Small-Scale Farmers' Decisions to Purchase Subsidized and Non-subsidized Fertilizers: A Logistics Regression Analysis

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Abstract. Fertilizer is becoming a big subject among small farmers. Due to a lack of fertilizers, small-scale farmers have been obliged to purchase both subsidized and unsubsidized fertilizers. This issue has effects on farmers' decisions to purchase fertilizers that are subsidized or not. This study intends to examine how small farmers choose between buying fertilizers that are subsidized and those that are not. This study used 30 farmers who used subsidized fertilizers and 30 farmers who used non-subsidized fertilizers. Logistic regression analysis is used in this investigation. The findings revealed that factors influencing the purchasing decisions and use of small-scale farmers' fertilizers are education, farming experience, production, farmer income, ease of obtaining, and affordability. Small-scale farmers tend to buy subsidized fertilizers compared to non-subsidized fertilizers.

Keywords: subsidized fertilizer · small scale farmer · rice production · paddy production · logistic regression

1 Introduction

Agriculture is still the most important sector for the Indonesian economy. The agricultural sector is one of the supporting sectors of the economy through its contribution to the Gross Domestic Product (GDP). Indonesia's GDP contribution in 2017–2019 is around 10–11 percent. The agriculture industry continued to be one of the largest economic pillars in Indonesia throughout the Covid-19 epidemic, which struck the country from 2020 to 2022, with a growth of 15%. This is further supported by the state of the agriculture industry, which is currently expanding favorably in contrast to other sectors, which have seen a drop [1]. In addition, agriculture is one of the supports for national food security. The realization of national food security can occur if food is available sufficiently and evenly, and people have access to food both economically and physically [2, 3]. This assertion suggests that agricultural progress ought to have continued. Agricultural development aims to enhance the output and productivity of food commodities to fulfill the population's expanding food demands.

One of the government policies to increase the production and productivity of agricultural commodities, especially rice plants, is carried out through a policy of providing subsidized fertilizers for farmers. The Government provides fertilizer subsidies to

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increase food production, especially rice, and to help farmers access fertilizer at relatively affordable prices [3]. The provision of subsidized fertilizer is expected to increase rice production and productivity.

Jember Regency as one of the centers of agriculture, especially rice in East Java, is also experiencing problems related to the distribution of subsidized fertilizers. Subsidized fertilizers in Jember Regency have recently experienced delays in distributing fertilizers. In addition, in 2021, there will be an increase in the Highest Retail Price (HET) for subsidized fertilizers which will increase by IDR 300–450 per kilogram as stated in Minister of Agriculture Regulation No. 49 of 2020 concerning guidelines for the highest retail price (HET). This has implications for subsidized fertilizer prices to increase. This phenomenon impacts many small-scale rice farmers in Jember Regency who perceive subsidized fertilizer prices to be expensive, so farmers reduce their use. The increase in fertilizer prices will also affect farmers' decisions to purchase subsidized fertilizers. Therefore, it is important to research the decisions of small farmers in purchasing subsidized fertilizers in the Jember District.

Research related to fertilizers has been carried out by (Haneloy, Sipayung, Joka, & Bukifan, 2021 [4]; Khachatryan, Suh, Zhou, & Dukes, 2017 [5]; Koli, Sipayung, Kune, & Nubotonis, 2017 [6]; Okuma & Isiorhovoja, 2017 [7]; Rachmah, Darwanto, Mulyo, Flora, & Yogyakarta, 2020 [8]; Xin, Yanping, & Tan, 2022 [9]; Jongare and Michael, 2015 [10]; Alhassan, Abdul-Hamid and Gazali, 2020 [11]). In previous studies, we have discussed more about preference decisions for the use of subsidized fertilizers. This research does not only focus on farmers' decisions in purchasing subsidized and non-subsidized fertilizers. In addition, this research also focuses more on small-scale farmers in Jember Regency. This study aimed to determine the factors influencing small-scale farmers' decisions to purchase subsidized and non-subsidized fertilizers in Jember Regency.

