FARMING EFFICIENCY AND AGRICULTURAL EXTENSION PERFORMANCE IN CENTRAL JAVA

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Abstract

The study aims to analyze the level of agricultural sector efficiency and agricultural extension performance in Central Java. A stochastic production function is used to estimate the efficiency. Meanwhile, descriptive statistics was employed to assess the performance of agricultural extension. The result reveals that agricultural sectors; corn, rice, and vegetable, are considered to be less efficient. However, there is an opportunity to optimize the agricultural products by using production factors based only on the needs. Moreover, it is found that the respondents' perception of the agricultural extension performance is less optimum and the number of extension is not yet ideal.

Keywords: Efficiency, stochastic frontier, performance, agricultural extension
JEL Classification Numbers: C61, Q16.

Abstrak

Penelitian ini bertujuan untuk menganalisis tingkat efisiensi sektor pertanian dan kinerja penyuluh pertanian di Propinsi Jawa Tengah. Model fungsi produksi stokastik disusun untuk memperkirakan tingkat efisiensi, dan statistik deskriptif digunakan untuk menaksir kinerja penyuluhan pertanian. Hasil penelitian menunjukkan bahwa pertanian jagung, padi, dan sayur belum efisien. Masih terdapat kesempatan untuk mengoptimalkan produksi pertanian melalui penyuluhan untuk menggunakan faktor produksi berdasarkan kebutuhan. Persepsi responden terhadap kinerja penyuluh pertanian menunjukkan bahwa mereka belum optimal dan jumlahnya belum ideal.

Kata kunci: Efisiensi, stochastic frontier, penyuluhan pertanian
JEL Classification Numbers: C61, Q16

INTRODUCTION

Recently, food and nutrition inadequacies have threatened health, intelligence, and the survival of 854 million people in the world; 820 million in developing countries, 9 million in developed countries, and 25 million in transitional countries (FAO, 2007). Syahyuti (2007) suggests that agricultural sector might not only be one of the strategies for coping with such threat, but it can also be the basis for the development of real sector. Law No. 7 of 1996 Republic of Indonesia about food states that the government functions to regulate, guide, control, and supervise farming system, while community organizes the process of production, availability of production factors, trade, distribution, and consumers' right to obtain qualified food adequately, safe, nutritious, various, equitable, and affordable.

Some prominent food commodities in Central Java are potential to be developed. They are paddy, corn, and vegetable. In 1970-2009, the productivity of paddy was fluctuative. To cope with such problem, intensification and technology improvement can be executed. Unfortunately, in fact, there is limited budget from government to provide irrigation site and there is high competition of the land use for non-agricultural use. Therefore, expanding the rice field becomes expensive. The other alternative is by improving land productivity through efficiency (Kusnadi et al, 2011).

Besides rice plant, the other demanded commodity is corn. Corn has adequate nutritional value and been used in some regions in Indonesia regarded as the staple food. Corn is the prominent cereal commodity and the main source of carbohydrate raw material after rice (Budiyah, 2004). The other food commodities are vegetables which contain essential vitamins and minerals for human body. Vegetables are potential as the source of new development for nutritional adequacy, foreign exchange, prosperity improvement of community, and farmers' income (Choliq and Ambarsari, 2009). Then, there is a fact that one condition faced by farmers upon food commodities is poor productivity (Supadi and Sumedi, 2004). Poor productivity of agricultural efforts will cause farmers' low income resulting in financial weakness to support their economic activity (Nwaru et al., 2006).

Agricultural institution is a government body that is directly engaged with farmers. This institution is considered as the agent who is able to transfer knowledge in empowering farmers. By giving reinforcement and mentoring to explore, create, and use the access of institution related to production, distribution, and consumption of agricultural products, it is expected that the productivity and farmers' income can be improved. The agricultural institution has the Agricultural extension Personnel (AEP). The duty of AEP is to remove the obstacles faced by farmers by providing information and perspectives related to existing problems. In fact, it has been found in the previous study that the agricultural extensions cannot optimally perform their functions as expected.

