Technical Efficiency of Palm Oil Plantation in Lampung, Indonesia

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Abstract: The research aims to analyze the technical efficiency of palm oil plantation in Lampung. This research was conducted at the center of palm oil in Lampung, including Mesuji, Central Lampung, Tulang Bawang, North Lampung, Way Kanan, and South Lampung, where in each district taken 4 to 5 farmers to be respondent research. The research respondents consisted of 27 farmers spread over six districts. The study was conducted in June - August 2017. Data analysis method used is quantitative analysis. Quantitative analysis is used to analyze the efficiency of productions in palm oil farming using Data Envelopment Analysis (DEA) method. The result of this research was (1) based on the measurement of technical efficiency of palm oil farming, the respondent farmers who have been efficient from the use of all inputs are only 10 farmers (37.04 percent) who are technically efficient because they have performance efficiency value equal to 1.00. An efficient farmer has achieved zero slack assumptions on all input supply chain variables used; and (2) Based on reference comparison of farmer 1 and 10, farmers 1 had a supply chain that was due to the technical efficiency of farmers 1,000 was equal to one, while the value of farmers' supply chain efficiency was only 0.702. There were differences in the value of input variables on each respondent, so there were different slack inputs and slack outputs of both.

Keywords: DEA; efficiency; palm oil; technical

1. Introduction

Plantation commodities that are seeded by Lampung include seven main commodities: coffee (robusta coffee), pepper, cocoa, rubber, palm oil, coconut, and sugarcane. The seven plantation commodities contributed greatly to the economy of Lampung Province. The development of the plantation area and plantation production in Lampung Province in 2014 - 2016 can be seen in Table 1.

Palm oil (Elaeis) is one of the plants producing cooking oil, industrial oil, and fuel (biodiesel). Palm oil grows as a cultivated plant spread in tropical countries even near subtropical in Asia, South America and Africa (Setyamidjaja, 2006). Palm oil is the second most successful agricultural product in Indonesia after rice. Palm oil is also the largest agricultural export commodity. The world's palm oil demand has grown rapidly in recent decades with current palm oil production estimated at more than 45 million tonnes. Indonesia is one of the largest producers and exporters of palm oil in the world, with the production of more than 18 million tons of palm oil per year (Hasan, 2015).

Table 1. Concentration of spores’ suspension from 5 Fusarium strains

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Plantation Area (Ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2014</td>
</tr>
<tr>
<td>Coffee</td>
<td>161.677</td>
</tr>
<tr>
<td>Pepper</td>
<td>63.640</td>
</tr>
<tr>
<td>Rubber</td>
<td>94.619</td>
</tr>
<tr>
<td>Sugarcane</td>
<td>10.570</td>
</tr>
<tr>
<td>Cacao</td>
<td>50.328</td>
</tr>
<tr>
<td>Coconut</td>
<td>126.458</td>
</tr>
<tr>
<td><strong>Palm Oil</strong></td>
<td><strong>84.587</strong></td>
</tr>
</tbody>
</table>

Source: Statistics Indonesia of Lampung, 2016

Palm oil is one of the leading plantation crops of Lampung Province which has increased regarding the area. The center of palm oil plantation of Lampung Province is located in Mesuji and Central Lampung District.
According to BPS (2015), Central Lampung has the second largest palm oil plantation area in Lampung Province with an area of 29,180 ha.

The constraints faced by palm oil plantation farmers are caused by the still abundant palm oil crops that have not produced the fruit well, and palm oil plant is still short-lived, less than 5 years that produce fresh fruit bunches of small size or commonly called farmers with the fruit of palm sand. The emergence of various problems on palm oil farming is certainly not to be left alone, it takes a variety of scientific studies to solve the problem, one of which is to analyze the technical efficiency of palm oil farming, and whether the production factor used is enough or should be reduced.

2. Methodology

This research was conducted at the center of palm oil in Lampung Province, including Mesuji, Central Lampung, Tulang Bawang, North Lampung, Way Kanan, and South Lampung, where in each district taken 4 to 5 farmers to be respondent research. The research respondents consisted of 27 farmers spread over six districts. The study was conducted in June - August 2017. Data analysis method used is quantitative analysis. Quantitative analysis is used to analyze the efficiency of productions in palm oil farming using Data Envelopment Analysis (DEA) method.

2.1. Measurement of Efficiency with DEA Approach

This study measures efficiency by minimizing inputs because each farmer already has a standard or the ability to get output so that the input value can still be suppressed. The input and output variables used are based on the matrix. The inputs used are the cost of seeds, fertilizer costs, the cost of pesticides, labor costs while the output variable is the total production of palm oil.

