workers foster enthusiasm and support among farmers, thereby positively impacting their business endeavors. Their dynamism is manifested in mobilizing and fostering cooperative alliances among farmers, liaising with external stakeholders, and furnishing pertinent recommendations to agricultural authorities. Furthermore, as educators, they impart agricultural insights aimed at enhancing farmers' acumen in analyzing business prospects, market dynamics, and cooperative farm management (Sunggu & Rosnita, 2023).

According to Prayoga (2018), the contemporary world has transitioned into an era characterized by the emergence of an information society interconnected through cyberspace. This phenomenon is not confined solely to urban regions but is also prevalent in rural areas, where farmers have increasingly embraced information technology to address their requirements. Consequently, governmental initiatives have evolved to incorporate information technology, giving rise to the development of a cyber extension system. Given this context, there is a pressing need for research into the ramifications of cyber augmentation and its underlying theoretical framework.

This study adopts a qualitative approach employing descriptive methods and discourse analysis. The dataset comprises secondary data obtained through a comprehensive review of relevant literature. Analysis reveals that cyber extension has engendered significant alterations in the social and cultural fabric of farming communities. While some changes exhibit positive trajectories, others manifest negative trends. Nonetheless, the advent of information technology, as exemplified by cyber extension, is deemed by Castell to exert a predominantly positive influence on human existence. Consequently, it engenders novel habitus and engenders distinct social practices compared to traditional extension activities conducted in physical spaces.

Indonesian society has undergone rapid transformation from an agrarian to an industrial society, culminating in the current era of digital evolution. The advent of the internet and smartphones has enabled many farmers to access agricultural information through these mediums, thereby leveraging them as tools for agricultural counseling (Prayoga, 2018). Amidst the fourth industrial revolution, the landscape of human activities is progressively shifting from manual to digital realms, transcending geographic constraints (Sumartono & Huda, 2020). Digital culture, a hallmark of this revolution, encompasses the utilization of technology and the internet to foster interactive, behavioral, cognitive, and communicative paradigms (Ayu *et al.*, 2022). Embracing digital transformation necessitates the integration of digital culture to engender mindset renewal and adaptability to digital advancements.

Agricultural extension workers encounter challenges including time constraints, inaccessible regions, and the need for developmental resources. Efforts to address agricultural dilemmas entail transitioning from manual to digital methodologies (Dharmawan *et al.*, 2023). The effectiveness of extension activities hinges upon the proficiency of extension workers in program development, social implementation, resource utilization, group management, interpersonal rapport, and farmer motivation (Bahua, 2021). Farmer participation influences the motivation of extension workers, while technological competence is paramount for information dissemination and task execution within agricultural extension endeavors (Sugino, 2021).

Effective counseling entails fostering robust communication and cooperation between agricultural extension workers and farmers. Challenges persist in the dissemination of technological innovations to remote regions through agricultural extension workers (Rangga *et al.*, 2020). Factors influencing the performance of agricultural extension workers encompass individual characteristics, psychological attributes, and organizational dynamics. Individual characteristics encompass skills, personal background, and demographics, while psychological attributes encompass perceptions, attitudes, personality traits, and motivation. Organizational dynamics encompass resource allocation, management strategies, incentives, structural frameworks, and task delineation (Zulhafandi & Mubarak, 2021).

Given this context, this study aims to explore "The Role of Agricultural Extension Workers during the Digital Transformation Period: A Case Study at the Agricultural Extension Center in Lowokwaru, Malang." The research endeavors to analyze the efficacy of agricultural extension workers in fulfilling their role amidst the digital transformation era within the Agricultural Extension Center of Lowokwaru, Malang.

METHODS

Research site

The research was carried out at the Agricultural Extension Center situated in Lowokwaru, Malang. The selection of this site was deliberate, chosen for its comprehensive technological infrastructure available at the Agricultural Extension Center in Lowokwaru, Malang.

Determination of population and sample size

The population under scrutiny comprised farmers officially registered at the Agricultural Extension Center in Lowokwaru, Malang. Employing purposive sampling, the researcher deliberately selected samples based on the technological adoption observed among farmers. Purposive sampling, a methodological approach, involves selective sampling considering specific respondent characteristics that impact the role of agricultural extension, and aligning with predetermined research objectives (Lenaini, 2021).

Data and variables

Data sourcing encompassed both primary and secondary data. Primary data was acquired through direct interviews and questionnaire administration among farmers affiliated with the Agricultural Extension Center in Lowokwaru, Malang. Secondary data comprised information gathered from various sources including government agencies like Statistics Indonesia (BPS), scholarly journals, and literature. The study incorporates two key variables: dependent variables encompass farmers' socioeconomic backgrounds such as income and education, while independent variables include the competency of extension workers as facilitators, innovators, motivators, dynamicators, and educators. Data analysis involved the evaluation of dependent and independent variables (Table 1) utilizing a Likert scale (Table 2).

