

RICE PRODUCTION AND CONSUMPTION OF FARMER HOUSEHOLDS IN PEKALONGAN REGENCY

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ABSTRACT

Pekalongan Regency is a district with the highest growth rate of the agricultural sector in Central Java, but conventional rice farmers face various problems including fluctuations in rice production, limited resources and farmers who have dual roles as producers and consumers. Further analysis of rice production and consumption among farmer households is needed to address this issue. Therefore, this study aims to examine the factors impacting rice production and consumption, as well as marketable surplus, among farmer households. The research was conducted in Kandangserang District as one of the highest rice producers with a sample of 95 farmers were taken by simple random sampling. The analytical tool used is ordinary least squares. based multiple linear regression. The findings indicate that seed quality, fertilizer use, and the presence of technology significantly impacted rice production, while land area, labor, and technology had no significant effect. Furthermore, the number of family members was a significant factor, while income and rice price had no significant impact to the consumption and the marketable surplus sold was determined to be 46.26%. Based on these results, it is recommended that farmers utilize quality seeds, balanced fertilizers, productive labor, and technology to increase the quantity and quality of rice production. Additionally, the consideration of alternative staple foods to rice may help to increase the marketable surplus available for sale.

Keywords: *consumption, farmer household, marketable surplus, production, resources*

BACKGROUND

Pekalongan Regency in Central Java has experienced significant growth in the food crops sub-sector, with a growth rate of 6.36% in the agricultural sector (BPS Jawa Tengah, 2020). Kandangserang Sub-district is a major contributor to this growth, as it is a major rice producer in the region. Kandangserang District in 2020 became the 5th highest rice producer with rice production reaching 16,835.89 tons (BPS Kabupaten Pekalongan, 2020b). Rice production in Kandangserang has fluctuated from time to time, in 2021 production has decreased compared to the previous year to 12,305 tons, but the following year it has increased to 13,104.70 tons in 2022. For general food expenditure for residents with the lowest 40% income always above 50% of total expenditure. In 2019 food expenditure was 65.41%, then in 2020 it decreased to 63.89%, then in 2021 it decreased to 54.04% and in 2022 the percentage of food expenditure compared to total expenditure was 62.33%. The biggest food expenditure is processed food, while expenditure on grain from 2019-2022 averages 13.18% of food expenditure.

However, rice production in Kandangserang can vary significantly due to various factors such as land type, which is predominantly latosol soil with hilly topography leading to partitioned rice fields. Soil structure in Kandangserang District is hilly with slopes between 5% to 60% with soil types: 50% Latosol, 30% Andesal, and 20% Grumasal (BPS Kabupaten Pekalongan, 2020a). Rice is well-suited to latosol soil because of its clay content, erosion resistance, and good water retention (Arabia et al., 2018). Soil with good water resistance is suitable for these plants because the growth requires flooded land with the ability to hold water longer. The rice field area is one of the main inputs in conventional agriculture used as a factory that produces products. Production yields can be affected by land area (Tou, 2017; Akbar et al., 2018), seed quality (Tou, 2017), and the use of fertilizers (Anggrayini, 2020). Labor and modern technology, like tractors, can also boost production yields compared to traditional techniques such as hoes and animal power (Bashir & Yuliana, 2019; Herman & Zulham, 2018). Agriculture in Pekalongan is almost entirely conventional farming which relies on land as its factory. To be able to produce products, apart from depending on land, production factors are used such as seeds, labor and some use tractors as a type of technology applied to help cultivate land, as well as other production factors.

In addition to production, it is important to consider consumption among farmer households. Based on previous research, income affects farmer household consumption because the amount received shows purchasing power (Fitriani & Partini, 2019). The number of family members can also increase the need for consumption (Panjaitan et al. 2018), and the next factor is the price of rice (Prasetyoningrum et al. 2017). This research examines the dual role of farmers, namely the role of farmers as producers but also examines farmers as consumers. Limited resources can lead to the use of simple technology, resulting in low production yields and potentially limited marketable surplus, which causes small farming businesses to prioritize meeting household needs. Farmers in Kandangserang have limited resources as indicated by low land ownership of an average of 0.99 hectares and not all of them use tractors as a simple type of technology, namely only 62% with an average production that is not maximized, namely 638 kg. Further research on the interrelated factors of production, consumption, and marketable surplus is necessary, which is the purpose of the study Rice Production and Consumption of Farmer Households in Kandangserang Sub-district, Pekalongan Regency.