DEA measures the degree of inefficiency by comparing the DMU’s achievement against the efficient value generated by DMUs with inefficient values. Each decision-making unit is assumed to be free to determine the weight to determine the output or input variables (Bolstroff and Rosenbaum 2011).

DEA can measure multiple inputs and outputs, as well as evaluate quantitatively and qualitatively, enabling a company to make sound decisions at the efficiency level of the units analyzed. Data processing by DEA method is done by using software DEAP version 2.1. The result of processing with this method is a potential performance matrix to be improved (Liang et al. 2006).

Manning et al. (2008), assuming CRS is more appropriate when all DMUs work at optimum scales. Meanwhile, the VRS assumption is used when not all DMUs are at optimal scales. Another difference between CRS and VRS is the calculation of the value of efficiency variation with DMU scale size. On the VRS assumption, a DMU can be compared to other larger or smaller DMUs. This is not applied to the assumption of CRS. Calculation of technical efficiency with VRS model will get the value of efficiency scale on each DMU. The efficiency scale rating of a DMU can be calculated as the ratio between the efficiency assuming CRS or VRS of a DMU. A DMU will be inefficient if there are differences in the value of technical efficiency of CRS and VRS. Mathematically, the calculation of technical efficiency with the variable return to scale model (VRS) is as follows:

\[
\begin{align*}
\text{Min } & \theta, \lambda, \\
& s.t. \quad q_i + Q \lambda \geq 0 \\
& \theta x_i - X \lambda = 1 \\
& \lambda \geq 0
\end{align*}
\]

Note :  
\(I_1 = \text{Vector } I \times I\) 
\(\theta = \text{Possible proportional reduction of input for the i-th DMU assumes the constant output}\) 
\(\lambda = \text{The weight of the i-th DMU}\)

3. Results and Discussion

3.1. Respondent Characteristic

Characteristics of respondents are the specific characteristics of a person such as age, education level, farming experience, land area, and land tenure status. Asih Research (2009) in Sulawesi revealed that the characteristics of age, education, and farming status affect the farmer’s skill in managing palm oil farming.
Palm oil farmers are dominated by farmers within the productive age range between 20 - 55 years. In general, productive people have a high spirit to develop their business, driven by high demand and able to make onion farming better than older farmers.

The level of education of respondent farmers is dominated by undergraduate or diploma education, while farmers of respondents who use uncertified seed is still dominated by junior high school education. This means that the majority of farmers are not certified respondents have a standard level of formal education. This will certainly affect the level of courage to take decisions and risks in the management of palm oil farming. This is in accordance with the research of Emiria et al. (2014) which states that limited funds result in many farmers who choose not to go to school again and continue the work of their parents as farmers.

In palm oil farmers most have experience of farming between 5-16 years. The experience of farming shows the length of farmers engaged in palm oil farming. The longer the experience of farming, it can be concluded that the farmers have understood the cultivation techniques in the activities of farming.

The land is a base in farming activities that acts as one of the capital in agriculture in addition to labor and capital. Respondents of palm oil farmers are generally classified into medium-sized farmers with more than 0.5 - 1 hectare land concessions.

Status of land ownership of farmers whether using certified seeds or not most of the land is owned by themselves. The main reason farmers have their own land is because palm oil is an annual plant with long economic life, so it will be more efficient if the land is a land of his own.

3.2. Technical Efficiency of Palm Oil Plantation in Lampung

Measurement of efficiency was conducted for one year. Measurements were conducted on 27 palm oil farmers spread across six districts in Lampung Province. Data is data from each input and output obtained in one year of palm oil farming. After that, the data is processed to get information on which farmers have efficient business activities.

In the measurement of technical efficiency can be known which farmers should be improved performance, through increased output or minimize input. According to Firmana (2016), farmers are technically efficient farmers who have a technical efficiency value of 1,000, while farmers’ respondents who have technical efficiency of less than 1,000 are farmers who are not technically efficient. The value of technical efficiency obtained from the calculation is the value of relative efficiency, so it cannot be concluded in general (general). The efficiency score indicates that a respondent farmer is relatively efficient in the location of the research on the farmers of other respondents at a certain time.

