The Influence of Production Factors on The Income Level of Rice Farmer in The Rambutan Banyuasin District

Fyra Agustine[1*], Yudhi Zuriah Wirya Purba[1], Eka Thanomutiara[1]

[1] Master of Agribusiness Study Program, Universitas of Sjakhyakirti, Indonesia

Abstract: This study examines the influence of key production factors—land area, NPK fertilizer usage, and labor—on the income level of rice farmers in Rambutan District, Banyuasin Regency, with production output considered as a mediating variable. Data were collected through a combination of primary surveys and secondary sources, and analyzed using Path Analysis to determine direct effects, while indirect effects were tested using the Sobel method. The analysis reveals that land area and NPK fertilizer have a significant and positive direct effect on production, whereas labor does not show a significant contribution. Furthermore, land area, NPK fertilizer, labor, and production each exert a direct influence on farmers' income. However, the mediating role of production between the production factors and income is found to be statistically insignificant. These findings suggest that income improvements are more strongly driven by direct inputs—particularly land and fertilizer—than by production gains alone, underscoring the importance of resource allocation in farming strategies.

Keywords: Income level; Production factor; Production.

Introduction

Indonesia is a country that is blessed with abundant natural wealth, as well as geographical conditions that are located in tropical areas that have high rainfall, so that many types of plants can live and grow quickly, this is the basis for Indonesia being an agricultural country(PRASETYO ADHI et al., 2019). Most of the livelihoods of the Indonesian population work in the agricultural (agrarian) sector. Even though over the years, Indonesia's population that depends on the agricultural sector is decreasing, this sector remains the largest contributor to employment in Indonesia(Sadono, 2008).

Rice farming is a production process that is carried out as a commercial business that requires production factors(Nurhidayah et al., 2023). One of the causes of farmers' failure in carrying out farming is low productivity as a result of a lack of efficiency in the use of production factors (Walis et al., 2021). Even though agriculture in Indonesia really helps economic growth, especially for farmers, the problems experienced by agriculture in Indonesia have not been spared, one example of which is as stated by the General Chair of the

Indonesian Farmers' Harmony Association (HKTI), Moeldoko (2020) who said that one The big challenge in agriculture today is the problem of land availability. He conveyed this at the opening of the Asian Agriculture and Food Forum (ASAFF), 2020 in Jakarta(Suryani et al., 2020). The problems often faced by farmers are lack of capital, limited land, low labor productivity, and the ability to use production technology facilities. This has a big impact on productivity and income earned by farmers.

The development of rice production in South Sumatra in the last three years has experienced quite an encouraging increase amidst issues of food insecurity and Elnino(Kakar et al., 2019). South Sumatra is considered capable of maintaining itself as a contributor to the national agricultural sector. There are five districts/cities that provide the largest rice production value in South Sumatra, namely Banyuasin, East OKU, OKI, Musi Banyuasin, and Musi Rawas. In Table 1, it can be seen that Banyuasin produced 887,255.63 tons in 2021, increasing to 897,427.60 tons in 2022 and continuing to increase to 920,413 tons in 2023. Not much different from Banyuasin, East OKU also consistently experienced an increase in rice production from 574,966.07 Tons in 2021,

to 701,509.52 tons in 2022, and increase again in 2023 to 716,876 tons.

Table 1. Development of Rice Production (Tons) in South Sumatra (2021-2023)

