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The Impact of Agricultural Extension on the Technical Efficiency of Rice Farming in Tanjung Village, Pamekasan Regency

Pengaruh Penyuluhan Pertanian terhadap Efisiensi Teknis Usahatani Padi di Desa Tanjung Kabupaten Pamekasan

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ABSTRACT

A national decline in rice production of 0.036 million tons per year during the 2019–2023 period, accompanied by an increase in rice consumption of 0.753 kilograms per capita per year, has resulted in an imbalance between supply and demand, thereby prompting Indonesia to import rice. One of the strategies implemented by the government to boost agricultural productivity is through agricultural extension services. This study aims to analyze the effect of agricultural extension on the technical efficiency of rice farming in Tanjung Village, Pamekasan Regency. The analytical approach employed is Stochastic Frontier Analysis (SFA) using a Cobb-Douglas production function model. The total population of farmers in the research area comprised 130 individuals, from which 100 respondents were selected using a simple random sampling technique. The findings indicate that the average technical efficiency of farmers is only 53.6%. Land area, seed, and urea fertilizer were found to have a significant effect on production, while age, education, land ownership status, and participation in extension activities influenced inefficiency levels. Farmers who participated in extension programs were found to be more efficient than those who did not. These results highlight the importance of sustaining and improving the quality of agricultural extension services to support national food security. The government is expected to increase the number of officers overseeing agricultural activities in rural areas to enhance productivity.

Keywords: Agricultural Extension; Rice Farming; Rice Production; Stochastic Frontier Analysis; Technical Efficiency

ABSTRAK

Penurunan produksi beras nasional sebesar 0,036 juta ton per tahun selama periode 2019–2023, disertai dengan peningkatan konsumsi beras sebesar 0,753 kilogram per kapita per tahun, telah menyebabkan ketidakseimbangan antara pasokan dan permintaan, sehingga mendorong Indonesia untuk melakukan impor beras. Salah satu strategi yang diterapkan pemerintah untuk meningkatkan produktivitas pertanian adalah melalui penyuluhan pertanian. Penelitian ini bertujuan untuk menganalisis pengaruh penyuluhan pertanian terhadap efisiensi teknis usahatani padi di Desa Tanjung, Kabupaten Pamekasan. Pendekatan analisis yang digunakan adalah Stochastic Frontier Analysis (SFA) dengan model fungsi produksi Cobb-Douglas. Jumlah total petani di wilayah penelitian berjumlah 30 orang, dimana 100 responden dipilih menggunakan teknik sampling acak sederhana. Hasil penelitian menunjukkan bahwa rata-rata efisiensi teknis petani hanya sebesar 53,6%. Variabel luas lahan, benih, dan pupuk urea berpengaruh signifikan terhadap produksi, sedangkan usia, pendidikan, status kepemilikan lahan, serta partisipasi dalam kegiatan penyuluhan berpengaruh terhadap tingkat inefisiensi. Petani yang berpartisipasi dalam program penyuluhan terbukti lebih efisien dibandingkan dengan yang tidak mengikuti. Temuan ini menegaskan pentingnya mempertahankan dan meningkatkan kualitas layanan penyuluhan pertanian guna mendukung ketahanan pangan nasional. Pemerintah diharapkan meningkatkan jumlah petugas yang mengawasi kegiatan pertanian di wilayah pedesaan guna meningkatkan produktivitas.

Kata Kunci: *Efisiensi Teknis; Penyuluhan Pertanian; Produksi Padi; Stochastic Frontier; Usahatani Padi*

1. Introduction

Indonesia possesses approximately 26.3 million hectares of agricultural land, accounting for 13.9% of the country's total land area (World Bank, 2021), with 88.42% of its agricultural workforce employed informally (Badan Pusat Statistik, 2023c). The rice cultivation area in Indonesia encompasses approximately 10.2 million hectares, generating an aggregate production output of 53.6 million metric tons of unmilled rice (gabah) (Badan Pusat Statistik, 2023b). Based on these data, the trend of rice production in Indonesia during the 2019–2023 period has shown a decline of 0.036 million tons per year. Conversely, rice consumption in Indonesia has been increasing, with an average growth of 0.753 kilograms per capita per year (Pertanian, 2023). This imbalance has necessitated the importation of 3.06 million tons of rice to meet domestic demand. According to Dinar et al. (2023) rice imports are largely attributed to the failure to meet national consumption needs.