According to Sail (2008) agricultural extension performance is defined as informal education to make changes on knowledge, behaviour, and activities of clients by providing education elements through participation approach. Having this done, farmers are empowered to later enable them to solve existing problems such as whether they would accept or decline a new technology introduced to help them in production process. Further, if this empowerment is successfully conducted, the quality and productivity of agricultural extension performance can be achieved. Having said this, the human development focuses on farmers' empowerment to have better skills in problem solving and decision making. This focus is based on the philosophical principle "Human Resource Development" (HRD) saying that the development of clients is prioritized before the Transfer of Technology (TT) program. Further, Sail (2008) suggests that the development of human resources in agricultural extension should be conducted simultaneously with the transfer of technology.

The performance of agricultural extension is the success of personnel's in accomplishing their duty. Further, The level of achievement of agricultural extension in accomplishing his duties and obligations is adjusted to his skill and TT competence. Having said this, the performance of agricultural extension can be influenced by the factors of agricultural extension competence such as Human Resource Development (HRD) and Transfer of Technology (TT) adapted to the system in Indonesia. Thus, to measure the performance of agricultural extension, the indicators proposed by Department of Agriculture (2008) involving Human Resource Development and Transfer of Technology are used.

METHODS

In this study, the samples used were 60 farmers of each commodity of rice, corn, and vegetable by using purposive sampling technique. Statistic descriptive was employed to measure the performance of agricultural extension. This has been applied by Sucihatiningsih & Waridin (2010). In this research, stochastic frontier production function was conducted to measure the efficiency. Stochastic frontier production function had previously been applied in many sectors, such as in industrial sector conducted by Parsons (2004); Salim (2006); Cheng and Lo (2004), Oyewo et al. (2009) whereas in agricultural sector was conducted by Sukiyono (2004) and Puspitasari (2009).

Stochastic frontier allows us to analyze technical inefficiency in the framework of production functions. Production units (firms, regions, countries, etc) are assumed to produce by making use of technology and attain the frontier when they produce the maximum possible output for a given set of inputs. Inefficiencies can happen due to structural problems or market imperfections and other factors which cause countries to produce below their maximum attainable output (Mastromarco, 2008).

This function will describe the maximum production resulted from the use of production input. The variable of Stochastic frontier production function is essential to estimate the technical efficiency. It is the existence of impact separation of the exogenous shock variable of the output with contribution variety in the form of technical efficiency (Giannakas et al. 2003).

In this study, we have considered the stochastic Frontier Model to measure the technical efficiency of selected farming performance in Central Java. Efficiency is classified into three: technical, allocative, and economic efficiency (Kusnadi et al., 2011). Colli et al (2005) mentions that based on economic theory, efficiency can be seen from two perspectives; technical efficiency and price or allocative efficiency. Technical efficiency happens when maximum output quantity is achieved using production factors. Farrel suggests that there are two approaches: input and output. Input approach is described through isocost curve shown with *AA'* curve and isoquant shown by BB' curve (see figure 1), where point *P* represents an inefficient firm and the distance *SP* is the amount by which all inputs could be reduced (proportionally) without lowering output to achieve the technically efficient level of production (Lopez & Ureta, 2009).