2 Research Methods

A. Location and Time of Research

This research will be carried out in Jember Regency, especially in the southern Jember area (Ambulu District, Wuluhan District and Balung District). The location selection was carried out purposively with the consideration that the South Jember region is a rice center area in Jember Regency. After that, the sample sub-districts were selected to be used as research locations, the three sub-districts with the highest production in Jember Regency.

According to Fig. 1, the predominant land uses in the Jember Regency are natural forests, rice fields, and plantations, which occupy around 13.15 percent, 11.44 percent, and 10.94 percent of the total area, respectively. In addition, there are additional uses such settlements (5.16%), agricultural dry lands (4.13%), and uses that are less than 3%. Additionally, the South Jember region would experience a lack of subsidized fertilizers in 2020 and 2021. The time frame for this study was June through October 2022.

B. Sampling Method

The sampling method for farmer respondents who receive subsidized fertilizers in the southern Jember region (Ambulu District, Wuluhan District, and Balung District) is

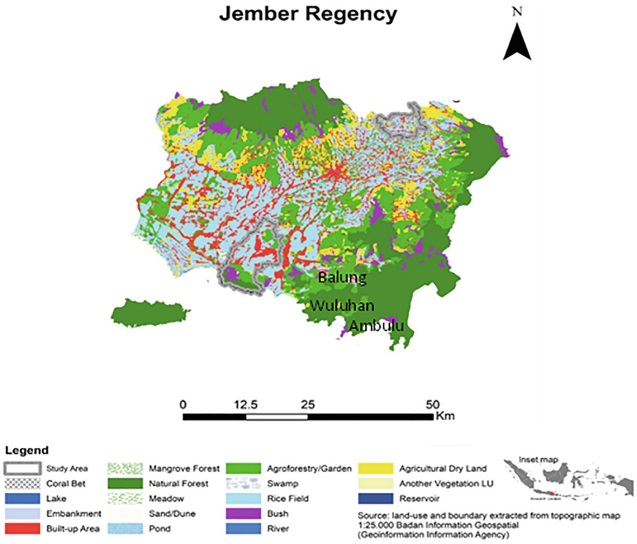

Fig. 1. Topographic Map of Jember Regency

carried out using a quota sampling technique. Sampling was carried out by randomly taking 20 sample respondents in each of the sample districts so that the total sample used in this study was 60 farmers. The criteria for the farmers who were sampled were rice farmers who used subsidized fertilizers and had small or narrow land areas (<0.25 Ha). The population of this study are farmers who do paddy farming. There are 3 sub-districts in Jember taken as the research locus by considering the selected location as the center of paddy production in Jember.The population of farmers in Ambulu, Wuluhan, and Balung sub-districts represents small-scale farmers using subsidized fertilizers, whose precise number is unknown due to the fact that almost every villager in the three sub-districts is a farmer and difficulties in the field in finding farmers who can be interviewed. This is considered when choosing the sample using the quota sampling technique.

C. Sampling Method

Testing the problems regarding the factors that influence the decision-making of small-scale farmers in buying subsidized fertilizers is used logit analysis. In general, a logistic regression probability model involving several predictor variables (x) can be formulated as follows [12]:

$$\begin{aligned} Zi = {} & \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 \\ & + \beta_5 X_5 + \beta_6 D_1 + \beta_7 D_2 + \beta_8 D_3 \end{aligned} \tag{1}$$

where:

Zi = Rice Farmers' Decisions (Dummy Variable) (0 = buy non- subsidized fertilizer, 1 = buy subsidized fertilizer

β = constant

X_1 = Farmer's Age (years)

X_2 = Formal education (years)

X_3 = Farming experience (years)

X_4 = Rice Production (Tons)
X_5 = Rice farming income (Rp)
D_1 = Knowledge about subsidized fertilizer distribution (dummy variable) (0 = don't know, 1 = know)
D_2 = level of ease of obtaining (dummy variable) (0 = difficult, 1 = easy)
D_3 = Affordability (dummy variable) (0 = unaffordable, 1 = affordable).

