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CONSERVATION FARMING APPLICATION ON POTATO FARMING PRODUCTIVITY IN BUMIAJI, BATU INDONESIA

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Abstract: This paper aims to find out the potato farming conservation in Batu, East Java, Indonesia. This research is performed because it is important to remember that potato is one of substitution products of rice. Beside that, potato is affordable, compared to rice. Data used in this study is primary data obtained from the research location, Bumiaji, Batu, Indonesia. This study has three objectives. First is to find out the impact of conservation farming on farmer's income, second is to assess the adoption rate of conservation farming and potato farming efficiency level in the research location, as well as the adoption of conservation farming implementation factors. From the research results, the implementation of conservation farming influences the income of farmers. From second objective, it can be known that the efficiency level in the research location is low, while the factors that influence farmers to adopt conservation farming are age, land area, and knowledge of the importance of conservation farming.

Keywords: Potato, Conservation Farming, Efficiency, DEA Model.

INTRODUCTION

Potato is one of horticultural crops which root is consumed. In the community, it is known as root vegetable. Potato is high in carbohydrates that are beneficial to our body. Due to its high content of carbohydrates, potato is known as a substitute for other carbohydrate foods derived from rice, wheat, and corn. It has lower carbohydrate content (18 percent of carbohydrate, 2.4 percent of protein and 0.1 percent of fat) from all three carbohydrate sources mentioned above. (Hartoyo, 2012). That is the reason why potato remains as a substitute of the three carbohydrate foods. Because it is one of the main sources of carbohydrates, potato becomes the staple food in some countries.

One of the potato producing regions in East Java is Bumiaji District. Bumiaji District is located at an altitude of > 1400 meters above sea level (masl), which meets the requirement of growing potato plants. Potato plants can grow well in areas with an altitude of 800-1500 masl (Sunarjono, 2007). In the implementation of agriculture today, farmers only pay attention to the results of production achieved regardless the sustainability of the land. Land utilization above its carrying capacity without counterbalance it with conservation efforts and land conditions improvements will lead to land degradation. Upland with steep slopes suitable only for forests, if they are converted into agricultural land for annual crops, it will be suspectible to erosion and/or landslides. Changing the use of sloping land from permanent vegetation (forests) into intensive agricultural land causes the soil to be degraded more easily by soil erosion. The practice of

deforestation is a major cause of erosion in watershed areas.

Technology plays an important role in developing the potential of food crop resources, livestock resources, and fishery resources. Technology generated from research and studies (litkaji) will be in futile if it is not applied in the field, especially in the effort to empower farming communities. The implementation of land conservation techniques to highland vegetable farming is expected to be able to suppress the rate of erosion and also provide high yield for farmers in a short term without damaging land resources for long-term use (Arsyad, 2000). According to Dariah, 2004, agricultural cultivation in the mountains includes two main activities, namely farming and conservation activities. Both activities on a plot of agricultural land are integrated into a conservation farming system. In conservation farming practice, there are conservation farming principles that must be considered, such as reducing the surface water flow to minimum and absorb as much water as possible into the soil, minimize the negative impact of rain fall on the soil surface, making the most of natural resources by preserving the sustainability of nature.

This study aims to determine the level and impact of conservation farming practices on farmers' revenue. It is analyzed by using a cross-table analysis tool. Singarimbun and Efendi (2008), cross-table analysis is an analytical method used to observe the relationship between two variables. This table can be made for relationships between influencing variables, variables that influence or between influencing and influenced variables. The table used was arranged based on variables that have a certain relationship between each other. The second objective is to assess the efficiency of potato farming. To analyze this objective, analysis tool was used. This research used the Data Envelopment Analysis (DEA) to analyze the technical efficiency level of potato farming. The technical efficiency level is limited by a score between 0 and 1. If the technical efficiency level is less than one, it means that the potato farmers have technical inefficiency, if the technical efficiency level is one; it means that the potato farmers have reached technical efficiency. The third objective is to find out the conservation farming system application. In order to know the result of that objective, Tobit regression analysis model was used. This analysis tool was used to analyze the factors that influence the technical efficiency score of potato farming in the research area. There are several factors that need to be analyzed, such as: farmer's age, land area, land slope, land conservation knowledge, soil conservation knowledge, and knowledge of the importance of conservation farming.