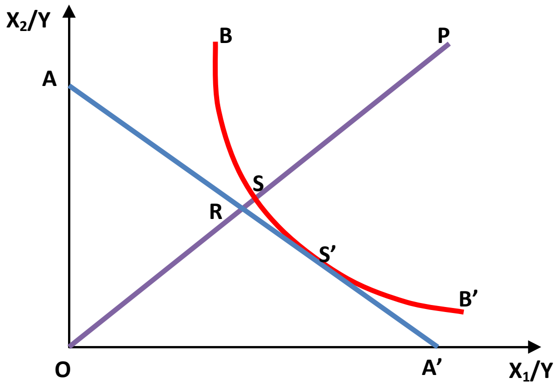

Figure 1: Efficiency Measure by Farrel

Both axial lines indicate the level of the use of each input per output unit where *X* is the input and *Y* is the output. *AA'* is the isoquant line showing several combination of input *X1* and *X2* to get one unit of isoquant which is technically efficient and also shows frontier line of Cobb-Douglas function called efficiency curve of isoquant unit. The area located in the right ride of *AA'* is technically inefficient to obtain one unit of output while the one located in the left side of *AA'* is the area which is not possible to be achieved. If the company moves at P point by drawing a straight line from P to 0 point cutting *AA'* curve at *S*, *SP* over-uses both production factors and tose most efficiently used. Thus, the measurement of efficiency technique at *P* point is the ratio between *OS* and *OP*.

To seek the price efficiency, knowing the price of relative production factor is required. The price line of production factor *X1* and *X2* is shown by *AA'* line touching *BB'* curve at S' and cutting *OP* line at *R* point. *AA'* line is the price line showing the combination of input site used to obtain one unit of output with the lowest cost showing *S'* touching point at *BB'* curve. Thus, price efficiency of company moving at *OR/OS* point is called the economic efficiency resulted from the technical efficiency and *OS/OP* price. *OR/OS=OR/OP*.

The economic approach functions to estimate frontier models by using a parametric representation of technology along with a two-part composed error term. Under the assumption that $f(xi; \beta)$ is of Cobb-Douglas type, the stochastic frontier model can be written in logs (Mastomarco, 2008)

$$yi = \alpha + xi\beta + \varepsilon i \quad i = 1, \ldots N, \tag{1}$$

Where ε_i is error term with $\varepsilon_i = v_i - u_i$. Random error, vi, is used to calculate the invalid measurement and the other random factor such as weather, etc, together with the effects of the undefined input variable combination in the function of production. Vi variable is the independent random variable and is independent-identically distributed or *i.i.d* with the average value of 0 and constant mode, σ_v^2 or $N(0, \sigma_v^2)$. This reveals the efficiency of production technique of company (agricultural performance). ui variable is assumed as *i.i.d.* exponential or half-normal variables. ui variable functions to recognize the inefficient technical effects. Based on equation (1) in this study, the empirical shape of stochastic frontier production function model of Cobb-Dauglas can be formulated as follows:

$$\begin{aligned} \ln Y = b_0 + b_1 \ln X_1 + b_2 \ln X_2 \\ + b_3 \ln X_3 + b_4 \ln X_4 \\ + b_5 \ln X_5 + (V_i - U_i) \end{aligned} \tag{2}$$

where X_1 is area, X_2 is seed, X_3 is employee, X_4 is fertilizer, X_5 is pesticide, b_0 is Constants, $b_{1\text{-}5}$ is regression coefficient, and $(v_i - u_i)$ is error term.

Next is price efficiency (allocative). To maximize profit, price efficiency happens when *NPMxi* is equal to marginal cost for factor *Xi* meaning that the ratio between *NPMxi* and marginal cost for factor (BMF) *Xi* is equal to 1. In the farming activities process, every farmer has different input and output cost, various level of production factors use, and different quantity of products. Therefore, every farmer has different marginal product and its value (Suslinawati, 2011). This means that the ratio between *NPMxi* with *BMFXi* is not always equal to 1. The ratio value is written in *k*,

$$\frac{NPMxi}{Pxi} = ki \tag{4}$$

Ki is allocative efficiency where *i*= 1, 2,..... *n*. To calculate k, we use the average value of product output, the level of *X*i use, and selling price and the cost for input *Xi*. Hence, in each input used, we can determine alternative measurement to meet the need of price (allocative) efficiency (Sulisnawati, 2011):

$$\frac{NPMxi\,bi}{Pxi\,Pxi} = 1\,NPMxi = YPy \tag{5}$$

Note:
b is production elasticity
Y is number of production
Py is price of production
X is factor of production
Px is price of production factor

RESULTS

Efficiency Level

The result of efficiency analysis from the commodity of rice, corn, and vegetable is as in Table 1. In the research, technical, price and economic efficiency are assessed. Price efficiency is calculated manually by seeking for Net Profit Margin for each variable influencing the corn, vegetable, and rice production. Economic efficiency is gathered by multiplying technical and price efficiency.

