

Farmers' Participation as an Accelerator in Digital Agriculture in Kendal Regency**Wulan Sumekar¹, Siwi Gayatri^{1*}, and Alexander Morados²**¹Agribusiness Study Program, Universitas Diponegoro²Camiguin Polytechnic State College Central Mindanao University*Correspondence e-mail: siwigayatri@lecturer.undip.ac.id

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ABSTRACT

The study was conducted to describe the level of farmers' participation and analyze the factors influencing their participation in adopting digital communication and information technology in farming activities. The research was carried out from July to December 2023 in Tampingwinarno Village, one of the villages in Sukorejo Subdistrict, Kendal Regency. This location was selected because the village's primary economic activities have shifted from rice farming to guava plantations accompanied by downstream industries. The respondents were active members of farmer groups engaged in agriculture especially cassava and guava products and utilizing internet access through social media for product marketing and communication among farmers. The total number of respondents was 125. Primary data were collected through interviews using a questionnaire as a reference, along with field observations. The data were analyzed using multiple linear regression. The results showed that the average level of farmers' participation was relatively high (64.01%). Experience, equality, access, business complexity, age, and education significantly influenced participation simultaneously ($p < 0.001$) with an R^2 of 0.7549. Partially, factors like access ($p < 0.001$), business complexity ($p < 0.05$), equality ($p < 0.1$), and education ($p < 0.1$) affected farmers' participation in adopting digital communication and information technology. Farmers' participation can accelerate digitalization in the 5.0 era to enhance farmers' competitiveness.

Keywords: accelerator, digital agriculture, participation, farmers

INTRODUCTION

The development of the Industrial Revolution, which integrates digital technology and the Internet with conventional industries, has significantly increased productivity in business efficiency and reduced unemployment rates. Communication and information technology have contributed to economic growth, with a recorded increase of 5.90 in 2023 compared to 5.85 in 2022 on a scale of 0–10 (BPS, 2024). ICT (Information and Communication Technology) innovations have enabled interactions among agricultural stakeholders regardless of distance, thus improving farming efficiency (Setiawan et al., 2021). The internet penetration rate in Indonesia's population has increased in 2022, 2023, and 2024, with 77.01%, 78.19%, and 79.50%, respectively (Arif, 2024; Miine et al., 2023).

Javaid et al. (2020) and Harahap (2023) observed that integrating digital communication and information technology with the internet has influenced human relationships across various agriculture activities, for example, for market access, online marketplace, as well as extension

services. BPS (2023) data reveal that internet penetration among Generation X and Millennials productive generations in Indonesia aged 27–58, stands at only 49.58% of the potential 68.00%. Internet penetration also exhibits disparities based on location, with 69.50% in urban areas versus 30.50% in rural regions and by gender, with 50.70% for men and 48.10% for women (Arif, 2024).

Several factors contribute to the disparity in internet penetration, particularly in agriculture. These include equipment compatibility, physical, social, and economic access, rural communication infrastructure (e.g., limited communication networks), and scale of farming operations. Farmers with larger-scale operations are more inclined to invest in technology than those with smaller-scale operations (Anwarudin and Dayat, 2019; Audrej et al., 2020). Most Indonesian farmers operate on less than 0.5 hectares of landholdings and have relatively low education levels (BPS, 2022).

Communication and information technology penetration can be enhanced through collaboration involving extension workers and group institutions (Intiaz, 2022; Kotler et al., 2022). The Indonesian government's economic policies to address the challenges of the Industrial Revolution focus on equipping human resources, expanding employment opportunities, and facilitating entrepreneurship through micro economic in individual business centres and franchise areas with easy internet access down to the village level. Therefore, research is needed to examine farmers' participation as a representation of technological advancements in communication and information technology toward the industrialization era 5.0. The research also wanted to described the impact of using information technology on farmers' participation in farmer' group include planning, implementation of an activity in farmer' group. This study aims to describe the level of farmers' participation and analyse the factors influencing their participation in adopting digital communication and information technology in farming practices.

