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Technical, Allocative, and Economic Efficiencies of Rice cultivation

Avi Budi Setiawan [1]✉, Prasetyo Ari Bowo[2]

FE, Semarang State University, Indonesia

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Abstract

This research aims to analyse efficiency of rice cultivation at Grobogan Regency. This regency was chosen as the research area because it gave a major contribution in the rice crop in Central Java Province and it has become the national food stock. There are three efficiency analyses: technical, allocative, and economic efficiencies. The result showed that the farmers in Grobogan Regency are still not efficient both technically and economically in growing the rice.The inefficiency was driven due to the excessive use of input. The excessive use of production factor caused the decrease of soil quality. It then made the production of the crop less optimal. Besides, the use of excessive inputs caused decreasing return to scale because the generated marginal output was less than the marginal input.

Keywords: Efficiency, Rice, Technical, Allocative, Economy, Grobogan.

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✉ Corresponding author :
Address: Kampus Unnes Sekaran, Semarang 50229
E-mail: avi_bs19@rocketmail.com

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INTRODUCTION

Indonesia is an agricultural country where the agricultural sector is one of the main sectors that plays a role in the regional economic development. Agriculture is one important factor considering the needs of consumers for food is great, the livelihood of most people in Indonesia are also derived from the agricultural sector. In this globalization era, the development of the agricultural sector should be conducted considering that agricultural commodities do not only become the consumer goods but also become the industrial commodities both as the raw materials and the goods ready for consumption (Mahabubul, 2009).

The development economy in general and the agricultural economy have focused on how the agricultural sector can contribute a high level on the economic growth of a country. (Svotwa, 2009).

The agricultural sector in Indonesia is one of the main sectors of the economic driving, which is proved by the agricultural sector's contribution to GDP Indonesia that is the second largest after the industrial sector. In its development the agricultural sector is still concentrated in Java, especially for food crops (rice, corn, and soybeans), so that Java can be said as supporting the agricultural sector in Indonesia, in which its contribution to the national agricultural map, Central Java Province is one of the main agricultural regions in the island of Java.

Central Java Province is a region of national food suppliers. Rice food production contributes 16% of the national rice production (Dispertan Central Java: 2007). Comparison of production of some food commodities of national importance can be seen in Table 1.

Table 1. Food Provision is Central Java In 2009-2010 (in ton)

No	Commodity	2009	2010	Growth
1	Rice	5,362,423	5,634,368	5.07
2	Corn	2,782,639	2,949,831	6.01
3	Soybean	148,883	154,312	3.65
4	Meat	303,173	319,381	5.35
5	Egg	281,559	295,975	5.12
7	Milk	317,427	323,775	2.00

Source: Mass Guidance Bureau of Food Security of Central Java in 2010

From Table 1 we can see that the rice is the highest commodity in Central Java, while the lowest commodity is the eggs commodity eggs. During its growth from 2009 to 2010, corn has the highest growth in terms of food provision, which is 6.01 percent.

Grobogan is the regency with the third largest area in Central Java consisting of 18 districts. The great potential of land makes Grobogan one of the barns in Central Java and even Indonesia; the majority of the population of Grobogan also works in the agricultural sector.

Superior agricultural commodities in Grobogan consist of three those are rice, corn, and soybeans. All three commodities become superior agricultural commodities in Grobogan considering their great contribution to the total output of the agricultural sector and the good quality production. Therefore, this research is conducted on rice paddy commodity considering its commodity to the agricultural production in Grobogan Regency.

Table 2. Production of Food Crop Commodities in Grobogan Regency in 2010 (in ton)

No.	**Commodity**	**Production**
1.	Rice Paddy	663,758
2.	Corn	708,013
3.	Soybean	78,164
4.	Greenbean	23,842
5.	Peanut	1,441

Source: BPS of Grobogan Regency in 2010.

Table 3. Rice Paddy Center Spread over 12 Regencies In Central Java in 2010 (kw/ha)

Regency/City		Harvest Area (ha)	Result/Hectare (kw)	Production (ton)
01.	Cilacap	135,233	57.39	776,165
02.	Banyumas	69,728	54.66	381,161
03.	Kebumen	76,667	58.25	446,585
04.	Klaten	54,801	55.40	303,591
05.	Sragen	95,876	56.56	542,299
06.	Grobogan	110,104	62.31	686,003
07.	Blora	80,110	53.41	427,899
08.	Pati	110,836	54.99	609,506
09.	Demak	102,863	58.69	603,689
10.	Pemalang	78,333	49.72	389,455
11.	Tegal	63,775	55.24	352,299
12.	Brebes	93,567	60.74	568,324

Source: BPS of Central Java Province in 2010

Production of corn is the highest commodity in Grobogan, which can be seen in table 2. While rice paddy is the second highest after the corn. Rice paddy is one of the agricultural commodities featured in Grobogan; all farmers always grow the rice every year with the intensity of planting that varies depending on the topography of the area and the availability of the irrigation network. The provisions of factors of production such as fertilizers and certified seeds are also the farmers' reasons to grow the rice paddy.