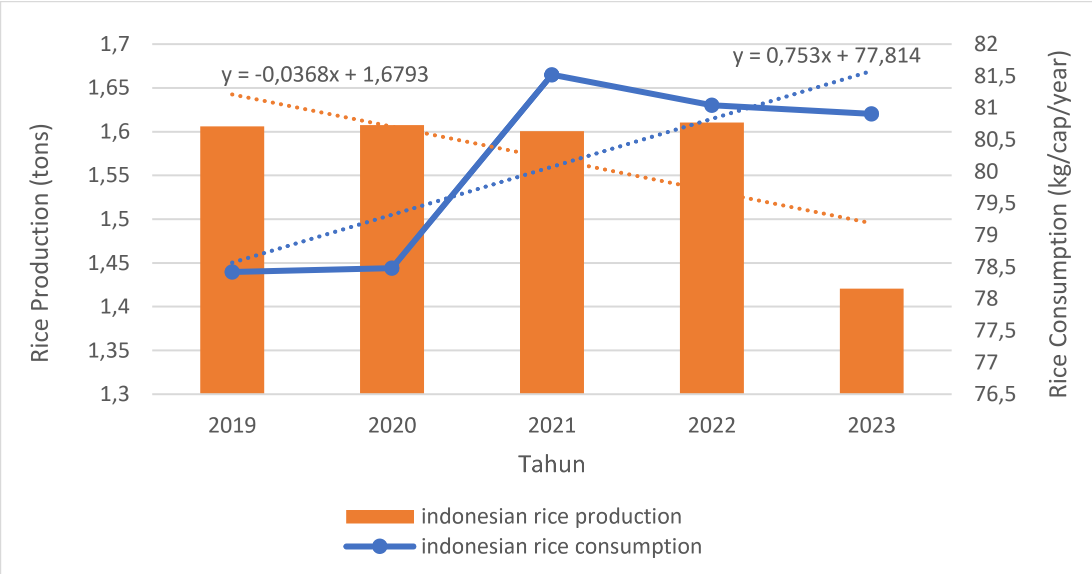

Figure 1. Proportion of rice production and consumption in Indonesia
Source: Processed Primary Data, 2025

The decline in rice production can be attributed to several factors. One of the key factors is climate change, which has led to increased pest infestations and higher rainfall intensity (Nuraisah & Kusumo, 2019). In addition, climate change has led to shifts in rainfall patterns, which in turn have affected the timing and seasonality of rice planting. Although climate change cannot be completely eliminated, its adverse impacts can be mitigated through farmers' anticipatory actions and adaptive strategies (Rozci, 2023). Farmers' limited capacity to adopt and utilize modern agricultural technologies has further heightened the risk of farming failures (Ali, 2017). These limitations arise from disparities in access to technology and internet infrastructure across regions, the generally limited level of formal education among farmers, and the generational gap between millennial farmers and earlier generations, which constrains the effective transfer of knowledge and skills related to agricultural technology (Faried et al., 2024). Another significant factor is land-use conversion, particularly on the island of Java. In this region, land conversion accounts for 90% of changes in land use and has contributed to a 60% reduction in rice production, thereby threatening Indonesia's food security (Dewinta & Warlina, 2020).

To address these challenges in rice production, the Indonesian government has undertaken initiatives such as forming farmer groups, and delivering agricultural extension services (Handayani et al., 2019). Agricultural extension is believed to have the potential to improve the efficiency of rice farming. This is because collaboration between farmers and extension agents can foster a more productive and sustainable agricultural system (Eryanto et al. 2024; Jamil et al. 2023). Extension workers play a vital role in enhancing agricultural productivity by acting as facilitators, motivators, and communicators (Tambipessy, 2023). Research by Rahman & Connor (2022) found that fertilizer use became more efficient following farmers' participation in extension activities. Similarly, Pan & Zhang (2018) demonstrated that farmers' knowledge of fertilizer management increased by 40% after attending extension programs. Furthermore, agricultural extension also plays an important role in improving farmers' risk management strategies (Asravor, 2019).

Numerous studies have examined the technical efficiency of rice farming in Indonesia. Howefer, relatively few have explored in depth the role of agricultural extension services. Novia & Satriani (2020) reported that the age of farmers had a negative regression coefficient, indicating that older farmers tended to be more efficient. Aprianti et al. (2020) identified that household size influenced technical efficiency, while Kusnadi et al. (2011) found that membership in farmer groups significantly affected inefficiency levels. However, in-depth research specifically examining the impact of agricultural extension on the technical efficiency of rice farming remains limited. For example, Sumarno et al. (2019) found that both agricultural extension officers and military personnel (Babinsa) were rated positively by farmers for their support roles. Similarly, Ardita et al. (2017) concluded that farmers evaluated the performance of extension officers favorably across several indicators. Based on these considerations, this study aims to examine the role of agricultural extension in enhancing the technical efficiency of rice farming.

2. Research Methods

2.1. Study Area

The study was conducted in Pamekasan Regency, East Java, Indonesia (Figure 2). This location was purposively selected due to a declining trend in rice production between 2018 and 2023, averaging 764.9 tons per year, despite simultaneous increases in productivity and harvested area (Badan Pusat Statistik [BPS], 2024). In addition, shifts in the rice planting season have been observed as a consequence of changing weather patterns, which are projected to further reduce rice production in the region (Iswantoro, 2024; Margaretta, 2024; Syarif & Sulaiman, 2024).

Within Pamekasan Regency, Pademawu District was chosen because it has one of the largest agricultural land areas, covering 3,772 hectares (BPS, 2023a). Furthermore, Tanjung Village was selected as the specific study site due to its status as the village with the largest agricultural land area in Pademawu District, amounting to 740 hectares (BPS, 2019).