The level of technical efficiency of the corn farmers in Grobogan regency is 0.838. This level is lower than that of the technical efficiency of rice in Klaten regency. This suggests that the corn farming is technically not efficient and needs to be optimized by improving the production factors. Farmers are found to overuse the production factors. This condition has led to inefficient use of resources as it also happens in rice farming. Corn farmers usually believe that using more fertilizers would help them improving the production during the dry season. They water the corn field in the dry season by mixing the water with fertilizers and medicines in huge quantity. Technically, it leads to inefficiency because farmers will need more workers due to longer watering process. However, at the harvest season, the result of the production is found to be far from the expectation even though the production factors used are high.

Corn commodity is planted in a dry season and needs less water to grow. It is also easily cultivated. It is appropriate with the dry land condition in Grobogan. Baehaqi (2010) mentions that the corn commodity is one of superior commodities intended to develop. This is due to the high demand of the corn. Unfortunately, the supply of the local corn product cannot meet the demand in the market.

The other discussed commodity is vegetable. It is the superior commodity from Magelang regency. Therefore, knowing the information about its efficiency is useful in formulating the development programs. For instance, how to optimize the production factors in order to have better efficiency level. Technically, the efficiency of the vegetable farming in Magelang is found to be inefficient. The efficiency level of the vegetable farming is 0.7658 or lower than that of the corn and rice. The farmers are technically unable to optimize the use of production factors. They overuse the production factors which effect to a slower growth of vegetable. In contrast, the previous research has confirmed that the increased use of fertilizers for vegetable farming had been considered important due to the lifespan of the vegetable reaching five months to the harvest time. Hence, farmers should keep the vegetables well by having more fertilizers to have maximum production.

In Magelang regency, the use of the medicine and fertilizer on vegetable has proven to be inefficient. As mentioned earlier, vegetable needs more fertilizer due to its lifespan. However, the provision of the fertilizer and medicine should be proportional. Farmers are found to have less knowledge on this. Adding more fertilizer has made vegetable vulnerable. This condition makes vegetable become vulnerable towards medicine used for pesticide and disease. For instance, some vegetable farmers complained about insects that could not be combatted easily. This was due to the use of huge quantity of fertilizers and medicine leading to the vulnerability of the pesticide.

Based on the research, it is found that the level of efficiency of the rice cultivation in Klaten is 0.994. This number confirms its inefficiency. The farmers are unable in making use of production factors wisely leading to technical inefficiency. The level of less than 1 point means that mostly, the farmers overuse the production factors. Hence, farmers are expected to decrease the use of the production factors.

Table 1: Efficiency Estimation Result

No	Commodity	TE	EH	EE
1	Corn	0,838	16,74	14,08
2	Rice	0,994	2,07	2,07
3	Vegetable	0,765	5,98	4,57

Note: TE = Technical Efficiency, EH = Price Efficiency, EE = Economy Efficiency

The Performance of Agricultural extension

By wisely using the production factors in rice, corn, and vegetable cultivation, it is expected that the income of the farmers will increase and the food security will be maintained and improved. This has been noted in the Government Regulation No. 68 2002 mentioning the Food Security. To make it successful, the efficiency development programs are expected to run well.