Table 3 shows that Grobogan with the harvest area of about 110,104 hectares, has the highest harvest yield among the regencies in Central Java amounted 62.31 quintal / hectare. The high contribution of Grobogan to the total production of agricultural commodities in Central Java in particular the paddy crop commodity makes Grobogan become one of the agricultural centers in Central Java Province, moreover its area as the third largest in Central Java will certainly has an impact on the growing potential of farming land under cultivation.

Table 4. Target and Realisation of Productions of Rice Paddy, Corn, and Soybean in Grobogan in 2010

No	Commodity	Target of Production (ton/Ha)	Realisation of Production (ton/ Ha)
1.	Rice Paddy	10	6.33
2.	Corn	5.5	5.3
3.	Soybean	3	2.5

Source: Dipertan TPH of Grobogan Regency, 2010

Table 4 shows that there is a discrepancy between the production target for paddy crops, corn and soybeans with the realization of production in the field. The discrepancy between the target and this realization is a phenomenon that needs to be studied mainly related to the farming efficiency, which is suspected of inefficiency of the use of production factors that makes the production under the expected target.

The agricultural sector can contribute to the economic growth with increased use of inputs and the increase of productivity. Its components include labor, water, soil, pesticides, and fertilizers. (Masood Anwar, 2015). Agriculture is also an important political issue because it reflects the state of food security of a country, because achieving and maintaining agricultural self-sufficiency is the main goal of a country. (Baldwin, 2013).

Rice paddy commodity is the superior agricultural commodity in Grobogan; the community needs a profound effect on the request of the three commodities. The Productivity of rice pady farming in Grobogan turned out to be below the target set by the Government of Grobogan, which in this case is the Department of Agriculture and Horticulture. The target set by the Government is 10 tonnes per hectare, but the actual production of rice farming is only 6.33 tonnes per hectare. The productivity level is below the target is a problem in this research is inefficiency in rice farming which led to production being below the target of achievement.

RESEARCH METHODS

According to Arikunto (2010: 173), population is the overall subject of research. If someone wants to examine all elements within the research area, it is a population research. The study or research is called population study or sensus study. The population in this research is the market traders at Karangayu, Semarang City, amounted 1,934 merchants.

According to Sugiyono (2010: 118), sample is part of the number and characteristics possessed by the population. If the population is large, the researchers may not learn all that exist on the population. Therefore, the samples taken from the population should be rigorously representative.

The samples are calculated by the formula as follows.

sample formula: $n = \frac{N}{1+Ne^2}$

in which:

N is the population size

N is the population size (total population of Karangayu market traders)

e is the percentage of inaccuracy due to the sampling error that can be tolerated or tested, for this research it uses 10% (Slovin in Riyan, 2009: 28).

The model used in this research is the production function model with stochastic frontier production approach of eight variables. The mathematical model of production function of rice farming, corn, and soybean with the stochastic frontier production approach in this study is:

Rice farming

$$LnY_p=b_o + b_1LnX_{1p} + b_2LnX_{2p} + b_3LnX_{3p}+ b_4LnX_{4p} + b_5LnX_{5p}+b_6LnX_{6p}+ b_7LnX_{7p} + b_8LnX_{8p} (V_1-U_1)$$

Technical efficiency

The calculation of technical efficiency can be conducted through variant ratio approach as follows:

$$\gamma = (\sigma_u^2) / (\sigma_v^2 + \sigma_u^2)$$

When γ is close to 1, σ_u^2 is close to zero and u_i is the error rate in the equation above that shows inefficiency. In this research, the differences in management and the results of efficiency are the most important part because of the specificity in the management. Furthermore, this analysis is to identify the effects of differences in some faktors. To get the technical efficiency (TE) of rice farming, corn, and soybeans can be calculated as follows:

$$TE = \exp [E(\mu_i \mid e_i)]$$

in which $0 \leq TE_i \leq 1$ dan $\exp [E(\mu_i \mid e_i)]$ is the *stochastic production frontier.*