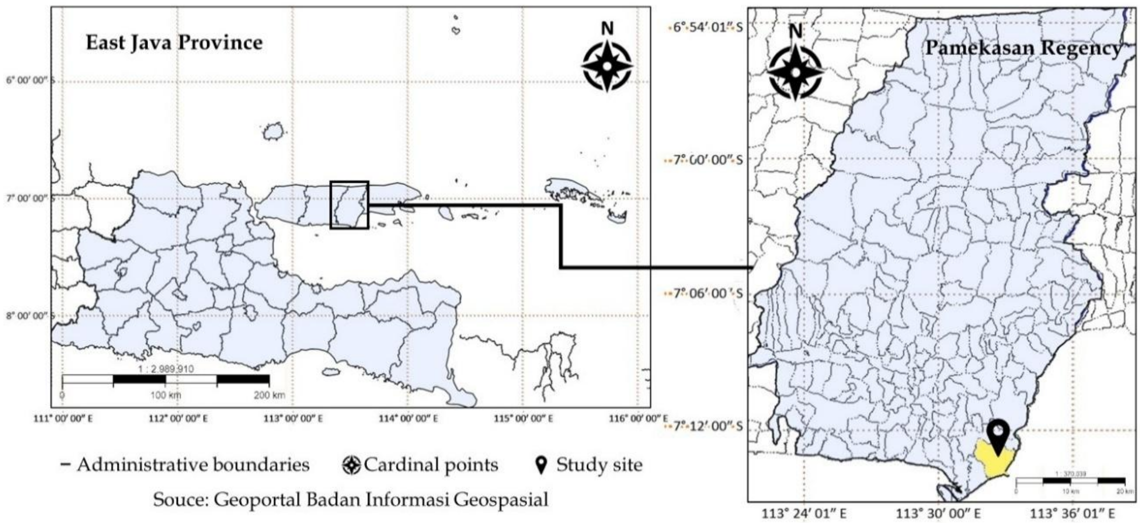

Figure 2. Location of the study
Source: Geoportal Badan Informasi Geospasial, 2025

2.2. Research Design and Data Collection

This study employed a quantitative research approach, utilizing numerical data to analyze and explain the phenomena under investigation (Djollong, 2014). The data used were primary data, collected through direct interviews with rice farmers using structured questionnaires.

2.3. Sampling Technique

The sampling technique applied in this study was simple random sampling, whereby each member of the population had an equal probability of being selected as a respondent (Arieska & Herdiani, 2018). The sample size was determined using the Slovin formula, as described by Malik and Chusni (2018):

$$n = \frac{N}{N\,(e)^2 + 1} \quad (1)$$

where *N* represents the total population of farmers, *n* denotes the sample size, and *e* is the tolerated margin of error, set at 5% (0.05). Population data were obtained from the local Village Office. Based on this formula, the sample size was calculated as follows:

$$n = \frac{130}{130\,(0.05)^2 + 1} = 100 \quad (2)$$

Thus, a total of 100 farmers were selected as respondents.

2.4. Analytical Method

This study applied Stochastic Frontier Analysis (SFA) using the Cobb–Douglas production function, estimated with Frontier 4.1 software. SFA is used to evaluate production performance by measuring the gap between actual output and the frontier (maximum attainable) output. A larger gap indicates greater inefficiency and higher potential for production improvement (Hilalullaily et al., 2021).

The Cobb–Douglas production function is specified as follows:

$$Y = A \times X_1^{\beta 1} \times X_2^{\beta 2} \times X_3^{\beta 3} \times X_4^{\beta 4} \times X_5^{\beta 5} \times X_6^{\beta 6} \quad (3)$$

To facilitate estimation and interpretation, the model was transformed into a double natural logarithmic (ln) form, which helps normalize data, reduce heteroscedasticity, and allows the coefficients to be directly interpreted as production elasticities (Novia & Satriani, 2020):

In this model, Y represents rice production, A is a constant, and X_1–X_6 denote the input variables, namely land area (X_1), seed (X_2), urea fertilizer (X_3), phonska fertilizer (X_4), pesticides (X_5), and labor (X_6). The term v_i captures random effects associated with external factors beyond the farmer's control, while u_i represents the non-negative inefficiency term reflecting technical inefficiency.

2.5. Measurement of Technical Efficiency

Technical efficiency (TE) was measured by comparing actual output with potential (frontier) output (Prasetyo & Fauziyah, 2020):

$$TE_i = \frac{Y_i}{Y_{i*}} \quad (4)$$

where Y_i denotes actual rice production and Y_{i*} represents potential production. The value of technical efficiency ranges from 0 to 1, with values closer to 1 indicating higher efficiency.

2.6. Inefficiency Model

The sources of technical inefficiency were identified using the inefficiency effects model proposed by Coelli et al. (2005). Technical inefficiency (U_i) is modeled as:

$$Ui = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + \delta_6 Z_6 + \delta_7 Z_7 + Wi \quad (5)$$

where U_i represents the level of technical inefficiency. The explanatory variables include gender (Z_1), age (Z_2), years of education (Z_3), household size (Z_4), farming experience (Z_5), land ownership status (Z_6), and participation in agricultural extension services (Z_7). The error term W_i captures random disturbances in the inefficiency model.

