

Article

The Impact of Government Food Policy on Farm Efficiency of Beneficiary Small-Scale Farmers in Indonesia

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Abstract: Enhancing self-sufficiency and national food security have been strategic policy goals of the Indonesian government. From 2015 to 2019, a food policy program called *Upsus Pajale* had been implemented to provide input subsidies and extension assistants to farmers for three strategic commodities: rice, maize, and soybeans, to accelerate productivity and increase production. The study was done by interviewing 374 beneficiary farmers. The objectives were to explore production efficiency and the farmers' perspectives on the policy programs. By conducting stochastic frontier production function estimation, the results show that the mean efficiency level was 0.866. This study revealed that land size, seed cost, and labor cost were found to be important determinants of technical efficiency. In addition, the results of the inefficiency model indicated that age and farmers' associations had a significant and positive effect on efficiency scores, whereas education had a negative effect. Contrarily, none of the policy program instruments appear to be essential determinants of efficiency. Furthermore, the research found that farmers prioritized their habits and profitability when deciding which crop to cultivate and that pests were their main concerns. Hence, the government should focus on enhancing research and development for improved seedling pest management control and encourage the establishment of farmers' association to share experience and transfer information and technology for farmers to improve their efficiency.

Keywords: food policy; technical efficiency; stochastic frontier; strategic commodities



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1. Introduction

Zero hunger reduction is one of the focuses of the Sustainable Development Goals (SDGs), and specially SGD 2. Over the last decade, the world has been committed to reducing hunger and poverty. The number of undernourished people in developing countries has fallen by almost half, from 23.3% in 1990–1992 to 12.9% in 2014–2016 [1]. The international community stepped up their commitment to combat hunger by adopting the 2030 Agenda for Sustainable Development, especially SGD 2. The target is to end hunger, ensure food access, end all forms of malnutrition, and double the agricultural productivity and income of small-scale food producers [2]. In achieving the 2030 Agenda for SGD 2, supporting agricultural development is essential to ensure sustainable food production systems and double the agricultural productivity and incomes of small-scale food producers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets, and opportunities for value addition and non-farm employment. Although developing countries tend to show greater reliance on farming activities, food production and consumption are fundamental to any

economy and pervade every society [3]. Consequently, there is no doubt that every country is always trying to ensure national food security.

In order to achieve food security and ensure sustainable food production, many nations are focusing on a strategy of food self-sufficiency by providing various agricultural policy programs. The policies are aimed to increase production, improve productivity, and enhance the production areas. In Thailand, the Thai government has attempted to enhance rice production by expanding the area and increasing their productivity by encouraged the farmers to use new technology such as high-yielding cultivars and improve agricultural tools [4]. Furthermore, this intervention will also simultaneously raise wages, reduce food prices, and promote economic growth [5]. The concept of food self-sufficiency is taken as the ability of the country to satisfy its food needs through its domestic production. The merits of food self-sufficiency as a national policy goal will provide both economic and political benefits. As an economic development strategy, it might strengthen the country's domestic farm sector, reduce production shortfalls in other countries, or cause sudden and sharp rises in food prices. Moreover, the study conduct by Puma MJ et al. [6] showed that developing countries suffer greater import losses through their increased dependence on imports for staple foods. Politically, it is not only a strategy for building national pride, but also a means by which to reduce vulnerability on the world political stage stemming from over-reliance on other countries for essential supplies [7].

Several nations have elevated food self-sufficiency on their policy agendas in response to the extreme food price volatility experienced during the 2007–2008 food price crisis and its aftershocks. Globally, a previous study found that around 77% of the world's countries are in calorie deficit [8] and 83% of countries have low or marginal food self-sufficiency [6]. Regardless of whether they are developed or developing countries, various nations, including Senegal, India, the Philippines, Qatar, Bolivia, and Russia, have indicated a desire to increase their food self-sufficiency, because countries that are not food self-sufficiency may have no problem in securing adequate food supplies for their population through a reliance on international trade [8,9]. High-income or developed countries can afford to import food regardless of whether food prices are high or volatile on international markets, while other countries may find it extremely difficult to import enough food for their population. In addition, hunger and poverty issues arise when a developing country continues to rely on imports, particularly for its staple foods.

Indonesia is one of the developing countries where food self-sufficiency has risen to the top of the political agenda for its government. It has been decades since the staple food consumed, rice, in Indonesia has relied on imports to fulfill domestic needs. For more than 32 years, Indonesia has been unable to meet its population's needs through domestic production of rice and other strategic commodities that serve as reliable foods for the population, such as maize and soybeans. Despite being the world's third-largest rice producer, Indonesia is also one of the world's largest rice consumers. As the population has risen 5.74 percent in 2010 to 2014, rice imports have increased by 18.57 percent, from 687,582 tons in 2010 to 815,285 tons in 2014 [10]. Maize imports rose by 107.9% from 1,527,516 tons in 2010 to 3,175,362 tons in 2014, owing to a rise in demand per capita of 1.97 kg per year in 2015, and it increased by approximately 9.92 percent from 2011 to 2015. Soybeans are consumed as a raw or industrialized product by Indonesians. In 2014, per capita consumption was 7.13 kg. The imports of soybeans rose by 12.85%, from 1,740,505 tons in 2010 to 1,964,081 tons in 2014 [10].

