The Comparison of Level of Efficiency of Farm Plant Production: Empirical Evidence in Bojonegoro

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Abstract: Agricultural area Bojonegoro's food crop is the area where most of the people in farming even contribute to more than 35% of East Java's agriculture. This study employed a stage of analysis, namely the calculation stage of agricultural productivity of food crops by using Data Envelopment Analysis (DEA) techniques. The results of the Bojonegoro Regency Regency can be seen from the average efficiency of the Bojonegoro Regency 0.88725; Tuban Regency area is 0.897875 and Lamongan Regency area is 0.855. From the above data it can be seen that on average, the Tuban Regency has a good efficiency value compared to Bojonegoro and Lamongan Regencies.

Keywords: Agricultural Land, Labor, Irrigation, Subsidies, productivity and DEA

I. INTRODUCTION

Indonesia is an agrarian country with a large part of the population earning a living as a farmer. Indonesia until now cannot be separated from the agricultural sector, because this sector has a very important meaning in determining the formation of various economic and social realities of people in various regions of Indonesia. Indonesia also has a vast expanse of land, a diversity of flora and fauna, and has a tropical climate that can help people to farm.

The potential possessed by the Indonesian State makes agriculture an important role in the national economy. One of the islands in Indonesia, most of which work as farmers, is Java. East Java is one of the national food storage provinces with a potential land resource of 1.147 million hectares. East Java is still the mainstay of domestic food production, especially agriculture. Millions of families in East Java rely on agriculture for their livelihoods, thus appropriate development and development strategies are needed to increase farmers' productivity and reduce poverty in East Java.

The development and development of the agricultural sector is considered very important in the development of the Province of East Java because agricultural development has considerable potential associated with contributing to the economy to increase productivity and reduce poverty. According to (Jhingan 2000) there are several forms of contribution of the agricultural sector to growth and development, namely: (1) providing a growing food surplus to an increasing population, (2) increasing demand for industrial products and thereby encouraging the need to expand the secondary and tertiary sectors, (3) providing additional foreign exchange income for imports of capital goods for development through agricultural products continuously, and (4) improving the welfare of villagers. This aims to reduce poverty in East Java Province (Abid Muhtarom, Tri Haryanto 2019).

The food crop agriculture sector is a source of the economy of the people of East Java Province, in addition to that the sector is also a source of income for the community, especially people with low education levels, the impact of low education inability and expertise in the types of work that can be done. Based on the characteristics of the food crop agriculture sector that does not require a high level of education, this sector is the main source of employment for most people.

The success of East Java's food crop agriculture cannot be separated from existing problems. As for the problem of declining productivity of the food crop agriculture sector (tons / ha) caused by experts in the function of agricultural land for food crops in East Java which causes the reduction of agricultural land for food crops. If these conditions occur in the years to come, the need for results from agricultural food crop resources will experience shortages, therefore a solution is needed to increase agricultural production of food crops. Even the government's efforts to maintain farmers' land through the LP2B (Sustainable Agricultural Development Land) program where land that cannot be sold by farmers have not been effective (Muhtarom and Haryanto 2018);(Abid Muhtarom; Tri Haryanto; Nurul Istifadah 2019).

Meanwhile, food crop agriculture in Bojonegoro Karisidenoro region with the Bojonegoro Regency area; Tuban Regency and Lamongan Regency (except Blora Regency, Central Java region) are geographically productive areas as well as agricultural land, plus most of the community's livelihoods are farmers of food...
crops. The results of the Bojonegoro Karisidenoro agriculture could contribute to almost 30% of the agricultural sector's GRDP in East Java. However, researchers see that whether the food crop agriculture in the area is efficient or not efficient that can be increased to efficient? Or in 2010-2017 there are already efficient but the following year is not efficient? To see that all researchers used the Non Parametric approach with the Data Envelopment Analysis (DEA) method according to (A.Charnes;W.W.Cooper and E. Rhodes 1978)

II. LITERATURE REVIEW

Previous Research Review

Many have identified how agricultural productivity and poverty influence especially developing countries. All existing studies can be grouped based on approaches in calculating productivity that can be grouped, among others, by using output-to-input ratios such as (Irz et al. 2001) estimate cross-section data for 40 countries using production indicators per land area and the number of workers as a measure of productivity, concludes that the productivity variable has an effect on poverty reduction. (Cervantes-Godoy and Dewbre,2010) use the ratio of the production value of the agricultural sector to labor while (Dhrifi 2014) uses the percentage of the value added of the agricultural sector per Gross Domestic Product (GDP).

Another study with a different approach in measuring agricultural productivity is the Stochastic Frontier Analysis (SFA) based on estimation of production models, among others, conducted by (Mendali, Student, and Gunter 2013), (Abro, Alemu, and Hanjra 2014) (Devkotaa and Upadhyay 2013) excellence if using SFA is biased to calculate the level of productivity with multiple inputs unlike previous studies that use the production ratio of each particular input unit that is usually used is land or labor. Another technique that accommodates multi input calculations is Data Envelopment Analysis (DEA) which can accommodate single or multi input and single or multi output based on linear programming. In linking between agricultural productivity and poverty, no DEA technique has been used, so in this study DEA techniques will be used.

III. METHODOLOGY

Research Methodology
Model Specifications

This study uses a stage of analysis, namely the calculation stage of agricultural productivity of food crops by using Data Envelopment Analysis (DEA) techniques.

DEA model

This study employed Data Envelopment Analysis (DEA) method to measure technical efficiency. DEA method is a non-parametric analysis method that aims to measure the level of relative technical efficiency compared to other production units that have the same goal. The production unit here is in the form of a decision making unit (DMU) where the DMU in this study is the food crops sub-sector 3 of the Regency of the Bojonegoro Regency in East Java where one region is not examined because the Central Java region is Blora Regency.