RESEARCH METHOD

The study was conducted from July to December 2023 in Kendal Regency, Central Java, Indonesia. Kendal is a region encompassing lowlands, highlands, and coastal areas. Tampingwinarno Village, located in Sukorejo Subdistrict, was selected as the research site due to its economic transition from rice farming to guava plantations, accompanied by downstream industries. Its strategic location near Kendal city center has also transformed Tampingwinarno into a tourist destination.

The respondents were active members of farmer groups engaged in cassava and guava farm include selling the products. These farmers utilized internet access via social media platforms for product marketing and communication among fellow farmers. They were 125 respondents who actively using internet access for marketing and communication.

Primary data were collected through interviews using questionnaires as guidelines, supported by field observations. Secondary data were obtained from records provided by relevant institutions. Survey was employed to this research. The collected data were analyzed using multiple regression analysis. Participation questionnaire encompassed respondents' involvement in planning, implementation, and decision-making in digitalization through social media platforms (WhatsApp, Instagram, and websites). The level of participation and the factors influencing participation were measured using a Likert scale, with scores of Very High = 5, High = 4, Moderate = 3, Low = 2, Very Low = 1. Moreover, the data also was tested to determine data reliability and validity. The test resulted that data was reliable and valid. The influence factors (farming experience, equality, internet access, business complexity, age, and education) toward farmers' participation using information technology in farming was analyzed using a multiple linear regression formula as follows:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + e$$

Explanation:

Y = Participation level

a = Constant

b = Regression coefficient

X_1 = Farming experience

X_2 = Equality

X_3 = Internet access

X_4 = Business Complexity

X_5 = Age

X_6 = Education

e = Standard error

RESULTS AND DISCUSSION

Tampingwinarno Village is located in Sukorejo Subdistrict, Kendal Regency, Central Java Province, Indonesia. Kendal Regency is geographically positioned between 109°40'–110°18' East Longitude and 6°32'–7°24' South Latitude. The regency is strategically located along the Pantura highway, which connects major cities such as Jakarta, Semarang, and Surabaya.

Kendal Regency is generally divided into lowland (coastal) areas in the northern part and highland (mountainous) areas in the southern part. Tampingwinarno Village is situated in the highland region of southern Kendal, characterized by mountainous terrain with altitudes ranging from 10 to 2,579 meters above sea level. The climate is relatively cool, with an average temperature of 25°C and an annual rainfall of 2,200 mm. These topographical and climatic conditions make Tampingwinarno suitable for plantation crop development. Its ranking is the second-highest in guava farming, with guava farmers comprising 9.57% of the population. This creates alternative employment opportunities for 19.15% of the population, primarily casual laborers (BPS, 2023).

The total population of Tampingwinarno Village is 2,434 people, with 49.55% male and 50.45% female. The productive age group (15–60 years) makes up 64.46% of the population, indicating that Tampingwinarno has favorable economic and social conditions. The productive population is sufficient to support the social and economic needs of the non-productive population.

Respondent Characteristics

Farmers today are required to evolve from conventional farming to practices that integrate communication and information technology (ICT). As stated by Khaeron (2022), agricultural practices must embrace automation in production and environmentally intelligent technologies. Thus, it is essential to identify the characteristics of farmers managing these farming operations. The respondent characteristics are summarized in Table 1.

Table 1 shows that most respondents rely on farming as their primary livelihood (74.40%). Socially, the respondents are categorized as having low educational attainment, with 76% having less than six years of education (not completing elementary school). Furthermore, 79.29% of respondents belong to generations that did not grow up with internet access, relying heavily on their experience; 60% have more than 15 years of farming experience. As noted by Setiawan et al. (2021) and Intiaz (2023), enhancing the adoption of agricultural information technology requires strengthening collaboration among farmer groups and increasing the role of agricultural extension workers. Members of farmer groups allow respondents to engage directly with agricultural stakeholders through digital innovations without geographical constraints.

Economically, Table 1 illustrates that most respondents are small-scale farmers (64% own less than 0.50 hectares of land) and primarily engage in on-farm activities (51.20%). This condition indicates inefficiency in farming practices. These findings align with BPS (2022) data, which show that the majority of agriculture in Indonesia is carried out by smallholder farmers (petani gurem) with limited land ownership (less than 0.50 hectares), low educational levels, and a high degree of diversity. Burg et al. (2019) argued that achieving efficient farming requires both the development of

agricultural communication and information systems and the incorporation of digital agriculture concepts.