As a response, in 2015 to 2019, the Indonesian government implemented a food self-sufficiency policy in order to achieve national food security for strategic commodities such as rice, maize, and soybeans in four years after the policy was implemented. The food policy program is called *Upsus Pajale*. Both strategies and efforts are made in the *Upsus Pajale* programs to increase production through increasing area and productivity. The program is officially administered by the Ministry of Agriculture under the formal regulation number 14/PEMENTAN/OT.140/3/2015. Farmers of rice, maize, and soybeans gradually received one-time government subsidies, such as seeds, fertilizer, chemicals, machinery (tractors),

and reconstruction of damaged infrastructure (irrigation canal systems). The extension officer and researchers from the Agricultural Service Center also provide intensive farm technical assistance to help farmers increase the productivity of their farms. Moreover, the Ministry of Agriculture cooperates with universities (students and lectures) and the Indonesian Army (*Babinsa*) to facilitate training and solve the farmers' problems as part of *Upsus Pajale* programs. The program was held gradually starting from the central of production areas of the following provinces: East Java, Central Java, North Sumatra, South Sulawesi, Jambi, West Kalimantan, South Kalimantan, and Central Kalimantan as the priority areas of the program (Figures 1 and 2) [10]. The Indonesian government believes that these programs will play an important role in increasing production, improving productivity, increasing farmers' income, and ultimately contributing to increased national food security.

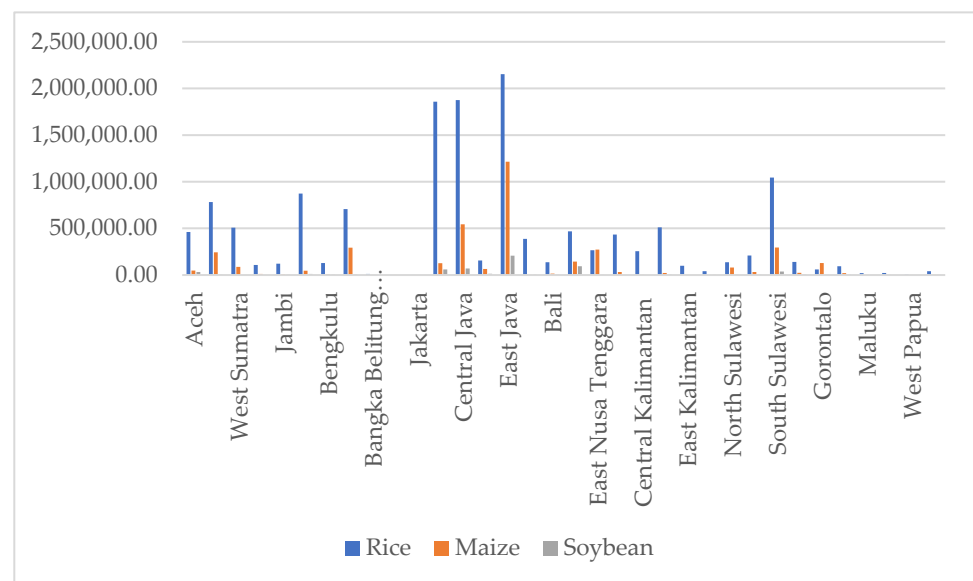


Figure 1. The area of rice, maize and soybean in Indonesia in 2014. Data source: Central Bureau of Statistics Republic of Indonesia.

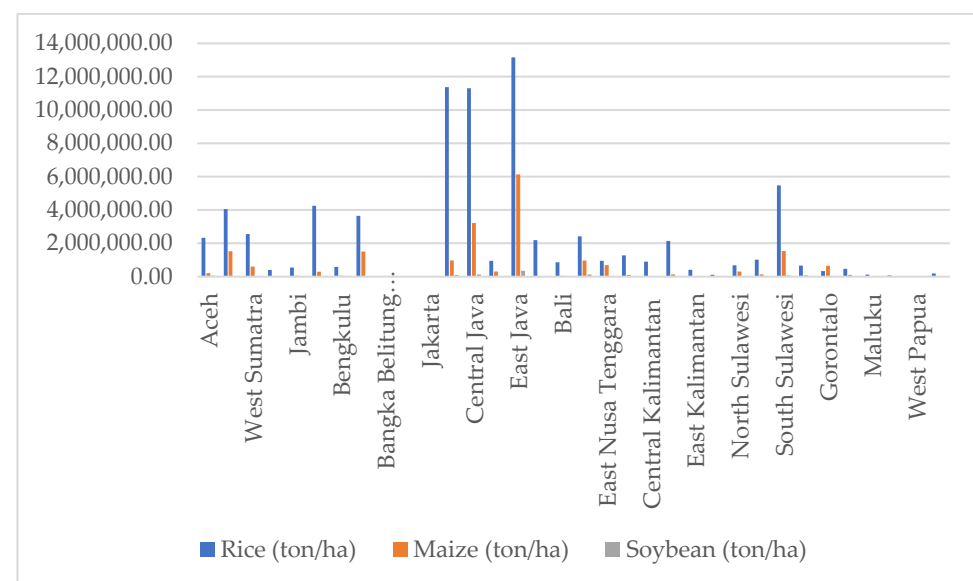


Figure 2. The production of rice, maize and soybean in Indonesia in 2014. Data source: Central Bureau of Statistics Republic of Indonesia.