Based on the results of the DEA calculation with the VRS assumption, that most of the palm oil farmers who have an efficiency value equal to one of only 10 farmers, meaning that only 37.04 percent of palm oil farmers are technically efficient. The average value of technical efficiency of palm oil farmers in Lampung Province is 0.918. Compared with the research of vegetable supply chain performance by Setiawan et al. (2011) and Yolandika (2016) with DEA approach, vegetable farmers in West Java have not been technically efficient,
so to achieve efficiency level, vegetable farmers have to increase the output and decrease at the input. Purba (2015) conducted a study of vegetable supply chain performance in North Sumatra with marketing margin and farmer’s share approach. Based on Purba (2015) research, the performance of the vegetable supply chain in North Sumatra from the marketing system, which consists of the marketing margin and farmer’s share was already efficient.

In Figure 1, it can be seen that there are still 17 farmers who have not been technically efficient. This means that only 10 farmers have a performance efficiency value equal to 1.00, such as farmers 1, 2, 3, 4, 6, 8, 11, 14, 19, and 27. However, farmers 10 have the lowest efficiency performance value of 0.702. The farmer has a high input value. This is due to the difference in the number of inputs used by each farmer, especially from the cost of fertilizer. Also, for farmers’ performance to be increased by up to 100 percent, farmers should increase the value of output and decrease in potential farmer inputs by increasing the output value and decreasing the average input that can be done by the farmers. Based on the calculation of potential improvement, farmers 10 have input value that can still be derived because the use of excess is still the cost of fertilizer, pesticide costs, and labor costs. Farmers should lower the cost of fertilizer amounting to Rp 154,636.16, which was originally Rp 742,857.14 to Rp 588,220.98. Farmers also have to reduce the cost of pesticides amounting to Rp 36,842.44 from the beginning, which initially Rp 100,000.00 to Rp 63,157.56, and labor cost of Rp 201,904.56 from the beginning, which initially Rp 1,085,714.29 to Rp 883,809.73. Based on the calculation of potential improvement on farmers 10, also must increase the output of production worth 3,141 kg from the original, which initially only 9,086 kg to 12,227 kg.

Table 2. Distribution of output and input variables used two farmers respondents.

<table>
<thead>
<tr>
<th>DMU</th>
<th>Fertilizer cost (Rp)</th>
<th>Pesticide cost (Rp)</th>
<th>Labor Cost (Rp)</th>
<th>Production (Kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>366,666</td>
<td>33,333</td>
<td>560,000</td>
<td>12,227</td>
</tr>
<tr>
<td>10</td>
<td>742,857</td>
<td>100,000</td>
<td>1,085,714</td>
<td>9,086</td>
</tr>
</tbody>
</table>

Based on the calculation with DEA method, it is known there are 17 farmers of respondents who have input slack, whereas only 10 farmers of respondents who have slack output. Slack input values are distributed across four input variables, namely number of seeds, fertilizer costs, pesticide costs, and labor costs, with average slack inputs of 1.66 stems, Rp 94,539.49, Rp 24,585.03, and Rp 15,093 .16. Similarly, with output, the output value of slack is spread over one output variable, i.e. total production with an average value of 1163.78 Kg. With this slack, it must be improved, either increased output, as well as input reduction. Respondent farmers who have been efficient from the use of all inputs only 10 farmers (37.04 percent). An efficient farmer has achieved zero slack assumptions on all input supply chain variables used. Utoyo and Yolandika (2018) showed that seed price had big influenced to make the consumer buy the palm oil seed. If they can make the efficient cost, they can get an efficient price.

Reference comparison was an analysis used to compare the performance of farmers owned by an efficient and inefficient unit. In Table 2 can be seen a comparison between farmers of respondents (DMU) 10 with other farmers’ respondents, namely farmers’ respondents 1 and 10. Farmers 1 had a supply chain that was due to the technical efficiency of farmers 1.000 was equal to one, while the value of farmers’ supply chain efficiency was only 0.702. There were differences in the value of input variables on each respondent, so there are different slack inputs and slack outputs of both.

4. Conclusions

Based on the measurement of technical efficiency of palm oil farming, the respondent farmers who have been efficient from the use of all inputs are only 10 farmers (37.04 percent) who are technically efficient because they have performance efficiency value equal to 1.00. An efficient farmer has achieved zero slack assumptions on all input supply chain variables used.

Based on reference comparison of farmer 1 and 10, farmers 1 had a supply chain that was due to the technical efficiency of farmers 1.000 was equal to one, while the value of farmers’ supply chain efficiency was only 0.702. There were differences in the value of input variables on each respondent, so there are different slack inputs and slack outputs of both.
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[13] Statistic Indonesia 2015 Statistik Lampung dalam Angka (Bandar Lampung: Badan Pusat Statistik)