Table 1. Characteristics of Respondent Farmers

Characteristics	Number	
	N	%
Age by Generation (years)		
- Baby boomer (59 – 77)	39	31,20
- X (43 – 58)	60	48,00
- Millennial (27 – 42)	26	20,80
Gender		
- Male	97	77,60
- Female	28	22,40
Education (years)		
- ≤ 6	95	76,00
- > 6 - 9	17	13,60
- > 9 - 12	12	9,60
- > 12	1	0,80
Family Size (number of members)		
- ≤ 4	118	94,40
- > 4	7	5,60
Main Occupation		
- Farming	93	74,40
- Non-Farming	32	25,60
Farming Experience (years)		
- ≤ 5	20	16,00
- > 5 - 10	17	13,60
- > 10 - 15	13	10,40
- > 15 - 20	18	14,40
- > 20	57	45,60
Land Ownership (m ²)		
- Small Scale (≤ 500)	80	64,00
- Medium Scale (> 500 – 1000)	14	11,20
- Large Scale (> 1000)	31	24,80
Farming System Variety		
- Upstream – on farm – Downstream	3	2,40
- on farm		
- Upstream – on farm	64	51,20
- on farm - Downstream	26	20,80
	32	25,60

Source: Primary data processed, 2024

Information and communication technology development programs for smart agriculture aim to involve all farmers, regardless of gender. The study reveals that male respondents (77.60%) outnumber female respondents (22.40%). This male dominance is influenced by the patriarchal culture, where men, as heads of families and breadwinners, are more likely to participate in work-related activities. According to Putri and Prawinda (2021) and Bustanul et al. (2023), women's participation in agricultural activities is often perceived as merely assisting their husbands rather than independently engaging as farmers. Similarly, Deluna (2023) notes that the success of agricultural

succession is influenced more by gender-conscious participation in agricultural activities than by women's involvement in decision-making processes.

Farmers' Participation in Using Communication and Information Technology

Agriculture development in Indonesia has been advanced through communication and information development programs across urban and rural areas. Extension activities and farmers' participation influence the success of smart agriculture. According to Anwarudin and Dayat (2019), the sustainability of agricultural agribusiness is affected by, among other factors, extension activities and farmers' involvement in these activities. The state of farmers' participation in internet usage is shown in Table 2.

Table 2. Number of Respondents Based on Participation in Internet Usage for Farming

Form of Participation	Participation in Internet Usage for Farming					
	High		Medium		Low	
	n	%	n	%	n	%
Planning	85	68,00	31	24,80	9	7,20
Implementation	59	47,20	55	44,00	11	8,80
Decision Making	26	20,80	38	30,40	51	40,80

Source: Primary data processed, 2024

The average level of respondents' participation in using the Internet for farming is considered high, at 64.01%. According to Riswandi et al. (2024), the ability to quickly transform digitally is a benchmark for farmers to apply communication and information technology 5.0. This is believed to be due to farming being their primary source of income (Table 1), in line with Taramuel et al. (2023), who state that the advantages of economies of scale and farming as a primary income source will drive the adoption of new technologies. This situation is better than the data from Arif (2004), which shows internet usage penetration in urban areas at 69.5% and in rural areas at 30.5%.

Table 2 shows that most respondents participate in planning and implementation activities for using the Internet in farming, with high to moderate participation levels of 92.80% and 91.20%, respectively. However, participation in decision-making activities is relatively low, at 40.80%. Based on interviews, most of the farmers thought that they had highly trust to farmers group to support their farming activities. The farmers believed farmer group will make best decision to support their activities. Moreover, this is also suspected because respondents belong to the Baby Boomer and Generation X cohorts, making up 79.20% (Table 1), who rely more on experience, with 70.40% of respondents having more than 10 years of farming experience before the internet era. According to Deluna (2023), the success of agricultural succession is influenced more by gender-aware agricultural involvement than participation in decision-making. Similarly, Hutasuhut et al. (2024) argue that agricultural succession interventions and extension activities require the daily involvement of the younger generation in agricultural operations rather than relying solely on experience.