Recently, Indonesia has continued to import these three commodities. According to the Central Bureau of Statistics of the Republic of Indonesia, rice imports in 2014 reached 844,163.7 tons and decreased to 429,207.3 tons in 2022. Meanwhile, maize imports decreased from 3,300,000 tons in 2014 to 995,990 tons in 2021. In the meantime, imports of soybeans decreased from 2,671,914.1 tons in 2017 to 2,324,730.8 tons in 2022. This situation demonstrates that the *Upsus Pajale* programs are not performing as well as the Indonesian government had expected. This fact is also in line with research conducted by Juhandi [11], which revealed that the goals of the *Upsus Pajale* policy have not been achieved and the production of priority provinces of the program has not changed much before and after the *Upsus Pajale* program was implemented [11]. Therefore, it is interesting to look again at what and how the impact of this policy has affected farmers who were beneficiaries of the subsidies programs at the micro level, as well as explore what problems farmers faced that might have prevented the target of self-sufficiency in rice, maize, and soybeans from being achieved.

Various studies have found that policy programs by providing financial and economic incentives such as subsidies have a positive impact on productivity [12,13]. The *Upsus Pajale* is expected to increase production by increasing farm productivity, which is in line with the assumption of increasing farm efficiency in order to maximize profit with low production costs. Therefore, after applying the policy program, the question arises, “what is the farm performance of the farmers involved in the programs?” Efficiency could be evaluated to determine whether a farm is producing the highest level of output potential given the resources being used [14]. Furthermore, to increase the productivity, it is important that farmers are able to utilize their farm resources efficiently by improving their technical efficiency [15]. Frontier efficiency is an essential analysis and has received substantial attention as one of the indicators to assess the technical efficiency of agricultural production performance [12,16–24].

Analyzing the technical efficiency using stochastic frontier analysis (SFA) is somehow still a popular and reliable calculation of the efficiency level and factors that influence inefficiency. To the authors’ knowledge, in Indonesia, there are only a few empirically based studies evaluated the impact of the *Upsus Pajale* program [11,25–29]. Most of those studies analyzed the factors that influence the inefficiency using characteristic demographics and social economics of farmers’ household [18,30–32]. This study focused on the subsidy’s instruments of program as variable indicators affecting inefficiency level which has not been analyzed. Furthermore, to provide more comprehensive research the study explored the farmer’s perception and agricultural problems they faced in managing their farm. Therefore, the study aims to analyze the technical efficiency of the farmers by employing SFA, and by using the same questionnaire, the close-ended survey questions were utilized to discover the farmers’ perspectives on the *Upsus Pajale* program as well as to find out the problems that farmers faced in farming. As such, the present study would fill up the gap in the literature. In the hope that this study could provide a more comprehensive assessment of the program’s impact on farmer beneficiaries of *Upsus Pajale* policy programs.

The subsequent sections of the article are organized as follows: materials and methods, empirical results and discussion, conclusion and policy recommendation, and limitations and future recommendations.

2. Materials and Methods

2.1. Study Area and Sampling Design

Data were collected by close-ended survey questionnaires in Jember, East Java province, Indonesia (Figure 3). East Java is the largest production area of rice, maize and soybeans in Indonesia (Figures 1 and 2), and it was also the one of priority province for *Upsus Pajale* policy programs. Jember accounts for the highest rice production area compared to other regions in East Java and produced 998,559 tons of rice in 2015. In the same year, for maize and soybeans, Jember ranked second and fifth, respectively, among 38 regions in East Java; it produced 427,064 tons of maize and 25,178 tons of soybeans. The sample of our

study was the farmers who have been receiving one of the subsidies from the *Upsus Pajale* policy programs. Due to the data limitations, the population number of farmers that were beneficiaries of the subsidies from the *Upsus Pajale* program was unknown, therefore the authors collaborated with the extension officer from Technical Implementations Unit of the Agriculture Department (UPTD) from the Ministry of Agriculture to run interviews. The reason for this is, because they are the ones who execute the program, they therefore know accurately which farmers were the beneficiaries of the *Upsus Pajale* program. The interviewers received instructions and conducted a survey from October to December 2016.