RESEARCH METHODS

This research was conducted in September-October 2021 in Simalungun Regency, North Sumatra. The location determination was chosen purposively with the consideration that Simalungun Regency is a producer of black tea production in North Sumatra. The sampling technique used is judgement sampling. Judgement sampling is a sampling technique by considering that the sample used has extensive information and is able to explain about the problem topic (Hidayanti et al., 2018). The data obtained were analyzed descriptively and quantitatively. Analyzing the level of risk using the calculation of the coefficient of variation (CV) according to Lawalata et al. (2017) as follows:

$$CV = \sigma / E$$

Information:

CV : Coefficient of variation

σ : Standard deviation (kg)

E : Average production value (kg)

The study included a population of 2,175 farmers from three villages in the Kandangserang Sub-district, which were identified as having the highest rice production in 2020. The sample size was calculated using the Taro Yamane formula with a desired precision of 10%, resulting in a sample of 95.60 farmers rounded up to 95. The sample used purposive sampling based on highest rice producer. The number of respondents per village based on proportional random sampling with 28, 39, and 28 farmers from Garungwiyoro, Gembong, and Lambur Village. Data was collected through field surveys and direct interviews with a questionnaire conducted in June and July of 2022.

The analysis tool used was multiple linear regression based on Ordinary Least Squares (OLS), which was chosen because it has the lowest variance among other linear estimates known as Best Linear Unbiased Estimators (BLUE) (Duli, 2019), and the formulation of the model is as follows:

$$Y_i = \beta_0 + \beta_1 LL_{1i} + \beta_2 BN_{2i} + \beta_3 PPK_{3i} + \beta_4 TK_{4i} + \beta_5 D_{T_i} + \beta_6 D_T TK_{i} + \varepsilon_i$$

The combination model determines the impact of the technology dummy variable on the intercept and the parameters in the regression model. This allows a more comprehensive understanding of the relationship between the technology dummy variable and rice production.

Information:

Y	: Rice production (kg)
β_0	: Constant value
β_i	: Parameter value of variable X to i
LL	: Land area (Ha)
BN	: Seed (kg)
PPK	: Fertilizer (kg)
TK	: Labor (HOK)
D_T	: Tractor dummy
Conditions	: $D = 1$; for tractor use and $D = 0$; for uses other than tractors
$D_T.TK$: Interaction of the use of tractor with labor
ε	: error term

The formulation of the regression model for rice consumption in this research is:

$$Y_i = \beta_0 + \beta_1 P_i + \beta_2 JAK_i + \beta_3 H_i + \varepsilon_i$$

Information:

Y	: Rice consumption (kg)
β_0	: Constant value
β_i	: Coefficient value of variable X to i
P	: Family income (Rp)
JAK	: Number of family members (people)
H	: Price of rice (Rp/kg).
ε	: error term

The coefficients resulting from multiple linear regression analysis based on Ordinary Least squares should be BLUE. Therefore the model should fulfill the following classical assumption test (Duli, 2019).

1. **Multicollinearity Test.** The multicollinearity test aims to determine the presence of correlations between independent variables in multiple models. This can be determined through the Variance Inflation Factor (VIF) value (Duli, 2019). The model is not affected by multicollinearity problems in the tested data when the VIF value is less than ($<$) 10. However, it is affected by multicollinearity problems in the data being tested when the VIF value is greater than or equal to (\geq) 10.
2. **Heteroscedasticity Test.** The heteroscedasticity test is used in regression models to examine when the variance of the regression model is unequal from one observation to another using the Glejser test (Duli, 2019). The phenomenon does not occur when the significance value is greater ($>$) than $\alpha = 0.05$. However, when the significance value is less than or equal to (\leq) $\alpha = 0.05$, the phenomenon occurs in the model.
3. **Normality Test.** The normality test is used in regression models to determine when the residual values are normally distributed through the histogram test using the J-Bera value (Duli, 2019). The data is normally distributed when the probability value of J-Bera is greater ($>$) than the significance level of $\alpha = 0.05$, while it is not normally distributed when the value is less than or equal to (\leq) the significance level of $\alpha = 0.05$.