3 Results and Discussion

A. Respondent's Socio-economic Characteristics

The important characteristics of respondents in this research include age, education, and number of family members, which are presented in Table 1. Table 1 shows that most of the small-scale farmer respondents in the three sub-districts have 4 to 5 family members consisting of a wife and 2 to 3 children. When viewed based on the level of education, the average education of small-scale farmers in the three sub-districts is elementary and junior high schools with a proportion of 40% and 43.3%. Meanwhile, from the age distribution of farmers it is known that most of the small-scale farmers are aged 41 years and over with a range of 41–59 years by 45% and farmers over 50 years by 36.67%. This shows that the farmers in Jember Regency are old farmers, so they still depend on subsidized fertilizers.

Table 1. Respondent's Socio-Economic Characteristics

Variable	Respondents	Percentage
Number of Family Members (persons)		
≤4	43	71,67
>5	17	28,33
Educational status (years)		
Elementary School	24	40
Middle School	26	43,33
High School	10	15,67
Age (years)		
20–30	3	5
31–40	8	13,33
41–50	27	45
>50	22	36,67

Note: Grouped samples are calculated in percentage (%) using the provided interval scale criteria

B. Small-Scale Farmers' Decisions to Purchase Subsidized and Non-subsidized Fertilizers in Jember Regency

Logistic regression analysis was used to analyze the factors that influence farmers to purchase subsidized and non-subsidized fertilizers. Variables used in this study include farmer age, education, length of farming, rice production, farmer income, knowledge dummy of subsidized fertilizer distribution, easiness level of obtaining subsidized fertilizer dummy, and price affordability dummy. The results of the logistic regression analysis can be seen as follows (Table 2):

Table 2. Factors influencing the decision of small-scale farmers to purchase subsidized fertilizers

Variable	Coefficient	Sig.	Odd ratio
Constant	−201,009	0,002	0,000
Farmer's age (years)	0,112	0,290	0,786
Formal education (years)	−0,025	0,045*	0,671
Farming experience (years)	0,013	0,001*	1,010
Rice production (Tons)	0,004	0,027*	1,028
Rice farming income (Rp)	0,218	0,019*	0,976
Knowledge about subsidized fertilizer distribution (dummy variable)	−0,031	0,696	0,992
level of ease of obtaining (dummy variable)	0,017	0,047*	1,117
Affordability (dummy variable)	0,022	0,002*	1,825
	Chi Square	Sig.	
Hosmer and Lemeshow test	9,671	0,211	
Omnibus Test of Model Coefficients	71,760	0,000	
Nagelkerke R Square	0,877		

Note: * significant at $\alpha = 5\%$

This logit regression model has a Nagelkerke R Square value of 0.877. This value means that the ability of the independent variable to predict the dependent variable is 87.7 percent, the remaining 12.3 percent is explained by other variables outside the model. The Hosmer and Lemeshow test values are used to test the goodness of the model. The Hosmer and Lemeshow values are known to be 9.671 with a significance level of 0.211 or greater than the error level value of 0.05. That is, the model used to predict the decision of small-scale farmers to purchase fertilizer can be said to be good. The influence of these factors on the decision of small-scale farmers to purchase the subsidized and non-subsidized fertilizers can be described as follows:

1. *Farmer's Age*
   Farmer's age has no significant effect on farmers' decisions in purchasing subsidized fertilizers and non-subsidized fertilizers. Farmers buy subsidized or non-subsidized fertilizers not based on age, so the farmer's age does not affect the purchase of subsidized and non-subsidized fertilizers in the Jember Regency. These results are in contrast to research [10, 11], which shows that the age of the farmer has a positive effect on the purchase of subsidized fertilizer.
2. *Formal education*
   Farmers' formal education has a significant effect at the 5% level of significance on farmers' decisions in purchasing subsidized or non-subsidized fertilizers. The coefficient value of formal education is −0.025. This figure shows that the higher the education of small-scale farmers, the lower the logistics opportunities for farmers to buy subsidized fertilizers, and conversely, the low education of farmers will

encourage farmers to buy more subsidized fertilizers. Farmers with higher education will choose to buy alternative fertilizers or non-subsidized fertilizers or make organic fertilizers that are cheaper and easier to obtain. These results are in accordance with research by [4, 10, 11] which shows that farmers with higher education will reduce the purchase of subsidized fertilizers.