Regency/City	Production of Rice. (Ton)		
	2021	2022	2023
Ogan Komering Ulu	12.015,11	13.784,51	13.956,00
Ogan Komering Ilir	465.965,86	534.586,78	525.900,00
Muara Enim	47.035,46	55.650,55	58.789,00
Lahat	66.001,95	74.549,71	68.922,00
Musi Rawas	120.025,94	100.005,52	107.355.00
Musi Banyuasin	149.202,80	144.445,74	143.115,00
Banyuasin	887.255,63	897.427,60	920.413,00
South OKU	44.654,28	39.203,30	47.059,00
East OKU	574.966,07	701.509,52	716.876,00
Ogan Ilir	76.856,01	104.927,85	101.395,00
Empat Lawang	45.149,22	39.687,30	50.708,00
Pali	16.783,50	22.573,26	25.465,00
Musi Rawas Utara	12.471,86	12.304,47	11.976,00
Palembang	10.301,44	11.067,82	15.299,00
Prabumulih	142,91	143,12	159,00
Pagar Alam	14.594,21	16.820,27	18.709,00
Lubuk Linggau	9.020,94	6.381,94	6.679,00
South Sumatera	2.552.443,19	2.775.069,26	2.832.774,00

Source: BPS (2024)

Banyuasin Regency has a very large agricultural land area, reaching 179,770 hectares, spread across 21 Districts. If you look at the types of rice fields, Banyuasin has two types of land, namely Tidal and Lebak Rawa. Rambutan is a sub-district that has a swamp potential of 7,437 hectares, second only to Rantau Bayur District with a potential of 17,947 hectares. Lebak swamp land has great potential as a national food barn because it has several advantages, including: abundant water availability, relatively flat topography, access to development areas can be via land and water routes, making distribution routes easier (Wildayana et al., 2016). The development of lowland swamp land can be an effective adaptation strategy in facing climate change and natural phenomena such as El Nino, as well as contributing to food security and community welfare, especially rice farmers(Helmi, 2015).

To increase rice production, farmers usually fertilize their plants using fertilizer, one of which is NPK fertilizer which contains the nutrient N (15%) in the form of NH3, the nutrient P (15%) in the form of PO5 and the nutrient K (15%) in the form of (K2O) (Hilalullaily et al., 2021). The element Nitrogen (N) is needed for the formation of carbohydrates, proteins, fats and other organic compounds and the element Nitrogen plays an important role as a constituent of chlorophyll which makes leaves green(Kim et al., 2020). Phosphorus (P) plays an important role in transferring energy within plant cells, encouraging root development and early fruiting, strengthening stems so they do not fall easily, and increasing uptake at the start of growth(Lambers,

2022). The element potassium (K) also plays a very important role in plant growth, for example to stimulate the translocation of carbohydrates from leaves to plant organs(Işinkaralar & Erdem, 2022). With its large nutrient content, NPK fertilizer is the most widely used by farmers.

Farming in lowland swamp land has high potential for using direct physical labor. Human labor is the most important workforce in rice farming from land processing to post-harvest(PUTRA et al., 2022). With a potential of 285,941 ha of lowland swamp rice fields in South Sumatra, there is an area of 166,908 ha that can be planted with rice once a year, 29,966 ha planted with rice twice a year, and 8,982 ha of non-rice crops while 80,085 ha is not planted with rice (BPS Sumatra South, 2015). Energy efficiency of power sources is one of the eco-efficient principles and an adequate agricultural requirement. However, labor scarcity is a problem that often arises when implementing rice farming (Sellars & Alix-Garcia, 2018).

Land area is a very important production factor compared to other factors(Rondhi et al., 2018). The scale of income from agriculture is also determined by the size of the land that will be used in the production process. The area of agricultural land affects the scale of production and income which ultimately affects the level of efficiency of the farming business being carried out.

Productivity in farming is the result of a combination of business efficiency (physical) and land capacity(UU Republik Indonesia et al., 2022). However,

most previous studies have focused on national or provincial levels, with few specifically investigating how production factors (land, labor, fertilizer) influence rice farmers' income at the sub-district level, especially in high-potential but under-researched areas like Rambutan District in Banyuasin Regency. This indicates a clear research gap that needs to be addressed to provide more localized and actionable insights for policy and practice. Therefore, this study aims to analyze the direct influence of production factors—namely land area, fertilizer use, and labor—on rice farmers' income in Rambutan District, Banyuasin Regency.

Formulation of the Problem

Based on the background, the problem formulation in this research is what is the direct influence of land area, fertilizer, labor on rice income in Rambutan District?