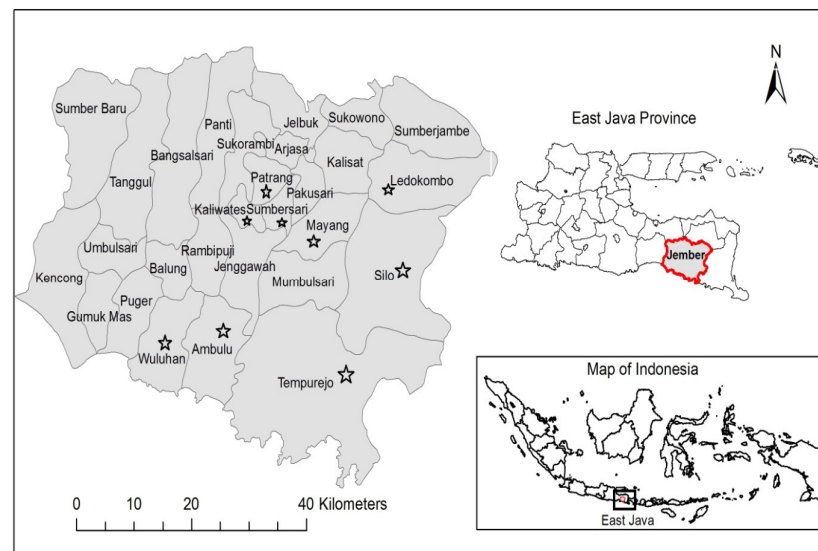


Figure 3. Map of Jember, East Java province, Indonesia. Note: In the figure, the stars sign represent the study areas.

This research used the multi-stage procedure for sampling design. This sampling method was ideal to be used when it was impossible or impractical to compile a list of the elements composing the population [33]. Jember has 31 districts and 10 UPTD, with each UPTD covering 3 to 4 district areas. The following UPTDs were chosen: UPTD Silo, UPTD Sumbersari, and UPTD Ambulu. These three UPTD have the most farm households, the largest production areas, and the highest productivity. These areas also have similar agro-ecologies (rain-fed and irrigation systems). In total, there were 9 districts targeted: Silo, Mayang, Ledokombo, Sumbersari, Kaliwates, Patrang, Ambulu, Wuluhan, and Tempurejo. In total, there are 70 villages in those 9 districts, and we randomly selected 42 villages as representatives. A total of 450 questionnaires were distributed. After removing invalid samples, which include incomplete questionnaires, the dataset consisting of 374 qualified farmers was used for analyses. By using the data, the study was able to explore the assessment of farm efficiency and discover farmers' perceptions of the *Upsus Pajale* program. In addition, this study also tried to explore the agricultural problems that farmers faced. The survey collected detailed information on three aspects. First, socio-economic characteristics of the farmers' household, i.e., gender, age, education, farming experience, and household size. Second, farm resource data, i.e., farm output production, farm size, and inputs, were used. The third was the farmers' general impression of the program and the agricultural problems they faced.

2.2. Theoretical Model

There are three concepts of efficiency: technical efficiency, price/allocative efficiency, and economic efficiency [34]. Farmers have higher technical efficiency compared to others if they could produce more output by using the same number of inputs. Price efficiency, or allocative efficiency, measures farmers' efforts to maximize profit, which is achieved

when the marginal product value of each factor of production equals the marginal cost. Economic efficiency is a combination of technical efficiency and price efficiency.

The stochastic frontier analysis (SFA) model was introduced by Aigner et al. [35] and Meeusen W, van den Broeck [36] and has been an important parametric approach to estimating the production frontier and factors influencing efficiency. The main strength of SFA models, also known as composed error models, is that they postulate the existence of technical efficiency in farm production that is involved in producing a particular output [16,17]. Theoretically, the inefficiency model is not explicitly formulated in terms of appropriate explanatory variables. The general model of stochastic frontier production function that assumes the technical inefficiency of production can be represented as:

$$y_i = f(x_i, \beta) + \varepsilon_i \text{ for } i = 1, 2, \dots, n \quad (1)$$

where y_i is the output of the i -th farm; x_i is the vector of input; β is vector of unknown parameters to be estimated; and ε_i is error term. The error term (ε) consists of two independent components,

$$\varepsilon_i = v_i - u_i \quad (2)$$

where v_i is a two-sided error term that represents statistical noises, which is assumed to be independently and identically distributed (*i.i.d*) $N(0, \sigma_v^2)$ and it captures the effect of random shocks outside the farmers' control (such as bad weather, luck, natural disaster, unpredictable variation in equipment performance, etc.); u_i is a one-sided error term that represents technical inefficiency, assumed to be independent to x_i and v_i , and it capture the effect of factors under farmers' control. The error component of $u_i = |u_i|$, where u_i is (*i.i.d*) $N(0, \sigma_u^2)$. It implies that u_i is half-normal but it also can be replaced by other assumptions, such as truncated-normal [37] and two-parameter gamma [38].

Referring to Battese and Coelli [17], we assumed that u_i is truncations (at zero) of the normal distribution with mean, $z_i\delta$, and variance, σ_u^2 . The production technical inefficiency effects can be described as:

$$u_i = z_i\delta + w_i \quad (3)$$

where δ is a $1 \times p$ vector of parameters to be estimated and z_i is a $p \times 1$ vector of variables that may influence the efficiency of the i -th farm-specific variable hypothesized to be associate with technical inefficiency. The distribution range of the random errors v_i is $[-\infty, +\infty]$, while the distribution range of the random inefficiency factor u_i is $[0, +\infty]$, and w_i is a truncated random error ($\geq -z_i\delta$). Given the input vector, x_i , the potential output is defined by the frontier function, $y^* = \exp(x_i\beta + v_i)$. The mathematical expectation (mean) of technical efficiency of i -th farm can be obtained as the ratio of the observed output for the i -th farm, relative to the potential output, which can be explained as follows:

$$TE_i = y/y^* = E[\exp(-u_i|\varepsilon_i)] \quad i = 1, 2, \dots, n \quad (4)$$

where TE_i is technical efficiency i -th farmer, $E[\exp(-u_i|\varepsilon_i)]$ is expected results (mean) from u_i , $0 \leq TE_i \leq 1$. If the $TE_i = 1$, the farming in efficient level condition.

