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Digital Technology Utilization for Increasing Rice Production in Farmer-Owned Enterprises: The Case of Lumpang Semar Sejahtera

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ABSTRACT

This study examines the effects of internet accessibility and internet usage intensity on farmers' knowledge and their implications for rice production at the Lumpang Semar Sejahtera Farmer-Owned Enterprise (FOE). The research is motivated by a production gap, where annual rice output (132 tons) remains significantly below consumer demand (240 tons). A quantitative approach was employed using a census method involving 70 rice farmers. Data were analyzed through path analysis with a bootstrapping technique to assess both direct and indirect relationships among variables. The findings reveal that internet accessibility does not significantly influence farmers' knowledge but exerts a significant negative effect on rice production. In contrast, internet usage intensity has a positive and significant impact on both farmers' knowledge and rice production. However, farmers' knowledge does not mediate the relationship between internet-related variables and rice production. These results indicate that internet utilization has not yet functioned as an effective driver of productivity improvement through knowledge enhancement. Therefore, this study suggests that the FOE should prioritize increasing the intensity of internet use while integrating digital information into conventional farmer group activities to address existing structural constraints.

Keywords: *Accessibility, Intensity, Internet, Farmers knowledge, Rice production*

BACKGROUND

The agricultural sector in Indonesia plays a vital role in national economic development and contributes significantly to food security. This sector accounts for 12.53% of Indonesia's economic growth (Badan Pusat Statistik, 2023). Agriculture consists of several subsectors, one of which is the food crops subsector. Rice is a primary commodity within this subsector. Based on the harvested area and rice production in Indonesia in 2024, the harvested area reached approximately 10.05 million hectares, a decrease of 1.64 percent or 167.57 thousand hectares compared to 2023. This decline was followed by a reduction in national rice production to 53.14 million tons of dry milled grain or, if converted into rice, the total production in 2024 is equivalent to 30.62 million tons of rice (Badan Pusat Statistik, 2025). These figures indicate that although Indonesia remains an agrarian country

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with a vast harvested area, the challenges in maintaining production stability remain high, particularly due to productivity fluctuations and limited technology adoption at the farmer level.

Productivity variations between regions are still quite significant and are influenced by cultivation characteristics and the application of technological innovations. Farmers using hybrid seed varieties are able to produce 52.25 quintals per hectare, slightly higher than those using inbred varieties at 51.36 quintals per hectare (Badan Pusat Statistik, 2025). Furthermore, farmers who are members of farmer groups have an average productivity of 51.55 quintals per hectare, slightly higher than non-member farmers at 51.17 quintals per hectare (Badan Pusat Statistik, 2025). This indicates that the level of knowledge, access to information, and the ability to implement agricultural technology remain differentiating factors among farmers in achieving optimal yields. Senthilkumar (2022) states that several factors affect rice production, including climate, weather, land area, selection of planted varieties, fertilizers, and the management of plant-disturbing organisms.

Similar challenges are experienced by the Lumpang Semar Sejahtera Farmers-Owned Enterprise (FOE), where average production reaches 132 tons per year, while consumer demand is approximately 240 tons. This gap between production capacity and market demand reflects that the potential for increasing yields has not been fully balanced by the farmers' ability to access and utilize relevant agricultural information. The utilization of information technology, such as the internet, can serve as a strategic solution to address these challenges. The internet has great potential for farmers to seek agricultural information. Social media platforms, online discussion forums, and websites allow farmers to learn and exchange information with other farmers, agricultural experts, and extension agents. Long-term internet utilization can help farmers increase their production yields by optimizing the distribution of production factors and cultivation structures (Tong et al., 2024).