RESEARCH METHODS

Location of the study was determined purposively in Bumiaji Sub-District, Batu City, East Java Province. The purposive technique was performed based on the consideration that Bumiaji Sub-District is a Sub-District in Batu City which area is in the upper watershed of Brantas and has many water springs. Agricultural land In Bumiaji Sub-District is mostly in the form of land slope that requires conservation farming in order to maintain environmental sustainability. This area is a potential area for potato farming. Farmers in Bumiaji Sub-District have not fully implemented conservation farming properly.

Data used in this study is the primary data from interviews with potato farmers in Bumiaji, Batu, Indonesia in the period between January-April 2012. In addition to the primary data, this study used supporting data (secondary data) from Bumiaji Sub-District Office, literature, and other supporting materials. Total respondents in this research were 63 potato farmers. Arikunto (2002), if the population is more than 100, sample can be taken between 10% - 15% or 20% - 25% or more of the population. Due to time constraints, the sample of this research was 10% of the population.

This study used three calculation methods, namely (1) cross-table analysis, (1) (Data Envelopment Analysis) DEA model, and (3) Tobit regression model.

1. The adoption rate of conservation farming is an assessment of conservation techniques implementation in agricultural processes. Conservation treatments applied include terraces, annual plants, amplifier plants, infiltration water channels, drainage, fertilizer use, and waste use. To assess the adoption rate, each variable was given one to five points (Likert scale). In collecting data, Cross Table Analysis system was performed to simplify the analysis process. According to Singarimbun and Efendi (2008) cross table analysis is an

analytical method used to observe the relationship between two variables. This table can be made for relationships between influencing variables, variables that influence or between influencing and influenced variables. The table used was arranged based on variables that have a certain relationship between each other.

Assessment was performed by differentiating the implementation level of conservation application into two groups, namely group with high conservation adoption application implementation and group with low conservation adoption application implementation. Implementation with low score (less than or equals to 21) is classified as low implementation. On the other hand, high application score (greater than or equals to 22) is classified as high implementation. The formula used in the calculation is (the highest score divided by two and then combined with the lowest score).

2. According to Tu, H. J. and Yen, W. C, 2012, Data Envelopment Analysis (DEA) was first introduced as a mathematically based linear programming (LP) to compare different DMU (Decision-Making Units) managerial performance based on multiple inputs and outputs. The ratio of input and output produces a single measurement of efficiency, referred to as relative efficiency. DEA allows us to compare the relative efficiency of companies by designating an efficient company as a benchmark and by measuring inefficiencies in terms of input combinations in other companies relative to the benchmark. The basic idea of DEA approach lies in each DMU. DEA can identify an efficient set or best unit practice (efficiency = 1). This means that the input used is optimal or in accordance with the results obtained. For efficient DMU (efficiency < 1), DEA can measure deficiencies in each input and output variable and know the reference group of efficient and comparable units.
3. According to Parsad, R and Sanju 2009, Tobit Regression Model is a statistical model to describe the relationship between the non-negative dependent yi variable and the independent (or vector) xi variable. Tobit model is also known as the censored regression model because there are several censored observations. It is also known as a regression model designed to estimate the linear relationship between variables when there are either left- or right-censoring in the dependent variable (also known as the the bottom- and top-censoring, respectively).

Tobit Model can be defined as:

$y^*; 0 \leq y \leq 1^*$

$y = 0; y^* < 0$

$1 < y^* 1$

$$y^* = \beta Xi + \varepsilon t$$

where y is the score of DEA VRS TE.

$$\varepsilon t \sim i \; e \; N \; (0, \sigma 2)$$

y* is the observed variable.

β is the vector of unknown parameters that determines the relationship between independent variable and observed variable. And, Xi is the vector of predictor variable.

RESULTS AND DISCUSSION

The calculation result of the conservation farming application impact to farmer's revenue is using Cross Table Analysis. To analyze the impact of the conservation farming application level in productivity, the average level of productivity at low application and high application must be known in advance. The application level in potato farming productivity is presented in the following table.

Table 1. Application Level of Conservation Farming in Average Potato Productivity per hectare in one growing season

No	Application Level		Average Productivity (kg/ha/MT)
	Category	Total (people)	
1	Low	22	18.293
2	High	41	23.261
Deviation			4.968

From the table above, it can be seen that there are 22 people with the average potato productivity of 18.293 kg/ha in low application level category. On the other hand, the result reaches 23.261 kg/ha in high conservation technology application category. From the production results, it can be know that the revenue of farmers with high conservation farming application is Rp.127.939.012, while the revenue of farmers with low conservation farming application is Rp.100.614.354 with the selling price of Rp.5.500/kg.