Method

Research uses an associative or relationship approach. Associative is research that aims to determine the relationship between two or more variables(Sugiyono, 2016). The things that will be studied are the influence of capital, labor, land area and use of technology on the income level of rice farmers.

This research method uses a survey. The research was carried out in Rambutan District, Banyuasin Regency in three villages, namely Pangkalan Glebak, Sako and Gelebak. The target population in this research includes all farmers in the villages of Pangkalan Gelebak, Sako and Gelebak Dalam, totaling 1,729 people. Details of the number of farmers in the three villages can be seen in Table 2.

Table 2. Number of Farmers in Rambutan District in 2024

Village	Number of Farmer
Pangkalan Gelebak	420
Sako	580
Gelebak dalam	729
Total	1729

Determining the number of samples in this study used the following Slovin formula:

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

Where:
n = Sample
N = Total of Population
e = Trust Level/Desired Decision 10%

By using slovin, the sample size is obtained

$$n = \frac{N}{1+N\,e^2}$$
$$n = \frac{1729}{1+1729\,(\llbracket 0,1 \rrbracket)^2}$$
$$n = \frac{1729}{1+1729\,(\llbracket 0,01 \rrbracket)^2}$$
$$n = \frac{1729}{18,29}$$
$$n = 94,53$$

So the number of samples used was 95 farmer respondents. The data collection instrument used in this study was a structured questionnaire. The questionnaire was designed to gather information from respondents regarding the main variables in the research model, including land area, fertilizer dosage, labor, use of technology, and income level of rice farmers. The questionnaire consisted of closed-ended questions, which allowed for standardized responses that are easy to quantify and analyze statistically.

Before being distributed to the respondents, the questionnaire underwent a trial process (pilot testing) to ensure its clarity, consistency, and relevance. Feedback from the trial was used to revise ambiguous or potentially misleading items.

To ensure the validity of the instrument, content validity was assessed by consulting with experts in agricultural economics and statistics. The content validity process ensured that all questionnaire items were aligned with the theoretical constructs being measured and accurately reflected the operational definitions of each variable.

In addition, construct validity was evaluated through factor analysis to confirm that the questions grouped under each variable truly represented the intended concept. Meanwhile, reliability testing was conducted using Cronbach's Alpha to determine the internal consistency of the instrument. A Cronbach's Alpha value above 0.70 was considered acceptable for all variable scales used in the analysis.

This research uses descriptive analysis and multiple regression analysis in the form of natural logarithms. Descriptive statistics are used to describe the general condition of the research area, while multiple regression analysis uses the Cobb-Douglas production function model, to analyze whether there is a relationship between rice production as the dependent variable and production inputs as the factors that influence it(Mishra et al., 2019). In general it can be described as follows

$$Y = b_0 X_1^{b1}\, X_2^{b2}\, X_3^{b3}\, X_4^{b4} \qquad (2)$$

To make calculations easier, the function (3.1) is then converted into natural logarithmic form, so that the mathematical equation becomes:

$$LnY = Lnb_0 + b_1 LnX_1 + b_2 LnX_2 + b_3 LnX_3 + b_4 LnX_4 + \varepsilon \qquad (3)$$

where:

Y	= Income Level
b_0	= Intercept
b1, b2, b3	= regression coefficien
X_1	= Land Area
X_2	= Fertilizer Dose (Kg/ha)
X_3	= Labor (HOK)

The data analysis technique used in this research is path analysis. Path analysis is a development of regression analysis, so that regression analysis can be said to be a special form of path analysis (Wooldredge, 2021). This analysis is also used to determine the direct relationship between independent variables and the dependent variable and indirect relationships through intervening variables(Irfan Syahroni, 2023). The structural equation can be stated as follows:

$$Y_1 = \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + e1 \qquad (4)$$

where:

X_1	= Land Area
X_2	= Fertilizer Dose
X_3	= Labor
Y_1	= Farmer Income

$\beta_1, \beta_2, …, \beta_9$ = Regression coefficient for each variable

The path coefficient is used to show the strength of the influence of the independent variable (X) on the dependent variable (Y). If the path coefficient value is low (the figure is below 0.05) then the influence of the path can be eliminated because the influence is considered low and insignificant. If the Tcount value is greater than Ttable and the significant value or probability is smaller than 0.05 ($p < 0.05$), then variable X has a significant effect on Y.