Better access to information allows farmers to increase their knowledge from the pre-planting, planting, maintenance, and harvesting stages to post-harvest rice processing. This knowledge is essential because comprehensive understanding is a key factor. Such understanding encourages farmers to adopt better cultivation practices, thereby contributing to the overall increase in rice production (Srisopaporn et al., 2015). The key to success for better agribusiness performance is developing the mindset of small scale farmers regarding the effective use of information, as well as educating and training them (Raungpaka & Savetpanuvong, 2017). Based on this description, this study aims to analyze the influence of accessibility and intensity of internet use on increasing rice production, with farmer knowledge as a mediating variable at the Lumpang Semar Sejahtera Farmers-Owned Enterprise.

RESEARCH METHODS

This research was conducted at the Farmers-Owned Enterprise (FOE) Lumpang Semar Sejahtera from September to November 2025. This location was purposively selected due to the existing gap between production and consumer demand, necessitating a study to identify relevant solutions, such as the utilization of the internet to support increased rice production. This study employs a quantitative research design with a census approach. A census is a quantitative method

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used to obtain data regarding beliefs, opinions, characteristics, behaviors, and variable relationships, as well as to test hypotheses within a population (Sugiyono, 2022).The data used in this study consist of primary and secondary data. Primary data were obtained directly through structured interviews supported by questionnaires administered to farmers at FOE Lumpang Semar Sejahtera. Secondary data were sourced from literature reviews of books, journals, and scientific publications relevant to this research. The sampling technique utilized a census method, where all members of the population were designated as respondents.

The population in this study comprised 70 rice farmers at FOE Lumpang Semar Sejahtera. An initial screening was performed via questionnaires to identify farmers who had utilized the internet for agricultural information. Out of the 70 respondents, 45 had used the internet and were included in the primary analysis, while the remaining 25 respondents who had not used the internet were recorded and analyzed descriptively.Data analysis was conducted using quantitative methods after the collected data were tabulated. Path analysis was performed using the SmartPLS version 4 application, applying the partial least square (PLS) method to evaluate relationships between variables within the model. Path analysis is employed to determine the direct and indirect effects of independent variables on the dependent variable through a mediating variable. The analysis focuses on the inner model, which examines the relationships between variables, their strength, and their significance. The evaluation of the inner model includes the coefficient of determination (R^2), path coefficients, path significance, and effect size (f^2).

RESULT AND DISCUSSION

Research respondents were dominated by 65 males (92.9%), while female respondents only numbered 5 (7.1%). Gender plays an important role in the division of labor within the rice production process. Men are more dominant in heavier and more hazardous work compared to women. Tasks such as land preparation, levee construction, fertilization, and the application of agricultural chemicals are predominantly performed by men. Meanwhile, tasks such as weeding and planting are dominated by women (Thapa et al., 2020). The role of men, who tend to handle technical and heavy aspects of rice cultivation, positions them as farm managers responsible for technical and strategic decisions. Men more frequently make decisions regarding fertilizer dosage and the use of agricultural chemicals, aligning with their control over inputs and access to technical services (Mishra et al., 2017).

The majority of respondents are in the 51-60 year age range, totaling 36 people (51.4%). The age group over 60 years consists of 18 people (25.7%) of the total respondents. Meanwhile, the 41-50 year age group accounts for 13 people (18.6%), and the remaining respondents belong to the 31-40 year age group, totaling 3 people (4.3%). This composition shows that rice farming in the research location is mostly driven by the older generation. Age is a relevant factor regarding the adoption rate of new developments in rice cultivation. In relation to the adoption of new seed varieties, older farmers tend not to adopt new varieties because they lack relevant information and rely more on

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conventional practices (Khan et al., 2021). However, this contradicts the findings of Tong et al. (2023), which suggest that older farmers tend to adopt new seeds according to current climatic conditions. This possibility may arise from extensive farming experience and a better understanding of climate adjustment. The formal education level of the majority of respondents is a primary school background, with 35 people (50%). This is followed by junior high school graduates with 22 people (31.4%). Respondents who completed high school numbered 12 people (17.1%), and only one respondent (1.4%) had a higher education background. Formal educational background often correlates with literacy skills, including digital literacy and the ability to absorb technical information. This is because only educated farmers can perceive the benefits of agricultural extension, receive such services, and practice their crop cultivation techniques according to the instructions and training provided by extension workers (Noor & Hossain, 2017).