3. Results and Discussion

3.1. Farmer Characteristics

The respondents in this study had an average age of 51 years, with an average rice production of 1,053 kg. The highest recorded production reached 7,500 kg from a land area of 13,590 m², while the lowest was 250 kg from a plot of 582 m². Previous studies have shown that variables contributing to increased rice production include land area (Aprianti et al. 2020; Tinaprilla et al. 2013), seed (Kurniawan, 2012; Tinaprilla et al. 2013), urea fertilizer (Aprianti et al. 2020; Nafisah & Fauziyah, 2020), and phonska fertilizer (Yoko et al. 2014). This study found that, on average, farmers cultivated rice on 1,822 m² of land and used approximately 9 kg of seed. The average use of urea fertilizer, phonska, and pesticides (herbicides and insecticides) was 91.3 kg, 83.8 kg, and 0.3 liters, respectively. The average cost spent on pesticides was around IDR 66,240. The labor required for sowing, land preparation, planting, fertilizing, pesticide spraying, and weeding averages 10 working days.

Technical inefficiency in rice farming can be attributed to the farmers' socioeconomic factors (Priyanto et al. 2022). These factors include gender, age, years of education, household size, farming experience, land ownership status, and participation in agricultural extension programs. The farmers had an average age of 51 years, ranging from 40 to 74 years, and an average education duration of 7.42 years, equivalent to the beginning of junior high school. The influence of age on efficiency levels remains debated among researchers. Murniati et al. (2017) found that increasing age tends to reduce efficiency, likely due to older farmers having greater difficulty adopting new technologies. Conversely, farmers within a productive age range tend to perform better in farm management, technology adoption, and innovation (Dhungana et al. 2004). Higher education levels among farmers are positively associated with increased efficiency (Abubakar et al. 2019), as is a larger household size (Yoko et al. 2014). On average, the farmers had 3.7 household dependents and 27.44 years of farming experience. Studies by Rifaini et al. (2022) and Yoko et al. (2014) found that larger household sizes enhance efficiency, as does greater farming experience Ismail et al. (2017) The majority of farmers did not own the land they cultivated, and 57% had participated in agricultural extension programs. Farmers who owned their land and participated in extension services tended to be more efficient (Rifaini et al. 2022; Rivanda et al. 2015).

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Participation in extension programs has been shown to significantly improve efficiency compared to non-participating farmers (Shrestha et al. 2016; Syahputra et al. 2023). The characteristics of the farmers are presented in Table 1 below.

Table 1. Descriptive Statistics of Variables

Variable	Description	Mean	Standard Deviation
Production	Paddy Productionn(kg)	1053	779,44
Land Area	Rice Planting Area (m^2)	1822,5	1532,73
Seed	Seed Quantity (kg)	9,16	5,82
Urea	Urea Fertilizer Quantity (kg)	91,3	54,58
Phonska	Phonska Fertilizer Quantity (kg)	83,8	47,73
Pesticide	Cost of Pesticides (Rp/Planting Season)	66,240	43,640
Labor	Total Labor input (Person-Days)	10,17	16,76
Gender	Farmer's Gender (1=Male, 0=Female)	0,87	0,33
Age	Farmer's Age (Years)	51,22	6,96
Years of Education	Years of Farmer's Education (Years)	7,42	2,66
Family Dependents	Number of Farmer's Household Dependents (Persons)	3,7	1,40
Farming Experience	Years of Farming Experience (Years)	27,44	7,34
Land Tenure Status	Land Tenure Status (1=Owned, 0=Rented/Sharecropped)	0,11	0,31
Agricultural Extension	Farmer's Participation in Extension Activities (1=Participated, 0=Not Participated)	0,54	0,49

Source: Processed Primary Data, 2025

3.2. The Role of Agricultural Extension in Enhancing Productivity

Based on field findings, it can be confirmed that farmers who receive agricultural extension services are invariably members of farmer groups. However, not all farmer group members necessarily receive extension services. This is primarily because agricultural extension is commonly delivered through farmer group meetings. Moreover, several farmers perceive these meetings merely as forums for discussing the distribution of subsidized fertilizers, which often encounter delays. Consequently, the role of field extension officers is still considered insufficient in educating farmers, leading to the continued use of traditional farming practices—particularly in input application, where dosage is often based on habit rather than technical recommendations (Yoko et al. 2014). As illustrated in Figure 3, a total of 54 farmers in the study area reported having participated in agricultural extension activities, all of whom agreed that extension agents provided advice after listening to farmers' concerns. In contrast, 46 farmers did not participate in any extension activities. Extension services were typically provided during regular farmer group meetings held two to three times per month. There were also occasional ad hoc meetings initiated by field extension officers to convey important information or in response to farmers' requests.

Such requests were made when farmers encountered problems during rice farming activities and sought assistance.