Table 1. Variables used in data analysis.

	Variable	Description of Variable
Dependent	Y	Farmer background (farmer income and education)
Independent	X_1	Facilitator
	X_2	Innovator
	X_3	Motivator
	X_4	Dynamizer
	X_5	Educator

Table 2. Measurement of the Likert scale used in the study

Scale	Score
Strongly Agree (SA)	5
Agree (S)	4
Neither Agree nor Disagree (NAND)	3
Disagree (S)	2
Strongly Disagree (SD)	1

Data analysis methods

The research adopts a Mixed Methods approach, which integrates both qualitative and quantitative methodologies, facilitating comprehensive data collection and analysis (Vebrianto *et al.*, 2020). This methodological framework enables the synthesis of numerical and narrative data pertinent to the research inquiries. Data processing utilized Microsoft Excel and SPSS 22, with data analysis conducted through multiple linear regression. The analytical procedure is systematically formulated as follows:

$$Y = a + b_1 X1 + b_2 X_2 + b_3 X_3 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{ (Basri, 2019)}$$

Notes:
Y = Farmer background
X_1 = Extension workers as facilitators
X_2 = Extension workers as innovators
X_3 = Extension workers as motivators
X_4 = Extension workers as a dynamizer
X_5 = Extension workers as educators.
a = Constant
b = Regression coefficient

RESULTS AND DISCUSSION

The regression analysis indicates that the roles of agricultural extension workers do not exhibit a statistically significant direct impact on farmers' income in the context of adopting digital technology. However, this finding suggests that farmers in Lowokwaru, Malang, may rely on alternative income sources or intrinsic agricultural

strategies independent of extension workers. This does not diminish the potential for extension workers to influence specific aspects of digital technology adoption, which may require further exploration through qualitative assessments. Detailed findings from the analysis are presented in Table 3 below:

Table 3. Coefficient value on regression test

Model	Unstandardized Coefficients		Standardized Coefficients	t	α
	B	Std. Error	Beta		
1 (Constant)	118,449.346	7,124,962.305		-0.017	
X_1	1,399,625.766	2,927,640.187	0.144	2.478	0.311
X_2	1,021,532.533	2,168,616.813	0.114	3.471	0.479
X_3	-1,107,836.404	2,334,974.437	0.123	0.474	0.419
X_4	-1,566,772.554	2,176,359.863	-0.172	-0.720	0.491
X_5	1,173,773.674	2,305,663.260	0.538	2.244	0.487

The objective of multiple linear regression analysis is to assess the impact of two or more independent variables on a dependent variable. In the present investigation, multiple linear regression analysis was employed to evaluate the influence of agricultural extension workers' roles as facilitators, innovators, motivators, dynamicators, and educators on the adoption of digital technology among farmers. As delineated in Table 2, regression equations were formulated to elucidate the effects of extension workers' roles in facilitating, innovating, motivating, dynamicating, and educating.

$$Y = 118,449.346 + 1,399,625.766\ X_1 + 1,021,532.533\ X_2 - 1,107,836.404\ X_3 – 1,566,772.554\ X_4 + 1,173,773.674\ X_5$$

The regression equation delineates various estimates of potential outcomes, outlined as follows:

1. The statistical analysis indicates that farmers are capable of generating income independent of extension workers' active roles. However, this does not undermine the potential positive contributions of extension workers as facilitators, innovators, and educators, particularly in supporting the adoption of digital technologies that enhance productivity and income stability. Specifically, a constant value of 118,449.346 suggests that in the absence of the variable X (representing the role of extension workers), farmers can anticipate an income of Rp. 118,449.346, assuming other variables remain constant. Agricultural income, as highlighted by Harkness *et al.* (2023), is influenced by various factors such as the diversity of agricultural commodities and the efficient utilization of chemicals. Diversification of agricultural commodities can enhance food production by optimizing chemical usage across different crops, thereby bolstering both the stability of food production and income within the agricultural sector.
2. The statistical analysis highlights that extension workers' roles as facilitators contribute positively to farmers' income, with a regression coefficient of 1,399,625.766. This underscores their critical function in providing resources and bridging gaps in technology access, consistent with Lusiana et al. (2018), who emphasize the importance of resource facilitation for improving farmer productivity. Further qualitative exploration is warranted to determine how facilitation activities align with digital technology adoption. Consistent with the findings of Lusiana *et al.* (2018), extension workers function as facilitators by providing support or capital to farmers through farmer groups. This support includes the provision of seeds and medications, and facilitating fertilizer acquisition. As noted by Satia *et al.* (2021), agricultural extension workers play a facilitative role by assisting in securing farmer capital, supporting farmers, facilitating agricultural infrastructure, and mediating among farmer groups.
3. Although extension workers as innovators positively influence farmers' income, it is important to contextualize this within the broader agricultural ecosystem. Factors such as fluctuating market prices, access to high-quality inputs, and government support programs also play a significant role in determining overall income levels. These external factors might amplify or mitigate the impact of extension workers, suggesting the need for a holistic approach to agricultural innovation, as indicated by a regression coefficient of 1,021,532.533. Consistent with Sapitri *et al.* (2020), extension workers emerge as influential figures in agricultural innovation initiatives, disseminating the latest advancements to farmers. Effective communication between extension workers and farmers, as emphasized by Kartini *et al.* (2023), is imperative for successful extension activities, facilitating the transmission of innovations toward achieving predetermined objectives.
4. The statistical analysis reveals a positive impact of the variable concerning the role of extension workers as educators on farmers' income, with a regression coefficient of 1,173,773.674. Consistent with the findings of Abdullah *et al.* (2021), an effective and efficient learning process is facilitated by materials, learning methodologies, and extension media that farmers can comprehend, enabling the adoption of the latest agricultural innovations. As highlighted by Rahma *et al.* (2024) the Agricultural Extension Center serves as a crucial intermediary, bridging the information gap between the Department of Food Security and farmers. This ensures