This research also uses statistical tests seen from the value of the determination coefficient, the F statistic, and the t statistic as follows:

1. **Determination Coefficient Test (R^2).** The determination coefficient (R^2) is the value of the output results using statistical tools to describe the amount of variation, and the value of the coefficient of determination (R^2) is between zero and one. Furthermore, when the value gets smaller, it indicates that the ability of the independent variable is very limited in explaining the dependent variable (Ghozali, 2013).
2. **Statistical F Test.** The F test is used when the independent variables in the model simultaneously affect the dependent variable. This test is often called the overall significance analysis aimed at testing the dependent variable (Y) in a linear relationship with ($X_1, X_2, X_3 \dots X_n$) in the estimated model (Ghozali, 2013). The basis for decision-making in the F Test is:
 - a. $H_0: \beta_1 = \beta_2 = \dots = \beta_k = 0$ means that not all independent variables have no effect.
 - b. $H_a: \beta_1 = \beta_2 = \dots = \beta_k \neq 0$ means that all independent variables or at least one independent variable jointly affect the dependent variable.

The value of F can be formulated mathematically as follows:

$$F = \frac{R^2 / (k-1)}{(1-R^2)(n-k)}$$

Information:

R^2 : The determination coefficient

k : Number of independent variables

n : Number of data/samples

H_0 is accepted when $F_{count} \leq F_{table}$ but rejected when $F_{count} > F_{table}$.

3. **Individual Parameter Significance Test (Statistical Test t).** Knowing the independent or independent variable (X) in research affects the dependent variable (Y) by assuming others are constant (Ghozali, 2013). Mathematically, the t-statistical test can be formulated as follows:

$$t\text{-test} = \frac{\beta_1}{se(\beta_1)}$$

Information:

- β_1 : Regression coefficient
 $se(\beta_1)$: Standard error of the regression coefficient.

Criteria for decision-making in the t-test is $H_0: \beta_1 = 0$ and $H_a: \beta_1 \neq 0$

- H_0 is accepted when $t_{\text{count}} \leq t_{\text{table } \alpha}$ (Sig $\geq 0,05$), meaning that the independent variable (X) does not affect the dependent variable (Y) whereas,
- H_0 is rejected when $t_{\text{count}} > t_{\text{table } \alpha}$ (Sig $< 0,05$), meaning that the independent variable (X) affects the dependent variable (Y).

Marketable rice surplus can be calculated as total production minus total consumption (Afifah et al. 2019). It can be formulated systematically as follows:

$$MS = Q_p - Q_c$$

information:

- MS : Marketable surplus
 Q_p : Total rice production (kg/year)
 Q_c : Total consumption of rice by farmer households (kg/year)

Therefore, if $Q_p > Q_c$, there is a marketable surplus of rice and farmers are more inclined to be producers. Meanwhile, if $Q_c \geq Q_p$, there is no marketable surplus of rice, and farmers are more inclined to be consumers.

RESULT AND DISCUSSION

Rice Production Model

Rice production uses two types of dummy variables in the combination dummy model, namely the intercept and the parameter dummy. The intercept is indicated by the technology dummy variable (D_{Ti}). Meanwhile, the dummy parameters are shown by the interaction of the use of tractor with labor variable ($D_T.TK_i$), and the form of the rice production model equation is as follows:

$$Y_i = \beta_0 + \beta_1 LL_{1i} + \beta_2 BN_{2i} + \beta_3 PPK_{3i} + \beta_4 TK_{4i} + \beta_5 D_{Ti} + \beta_6 D_T.TK_i + \varepsilon_i$$

To produce the best alternative model, equation is transformed into the semilog: log-lin model, namely:

$$\text{Lin}Y_i = \beta_0 + \beta_1 \text{LL}_{1i} + \beta_2 \text{BN}_{2i} + \beta_3 \text{PPK}_{3i} + \beta_4 \text{TK}_{4i} + \beta_5 \text{D}_{Ti} + \beta_6 \text{D}_{T.TK}i + \varepsilon_i$$

The results of a complete multiple linear regression estimation of rice production (Y) can be seen in Table 1.

Table 1. Rice Production Multiple Linear Regression Output

Variable	Coefficient	t-statistics	Sig.
Constanta	5.543364	62.14648	0.0000
Land Area (LL)	0.025954	0.522903	0.6024
Seed (BN)	0.012830	4.352228	0.0000
Fertilizer (PPK)	0.001322	3.030857	0.0032
Labor (TK)	0.001117	1.575871	0.1186
Tractor (D _T)	0.213697	2.646081	0.0096
Interaction of the use tractor with labor (D _T .TK)	0.000213	0.191711	0.8484

t table: 3.707

Based on the regression output in Table 1, the establishment of a rice production model for farmer households in Kandangserang District is as follows:

$$\text{Lin}Y_i = 5,543 + 0.026\text{LL}_{1i} + 0.0123\text{BN}_{2i} + 0.0013\text{PPK}_{3i} + 0.0011\text{TK}_{4i} + 0.214\text{D}_{Ti} + 0.0002\text{D}_{T.TK}i$$