Table 1. Characteristic Respondent

Variable	Frequency	Percentage (%)
Age		
31-40 year	3	4,3
41-50 year	13	18,6
51-60 year	36	51,4
>60 year	18	25,7
Education		
Primary School	35	50
Junor High School	22	31,4
High School	12	17,1
Higher School	1	1,4
Experience		
10-20 year	10	14,3
21-30 year	18	25,7
31-40 year	27	38,6
>40 year	15	21,4
Land Area		
<5000 m^2	16	22,8
5000-10000 m^2	41	58,6
>10000 m^2	13	18,6

Source: Primary Data, 2025

Furthermore, respondents are highly experienced farmers in rice cultivation. The largest group consists of farmers with 31-40 years of experience, totaling 27 people (38.6%). Additionally, 15 people (21.4%) were recorded to have more than 40 years of experience. Long farming experience certainly ensures that respondents have understood established cultivation methods and practices. The longer the farming experience, the more skills and extensive knowledge the farmer will possess regarding the farm operation (Ardelia & Anwarudin, 2020). The distribution of respondents based on land area for rice farming shows that 41 people (58.6%) manage land in the range of 5,000 to 10,000

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square meters. The group of respondents with land less than 5,000 square meters numbered 16 people (22.8%), while farmers managing more than 10,000 square meters constitute the smallest group, at 13 people (18.6%). These data indicate that rice farmers in FOE Lumpang Semar Sejahtera are dominated by small to medium scale operations. This limited scale of operation causes productivity and farming efficiency to tend to be lower compared to farmers with larger land areas.

Based on Table 2, there are eight rice varieties planted by respondents in the research location. Out of 70 respondents, the most widely cultivated varieties are Ciherang and IR 64, each grown by 21 respondents (30.0%). Furthermore, the Inpari 32 variety is planted by 17 respondents (24.3%), the Mapan variety is cultivated by 6 respondents (8.6%), the Mekongga variety is grown by 2 respondents (2.9%), while the Cibatu 06, Inpari 42, and Mentik Wangi Susu varieties are each planted by only 1 respondent (1.4%). Research results by Qadir et al. (2024) indicate that Inpari 32, Ciherang, Inpari 42, and Mekongga are the most widely adopted types due to their high yield potential, resistance to pests and diseases, and good adaptation levels across various agroecological conditions. Similarly, Purbiati et al. (2024) reported that Inpari 32, Inpari 42, and Inpari 45 received positive acceptance among the community because of their superior grain quality in terms of color, aroma, taste, and texture.

Table 2. Rice Variety Grown by Farmer

Variety	Frequency	Percentage (%)
Cibatu 06	1	1,4
Ciherang	21	30
Inpari 32	17	24,3
Inpari 42	1	1,4
IR 64	21	30
Mapan	6	8,6
Mekongga	2	2,9
Mentik Wangi Susu	1	1,4

Source: Primary Data, 2025

The status of internet usage at the research location shows that out of a total of 70 respondents, 45 individuals (64%) have utilized the internet for farming activities, while the remaining 25 individuals (36%) have not yet adopted the technology. Farmers who use the internet generally seek information regarding cultivation techniques, pest control, agricultural product prices, and weather forecasts. This is consistent with findings that internet utilization plays a vital role in expanding access to information and positively impacting farmers' income (Dwi & Sulistiawati, 2021). Conversely, for farmers who do not use the internet, the primary obstacles identified are cognitive in nature, such as the inability to operate devices or the perception that learning new technology is too difficult at their age. This group ultimately relies heavily on traditional information sources such as Agricultural Extension Officers, fellow farmers, and agricultural shops. Pendidikan mempengaruhi petani bagaimana memanfaatkan perangkat yang dimilikinya dalam pertanian. Peningkatan pada sisi sumber