Table 5. Definition of Production Function Variables of rice farrming, corn, and soybean

No	Variables	Code	Definition	Scale of measurement
Rice Farming				
1	Dependent	$Y_{p,j,k}$	Production	Rp, Kg
2	Independent	$X_{1\,p,j,k}$	Field area	Rp, Hektar
		$X_{2\,p,j,k}$	Seeds	Rp, Kg
		$X_{3\,p,j,k}$	UREA Fertilizer	Rp, Kg
		$X_{4\,p,j,k}$	TSP Fertilizer	Rp, Kg
		$X_{5\,p,j,k}$	Phonska Fertilizer	Rp, Kg
		$X_{6\,p,j,k}$	Labors	Rp, Jam Kerja
		X_{7p}	Medicine type 1 (regent)	Rp, Liter
		X_{8p}	Medicine type 2 (saprodap)	Rp, Liter
		X_{7j}	Medicine type 1 (regent)	Rp, Liter
		X_{8j}	Medicine type 2 (gusadrin)	Rp, Liter
		X_{7k}	Medicine type 1 (skor)	Rp, Liter
		X_{8k}	Medicine type 2 (atabron)	Rp, Liter
		b_o	Intersep	
		b_1-b_8	Coefisient of regression	

Price efficiency

According to Nicholson (2002), price efficiency is achieved when the ratio between the values of the marginal productivity of each input (NPMXi) at a price of inputs (vi) is equal to 1. This condition requires NPMx equals to the price of production factor of X, or can be written as follows:

$$NPM = P_x$$

$$\frac{bYP_y}{X} = P_x$$

in which:

P_x = price of production factor

In practice, the average value of Y, PY, X and PX are taken, so the above equation can be written as follows:

$$\frac{b\overline{Y}P_{\overline{Y}}}{\overline{X}P_{\overline{X}}} = 1$$

Economic efficiency

Economic efficiency is a product of the entire efficiency with the price / allocative efficiency from all input factors. The economic efficiency of farming rice, corn, and soybeans can be stated as follows:

EE = TER.ARE

in which:EE = Economic Efficiency

TER = *Technical Efficiency Rate*

AER = *AllocativeEfficiency Rate*

According to Suryawati (2005) in Yulianik (2006), economic efficiency refers to the production with the lowest fare (least-cost production). In other words, at certain level of output, the manufacturer achieves the economic efficiency in production if and only if the manufacturer uses the factors of production (input) at a

certain ratio in which the cost (per unit of input) for the output number is the lowest.

RESULTS AND DISCUSSION

Technical Efficiency

By the definition, technical efficiency means the relationship between the level of inputs and output. When linked to the farming production, the technical efficiency is the relationship between the factors of production used by farmers with yields obtained, whether the input issued has been comparable to the resulting output. Technical efficiency is expressed by the notation between 0 and 1. Based on the research that has been done, the level of efficiency of rice farming in Grobogan is at 0.8741. This means that rice farming in Grobogan is still not technically efficient.

The farmers in Grobogan are still not able to utilize the factors of production owned so this causes the rice farming they live not technically efficient. The level of technical efficiency of less than 1 indicates that the farmers are generally too much in using the factors of production owned that leads to inefficiency. The farmers may need to reduce the use of factors of production to improve the efficiency of rice farming.

Price efficiency

Price efficiency is a condition where the marginal productivity value (NPM) of each input and input price is equal to 1. That is how manufacturers can maximize the profits. Based on the research results by calculating the Net Profit Margin (NPM) for each variable it is known that rice farming in Grobogan is still not efficient in price. It can be seen from Table 6 that NPM value for each variable is greater than 1, which means that all factors of production in rice farming is still not efficient in price. Coupled with the average value of NPM that indicates the level of efficiency of the overall price with a value of 1.08. Thus, it can be said that rice farming is not efficient in price.

Table 6. Efficiency of Rice Farming Price

No.	Variables	NPM
1	Field Area	-256.405
2	Seed	56.48
3	Urea Fertilizer	3.84
4	TSP Fertilizer	27.85
5	Phonska Fertilizer	4.56
6	Labors	-14.64
7	Medicine type 1	-75.26
8	Medicine type 2	266.131
Efficiency of Price		**1.08**

Source: Primary Data processed

The rice farmers in Grobogan are considered to be still not able to maximize the profits. The costs incurred for farming is considered not comparable to the benefits. Inefficiencies in the price of rice farming is indicated by NPM total value of 1.08, which indicates that the farmers still need to increase the farming efficiency level in the price and need to maximize the benefits obtained by the efficiency of the elements of the cost of production factors. But the rice farming in prices has almost reached the level of efficiency of price becase the value of NPM has been close to 1.