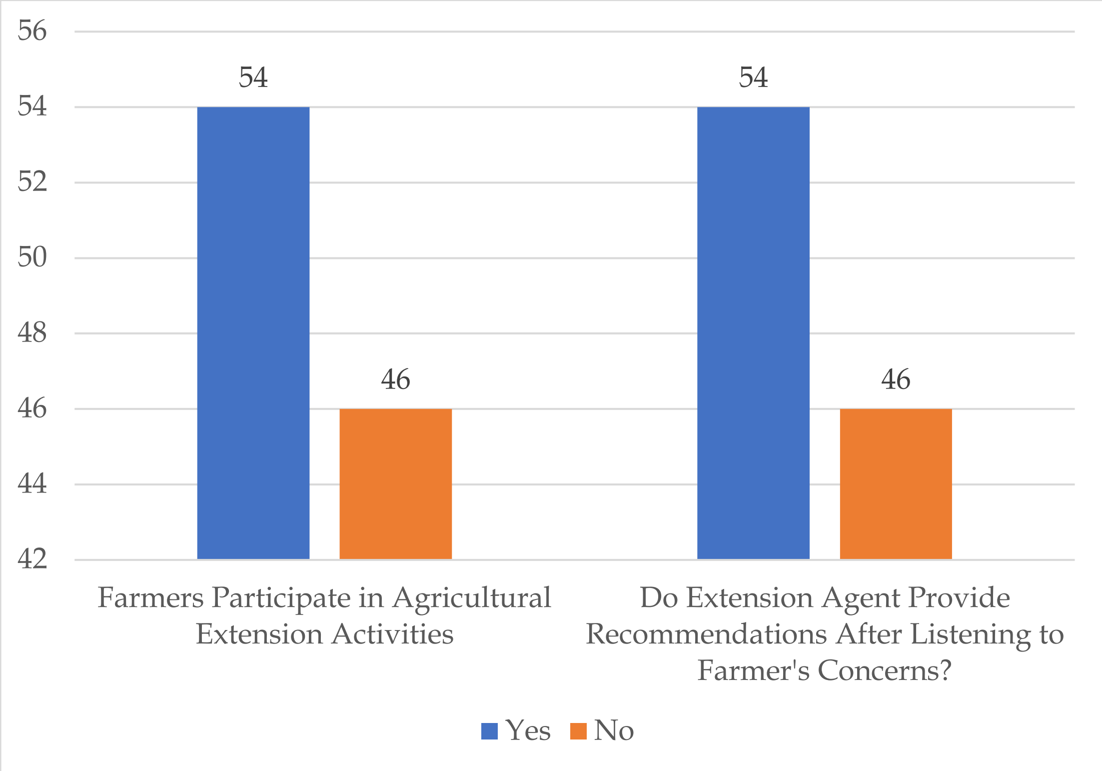

Figure 3. Proportion of Farmers Based on Participation in Extension Activities (in Percentage)
Source: Processed Primary Data, 2025

All extension activities attended by the farmers were provided by field extension officers assigned by the Agricultural Extension Center (BPP). This condition slightly differs from the findings of Yoko et al. (2014), in which the extension services received by farmers were delivered by field representatives of input suppliers from several well-known agribusiness companies.

The topics discussed during meetings between extension agents and farmers were adjusted according to farmers' specific needs. Common subjects addressed by the extension officers included seeds, fertilizers, planting distance, and pesticide usage. Regarding seeds, the extension officers typically provided guidance on selecting varieties suitable for different soil types, appropriate spacing between rice seedlings, and the use of high-yielding varieties. The most commonly used rice seed varieties among farmers in the study area were Inpari and Ciherang, each with its respective advantages and disadvantages. According to the farmers, the Inpari variety is more tolerant to extreme environmental conditions than Ciherang. However, this perception contradicts the findings of Akbar et al. (2022), which suggest that the Ciherang variety is in fact better adapted to the local environment.

Farmers in the study area used both urea and Phonska fertilizers in their rice farming practices. Urea was applied in greater quantities, with an average usage of 91.3 kg, compared to Phonska, which was used at an average of 83.8 kg per farmer. In this context, extension agents provided education on the importance of optimal fertilizer application for the healthy growth and development of rice crops. Moreover, excessive application of fertilizer can have detrimental effects on the environment. The same applies to Phonska fertilizer, for which the recommended application rate is 150 kg/ha. Deviation from this recommendation can make rice plants more susceptible to diseases, as each nutrient contained in Phonska is essential for proper plant development (Walis et al. 2021).

Plant spacing between rice seedlings was practiced by only a few farmers, using self-made tools crafted from bamboo with string markers to determine the distance between seedlings. Providing adequate spacing between seedlings allows for optimal growth, as it ensures a more even distribution of essential nutrients (Apriyanto et al. 2021).

Pesticides are required as a means of controlling pests and diseases that infest rice plants. Some farmers use different types of pesticides depending on the specific pests and diseases affecting their crops. The pesticides used include: Roundup for weed control; Curacron to target pests such as armyworms, aphids, whiteflies, grasshoppers, and fruit flies; Prevathon for managing stem borers, planthoppers, and caterpillars; Sankill for controlling caterpillars, rice bugs, and *kaper*; Basmilang and Nominee for weed management; Spontan for controlling planthoppers, white pests, leaf miners, and false white pests; Farmfosate for eradicating weeds and wild grasses; liquid organic fertilizer for improving soil quality; and Biopatek for treating bacterial leaf blight (*kresek*), red disease, and yellow/gemini virus. Through agricultural extension services, farmers are able to consult with extension agents regarding appropriate pesticide use for various rice crop diseases. The types and prevalence of diseases tend to vary with shifts in planting seasons, often causing confusion among farmers. Extension services serve as a platform for farmers to seek advice on plant health issues, including the most suitable pesticides, recommended dosages, methods of application, and the advantages of each pesticide (Sulandjari & Muhyiddin, 2020).