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daya manusia membuat petani lebih masuk akal dan menerima teknologi terkini (Mariyono, *et al., 2021)*. Some other reasons are that farmers do not have devices (*smartphones*, computers, or other devices) that can be used, but there are also farmers who actually have access to devices even though they are not personal property (belonging to children or relatives) but are not able to operate the devices, and consider it "difficult to learn". There is another reason why this group has not used the internet to find agricultural information, namely farmers use the internet as a means of communication or entertainment.

Table 3. Internet User

Group	Frequency	Percentage (%)
Internet User	45	64
Not Internet User	25	36

Source: Primary Data, 2025

In this analysis, the variables of accessibility (X1), intensity (X2), and farmer knowledge (Z) were measured using a three-point Likert scale (1–3) with a total of 12 statement items. Variables X1 and X2 were assessed only by the 45 respondents who used the internet, while variable Z and production increase (Y) were assessed by all 70 respondents. Specifically for variable Y, the data were measured in kilograms per planting season using a ratio scale.

Tabel 4. Descriptive Analysis

Variable	N	Mean	Std. Devation
Internet Usage Accesibility (X1)	45	24,9	5,6
Internet Usage Intensity (X2)	45	19,8	6,8
Farmer Knowledge (Z)	70	28,3	3,8
Rice Production Increase (Y)	70	384,6	616,6

Source: Primary Data, 2025

The descriptive analysis results show that Internet Usage Accessibility (X1) is in the high category with a mean value of 24.9. This high accessibility is driven by personal device ownership (primarily smartphones), stable internet network at both the farm and residence, and access costs that are considered affordable by farmers. The contrast between high accessibility and low intensity of internet use shows that there is an inconsistency in the use of technology. Farmers are able to access the internet, but do not take the time regularly. This indicates a lack of motivation and integration of digital habits in farming. The variable of Increasing Rice Production (Y) has a mean of 497.21kg/land area, and a standard deviation of 700.83. Standard deviation measures the level of variability of data, if the standard deviation value is greater than the mean value, then there is wide variability in the data (Ghozali, 2021).

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Farmers use the internet in farming activities by searching for agricultural information through *websites*, social media, and other media on the internet. Farmer groups who have used the internet generally use this access to obtain information related to cultivation techniques, pest control, agricultural product prices, and weather forecasts.

Despite the majority of respondents being elderly, they demonstrate sufficient proficiency in operating devices. The availability of physical infrastructure is a crucial prerequisite for farmers to have the means to search for information (Das & Pradip, 2021). However, this condition is inversely proportional to Internet Usage Intensity (X2), which falls into the low category with a mean of 19.8. This low intensity is evident from non-routine usage behavior, where most farmers access the internet ≤2 times per day with a short duration of less than 30 minutes. Furthermore, farmers tend to be passive and rarely participate in online forum discussions or digital information sharing. This indicates that although access is widely available, there is a lack of motivation or strong integration of digital habits into farming activities. As stated by Das & Pradip (2021), media usage behavior is the primary determinant of success in knowledge acquisition, rather than mere access availability. Meanwhile, Farmer Knowledge (Z) is in the high category with a mean of 28.3. This score reflects farmers' strong and comprehensive technical understanding from the pre-planting stage, land preparation, to post-harvest handling. Finally, for the Rice Production Increase (Y) variable, an average value of 384.6 kg was found. However, this variable has a very wide standard deviation (616.6), which, according to Ghozali (2021), indicates high data variability or uneven results among farmers. This large variability suggests that factors outside the cognitive scope (such as external factors) have a stronger influence on final production outcomes compared to farmers' theoretical understanding alone.