In this research, the Cobb–Douglas frontier will be used. Transforming to the logarithm form yields:

$$\ln y_i = \ln \beta_0 + \sum_{j=1}^n \beta_{ij} \ln x_{ij} + v_i - u_i \quad (5)$$

where y is output; x_j is the j -th input; i is i -th farmer, β_0, β_{ij} are parameters; $v_i - u_i$ is error term. The detail empirical model specification for the Cobb–Douglass production function of rice, maize, and soybean in Indonesia is:

$$\ln(y_i) = \ln \beta_0 + \beta_1 \ln(x_1) + \beta_2 \ln(x_2) + \beta_3 \ln(x_3) + \beta_4 \ln(x_4) + v_i - u_i \quad (6)$$

where y_i represents the quantity of output (in kg/farm); x_1 is the land size (in hectar); x_2 is the cost of seeds used in the farming areas (in rupiah/farm); x_3 is the cost of fertilizer

used in the farming areas (in rupiah/farm); x_4 is the total cost of labor used in the farming process (in rupiah/farm); β is an unknown parameter to be estimated along with the variance parameters and if the expected estimated coefficient: $\beta_1, \beta_2, \beta_3, \beta_4 > 0$, the positive sign of each variable will increase the production of the crop. The inefficiency effect model captures the social-economic variables and subsidies instrument that the farmers received from the *Upsus Pajale* programs. These variables might be possible to influence technical efficiency, as defined by:

$$u_i = \delta_0 + \sum_{j=1}^{11} \delta_j z_{ji} \quad (7)$$

where the δ_0 is intercept; δ_j is unknown parameter of 11 variables; z_1 is farmer's gender (man = 1; woman = 0); z_2 is farmer's age (years old); z_3 is farmers education level; z_4 is family numbers (person); z_5 is farming experienced (year); z_6 is a dummy for joint farmer's association (1 if join; 0 otherwise); z_7 is a dummy variable for received seed subsidies from government (1 if received; 0 otherwise); z_8 is a dummy variable for received pesticide subsidies from government (1 if received; 0 otherwise); z_9 is a dummy variable for received fertilizer subsidies from government (1 if received; 0 otherwise); z_{10} is a dummy variable for received machinery subsidies from government (1 if received; 0 otherwise); and z_{11} is agricultural extentions (the number of training/assistants that farmers have received in a year). The subsidies instruments in the study used dummy variable because the subsidies type and numbers that farmers received varied. The maximum likelihood estimates of the parameters were estimated using the computer program FRONTIER, version 4.1, developed by Tim Coelli in 1996.

This study also investigated the farmers' perspective about the *Upsus Pajale* program to discover general perception of the policy. Close-ended questions with multiple choice and Likert scale were used. The Likert scales are one of the most commonly used scales in social science research, and this measurement can measure the attitude of the respondents quickly and easy to make statements to capture the essence of a specific construct. It is also easy to understand, and respondents feel it easy to provide their perception through a Likert-type format [39].

3. Results and Discussion

The descriptive statistics of the social economic variable are presented in Table 1. The average farmers age of this study was 46.9 years old; 3.310 levels of education which could be qualified as junior high school; with 3.4 members of family; and the average number of farming experience around 21.69 years. The variables used in this study with their respective descriptive statistics are presented in Table 2. The farms involved were found to be relatively small-scale farmers with an average of less than one hectare. Labor costs stood as the highest compared to seed and fertilizer with an average of 2,582,374.564 rupiahs (190.7 USD). The average seed cost used for the planting season was 399,205.214 rupiah (29.5 USD), while the fertilizer cost was higher at 1,138,455.249 rupiah (84.07 USD). The average output was recorded at 4596.6 kg/farm.

Table 1. Descriptive statistics of the social economic variable of the sample.

Variables	Unit	Max	Min	Mean	Std. Deviation
Age	years	80	5	46.960	10.244
Education	level	10	0	3.310	1.8555
Family size	number	8	1	3.404	1.118
Farming experience	years	60	1	21.690	10.569

Table 2. Descriptive statistics for variables used in the study.

Variables	Unit	Max	Min	Mean	Std. Deviation
Output	kg/farm	22,000	300	4596.553	3411.384
Land size	hectare/farm	4	0.1	0.711	0.502
Seed cost	1IDR/farm	2,400,000	15,000	399,205.214	389,798.598
Fertilizer cost	1IDR/farm	5,650,000	36,000	1,138,455.239	674,806.721
Labor cost	1IDR/farm	10,600,000	100,000	2,582,374.564	1,856,451.483
Subsidy seed	dummy	1	0	0.888	0.316
Subsidy Pesticide	dummy	1	0	0.102	0.303
Subsidy Fertilizer	dummy	1	0	0.297	0.457
Subsidy Machine	dummy	1	0	0.088	0.284
Agricultural extension	number/year	24	0	5.307	5.425

IDR: Indonesian currency (Rupiah); 1USD = 13,540.89 IDR as of December 2016.