Table 2: The Performance of PSM (Human Resource Development) based on Farmer's Perception

Indicator	Category of	Grobogan (n=60)		Klaten (n=60)		Magelang (n=60)	
	Performance	Quantity	Percentage	Quantity	Percentage	Quantity	Percentage
The involvement of farmers in planning and implementing the work programs	Low	2	3.3	0	0	0	0
	Medium	41	68.3	34	56.7	45	75
	High	17	28.3	26	43.3	15	25
Establishing network and partnership between farmer and businessmen	Low	1	1.7	0	0	0	0
	Medium	46	76.7	50	83.3	48	80
	High	13	21.7	10	16.7	12	20
Creating entrepreneurship	Low	2	3.3	0	0	0	0
	Medium	54	90	57	95	47	78.3
	High	4	6.7	3	5	13	21.7
Playing role on social activity	Low	1	1.7	0	0	0	0
	Medium	54	90	57	95	48	80
	High	5	8.3	3	5	12	20
Creativity and initiative	Low	0	0	0	0	0	0
	Medium	12	20	80	61.7	45	75
	High	48	80	20	11.7	15	25

Table 3: The Performance of Extensions in Technology Transfer based on Farmers' Perception

Indicator	Performance	Grobogan (n=60)		Klaten (n=60)		Magelang (n=60)	
	Category	Quantity	Percentage	Quantity	Percentage	Quantity	Percentage
The provision and distribution of information technology	Low	2	3.3	0	0	0	0
	Medium	52	86.7	58	96.7	51	85
	High	6	10	2	3.3	9	15
Suggested Knowledge and Skill	Low	0	0	0	0	0	0
	Medium	53	88.3	54	90	44	73.3
	High	7	11.7	6	10	16	26.7
Knowledge and skill oncommunication and information technology	Low	0	0	0	0	0	0

Human Resource Development in the farming cultivation is the main element for the increase or the decline of the performance. To improve the human resource of the farmers, it requires facilitation and support from agricultural extensions. They can provide more opportunities for farmers by accommodating the need of the farmers, and improving their resources. The coordination between the farmers and extensions is expected to work well in order to create new strategies in coping with agricultural problems.

The improvement of the human resource, most of the times, has social and cultural barriers. Nonetheless, the problems can be solved if the agricultural extension has strategies by considering social and cultural aspects. Hence, the farmers will have better perception for their human resource improvement related to farming. The perception of the respondents on the agricultural performance in Grobogan, Klaten, and Magelang regency tends to consider social activity which plays important role for the improvement of the human resource.

Generally, Table 2 informs that the human resource development in Klaten and Grobogan is found to be in the medium level. The “medium” means that firstly, the extensions are available for farmers. Secondly, the role of extension is considered to be less optimum due to (a) farmers regard the extension as a complementary element meaning that his/her existence does not determine the success of the production improvement. Hence, there is no proactive action from both sides; (b) farmers acknowledge that extension has weakness such as temporary employees or candidate employees or inferior employees who have low income.

Farmers are the main actors in the farming cultivation. Meanwhile, the agricultural extension is as the supporting actor helping farming performance. These two are important actors. However, there is a barrier in the process of implementing the programs such as the technology transfer to farmers. Table 3 shows that perception of respondents towards the performance of extensions in technology transfer. The program of technology transfer has some barriers. Respondents consider that there is a need for agricultural extensions to improve their knowledge and skill on technology. Therefore, some trainings and information socialization towards new technology application need to be continuously executed.

The improvement of the capacity of agriculture extension institution is expected to give positive impact for farmers and during technology transfer. Hence, this could bring better farmer performance and improved food supply to meet the need of society as the increase of population in Central Java. It is in line with the Government Regulation No. 68 2002 about Food Security confirming that to meet the need of food supply, one of the ways is to develop food production system on the basis of the resources, institution, and local culture

CONCLUSIONS

To conclude, the research has confirmed that the performance of the farming activities in making use of the resources is found to be inefficient. Hence, it is required to optimize the farming production. This can be executed by having consultancy delivered by agricultural extensions to inform farmers the importance of using inputs wisely to be sufficient. In addition, there is also a need to improve the institution capacity aiming to enhance available resources of farmers and technology transfer activities. Having this executed, it is expected that the welfare of the farmers can be improved.

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