The outer model measures the relationship between variables and its indicators to ensure that the research instrument possesses good validity and reliability. Four main tests were conducted in the outer model, convergent validity, discriminant validity, construct reliability, and model fit. Convergent validity is measured by the loading factor value. The accepted criterion for an outer loading value is > 0.70 (Setiabudhi et al., 2024). Based on the results, all indicators across the variables of Internet Usage Accessibility (X1), Internet Usage Intensity (X2), Farmer Knowledge (Z), and Production Increase (Y) had outer loading values above 0.70, ranging from 0.822 to 1.000, thus declaring them valid. Discriminant validity ensures that the variables in the measurement model are truly distinct and do not overlap. This study utilized the Heterotrait-Monotrait (HTMT) ratio with an acceptance threshold of < 0.90 (Setiabudhi et al., 2024). After removing indicator X1_2 to resolve an initial overlap, the final HTMT values were all below 0.90, satisfying the requirements for discriminant validity. Reliability was measured using Cronbach's Alpha to test the consistency of the indicators. A variable is declared reliable if the value is > 0.70 (Setiabudhi et al., 2024). All variables met this criterion, with values for X1 (0.890), X2 (0.945), and Z (0.853). The Standardized Root Mean Square Residual (SRMR) was used to determine how well the model fits the empirical data. According to Henseler et al. (2016), SRMR is the appropriate fit criterion for PLS path models. The SRMR value for this research model was 0.080, which is below the < 0.10 threshold, indicating a good model fit.

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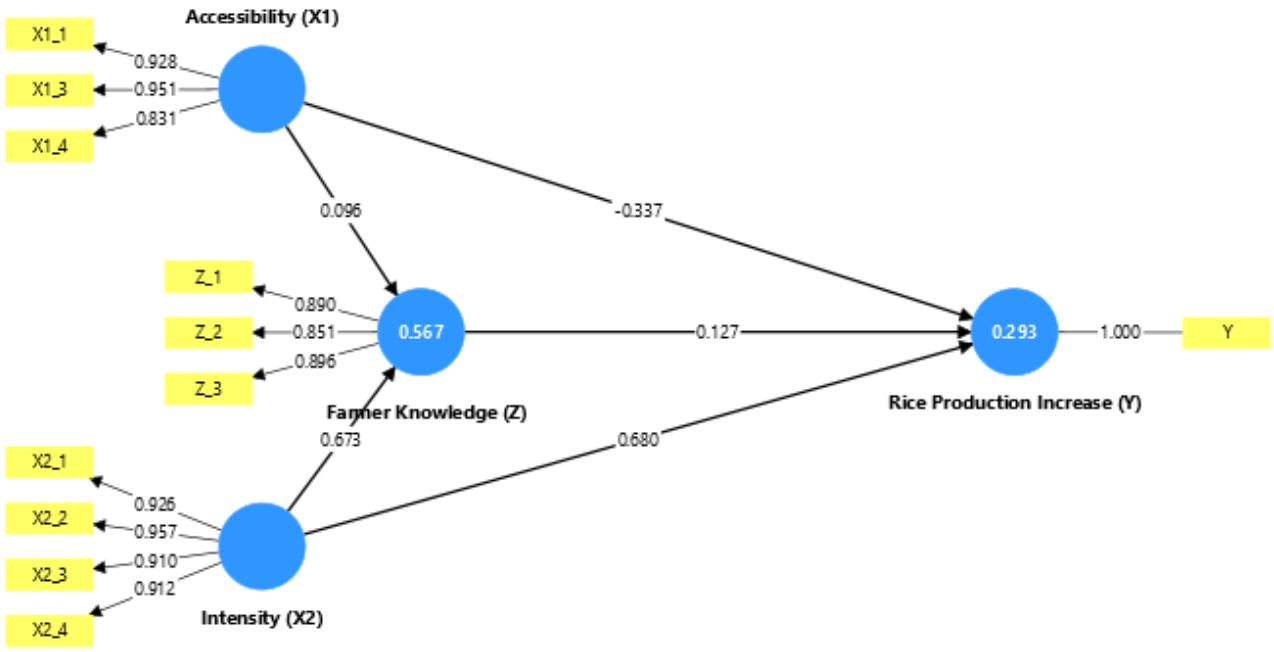