Information:

- LinY_i : Rice Production
- LL : Land Area
- BN : Seed
- PPK : Fertilizer
- TK : Labor
- D_T : Tractor dummy
- D_T.TK : Interaction of the use of tractor with labor

The classical assumption test shows that the rice production model is normally distributed and free from multicollinearity and heteroscedasticity problems. The F_{count} value of 24,45894 is > the F_{table} of 2,203, and R² value of 0.625 or 63%. This means the variables of land area, seed use, fertilizer use, labor, technology dummy, and technology dummy.labor (DT.TK) can explain 63% of the variance in rice production, while variables outside this research contribute to the remaining 37%. According to the results, the land area does not significantly affect rice production. This may be due to the narrow and partitioned structure of rice fields in this research, land ownership averaged 0.99 ha, of which 62.11% owned less than 1 ha of land. Which leads to relatively low rice production in line with Mufriantje and Feriady (2014). Seeds have a positive and significant effect on rice production, Increasing the number of seeds will encourage rice plant clumps so that more rice grains are produced. The types of seeds that are commonly used and according to land conditions include INPARI-32, IR-64, Toyo Arum, and Situ Bagendit. In additions, farmers have following Standard Operating Procedures (SOP), such as selecting good quality seeds and types according to the

characteristics and needs. Therefore, the seeds can be planted and grow well, this finding in line with Bidyasagar et al. (2017) and Tou (2017).

Fertilizer has a positive and significant effect on rice production because the use follows the recommendations for rice plants issued by the Agricultural Research and Development Agency under Anggrayini (2020) and Bidyasagar et al. (2017). Most of the farmers have implemented the use of balanced fertilizer, namely NPK according to the recommended composition. the use of balanced fertilizers and the right dosage will optimize plant yields and fast growth. Meanwhile, labor does not significantly affect rice production because the average use of labor is excessive and not in accordance with the recommendations for optimal use of labor. Excessive use of labor occurs when cultivating the land and irrigation. This is related to the limited semi-technical irrigation channel, 38% of farmers rely on rainfed irrigation as a source of water. The limited availability of water makes land cultivation more difficult and requires more labor. A lot of labor use will only speed up the work but not necessarily increase production, according to Lubis et al. (2021). Tractor dummy has a positive and significant effect on rice production, meaning the use of tractor causes differences and this is similar to the research of Herman and Zulham (2018). Interaction of the use of tractor and labor ($D_T.TK$) has no significant influence on labor. These results mean that the use of labor is considered as a potential moderation but does not interact with predictor variables and does not have a significant relationship with rice production. This result is due to the use of excessive labor than the recommendation per hectare, especially during irrigation. The high use of labor causes an increase in production costs, but does not always increase production. This is due to the limited semi-technical irrigation channels and the low quality of human resources.

Multiple linear regression was used to analyze the effect of income, the number of family members, and rice price on the consumption of farmer households in Kandangserang Sub-district, Pekalongan Regency. The form of the rice consumption model equation is as follows:

$$Y_i = \beta_0 + \beta_1 P_i + \beta_2 JAK_i + \beta_3 H_i + \epsilon_i$$

To produce the best alternative model, equation (9) is transformed into a double log model, namely:

$$\ln Y_i = \beta_0 + \beta_1 \ln P_i + \beta_2 \ln JAK_i + \beta_3 \ln H_i + \epsilon_i$$

The results of a complete multiple linear regression estimation of rice consumption (Y) can be seen in Table 2.

Table 2. Output Multiple Linear Regression of Rice Consumption

Variable	Coefficient	t-statistic	Sig.
Constanta	5.369854	1.038205	0.3019
Income (P)	0.043791	0.534589	0.5942
Number of Family Members (JAK)	0.325895**	2.023958	0.0459
Rice Price (H)	-0.078534	-0.136820	0.8915

t table: 5.841

Based on the regression output in Table 2, the establishment of a rice consumption model for farmer households in the Kandangserang Sub-District is as follows:

$$\text{Ln}Y_i = 5,3699 + 0.0438\text{Ln}P_i + 0.3259\text{Ln}JAK_i - 0.0785\text{Ln}H_i$$

Information:

LnY _i	: Rice Consumption
LnP	: Income
LnJAK	: Number of Family Members
LnH	: Rice Price

The classical assumption test shows that the rice consumption model in Kandangserang Sub-District, Pekalongan Regency is normally distributed and free from multicollinearity and heteroscedasticity issues. The F test shows that the F_{count} value of 3,072387 is > the F_{table} value of 2,705, with an R^2 value of 0.0919 or 9%. This indicates that the variables of income, the number of family members, and the price of rice can only explain 9% of rice consumption by farmer households, while 91% is affected by variables outside of this research. The results of the study show that the variables that affect consumption are more influenced by other variables outside the model such as the type/variety of rice, the price of alternative foodstuffs such as corn or cassava, production, and others.