Path method analysis is used to find out:

a. The direct influence of the land area variable (X1) on farmer income (Y1) is formulated as follows : $X_1 \rightarrow Y_1 = \rho Y_1 X_1$

b. Direct influence of the Fertilizer Dosage variable (X_2) on farmer income (Y_1) formulated as follows : $X_2 \rightarrow Y_1 = \rho Y_1 X_2$

c. The direct influence of the Labor variable (X3) on farmer income (Y1) is formulated as follows : $X_3 \rightarrow Y_1 = \rho Y_1 X_3$

Result and Discussion

Based on the research results, it can be seen the relationships between research variables which are the path coefficients in this research. This path coefficient can be created in a path diagram (Suyana Utama, 2008).

Structural Model II (Effect of Land Area, NPK Fertilizer, Labor and Production on Income)

The second regression equation test was carried out to see the direct influence of land area, workforce, work experience and production level on income. The results of data processing using the SPPS version 27 computer program are presented in Table 3 and a summary of the results is presented in Table 4.

Table 3. Coefficients

		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
Model		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	5.490E7	5.024E6		10.929	.000		
	Land Area (ha)	-7.454E7	5.237E6	-.570	-14.233	.000	.593	1.687
	NPK Fertilizer Dose (kg/ha)	30700.471	12271.160	.196	2.502	.014	.154	6.481
	Labor Allocation (HOK/ha)	-45667.012	21387.096	-.161	-2.135	.035	.168	5.961
	Produksi (ton/ha)	5.005E6	396391.854	.471	12.627	.000	.684	1.462
a. Dependent Variable: Farmer's Income (Rp/year)								

Table 4. Regression results of factors influencing rice income in Rambutan District

Variabel	Estimated Parameter Values	t Value	Significance Level	Toloerance	VIF	Elasticity
Intersept	5.490E7	10.929	.000			
Land Area (ha)	-7.454E7	-14.233	.000	.593	1.687	-0.575
NPK Fertilizer Dose(kg/ha)	30700.471	2.502	.014	.154	6.481	0.127
Labor Allocation (HOK/ha)	-45667.012	-2.135	.035	.168	5.961	-0.086
Production (ton/ha)	5.005E6	12.627	.000	.684	1.462	0.603
R2 =91.20; Fhit = 240.054 ; db = 97; dw = 2.359						

Source: Primary Data (2024)

The summary of regression results, apart from being presented in table form as above, can also be presented in the form of a regression equation as follows:

$$Y = 5{,}490 \times 10^7 - 7{,}454 \times 10^7 \, LL + 30700 \, NPK - 45667 \, TK + 5{,}005 \times 10^6 \, P$$

Evaluation of the Estimated Results of the Regression Equation

To assess whether the alleged regression results in the table above are considered good or not, it is necessary to carry out an evaluation stage. The evaluation stage uses three criteria, namely economic, statistical and econometric criteria.

1. Economic Criteria

The economic criterion is to assess whether the magnitude and sign of the resulting estimated parameters are in accordance with economic theory or economic logic(Ma'ruf et al., 2022). If it is not appropriate and cannot be justified, then there is a possibility that the results of our estimated regression equation are not correct. The sign of the estimated parameter for the land area variable is negative and according to economic logic it is expected that the sign is positive. This means that if the farmer's land area increases, income will increase, and vice versa.

The NPK fertilizer dosage variable is expected to have a positive presumptive parameter sign and the presumptive results also have a positive sign. This means that by increasing the dose of NPK fertilizer, income will also increase. Labor allocation has a negative sign and production has a positive sign.