Figure 1. Result of Diagram Path Analysis

The R Square (R^2) measures how effectively the independent variables in the model explain the dependent variable, representing the overall predictive power of the model. Based on the analysis, the R^2 value for the farmer knowledge variable (Z) is 0.567, meaning that 56.7% of the variance in farmer knowledge can be explained by the accessibility and intensity of internet use, while the remaining 43.3% is explained by factors outside the model. For the rice production increase variable (Y), the R^2 value is 0.293, indicating that 29.3% of the variation in production increase is explained by the variables within the model.

Table 5. Indirect Effect

Indirect Effect	Original sample (O)	P values
Accessibility (X1) -> Rice Production Increase (Y)	0.012	0.400
Intensity (X2) -> Rice Production Increase (Y)	0.085	0.223

Source: Primary Data, 2025

Significance testing via bootstrapping revealed that internet usage accessibility ($X1$) did not have a significant direct effect on farmer knowledge (Z) (p=0.304). Surprisingly, while accessibility showed a statistically significant relationship with production increase (Y), the effect was negative (-0.337, p=0.017), suggesting that mere access to the internet without a focus on informative agricultural content may actually hinder production optimization. Li et al. (2024) note that internet

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access only improves productivity if it is used specifically to obtain useful agricultural information. In contrast, the Internet Usage Intensity (X2) showed a significant positive effect on both Farmer Knowledge (Z) (P-value 0.000) and Production Increase (Y) (P-value 0.001). This is consistent with Chandio et al. (2023), who found that access to critical agricultural information helps farmers optimize production. However, farmer knowledge (Z) itself did not yield a significant direct influence on production yields (p=0.216), likely due to the presence of external factors or structural limitations that outweigh theoretical understanding. Bootstrapping results for indirect effects showed that Farmer Knowledge (Z) failed to significantly mediate the relationship between either Internet Accessibility (X1) or Intensity (X2) and Production Increase (Y). The effect size (f^2) analysis, which shows that while internet intensity has a large effect on knowledge ($f^2 = 0.351$), the effect of knowledge on production remains small ($f^2 = 0.010$). Consequently, farmer knowledge was not a significant mediator, failing to bridge the relationship between internet usage and measurable gains in rice production. It is suspected that the information or knowledge obtained by farmers through the internet is not applied in their cultivation land, then there is a knowledge bias because too much information is exposed from the internet, or the application of the knowledge obtained on the internet turns out to be not suitable for the condition of the farmer's land. Therefore, the increase in rice production increased.

CONCLUSION AND SUGGESTION

Based on the quantitative analysis, it can be concluded that internet usage accessibility (X1) has no direct effect on farmer knowledge (Z) or rice production increase (Y). This indicates that the mere availability of digital devices and network infrastructure is insufficient to drive improvements in farmers' technical knowledge or production yields. In contrast, internet usage intensity (X2) demonstrates a direct and significant influence on both farmer knowledge (Z) and rice production increase (Y). This finding underscores that behavioral factors including the frequency, duration, and active participation in seeking digital information are the primary determinants of a farmer's success in acquiring and forming new agricultural knowledge. Furthermore, farmer knowledge (Z) was found to have no direct effect on rice production increase (Y), meaning that high levels of knowledge obtained from either digital or traditional sources fail to translate into measurable yield gains. Consequently, farmer knowledge fails to function as a mediating variable, as internet usage (both accessibility and intensity) does not have an indirect influence on production increases through knowledge. Therefore, in its current state, the internet does not yet serve as a strategic solution to overcome the production gaps identified in this study.

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