3. *Rice farming experience*

   Farming experience significantly affects the small-scale farmer's decision to buy subsidized fertilizer. The coefficient value of the variable experience of farming is 0.013. This value indicates that the higher the farming experience of small-scale farmers, the greater the logistical opportunities for farmers to buy subsidized fertilizer by 0.013. Small-scale farmers are currently mostly dependent on subsidized fertilizers. This causes the purchase of subsidized fertilizer to be dominated by small-scale farmers. In addition, substituting subsidized fertilizers will be even more difficult because farmers already have a high dependence on subsidized fertilizers. This result is in line with research [6, 13], which states that farming experience will increase the use of subsidized fertilizers.

4. *Rice production*

   Farmers' rice production also influences farmers' decisions to purchase subsidized fertilizers. The effect value of rice production is 0.004. That is, the higher the farmer's rice production will increase the logistics opportunity for small-scale farmers to purchase subsidized fertilizer by 0.004. Small-scale farmers depend on the previous season's production to finance their farming. Therefore, high production yields will lead to increased purchases of fertilizers in the following growing season. In addition, the scarcity of subsidized fertilizers in several places, including in Jember, has caused small-scale farmers to stockpile the use of fertilizers for the following season when these fertilizers are available. In addition, small farmers tend to buy subsidized fertilizers because they are cheaper than subsidized fertilizers. These results are in accordance with research [13, 14], which shows that increased production will increase the purchase of subsidized fertilizer.

5. *Farming income*

   Farming income also indicates small-scale farmers' decision to buy subsidized fertilizer. The results of the analysis show an effect of 0.218. This value indicates that the increase in revenue of Rp. 1 will increase the logistical opportunities for small-scale farmers to purchase subsidized fertilizers in Jember District. This shows that an increase in farmers' income in the previous season will increase the opportunities for small-scale farmers to buy more fertilizer in the following planting season. Small-scale farmers who have higher incomes will buy more subsidized fertilizers, provided subsidized fertilizers are available. The use of non-subsidized fertilizers by small-scale farmers is only done when subsidized fertilizers are scarce. These results align with research [4, 10], which explains that income positively affects the use of subsidized fertilizers.

6. *Dummy Knowledge of subsidized fertilizer distribution*

   The dummy variable knowledge of the distribution of subsidized fertilizers has no significant effect on the purchase of subsidized fertilizers. This result is because small-scale farmers do not know how to distribute subsidized fertilizers. Small-scale farmers only know where to buy subsidized fertilizer.

7. *Dummy variable About ease of obtaining*
   The dummy variable, the ease of obtaining subsidized fertilizer, significantly affects the purchase of fertilizer. The effect value is 0.017. This figure means that the easier it is for farmers to obtain subsidized fertilizers, the implications for increasing the logistical opportunities for small-scale farmers to buy subsidized fertilizers. If subsidized fertilizers are easy to obtain, small-scale farmers will certainly buy more subsidized fertilizers.
8. *Dummy variable about Affordability*
   The affordability dummy variable is also one indicator determining small-scale farmers' decision to purchase subsidized and non-subsidized fertilizers. The effect of this variable is 0.022. Price is one of the determining indicators of a purchase of goods. According to the law of demand, the lower the price, the higher the quantity demanded. According to the law of demand, the affordable price dummy variable will increase the logistic opportunities for farmers by 0.022 to buy subsidized fertilizer. The price of subsidized fertilizers, which is much cheaper compared to non-subsidized fertilizers, also causes many small-scale farmers to choose to use subsidized fertilizers that farmers are sometimes willing to queue because of the limited availability of subsidized fertilizers. This result is supported by research [5, 9, 10, 14–17], which shows that price determines the purchase of subsidized fertilizer.

4 Conclusion

Factors that influence the purchasing decisions and use of small-scale farmers' fertilizers are education, farming experience, production, farmer income, the ease of obtaining dummy, and the affordability dummy. Small-scale farmers tend to buy subsidized fertilizers compared to non-subsidized fertilizers. This is because small-scale farmers can only buy subsidized fertilizers because they are affordable. Therefore, the availability of subsidized fertilizers needs to be maintained so that small farmers can access and buy fertilizers at affordable prices.

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