2. Statistical Criteria

The statistical criteria are seen from the coefficient of determination (R2), F test value and t test value from the results of the estimated equation(Subekti & Jazuli, 2022). Based on the regression results summarized in Table 4, the R2 and F values are very large, namely 91.20 percent and 240.054 respectively. The R2 value is equal to 91.20 percent, meaning that 91.20 of the variation in income can be explained by the variables in the equation, the remaining 9.80 percent is explained by other variables that are not included in the equation. The F value is also significant, which means that together the four independent variables in the equation have a real effect on production. Next, the third statistical criterion is the t test results. Based on the regression results presented in Table 4, of the four independent variables, all variables have a significant effect. This means that the results of the conjecture equation are very good.

3. Econometric Criteria

Econometric criteria are seen from whether or not there is a violation of the classical linear assumption or Gauss Marcov assumption(Ashayeri et al., 2018). There are three assumptions tested, namely heteroscedasticity, autocorrelation and multicollinearity tests. Below in Figure 1, data is presented to check whether the results of the regression equation are suspected of experiencing heteroscedasticity problems.
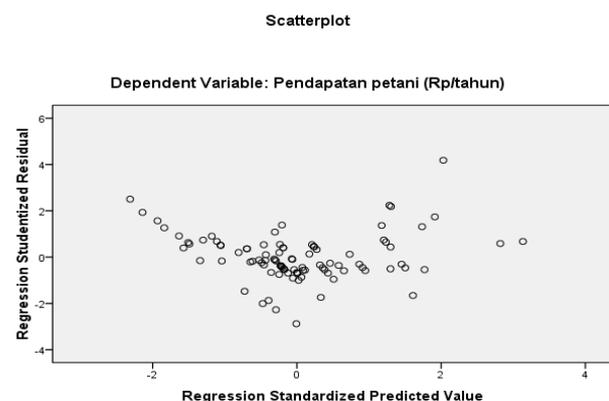

Figure 1. Distribution of data on deviation values and estimates to detect hetescedasticity problems

Based on the data distribution between deviation (residual) and predicted (predicted) values in Figure 1, the data distribution pattern is irregular. This condition shows that there is no relationship between the confounding error and the estimated value, which shows that there is no heteroscedasticity problem in the

estimated equation obtained. The problem of heteroscedasticity is when the variety or variance of confounding errors changes according to the estimated value. The variety of disruptive errors should be constant.

Next, to find out whether there is an autocorrelation problem, you can look at the Durbin Watson test value. If the Durbin Watson test value is close to 2, then it can be confirmed that the equation does not have an autocorrelation problem. The results of data processing are as presented in Table 3 and Table 4. The Durbin Watson value was 2.359, which shows that there is no autocorrelation problem because it is still close to the value of 2. Autocorrelation is the existence of an automatic relationship between two consecutive disturbing errors. This problem occurs more often in time series data, this research uses cross section data.

The final problem with econometric criteria is whether there is a high correlation problem among independent variables or a collinearity problem. If a strong relationship between independent variables occurs between more than two independent variables, it is called a double collinearity or multicollinearity problem. The results of data processing as presented in Table 3 and Table 4 show that none of the variable tolerance values is less than 0.1 and no VIF (Variance Inflation Vector) value exceeds 10. So it can be concluded that the estimated equation obtained does not indicate a double collinearity problem. or multicollinearity.

Based on the three criteria presented, the estimated regression equation obtained in this research is good. Therefore, the next step can be to interpret the results.

The influence of each factor on income
1. Land Area

The influence of the land area variable can be seen from the estimated parameter value as presented in Table 4, namely -7.454 x 107 which after carrying out the t test is significant at α = 0.01 or 0.1 percent. This means that because in this study α = 0.05 or a confidence level of 95% was used, it was decided to reject Ho which can conclude that land area has a real effect on income. The estimated parameter value means that if the area of rice farming increases by one unit, then income will decrease by 75,454,000. Conversely, if the land area decreases by one hectare, then income will increase by 75,454,000.