Economic Efficiency

The economic efficiency itself is the product of technical efficiency and price efficiency. The level of economic efficiency describes the condition of the overall efficiency. Based on the calculation result of economic efficiency, it is known that the economic efficiency of rice farming in Grobogan is 0.94. This means that the rice farming run by farmers are still not economically efficient so it needs a change in the composition of the factors of production

in order to achieve the economic efficiency.

Economic efficiency = 0.8741, 1.08
= 0.94

Value of economic efficiency for rice farming of 0.94 indeed means that the rice farming in Grobogan is still not economically efficient, and technically and the price of rice farming is still not efficient. But the economic efficiency value is close to 1. Such a condition provides a new statement that although the rice farming is still not economically efficient; the level of efficiency of rice farming is already close to efficiency because it is close to 1.

Rice commodity is the main commodity and always cultivated by the farmers in Grobogan every year. If the farming run utilizes the rice field, the farmers certainly will plant rice. The difference between one and the other farmers in each area is the intensity of planting. Some farmers plant twice a year, some only plant once a year.

The above conditions illustrates how important the rice paddy commodity is for the farmers' livelihood in Grobogan, so it needs a set of appropriate strategy and analysis to reach the progress of the farmers with rice paddy as the main commodity. From the research result, it has been discussed that rice farming is still not efficient either technically, allocatively, and economically. It is stated that the farmers are not able to optimize the use of production factors to be more efficient. The efficiency value in table 7 shows that rice farming is not efficient overall.

Based on the research result, it is known that in the field farmers face many obstacles in carrying out their farming. Many obstacles must be faced by the farmers. For example, they are not getting enough information and knowledge related to rice farming. Rice farmers in Grobogan often do not know the composition of the factors of production. In other words, farmers often use production factors unproportionately. In the case, in the field it is often found that the use of urea, TSP, and Phonska by the farmers to treat the rice plant is considered too excessive, so it will reduce the level of soil fertility because the substances contained in the soil becomes excessive and concentrated.

These conditions make the plant growth disrupted and not maximum, which consequently makes the harvest not good. The farmers initially assume that the large amounts of fertilizer will make the harvest bountiful. But conversely, this condition instead will reduce the level of soil fertility. This condition is similar to a research conducted by Yulianik (2006) who also said that the use of production factors for the farming is still not technically efficient allegedly because the use of factors of production are so excessive that it needs a reduction in the use of factors of production in order to achieve the efficiency.

Table 7. Calculation Result of Technical, Allocative, and Economic Efficiency of Rice Farming

	Technical	**Allocative**	**Economic**
Efficiency Value	0.8741	1.08	0.94
Explanation	Not efficient	Not efficient	Not efficient

Source: Primary Data processed

However, the losses obtained by the farmers who sell grain in wet conditions to the middlemen are also quite a lot. First, the farmers lost grain prices set by the

government in HPP mechanism because the grain sold is wet, whereas the price of dry grain is much more expensive than the wet grain. This huge profit margin will not be enjoyed by the farmers but by the middlemen and wholesalers. It is not a secret that the rice farmers do not have a high bargaining power. The farmers who grow rice with difficulty at harvest time are not protected by a good policy.

On the contrary, to the above empirical reality, marketing mix theory states that the price is determined by the manufacturer, which in this case is a farmer. If this condition is realized, the farmer will be able to have a better bargaining position because he acts as the price maker. But the conditions in the field run instead. The rice farmers are unable to determine the selling price of grain; automatically the farmers cannot enjoy the good selling price of grain because fixing the price of grain is determined by the market mechanism in this case the large rice warehouse and the rice distributor that greatly affects the price, not to mention the role of the middleman as speculators that influence the price. The implication is that there is a very large price margin between the grain and the consumption rice, but the price margin is not enjoyed by the farmers.

The rice farmers in Grobogan are already using superior and labeled seeds so the quality of the planted seed is good. However, the excessive use of seeds is also suspected to be the cause of the inefficiency of rice farming in Grobogan. Based on the observations and explanations of the rice farmers, sometimes they have to repeat the seeding in paddy nursery locations because the seeds stocked previously have been damaged by the pests or by floods. Repetition of seeding certainly makes the seeds are spread into more and higher costs.