Factors Affecting Farmers' Participation in the Implementation of Digital Communication and Information Technology in Farming

Based on the interview, most of the respondents were using digital communication and information technology for marketing their product and communication among them. Farmers were able to using online marketing and social media, such as Instagram to sell their agriculture product. They were communicating among them using internet, such us, WhatsApp and Facebook to share their thought or opinion or share experience about their farming and marketing activities. The research

results show that based on the F-test, factors such as experience, equality, access, business complexity, age, and education have a significant effect ($p < 0.05$) with a coefficient of determination (R^2) = 0.7549 (the model can explain 75.49% of the variable Y) (Table 3). Based on the t-test, as shown in the following regression equation:

$$Y = 38.045 + 0.143X_1 - 2.290X_2^* + 22.275X_3^{***} + 2.955X_4^{**} - 0.089X_5 - 0.487X_6^* + e$$

The results of the t-test analysis, as shown in Table 3, indicate that the access factor has a highly significant effect ($p < 0.001$) on farmers' participation in the application of communication and information technology in the industry. The complexity of the business, equality, and education have a significant effect ($p < 0.001$), ($p < 0.05$), ($p < 0.1$), and ($p < 0.1$) on the respondents' participation in the use of communication and information technology (WA, IG, and Facebook).

Table 3. Factors Affecting Farmers' Participation in the Implementation of Communication and Information Technology

Independent Variable	Dependent Variable		
	Farmers' Participation		
	Std. Coefficient	t value	p
Constant	38,0445	6,047	1,78e-08***
Experience	0,1424	0,633	0,5282
Equality	- 2,2900	- 1,878	0,0628
Access	22,2751	18,394	0,0000 ***
Business Complexity	2,9552	2,076	0,0401 *
Age	- 0,0890	- 1,617	0,1086
Education	- 0,4873	- 1,718	0,0884
F			0,0000***
R squared			0, 7549
Number of observation			125

Note : *** significant at $p < 0,001$, ** significant at $p < 0,01$, * significant at $p < 0,05$ dan significant at $p < 0,1$

Source: Primary data processed, 2024

Internet access significantly influences farmers' participation in implementing digital communication and information technology. According to Kotler et al. (2022), the success of digital transformation is determined by the organization's ability, which is assessed by the extent to which employees can work remotely and collaborate virtually using digital tools. Additionally, its digital expertise, agility, and culture reflect the organization's capabilities. The research findings show that education plays a significant role in farmers' participation in implementing digital communication and information technology, while experience and age do not have the same impact. This condition mainly some of the farmers were reluctant to apply digital communication for improvement of their farming activities. It need access for farmers for training and support to apply new technology. This aligns with the respondent characteristics, which reveal that only 20.80% of millennials are involved, serving as a driving force for digital transformation.

The equality factor also influences farmers' participation in applying digital communication and information technology. Women contribute to improve food security and family income from on-farm to off-farm activity. Based on this research shows that some of the farmers are women who give contribution for their farming activity. More than 20% of the farmers are women hence their involvement in in farming cannot be underestimated and they need to have access to use technology. Business complexity also impacts farmers' participation in digital communication and information

technology adoption. Business complexity in this research rely on farm size. It was effected by land size, capital, access to market. This is supported by 36% of respondents owning medium to large-scale land and 48.20% diversifying their farming businesses (Table 1). According to Kotler et al. (2022) and Mohd et al. (2022), the characteristic of high-tech industries is a short life cycle that emphasizes the ability to compete by adapting to rapid changes in preferences. This is further supported by Mirajiani (2022), who states that the constantly connected digital environment has transformed traditional farming strategies, rendering them ineffective and necessitating adjustments in long-term planning. Riswandi et al. (2024) also emphasize that fast digital transformation capability is a crucial benchmark for farmers in applying Communication and Information Technology 5.0.

CONCLUSION

The research on farmers' participation as accelerators of digitalization in the 5.0 era concludes that the average participation of farmers in applying digital communication and information technology in farming was high. Meanwhile, the factors of experience, equality, access, business complexity, age, and education simultaneously had a significant effect. Partially, variable of access, business complexity, equality, and education had influence toward farmers' participation in implementing digital communication and information technology.

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