Only a limited number of agricultural technologies have been adopted by farmers in the study area. Few farmers used combine harvesters during the rice harvesting process. This limited adoption is primarily due to field conditions that are not suitable for operating combine harvesters. Differences in soil structure also contribute to the reluctance of farmers to use this technology during the harvesting phase. Other technologies utilized in rice farming include tractors and electric pesticide sprayers. The provision of combine harvester technology through extension services has had a positive impact on productivity, as well as on time and cost efficiency during the harvest period—findings that are consistent with studies by Boy et al. (2024) and Fatimah et al. (2023) According to Hartoyo et al. (2019), the use of tractors in rice farming contributes to improved technical efficiency.

The success of extension agents' performance is determined by the level of responsiveness and feedback provided by farmers. Variables such as information absorption, the ability to capture farmers' aspirations regarding their farming problems, the provision of relevant advice, and the extent to which farmers adopt recommendations from extension agents can serve as key indicators of extension performance effectiveness. Approximately 46% of farmers were excluded from the analysis, as they did not participate in any extension activities.

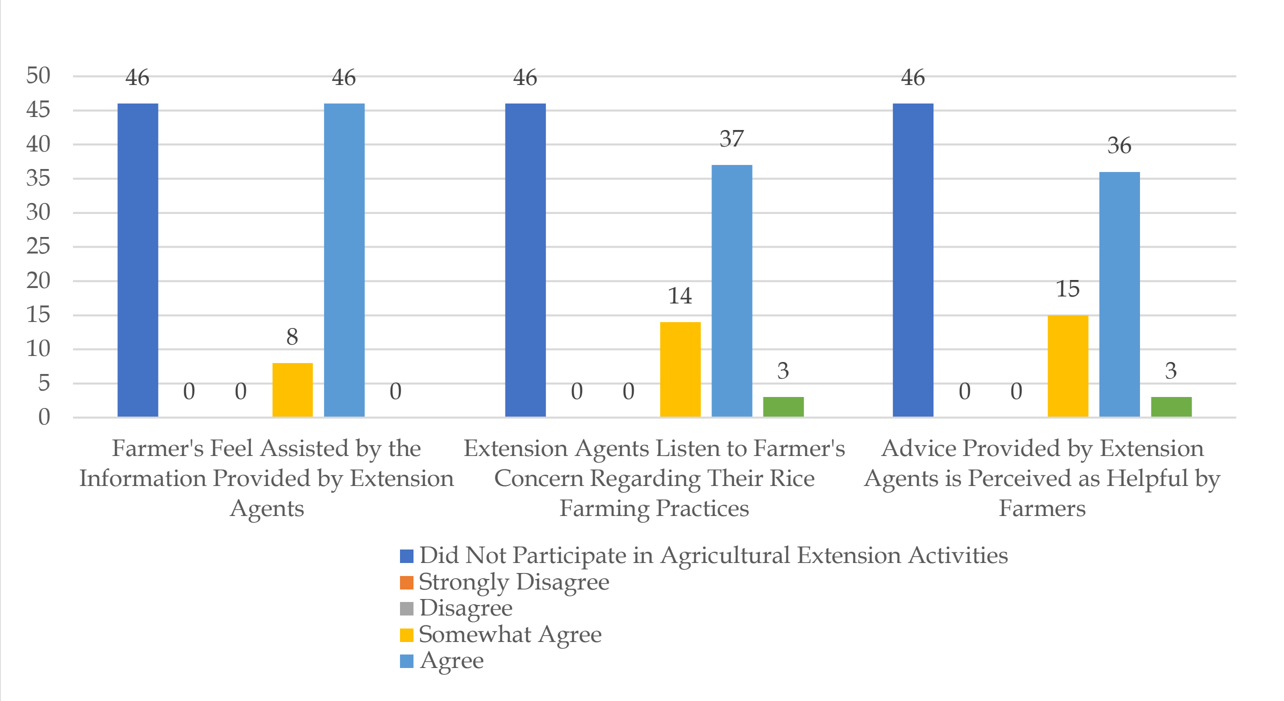

Figure 4. Proportion of Farmer's Evaluation of Agricultural Extension Agents (in Percentage)
Source: Processed Primary Data, 2025

The results indicate that the majority of farmers perceive agricultural extension officers as playing a significant role in their rice farming practices. Among the 54 farmers who participated in extension activities, 46 respondents agreed that the information provided by the extension agents was helpful, while 8 respondents somewhat agreed. Extension officers were also found to be responsive to farmers' concerns, with 3 farmers strongly agreeing, 37 agreeing, and 14 somewhat agreeing that their complaints were acknowledged. Based on these complaints, the extension agents provided advice which was perceived as highly beneficial by 3 farmers, helpful by 36 farmers, and moderately helpful by 15 farmers. Overall, these elements received positive evaluations from the farmers. These findings can be categorized as favorable and are consistent with those reported by Sumarno et al. (2019), suggesting that extension officers are expected to contribute to improving both the efficiency and productivity of rice farming.