The model of efficiency in Table 3 explains the stochastic frontier production function (SFPF) estimation result for farmers that received subsidies from the *Upsus Pajale* program in Indonesia using the Cobb–Douglas production model. Both the ordinary least squares and maximum likelihood analyses show that land size, seed cost, and labor cost were positive and significant at the 1% significance level, while fertilizer cost remained not significant at the 5% level. This means the output will increase as land size, seed, and labor increase. These results imply that when land (total area planted for the crops), seed cost, and labor cost are increased by 1%, it will lead to an increase in the quantity of crops harvested by 0.65, 0.18, and 0.14, respectively. Land became the most crucial factor for production. The results are in accordance with several studies that indicated that land had a strong impact on production, for example [4,40–42]. In addition, the typical Indonesian farmer is a small-scale farmer with a small farmland area, which makes the use of large machines difficult. Therefore, labor-intensive methods were most widely used instead machines, and the same results were estimated by [4,15,23,42,43]. Furthermore, the seed cost also has a positive influence on efficiency. This finding is consistent with the statement of Vu, Thi-Hien et al. [23], found that increasing the seed could boost the yield. Moreover, Haryanto et al. [44], and Chiona et al. [45], the used of certified seed which tends to be more expensive but observed to have higher technical efficiency. In short, the results suggested that farmers should adjust and allocate input factors such as land, seed, and labor appropriately to improve efficiency and in turn, this could further contribute to increase productivity and boost the national production.

Meanwhile, the maximum likelihood estimation result showed that the variance parameter (γ) was found to be highly significant at 1% level and the coefficient was found to be 0.89, indicating that there was a technical inefficiency that influenced the farming production in the study area. The higher share (0.89) of the efficiency of rice, maize, and soybeans was caused by farmers' farming management, while the other (0.11) was due to random errors that are out of the farmers' control. Based on the sigma squared (δ^2) results, we might know the difference of the reality that happened in their farming management system and the potential farming system. The result showed that sigma squared was bigger than zero, which was 1.03 and significant at 1% level, indicating that there was technical inefficiency.

The technical inefficiency effects in the lower half of Table 3 showed that the positive coefficient indicated that the variable has a positive influence on technological inefficiency, while the negative sign is the opposite. The more the estimated value differs from zero, the stronger this efficiency or inefficiency is. From the 11 factors of farmers' socioeconomic variables and policy instruments, inefficiency appears to be significant for the following variables: farmers' age and farmers' education at a 5% significance level, while the factor of joint farmers' association is statistically significant at a 1% significance level.

Table 3. The parameter technical efficiency.

Variables	Parameter	OLS			MLE		
		Coefficient	Standard-Error	t-Value	Coefficient	Standard-Error	t-Value
Efficiency Model							
Constant	β_0	3.83	0.87	4.38	3.96	0.77	5.13
Ln Land size (ha)	x_1	0.65	0.06	11.46 **	0.63	0.05	11.62 **
Ln Seed cost (IDR/farm)	x_2	0.18	0.03	5.70 **	0.22	0.03	8.18 **
Ln Fertilizer cost (IDR/farm)	x_3	0.02	0.04	0.49	0.00	0.04	0.00
Ln Labor cost (IDR/farm)	x_4	0.14	0.04	3.40 **	0.14	0.04	3.50 **
Inefficiency Effects							
Constant	δ_0				5.38	2.50	2.15 *
Farmer gender; 1 = Man; 0 = Woman	z_1				−1.89	1.70	−1.11
Farmer age (year)	z_2				−0.06	0.02	−2.38 *
Farmer education level	z_3				0.32	0.13	2.51 *
Family number (person)	z_4				−0.25	0.14	−1.84
Farming experienced (year)	z_5				0.00	0.02	−0.15
1 if joint farmer association; 0 otherwise	z_6				−4.21	1.38	−3.04 **
1 if received seed subsidy; 0 otherwise	z_7				−1.05	0.56	−1.89
1 if received pesticide subsidy; 0 otherwise	z_8				−0.15	0.83	−0.18
1 if received fertilizer subsidy; 0 otherwise	z_9				0.91	0.48	1.88
1 if received machinery subsidy; 0 otherwise	z_{10}				−2.54	1.45	−1.76
Agricultural extension (number/year)	z_{11}				0.07	0.04	1.73
Sigma-squared (δ^2)		0.36		0.21	1.03	0.27	3.79 **
Log likelihood function				−233.62			−202.84
Gamma (γ)		0.68			0.89	0.03	30.22 **
LR					61.55		

t-value at significance at 5% and 1% level correspond to * and **, respectively.