The elasticity value for land area is -0.57, significant at 0.000. For every 1% increase in land area, income will decrease by 0.57 percent, assuming other factors remain constant. This negative relationship may indicate that increasing land area may be ineffective or may even reduce income, possibly due to decreased land use efficiency or higher costs compared to increased production output.

2. NPK Fertilizer Dosage

The effect of using NPK fertilizer doses can be seen from the estimated parameter values. This effect can be interpreted if, after being tested using the t test, it has a statistically significant effect. Based on the regression data presented in Table 4, the estimated parameter value for the use of NPK fertilizer doses after carrying out the t test is significant at 0.014. This means that by using α = 5% or a confidence level of 95%, it is decided to accept Ho or it can be concluded that the dose of NPK fertilizer has a real effect on income. The estimated parameter value for NPK fertilizer is 30,700. Each one unit increase in NPK fertilizer use is estimated to increase the dependent variable by 30,700, assuming other factors remain constant.

In other words, increasing the dose of NPK fertilizer does contribute to increasing income, but the contribution is not too large. An elasticity of 0.127 usually indicates that NPK fertilizer has a positive additional role in increasing income, but may not be the dominant factor.

The elasticity value of the NPK fertilizer dose is 0.127. The elasticity value of the NPK fertilizer dose of 0.127 towards income shows that every 1% increase in the NPK fertilizer dose will increase income by 0.127%. This positive elasticity indicates a direct relationship between increased use of NPK fertilizer and increased income, although the effect is relatively small.

3. Labor

The effect of labor on income can be seen from the estimated parameter values. This effect can be interpreted if after carrying out the t test the statistics have a real effect. Based on the regression results presented in Table 4, the estimated parameter value for the labor allocation variable is -45667 and after carrying out the t test the significant value is 0.035. This means that by limiting the level of confidence in this research to α = 0.05 or 5%, it was decided that the null hypothesis was rejected, which means that labor allocation has a real negative effect on farmers' income. If the labor allocation increases by one unit, the farmer's income will decrease by -45667. Likewise, if the allocation of labor decreases by one unit, then income will increase by 45,667.

The elasticity value of labor allocation of -0.086 to income shows that every 1% increase in labor allocation will reduce income by 0.086 percent. This negative relationship indicates that additional labor has the potential to reduce income. A relatively small negative elasticity like this may reflect conditions such as overemployment or inefficiency in the use of labor. In this context, additional labor does not produce

significant additional output, so the costs incurred are actually greater than the profits obtained.

Practical Implications of Research Findings

Based on the results of the regression analysis and the evaluation using economic, statistical, and econometric criteria, several practical implications can be drawn to guide policy decisions and strategic improvements for increasing farmers' income in Rambutan District:

1. *Need for Efficient Land Use Management*

The finding that land area has a significant negative effect on income suggests inefficiencies in land management. This implies that expanding land area alone may not lead to higher income unless supported by efficient farming practices. Therefore, agricultural extension programs should focus on training farmers in effective land utilization strategies to ensure that additional land contributes positively to productivity and income.

2. *Optimizing NPK Fertilizer Use*

Although the impact of NPK fertilizer use on income is relatively small (elasticity = 0.127), it is positive and statistically significant. This implies that appropriate use of NPK fertilizer can support income growth. It highlights the need for targeted fertilizer subsidy programs and technical guidance to help farmers apply fertilizers in line with crop and soil requirements, thus maximizing their economic return.

3. *Re-evaluating Labor Efficiency in Farming*

The negative relationship between labor allocation and income indicates potential overemployment or labor inefficiency. This suggests that simply adding more labor does not necessarily improve outcomes and may instead reduce profitability. Practical efforts should focus on promoting labor-saving technologies or improved farming methods that optimize labor use, and on helping farmers match labor input to actual field needs.