According to the results, income does not have a significant effect on rice consumption by farmer households. This is because the farmers in this study are more inclined to be consumers, in which 53.74% of the production is intended for consumption. This because rice is a staple food, and households will prioritize meeting their basic consumption needs regardless of their income, in line with the research of Rohman & Maharani (2018), because consumption needs have been met, income is more intended to meet other needs. The number of family members positively and significantly affects rice consumption. This is likely because a larger number of family members means an increased need for food, as supported by the research of Asngari et al. (2020); Elias (2013); Fitriani and Partini (2019); Hanum (2018); Laitety et al. (2018) and Sulistiani et al. (2019). The price of rice has no significant effect on consumption by farmer households. This is because rice is a staple food hence changes in the price are not responsive to consumption. Therefore, households may prioritize meeting their needs for rice as a main source of energy and carbohydrates, regardless of the price, as supported by the research of Anggrayini (2020); Asngari et al. (2020); Bashir and Yuliana (2019); Fitriani and Partini (2019); Sulistiani et al. (2019). For a marketable surplus, it can be formulated systematically as follows:

$$MS = Q_p - Q_c$$

Information:

MS	: Marketable surplus
Q _p	: Total rice production (kg/year)
Q _c	: Total rice consumption by households (kg/year).

Table 3. Rice Production and Consumption as well as Marketable Surplus in the Kandangserang Sub District (2022)

No	Description	Total (kg)	Average	Percent (%)
1.	Lambur village			
	a. Production	10,074	359.77	100
	b. Consumption	5,262	187.94	52.24
	c. Marketable Surplus	4,811	171.83	47.76
2.	Gembong village			
	a. Production	14,453	370.58	100
	b. Consumption	8,604	220.62	59.53
	c. Marketable Surplus	5,848	149.95	40.47
3.	Garungwiyoro village			
	a. Production	14,289	510.33	100
	b. Consumption	6,991	249.68	48.92
	c. Marketable Surplus	7,298	260.65	51.08
4.	Total			
	a. Production	38,815	408.58	100
	b. Consumption	20,858	219.55	53.74
	c. Marketable Surplus	17,958	189.03	46.26

Based on Table 3, it can be seen that the marketable surplus in Garungwiyoro is significantly higher than in the other villages. This is because the land area and average rice production is higher than in Lambur and Gembong Villages. large areas of land supported by infrastructure support, namely the availability of semi-technical irrigation (75%) and the use of tractors (86%) resulted in high production yields. The average production is high, even though the average family member in Garungwiryo village is the highest compared to other villages, but the production that can be sold after deducting consumption needs is still the highest. In addition, the average age of farmers is still young and in productive age, which is an average of 45 years, so they have the ability to find markets to sell their products. The marketable surplus in Lambur and Gembong Villages is relatively low, at less than 50%, due to lower average rice production compared to Garungwiyoro. The low surplus because rice production is prioritized for fulfilling food needs, as supported by the research of Barokatuminalloh et al. (2022). Overall, rice farmers tend to act as consumers because the average consumption is higher, at 53.74%, than the average sale price, at 46.26%, even though actual production is primarily for consumption needs, with only a small surplus being sold. This suggests that rice production in Kandangserang Sub-District is used to fulfill food needs and generate income.

CONCLUSION AND SUGGESTION

In conclusion, seeds, fertilizers, and technology dummy significantly affect rice production in Kandangserang Sub-District, Pekalongan Regency, while land area, labor, and technology dummy.labor (DT.TK) does not have a significant effect. The rice consumption of farmer households is significantly affected by the number of family members, while income and rice price have no significant effect. Meanwhile, there is a marketable surplus of rice in the Kandangserang Sub-District, namely 46.26%. To increase the marketable surplus of rice, it is recommended to focus on increasing

production yields through the use of quality seeds, balanced fertilizers, and a productive workforce, as well as using tractors and considering alternative staple foods to rice for fulfilling basic consumption needs.

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