The coefficient of the farmers' age variable showed a negative relationship with the predicted inefficiency and was significant at the 5% level, implying that technical inefficiency will be reduced by 0.06 percent as the farmers' age increases. It seems that older farmers have more skills to apply and operate the farm than their younger peers, who may lack years of experience, which is consistent with the findings of Vu, Thi-Hien et al. [23] and Chiona et al. [45]. The coefficient of education level was significant at the 5% level; however, it had an unexpected sign; it was a positive sign. It implies that the higher the education of the farmers, the more inefficient their farms are; this result is in contrast to [15,23]. The reason was that in the study area, highly educated farmers tend to do farming as their second job. Therefore, they do not concentrate on the farming sector mainly, but busy themselves with their primary jobs as public officers, teachers, or sellers. These results are similar to Kune, S.J., et al. [46], who found that formal education negatively influenced the Indonesian maize efficiency level. Joining the farmers' association played an important role in reducing inefficiency. The variable was significant at the 1% level, with a negative relation to the inefficiency effect. This condition indicates that farmers who join a farmer's association tend to be more efficient; these results are in agreement with Ayodeji, O., et al. [47]. Farmers most likely receive more benefits from their farmers' association membership as a result of better access to market information, the transfer new farming technology, or discussions to help farmers solve their farming problems [23]. The policy instruments such as subsidies for seeds, pesticides, fertilizer, machinery, and extension officer assistance were not significant to the inefficiency effect. It was because those factors were not an essential determinant of technical inefficiency.

In brief, the government's approach to providing input subsidies was relatively ineffective because the beneficiary farmers are still facing technical inefficiency problems caused by their other farming management systems. The results of inefficiency revealed

that the government should consider encouraging farmers to join the farmers' association, which may influence a better efficiency level [47,48]. Figure 4 shows the summaries of the technical efficiency distribution of the studied farmers. There was significant variation in the level of efficiency among farmers, ranging from a very low 0.12–0.94. However, the mean efficiency level was 0.866. The distribution of efficiency shows that more than 50% of farmers have an efficiency level of more than 0.8, which is high.

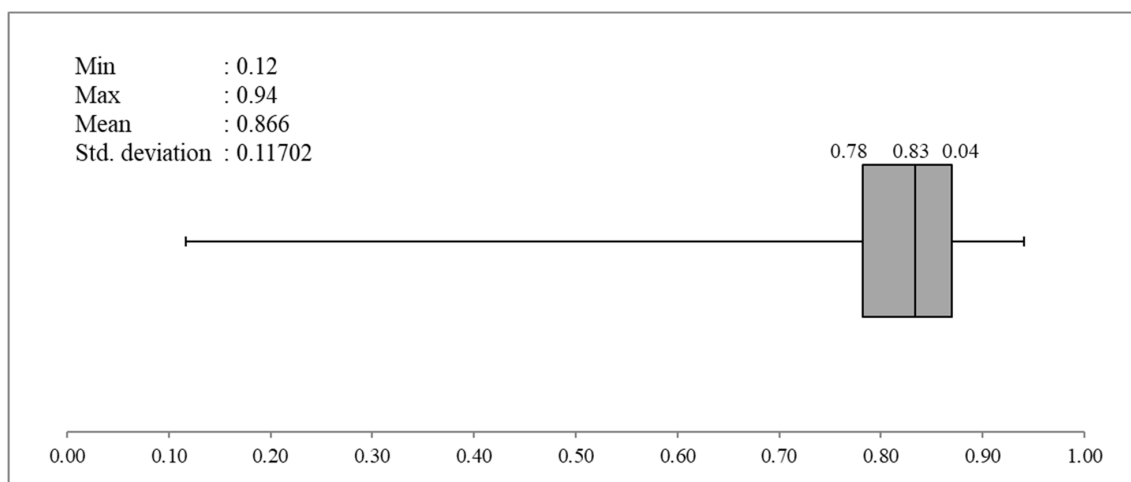


Figure 4. The distribution of farmers' technical efficiency level.

Hence, the policy instrument itself is not a significant determinant of efficiency. In a second step, this research examined the farmers' perspective to gain a better understanding of the real problems and farmers' behavior toward the *Upsus Pajale* program. According to Figure 5, the main reason farmers choose a specific crop is based on their habits, followed by profitability, irrigation system, marketability, price stability, and others. Habit became the farmer's first consideration because smallholder farmers are typically risk-averse [49,50]. Therefore, they prefer to plant a crop that is already familiar to them. Although rice, maize and soybeans might not be as profitable as other crops, these three strategic commodities are staple foods, particularly rice and maize, have stable market demand, and are consumed by family members. Consequently, farmers do not have to worry about an excess of supply in the market. Irrigation systems also became third indicators of the farmers considerations, which is in line with a study conducted by Haryanto et al. [44], who said that the irrigation infrastructure is essential for adequate water supply for rice farming. In terms of price stability, the Indonesian government provided a floor and ceiling price for rice; however, the results indicated that just 28.61% became a farmer's consideration. It is caused by the low price of rice set by the Indonesian government compared to the market.