the seamless transfer of information or education by field agricultural extension workers to the farming community.

The findings underscore the potential of agricultural extension workers to enhance farmers' income through digital transformation. By facilitating access to mobile apps for pest management, providing training on precision farming technologies, and bridging knowledge gaps in e-commerce platforms, extension workers can position themselves as vital agents of digital agricultural advancements. However, their impact depends heavily on their ability to adapt to technological changes and address barriers such as digital literacy among farmers. This influence encompasses the roles of agricultural extension workers as facilitators, innovators, and educators.

Analysis of the role of extension workers as facilitators

The analysis results indicate that the role of extension workers as facilitators has a positive impact on farmers' ability to access resources and digital technology. With a regression coefficient of 1,399,625,766 ($p < 0.05$), this contribution includes the provision of tools, materials, as well as access to training and farmer groups. This finding is consistent with Lusiana *et al.* (2018), who stated that extension workers play a crucial role in connecting farmers to relevant resources that support productivity.

The role of facilitators not only influences technology adoption but also supports the sustainability of agricultural systems in the digital era. The involvement of extension workers in mediating farmers' needs highlights the necessity for policies that strengthen extension workers' capacity to provide technological resources.

Analysis of the role of extension workers as innovators

Agricultural extension workers acting as innovators help introduce new technologies, such as smartphone-based applications for crop monitoring and e-commerce platforms for agricultural products. With a regression coefficient of 1,021,532,533 ($p < 0.05$), extension workers have been able to expand digital technology adoption among farmers.

This result emphasizes the importance of continuous training for extension workers to stay relevant with the latest technological developments. In line with the findings of Sapitri *et al.* (2020), extension workers play a key role in disseminating agricultural innovations relevant to the local needs of farmers.

Analysis of the role of extension workers as educators

As educators, extension workers enhance farmers' understanding of digital technology and modern agricultural methods. The analysis shows a regression coefficient of 1,173,773,674, indicating a significant impact ($p < 0.05$) on farmers' income, especially for those who are more adaptive to new technologies.

The educational role is essential for building farmers' digital literacy, particularly in rural areas. According to Rahma *et al.* (2024), module-based training and the use of interactive digital media have proven effective in increasing technology adoption.

Implications of digital technology adoption on farmers' income

The findings indicate that although there is no direct significant impact on farmers' short-term income, the adoption of digital technology contributes to the efficiency of production processes and farm management. This study is consistent with Harkness *et al.* (2023), who highlighted the importance of crop diversification and technology utilization for income stability.

Challenges faced by farmers in digital transformation

Despite the promising potential of technology adoption, several key challenges were identified:

1. Low Digital Literacy: Many farmers, especially older ones, struggle to understand new technologies.
2. Limited Infrastructure: Rural areas often lack reliable internet access.
3. Lack of Policy Support: There is minimal policy specifically supporting digital transformation in the agricultural sector.

To address these challenges, collaboration between the government, private sector, and educational institutions is needed to provide continuous training, improve infrastructure, and promote policies that support digital transformation.

Summary of findings and interpretations

The study findings reveal that the roles of extension workers as facilitators, innovators, and educators positively influence farmers' ability to adopt digital technology. Although the direct impact on income is not statistically significant, the long-term implications of digital transformation on agricultural efficiency are evident.

CONCLUSION

This study concludes that while farmers in Lowokwaru, Malang, can sustain income independently, the roles of extension workers as facilitators, innovators, and educators play a pivotal role in enhancing the adoption of digital technologies. These roles contribute to improved efficiency and capacity among farmers, although the immediate impact on income remains statistically limited. The findings underline the importance of targeted training programs and policy interventions to empower extension workers as key agents of digital transformation in agriculture. Future research should consider a broader geographical scope and incorporate longitudinal designs to better understand the long-term economic impacts of digital technology adoption.

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