The third objective of this research is to find out what factors causing potato

farmers/respondents to apply conservation farming. The analytical tool used to answer the third objectives of this research is the Tobit regression model. There are several factors that need to be analyzed, such as: farmer's age, land area, land slope, agricultural land-conservation knowledge, soil conservation knowledge, and knowledge of the importance of conservation farming. The following table presents the results of factor analysis affecting potato farmers/respondents in the application of conservation farming.

Table 1. Result of Tobit Regression Model

Variable	Coefficient	t value	P value
C	124.9911	6.677255	0.0000***
X1	-0.482601	-2.318800	0.0204**
X2	-0.001197	-2.071872	0.0383**
X3	-0.353150	-0.204671	0.8378
X4	-0.438693	-0.884684	0.3763
X5	0.695347	1.238861	0.2154
X6	-0.950131	-1.755617	0.0792*

Note 1. x1 = Farmer's Age; x2 = Land Area; x3 = Land Slope; x4 = K; x5 = Agricultural Land-Conservation Knowledge; x6 = Knowledge of the Importance of Conservation Farming.

Note 2. *Significant at 10%, **Significant at 5%, ***Significant at 1%.

The empirical equation of the test is:

Y = 124,911 - 0.482x1 - 0.001x2 - 0.353x3 – 0.438x4+ 0.695x5 - 0.950x6

Estimation results show that age, land area, and knowledge of the importance of conservation farming affect farmer's efficiency level. Age significantly affects the potato farmers/respondents because the older a farmer, the more experience he/she has. Therefore, age has a significant influence on potato farmers/respondents efficiency. The second variable affecting the conservation farming application is the land area. This variable is significantly influential. The coefficient mark for land area is positive, meaning that the increase of land area will increase the level of efficiency as well. The last significant variable is knowledge of the importance of conservation farming, because knowledge will affect the rate of agricultural adoption by potato farmers/respondents. If potato farmers have a better knowledge of the importance of conservation, they will grow potato crops more efficiently.

Variables that have a negative effect on efficiency are land slope, Agricultural Soil Conservation Knowledge, and conservation farming knowledge. Land slope gives a negative influence because potato is a seasonal crop suitable on flat land, but in this study, the land slope is greater than 45%. Land slope make the potato production less than the production in a flat land. Small production will decrease the efficiency score. Other variables such as agricultural soil conservation knowledge and conservation farming knowledge have a negative effect on efficiency.

CONCLUSION AND SUGGESTION

Conclusion

This study aims to analyze the efficiency of potato farmers in Batu, Indonesia. Some of the results of this analysis are:

1. The number of respondents who have reached the level of efficiency in the application of agricultural systems is 12 people. Meanwhile, the remaining 51 farmers have not reached the level of efficiency yet. Of the 12 respondents who have reached the level of efficiency, 9 people are farmers with high conservation farming implementation level, and 3 people are farmers with low conservation farming implementation level. Revenue for farmers with high conservation farming implementation is Rp 127,939,012.00 and revenue for farmers with low conservation farming implementation is Rp 100,614,354.00.
2. The calculation result of technical efficiency from each respondent shows that the average score of technical efficiency is 74.9%, the lowest score is 46.4% and the highest score is 100%. There are 12 farmers have a technical efficiency score of 1 or 100%. Meanwhile, 41 farmers have no technical efficiency score of 1 or 100%.
3. Factors affecting the technical efficiency level of respondents are estimated by using the Tobit regression DEA model. Estimation results show that age, land area, and knowledge of the importance of conservation farming affect the efficiency level. Age significantly affects the efficiency of potato farmers/respondents. The longer the life of a farmer, the more experience he/she has. Thus, the life of respondents significantly affect the efficiency of agriculture applied by the

respondents. The second variable is the land area. The last significant variable is knowledge of the importance of conservation farming.

Suggestion

The empirical results show that efficiency is important in potato farming. There are several differences between high conservation farming and low implementation of conservation farming. The recommendation of this research is that potato farmers should also consider the level of efficiency in agricultural applications.

The research study shows that the level of efficiency in the research area has not been achieved well. Farmers should seek for information on how inputs can be used to achieve a good level of efficiency. Further research is expected to use time series data, so that long-term impact of the application of conservation farming can be known.

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