This research period for 8 years from 2010 to 2017. Input variables used in this study are food crops, the number of agricultural food workers, irrigation per hectare, and government subsidies, while the number of output variables is in tonnes. The Linear Programming (LP) function carried out in this approach uses output oriented assumptions, so the objective function applied is the output maximization function with the available input levels.

The results of the processed technical efficiency measurement data will produce a value with two conditions, namely the condition of the efficient and inefficient areas where it can be determined by looking at the score or the value of the DMU efficiency. The technical efficiency score produced by the DEA method ranges from 0-1 where there are the following conditions:

1) DMU efficiency score ≤ 1 (less than one) means that the DMU is relatively inefficient (inefficient) compared to other units in using inputs and producing outputs.
2) DMU efficiency score = 1 (equal to one) means that the DMU is relatively efficient compared to other units in using inputs and producing outputs.

Here is a model of technical efficiency analysis assuming VRS with a one stage DEA approach: VRS

Model of Output Oriented Technical Efficiency Measurement

\[
\begin{align*}
\text{Max } & \Phi, \lambda, \Phi_i \\
\text{s.t. } & -\Phi y_i + Q \lambda \geq 0 \\
& x_i - X \lambda \geq 0 \\
& I \lambda = 1 \\
& \lambda \geq 0 \\
\end{align*}
\]

whereas : \( \Phi = \) efficiency score; \( \lambda = 1 \times 1 \) constant vector or barrier vector ; \( y_i = \) output vector ; \( x_i = \) input vector ; \( Q = \) whole matrix output ; \( X = \) whole matrix input

The above model is a model with an output-oriented approach in which the variable \( \Phi \) shows the calculation of technical efficiency (Coelli, T.J., Rao, D.S.P., O’Donnell, C.J., Battese 2005) with values \( \Phi \)
between 1 to \(\infty\) (infinity), and \(\Phi - 1\) is a proportional increase in output that can be achieved by DMU with constant input quantity. \(\lambda\) is an Ix1 vector of constants and \(I^1\lambda = 1\) is the convexity constraint, with \(I^1\) being an Ix1 vector of one. The convexity constraint shows that the variable return to scale (VRS) ensures that inefficient companies will only be compared with companies that have the same scale. Note that \(1 / \Phi\) indicates the value of technical efficiency which assumes a value at an interval of 0 to 1.

### IV. RESULTS FOR THE RESEARCH OBJECTIVES

#### Efficiency Calculation Results

Results of DEA (Data Envelopment Analysis) in 3 districts in East Java Bojonegoro’s residency by leaving Blora (Central Java region). Can be seen in table 1.1. showing 3 Bojonegoro Regency, Tuban Regency and Lamongan Regency. The observation year in this study was sourced from secondary data from the Central Statistics Agency during 2010 to 2017. Explanation of the DEA calculation has been discussed above.

Bojonegoro Regency, Tuban Regency and Lamongan Regency in 2010 had good efficiency, namely 1, with different average comparisons for Bojonegoro Regency, 0.887; Tuban Regency is 0.897 and Lamongan Regency is 0.855. As for the different standard deviations that show the relationship between the relationship of food crop agriculture throughout the year in the area of Bojonegoro Regency 1.36; Tuban Regency 1.26 and Lamongan Regency 1.60.

<table>
<thead>
<tr>
<th>AREAS</th>
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Source: BPS East Java in numbers with DEA calculation, processed

The efficiency value of the area of agricultural food crops can be seen from the performance of the region in the Bojonegoro Residence. Number 1 makes a sign that the area of agricultural food crops is increasingly efficient in the close relationship between input factors such as land area, labor, irrigation and subsidies for output factors of production as seen from the GDP.

The results of the DEA analysis above can be seen from 2010 to 2017 a comparison between the 3 Regions of the Karisidenan Regency of Bojonegoro can be seen from the average efficiency value of Bojonegoro Regency 0.88725; Tuban Regency area is 0.897875 and Lamongan Regency area is 0.855. From the
above data it can be seen that on average, the Tuban Regency has a good efficiency value compared to Bojonegoro and Lamongan Regencies. Where vast agricultural land for food crops receives a lot of agricultural produce, or abundant labor makes competent labor in agriculture even the last job in it. Or good irrigation has an impact on agricultural output or also government policies that provide subsidies to the agricultural sector affect a lot with changes in agriculture.

The agricultural efficiency of the Food Crops from the above explanation can show that land is not a major problem, although many land use experts that occur at this time in the Bojonegoro Residence area with government regulations can all be overcome and awareness of the importance of agriculture. The number of workers is still a scourge for each region because we know that workers in this sector are mostly workers who have no skills or have less skills added to this agricultural sector with a large number of workers chosen or chosen because of the absence or lack of sectors other workforce plus the tendency of the younger generation who do not work in the agricultural sector food crops or agriculture in general makes problems in future generations in agriculture. With the number of workers increasing in reducing agricultural land which is getting smaller, it will cause big problems in the future. Irrigation that continues to be built makes a good solution to improve the efficiency of agricultural food crops because production can continue without water shortages. This will be accompanied by subsidies provided by the government.

**V. CONCLUSIONS**

a) Workers in the food crop agriculture sector are mostly workers who have no skills or have inadequate skills plus this agricultural sector with a large workforce is chosen because of the absence or lack of other labor sectors.

b) The tendency of the younger generation who do not work in the agricultural or food crops sector in general makes problems for future generations in the field of agriculture.

c) Irrigation that continues to be built makes a good solution to improve the efficiency of agricultural food crops because production could sustain without water shortages

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**VI. REFERENCES**