3.3. Rice Production Function

Based on Table 2, it is evident that among the six variables analyzed, pesticides and labor do not have a statistically significant effect on rice production. The other variables, namely land area, seeds, urea, and phonska fertilizer, have a statistically significant effect on rice production at two different levels of significance.

At a 1% significance level, a 1% increase in land area leads to a 0.604% increase in rice production. This finding is consistent with the results of previous studies conducted by Abdallah, (2016), Abubakar et al. (2019), Duy (2015), and Kusnadi et al. (2011), which reported similar outcomes. An increase in land area is also positively correlated with the quantity of seeds that can be planted, thereby contributing to higher rice yields at harvest.

The seed variable significantly influences rice production at the 1% significance level, where a 1% increase in seed usage results in a 0.122% increase in rice output. This finding aligns with the study conducted by Murniati et al. (2017), which demonstrated that increasing the quantity of seed leads to higher rice yields. Therefore, the use of seed can be increased to boost rice production, provided that the selected seed variety is compatible with other factors such as climate. Suitable seed varieties are more likely to adapt to climate variability in specific regions, thereby enhancing agricultural productivity (Mar et al. 2018).

Urea fertilizer exhibits a positive and statistically significant effect on rice production at the 1% significance level, where a 1% increase in urea application leads to a 0.221% increase in rice output. This finding is consistent with the study conducted by Nafisah & Fauziyah, (2020). According to Ahmed et al. (2017), fertilizers play a crucial role in enhancing agricultural yields when applied appropriately. The high nitrogen content in urea is essential for crop growth, particularly during the vegetative stage, as it supports vital metabolic processes in plants. The chlorophyll content supported by nitrogen application enhances leaf greenness, accelerates growth, and increases protein levels, thereby improving both the quality and yield of crops, especially rice.

At a different level of significance, namely 10%, the application of Phonska fertilizer to rice cultivation shows a statistically significant negative effect, where a 1% increase in Phonska input reduces rice production by 0.029%. Although this result is contrary to initial expectations, it is consistent with findings by Susilowati & Tinaprilla (2012), who reported that excessive Phonska application may reduce agricultural productivity. In Tanjung Village, the average Phonska usage reached 83 kg per 0.182 hectares or approximately 456 kg/ha, which far exceeds the recommended dosage of 150 kg/ha, potentially leading to diminished yields. Sholeh & Ringgih (2017) also observed that optimal rice productivity was achieved with a combination of 250 kg/ha of urea, 200 kg/ha of Phonska, and 6,000 kg/ha of organic fertilizer. Each nutrient component in Phonska plays a specific role. Excess nitrogen (N) can make plants more susceptible to disease; excessive phosphorus (P) may impair the absorption of micronutrients such as Fe, Cu, and Zn; and excessive potassium (K) can interfere with the uptake of calcium (Ca) and magnesium (Mg) (Walis et al. 2021).

Variables not explicitly mentioned, such as pesticides and labor, were found to have no statistically significant effect on rice production. This is due to the t-ratio values for both pesticide and labor inputs being lower than the critical t-table values at the specified significance levels.

Table 2. Stochastic Frontier Estimation of The Cobb-Douglas Production Function

Variable	Code	Coefficient	Standard Error	t-ratio
Intercept	$\beta 0$	2,116	1,548	1,366
Land Area (X1)	$\beta 1$	0,604	0,016	37,481**
Seed (X2)	$\beta 2$	0,122	0,025	4,849**
Urea (X3)	$\beta 3$	0,221	0,029	7,474**
Phonska (X4)	$\beta 4$	-0,029	0,016	-1,767*
Pesticide (X5)	$\beta 5$	0,113	0,091	1,243
Labor (X6)	$\beta 6$	-0,003	0,051	-0,065
Sigma-squared	∂^2	0,063	0,008	7,531**
Gamma	γ	0,999	0,179	5,577**

Variable	Code	Coefficient	Standard Error	t-ratio
Log likelihood function		-2,615		
LR test		16,872		

Source: Processed Primary Data, 2025

Note: *,** denote significance at α = 10% (1.661) and 1% (2.630), respectively.

3.4. Average Technical Efficiency of Rice Farmers

The average technical efficiency of farmers in this study was 53.6%. There remains a potential improvement of 46.4% for farmers to make their farming operations more efficient and productive. This result is lower compared to findings by Nafisah & Fauziyah (2020) and Murniati et al. (2017), who reported average efficiencies of 70% and 83.61%, respectively. This difference is influenced by variations in technology adoption, farming experience, land ownership status, and farmers' education, all of which affect decision-making in farming activities (Rivanda et al. 2020). In this study, 48 farmers had an efficiency level of 50%, 46 farmers were in the 51–80% efficiency range, and the remaining 6 farmers exhibited efficiency levels above 80%.