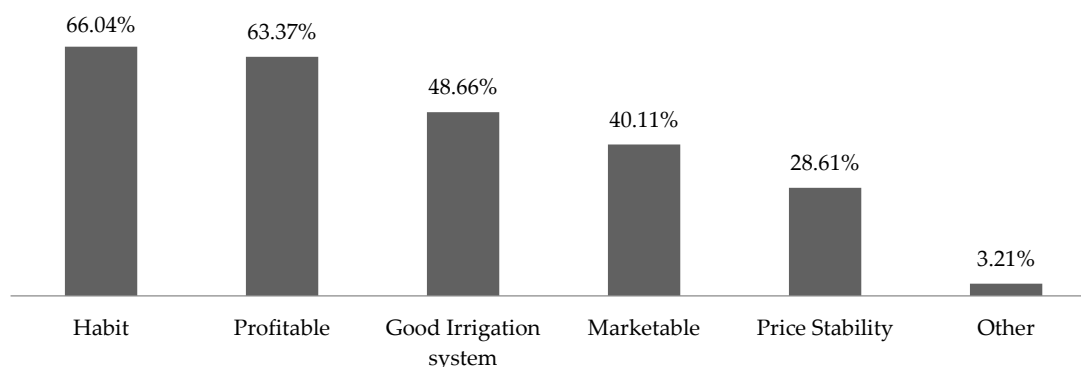


Figure 5. The reasons for farmers to choose their cultivated crops (percentage (%) refer to number of farmers from all the samples).

In Table 4, the study further revealed that about 56.1% of farmers agree that the program somehow helps solve some farming problems, such as adding extra capital. However, subsidies are not the main reason for farmers to choose to cultivate rice, maize, or soybeans. Particularly, about 50.3% of the farmers thought that planting those strategic crops was profitable, although they did not received any subsidies from the government. Moreover, the results also showed that the biggest agricultural problems that farmers face are mostly caused by pests (Figure 6).

Table 4. Farmers' perspective about the *Upsus Pajale*.

	Helped to Solve Farm Problem	Profitable although without Subsidies
strongly disagree	0.5%	2.4%
disagree	0.8%	9.4%
neutral	2.9%	29.4%
agree	56.1%	50.3%
strongly agree	39.6%	8.6%



Figure 6. The agricultural problems for farmers.

In short, the results revealed that the *Upsus Pajale* program may be beneficial to farmers in terms of helping with farm capital. However, the government's approach to providing input subsidies was relatively ineffective because the beneficiary farmers are still facing technical inefficiency. Reform of the government spending policy from input subsidies toward higher spending on general services such as research and development for better seedling and pest management control seems more reasonable. The government is urged to take the initiative to encourage the establishment of farmers' association, addressing the provision of a well-functioning reach-out extension system that can provide farmers with the knowledge to obtain better information and new technology to use inputs properly and efficiently in order to increase yields. Furthermore, the farmers' association activities, e.g., sharing experience and demonstrating first-hand knowledge of pests, processing, and accessing the market, might be helpful to less-experienced farmers to improve their efficiency.

4. Conclusions and Policy Recommendation

The *Upsus Pajale* policy program's main goal was to increase production in order to achieve self-sufficiency in rice, maize, and soybeans, which would then improve national food security. The study used SFA to analyze the production efficiency of Indonesian farmers that received subsidies from the programs. The TE results showed that average efficiency level of the farmers was 0.866, indicating that it still has opportunity to

be increased to reach its maximum potential. The following factors were identified as significantly contributing toward improving farmers' efficiency, such as land size, seed cost, and labor cost, while fertilizer cost is not significant. The finding suggests that in order to increase the yield, farmers should use the larger land, and increase their seed and labor cost. The variance parameter was significantly different from zero, particularly the gamma value of 0.89, indicating that technical inefficiency in the farm management system was responsible for a portion of the inefficiency. In sum, the model of inefficiency effect showed that the farmers' age and joining the farmers' association were identified as significantly contributing towards decreasing of farmers' inefficiency. Meanwhile, the education level was positively improving the inefficiency level. Furthermore, none of the policy program instruments appear significant as an essential determinant factor for efficiency in order to increase production and accelerate productivity growth as the government wants to achieve.

Another purpose of the policy was to increase farmers' willingness to cultivate rice, maize, or soybeans. The study discovered that farmers' willingness to cultivate specific crops was typically based on habits and profitability rather than the government's subsidy schemes. Farmers agree that subsidies helped them increase farm capital, but it was not the primary factor in their decision to cultivate certain crops. The biggest agricultural problem that farmers faced in the study was pest problems. Therefore, to tackle these findings and problems, the government should focus on research and development to provide better seed and pest management control. The government should also take the initiative to encourage the establishment of farmers' associations, which could provide farmers with the knowledge to obtain better information and access the newest technology in order to increase yields.

5. Limitations and Future Recommendation

The authors realize that this research suffers from some limitations. First, the empirical model in terms of investigating the causes of technical inefficiency, such as the degree of market competitive pressure, various farm managerial characteristics, and other external factors such as climate changes, has not been included. Therefore, it will be more interesting if the future research can include those factors in the study. Second, the research data were gathered in 2016, which was the time farmers in the study area received the one-time subsidies (seed, chemicals, fertilizer, machinery, and training from agricultural extension officers) from the *Upsus Pajale* program; thus, this study would like to recommend that future studies update with the newest data about farmers' efficiency levels. Third, the study was conducted only in East Java, so it would be better if further research could discover many more provinces to provide more solid results and policy implications for better management purposes.

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