4. *Increasing Production as the Primary Driver of Income*

Production is shown to have the most substantial positive influence on income (elasticity = 0.603). This underscores the importance of direct interventions to boost agricultural productivity, such as the use of high-yielding varieties, improved irrigation systems, and training in modern cultivation techniques. Enhancing output should be a top priority in rural development and agricultural programs.

5. *Comprehensive Farm Business Evaluation is Crucial*

The presence of negative relationships between some input variables and income also suggests the need

for a thorough evaluation of farm business models. Agricultural departments can assist farmers through cost audits and financial management training, ensuring that every input used in farming adds real value and contributes to income growth.

Conclusion

Based on the results of data analysis and discussion, this study concludes that land area and NPK fertilizer dosage have a direct effect on rice production in Rambutan District, while labor does not significantly influence production. Furthermore, land area, NPK fertilizer dosage, labor allocation, and production level all have a direct impact on farmers' income. These findings provide important practical implications. The negative relationship between land area and income indicates inefficiencies in land use, highlighting the need for improved land management strategies and farmer training to enhance the economic returns from expanded landholdings. Although NPK fertilizer use contributes positively to income, its relatively low elasticity suggests that better guidance on precise fertilizer application is needed to improve cost-efficiency and yield response. Labor, which shows a negative relationship with income, reflects the presence of labor inefficiencies, pointing to the importance of introducing labor-saving technologies and optimizing workforce planning in agricultural operations. Importantly, production has the strongest positive influence on income, affirming that improving productivity through the adoption of high-yielding varieties, modern farming practices, and effective irrigation systems should be prioritized. In addition, the complex interaction among production inputs underscores the need for comprehensive evaluation of farm business models, with support from agricultural authorities through cost-benefit analyses and financial management training. Collectively, these insights offer valuable guidance for policymakers, extension agents, and farmers in designing interventions aimed at boosting rice productivity and improving farmer livelihoods in the region.

Author Contributions
All authors had significant contributions in completing this manuscript.

Conflicts of Interest

The authors declare no conflict of interest

References

Ashayeri, M. S., Khaledian, M. R., Kavoosi-Kalashami, M., & Rezaei, M. (2018). The economic value of irrigation water in paddy farms categorized according to mechanization levels in Guilan province, Iran. *Agricultural Water Management*. https://doi.org/10.1016/j.agwat.2018.02.014

Helmi. (2015). Peningkatan produktivitas padi lahan rawa lebak melalui penggunaan varietas unggul padi rawa. *Jurnal Pertanian Tropik*. https://doi.org/10.32734/jpt.v2i2.2888

Hilalullaily, R., Kusnadi, N., & Rachmina, D. (2021). Analisis efisiensi usahatani padi di Jawa dan luar Jawa, kajian prospek peningkatan produksi padi nasional. *Jurnal Agribisnis Indonesia*, 9(2), 143–153. https://doi.org/10.29244/jai.2021.9.2.143-153

Irfan Syahroni, M. (2023). Analisis data kuantitatif. *EJurnal Al Musthafa*. https://doi.org/10.62552/ejam.v3i3.64

Işinkaralar, K., & Erdem, R. (2022). The effect of atmospheric deposition on potassium accumulation in several tree species as a biomonitor. *Environmental Research and Technology*. https://doi.org/10.35208/ert.1026602

Kakar, K., Xuan, T. D., Haqani, M. I., Rayee, R., Wafa, I. K., Abdiani, S., & Tran, H. D. (2019). Current situation and sustainable development of rice cultivation and production in Afghanistan. *Agriculture (Switzerland)*. https://doi.org/10.3390/agriculture9030049

Kim, S., Loose, F., & Chirik, P. J. (2020). Beyond ammonia: Nitrogen-element bond forming reactions with coordinated dinitrogen. *Chemical Reviews*. https://doi.org/10.1021/acs.chemrev.9b00705

Lambers, H. (2022). Phosphorus acquisition and utilization in plants. *Annual Review of Plant Biology*. https://doi.org/10.1146/annurev-arplant-102720-125738