Table 3. Average Technical Efficiency of Rice Farmers

Efficiency Level	Technical Efficiency	
	Total Number of Farmers (Persons)	Percentage (%)
< 0,50	48	48%
0,51 – 0,60	21	21%
0,61 – 0,70	18	18%
0,71 – 0,80	7	7%
0,81 – 0,90	3	3%
0,91 – 1,00	3	3%
Total	100	
Mean	0,536	
Minimum Value	0,289	
Maximum Value	0,988	

Source: Processed Primary Data,2025

3.5. Factors Affecting Technical Inefficiency in Rice Farming

This study found that age has a positive effect on technical inefficiency in rice farming. This positive effect indicates that older farmers tend to exhibit lower technical efficiency in rice farming. This finding contradicts the study by Priyanto et al. (2022), but aligns with the results of Kurniawan (2012), who argued that as farmers age, their work performance, willingness to take risks, and capacity for innovation decline, thereby negatively impacting the efficiency of their farming operations. A similar pattern is observed for the variable 'years of formal education', which also exhibits a positive coefficient. This suggests that higher levels of education are associated with greater inefficiency, in line with the findings of Asogwa et al. (2011). One explanation is that individuals with longer education tend not to pursue farming as their primary occupation, thereby leading to less efficient farm management practices. In contrast, the variable land tenure status demonstrates a negative relationship with inefficiency, implying that farmers who own their land tend to be more efficient than those who rent or sharecropped land. This finding supports the results reported by Priyanto et al. (2022). It is reasonable to assume that landowners are more willing to adopt innovations and experiment with new techniques, leading to greater technical efficiency. Similarly, farmers who participated in agricultural extension programs were found to be more efficient, as indicated by the negative coefficient at the 10% significance level. This result aligns with previous studies by Abubakar et al. (2019), Rivanda et al. (2015), Shrestha et al. (2016) and Syahputra et al. (2023). Farmers who attend extension services gain direct access to consultations on agricultural challenges and technological advancements. Several pieces of information provided by the agricultural extension workers to the farmers include optimal planting distance, advantages of each seed variety, their suitability to different soil types, recommended fertilizer dosages, as well as appropriate use of pesticides and other agrochemicals in accordance with established guidelines to maximize yield.

Table 4. Factors Affecting Technical Inefficiency in Rice Farming

Variable	Code	Coefficient	Standard Error	t-ratio
Intercept	$\delta 0$	0,318	0,252	1,261
Gender	$\delta 1$	-0,089	0,085	-1,054
Age	$\delta 2$	0,008	0,004	1,864*
Years of Education	$\delta 3$	0,013	0,005	2,294**
Family Dependents	$\delta 4$	0,014	0,020	0,702
Farming Experience	$\delta 5$	-0,004	0,004	-0,918
Land Tenure Status	$\delta 6$	-0,179	0,067	-2,664***
Agricultural Extension	$\delta 7$	-0,108	0,061	-1,767*

Source: Processed Primary Data, 2025

Note: *,**,*** denote significance at α = 10% (1,661), 5% (1,986), 1% (2.630), respectively.

4. Conclusion and Suggestion

This study found that the majority of farmers participated in agricultural extension activities with the expectation of improving the efficiency and productivity of their farming operations. These extension services were mainly facilitated through farmer groups under the supervision of the Agricultural Extension Center (BPP), where various topics and farming-related complaints were discussed and addressed through regular meetings. In terms of the production function, the findings revealed that several variables significantly influenced rice production at different significance levels, including land area, seed, and urea, all of which had a positive impact on yield. However, phonska fertilizer had a negative effect, as its application exceeded recommended dosages, thereby reducing production. The study also found that the average technical efficiency of rice farmers was relatively low at 53.6%, indicating a potential improvement of 46.4% for optimizing efficiency in rice farming. Variables found to significantly influence technical efficiency included age, years of education, land ownership status, and participation in agricultural extension programs. Based on farmers' evaluations of field extension agents, the activities organized by these agents play a crucial role in enhancing technical efficiency in rice farming. Most farmers positively assessed the performance of agricultural extension agents, recognizing their role in rice farming activities. This included providing previously unknown information during extension meetings, listening to farmers' concerns regarding their rice farming practices, and offering constructive recommendations in response to those concerns. All of these indicators received favorable evaluations from farmers who participated in extension programs.

This study can serve as a reference for farmers and the Agricultural Extension Center (BPP) as the institution responsible for coordinating agricultural extension activities. The findings provide important input for the BPP to guide farmers in the appropriate use of Phonska fertilizer in rice farming, in accordance with established recommendations. On one hand, farmers are more likely to heed the advice of field extension agents, as indicated by their relatively high level of trust in extension officers, which reflects the extent to which farmers are willing to adopt guidance provided. However, there is a need for field extension agents to reassess whether their recommendations are indeed being implemented by farmers to enhance the technical efficiency of rice farming. Farmers are also encouraged to regulate their use of Phonska fertilizer to avoid excessive application, which may otherwise reduce rice yields.

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