The provision of fertilizers also becomes the concern related to the inefficiencies in rice farming both technically, allocatively, and economically. All this time the need of urea fertilizer will be met through the subsidized fertilizer. For the TSP and Phonsla fertilizer, the farmers' needs are not relatively large because both fertilizers are merely complementary. Although its use is not subsidized by the government, but because the need for both types of fertilizer is not much, the implication for the cost of production is not so significant. The use of urea fertilizer massively by the farmers makes the availability in the market uncertain.

During this time, the needs of farmers for urea fertilizer are supplied through the farmers' groups. So, only those who become the members of farmer group who can buy the subsidized fertilizer. In fact, the farmers often have limited the supply of urea. This is because the ratio they receive is not proportional, then it is often found that the by the planting season the fertilizer is often scarce in the market. The farmers who originally get the fertilizers from the farmers' groups are forced to buy the fertilizer that is not subsidized to meet the demand for fertilizer. Of course, the price is more expensive, and because the condition of fertilizer before the planting season is scarce, the farmers are forced to buy at more expensive price.

Distribution of fertilizer that is too long is also suspected of causing inefficiency in rice farming. This can happen because the long chain of distribution allows no margin on the price of each chain due to the expectation of benefits to be obtained by the distributor. This condition certainly makes the value of fertilizer prices at the level of farmers become expensive. Moreover, the burden of high price is of course passed on to

the consumers, which in this case are the farmers. In accordance with this case, Budi Setiawan (2008) also stated that the long fertilizer distribution chain hinder the performance of rice farming. The farmers must wait the coming fertilizer too long while the planting season has already begun so the farmers are forced to rely on non-subsidized fertilizer at a price much more expensive. This is not to mention the incompatibility of fertilizer supplies that are delivered to the farmers through farmer groups with a need for subsidized fertilizer.

The agricultural sector is different from the formal sector. In the formal sector, the labors get the clear and planned work hours. However, the labors in the agricultural sector have different character with those working in the formal sector. In the agricultural sector, labors do not work every day, but at certain moments, such as near the planting season, the maintenance time and the harvest and post-harvest period if not cut down to the middlemen. The labors in the agricultural sector are often called seasonal unemployment, because they work only during certain seasons. The labors' wage is usually calculated by the daily system. There is no mechanism of the minimum wage in the agricultural sector. Moreover, those who usually work in the fields are the members of the family that are helping.

Some time ago in one of the regions in Grobogan there was the planthoppers; the farmers suffered the harvest failure because the fields ready for harvest directly were damaged by the planthoppers' attack. The crops' damage took place very rapidly and caused great losses because the worst effect of the hopper is the harvest failure. The farmers seeked to address the hopper by spraying the medication, but the opposite happened, the planthoppers more and more widespread and outbroke to the rice fields around it. The cost of medicines is high. The unsold problem of planthoppers led to inefficiencies in rice farming because the encouragement of production costs is not followed by an increase in production, in fact just the decline in production.

In rice farming, most farmers cultivate agricultural activities on their own land although some work on the leased land. The leased land is usually from the village land leased by the annual auction system. The leased price of land is determined by the location of the rice field. The land that has a high fertility rate and close to the irrigation network will have a high rental value. Theory von Thünen said that the price of land will be more expensive when getting closer to the location of the highway, but it is slightly different from the conditions of the reality on the ground, which shows that the agricultural land will be more expensive if it is close to a network of irrigation (watering) and high fertility. According to this, David Ricardo stated that the rental value of land will be more expensive if it has high fertility level and it is close to the irrigation network.

CONCLUSION

The research conducted has obtained some conclusions as follows. The rice farming is still not efficient whether technically, allocatively, and economically. This is proved by the value 0.8741 of the technical efficiency of 0.8741, then 1.08 of the price efficiency, and 0.94 of the economic efficiency. This is because the use of production factors is too excessive. The use of excessive production factors actually causes the soil become saturated and not optimal due to the overexploitation. On the

other hand, the cost of farm production grows because the use of factor of production is too much and the output is not optimal and the great input so that the expected profit cannot be maximum.

Therefore, the efforts need assistance from agricultural extension and agricultural practitioners to tell the farmers that what they are doing all this time is inefficient. It needs a transformation of the use of production factors and the paradigm shift that sees the more input is, the more output will be. Because that excessive input is not streamline output.

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