Ma'ruf, M. I., Kamaruddin, C. A., Sari, Y. P., & Rahmawati, D. (2022). Analisis potensi ekonomi kreatif Provinsi Jawa Timur. *E-Mabis: Jurnal Ekonomi Manajemen Dan Bisnis*, 23(1). https://doi.org/10.29103/e-mabis.v23i1.805

Mishra, P., Pandey, C. M., Singh, U., Gupta, A., Sahu, C., & Keshri, A. (2019). Descriptive statistics and normality tests for statistical data. *Annals of Cardiac Anaesthesia*. https://doi.org/10.4103/aca.ACA_157_18

Nurhidayah, S., Jakiyah, U., & Rosmala, A. (2023). Pemberdayaan Kelompok Wanita Tani Mawar Bodas dalam perhitungan kelayakan usaha stik dan keripik bayam. *JPPM (Jurnal Pengabdian Dan Pemberdayaan Masyarakat)*, 7(1). https://doi.org/10.30595/jppm.v7i1.9735

Prasetyo Adhi, Y., Sulistianingsih, D., & Novinda Sekar Putri, V. (2019). Membangun kesejahteraan masyarakat lokal melalui perlindungan indikasi geografis. *Jurnal Meta Yuridis*, 2(1). https://doi.org/10.26877/m-y.v2i1.3416

Putra, K. A. W., Anggreni, I. G. A. L., & Windia, I. W. (2022). Persepsi petani terhadap penggunaan rice transplanter di Subak Guama Kecamatan Marga, Kabupaten Tabanan. *Jurnal Agribisnis Dan Agrowisata*, 11(1). https://doi.org/10.24843/jaa.2022.v11.i01.p22

Rondhi, M., Pratiwi, P. A., Handini, V. T., Sunartomo, A. F., & Budiman, S. A. (2018). Agricultural land conversion, land economic value, and sustainable agriculture: A case study in East Java, Indonesia. *Land*, 7(4), 148. https://doi.org/10.3390/land7040148

Sadono, D. (2008). Pemberdayaan petani: Paradigma baru penyuluhan pertanian di Indonesia. *Jurnal Penyuluhan*, 4(1). https://doi.org/10.25015/penyuluhan.v4i1.2170

Sellars, E. A., & Alix-Garcia, J. (2018). Labor scarcity, land tenure, and historical legacy: Evidence from Mexico. *Journal of Development Economics*. https://doi.org/10.1016/j.jdeveco.2018.07.014

Subekti, F. E., & Jazuli, A. (2022). Pengembangan modul statistika deskriptif berbasis penalaran statistik. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, 6(3). https://doi.org/10.31004/cendekia.v6i3.1688

Sugiyono. (2016). *Metode penelitian*. Uji Validitas.

Suryani, S., Nurjasmi, R., & Fitri, R. (2020). Pemanfaatan lahan sempit perkotaan untuk kemandirian pangan keluarga. *Jurnal Ilmiah Respati*, 11(2). https://doi.org/10.52643/jir.v11i2.1102

UU Republik Indonesia et al. (2022). Penentuan alternatif lokasi tempat pembuangan akhir (TPA) sampah di Kabupaten Sidoarjo. *Energies*.

Walis, N. R., Setia, B., & Isyanto, A. Y. (2021). Faktor-faktor yang berpengaruh terhadap produksi padi di Desa Pamotan Kecamatan Kalipucang Kabupaten Pangandaran. *Jurnal Ilmiah Mahasiswa Agroinfo Galuh*, 8(3). https://doi.org/10.25157/jimag.v8i3.5419

Wildayana, E., Busri, A. S., & Armanto, M. E. (2016). Value changes of lebak swamp land over time in Jakabaring South Sumatra. *Journal of Wetlands Environmental Management*, 4(1). https://doi.org/10.20527/jwem.v4i1.25

Wooldredge, J. (2021). Path analysis. In *The Encyclopedia of Research Methods in Criminology and Criminal Justice: Volume II: Parts 5–8*. https://doi.org/10.1002/9781119111931.ch105