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Optimizing the Implementation of Standard Operating Procedure-Good Agriculture Practice for Organic Rice Farming

Suswadi[1], Agung Prasetyo[2], Kusriani Prasetyowati[3]

Abstract

The increase of organic rice consumption arises as people are increasingly concerned about healthy food consumption. A standardized organic food supply is needed to fulfill the need of food. This paper aimed to find out the level of implementation of Standard Operating Procedure-Good Agriculture Practice (SOP-GAP) for organic rice farming and the correlation between the implementation of SOP-GAP for organic rice farming and the increase of organic rice production in Indonesia with categorization and correlation analysis. The research location was determined by purposive sampling. A sample of farmers as the respondent was conducted with Snowball sampling. The research results show that the implementation of Standard Operating Procedure-Good Agriculture Practice (SOP-GAP) for organic rice farming in Indonesia is very high. There are nine sub-aspects of SOP-GAP that correlate with and significantly affect organic rice production, namely land suitability, seedling, pesticides, equipment, soil cultivation, irrigation, plant maintenance, and PDO (Plant Disturbing Organisms) control, and post-harvest. There are four sub-aspects of SOP-GAP that do not correlate with and have no significant effect on increasing organic rice production: fertilizer and fertilization, planting, and harvesting. In this case, efforts are needed to increase the use of quality fertilizers and planting buffer plants in farming.

Keywords: *organic, rice, correlation, optimizing, adoption.*

Introduction

Nowadays, People's cares more about health because it considers health as a valuable asset [1]. One determinant of physical and mental health is daily food consumption [2]. The current world development related to health issues is the transfer of food consumption from non-organic to organic food [3–5]. Organic food products are produced from organic farming, a production system that maintains soil, ecosystem, and human health [6,7]. This condition also occurs in Indonesia. Rice, which is a staple food produced from non-organic rice, experienced shifting of consumer demand towards organic rice consumption [8]. Organic rice is a food produced by organic rice farming [9]. Organic rice is believed to be safer [10–13]because it is a natural food produced without the use of chemicals and artificial fertilizers [14–16].

Organic rice farming is one option to produce quality food while improving agricultural resources, especially the quality of soil, waters and biodiversity[17–20]. The benefits of

[1] Department of Agribusiness, Faculty of Agriculture, Universitas Tunas, Pembangunan, Jl. Balekambang Lor No. 1, Surakarta, Central Java, suswadi@lecture.utp.ac.id
[2] Department of Agribusiness, Faculty of Agriculture, Universitas Tunas, Pembangunan, Jl. Balekambang Lor No. 1, Surakarta, Central Java
[3] Department of Agribusiness, Faculty of Agriculture, Universitas Tunas, Pembangunan, Jl. Balekambang Lor No. 1, Surakarta, Central Java

organic farming have been demonstrated by organic farming systems that are integrated [21], economical[22,23], eco-friendly, and improve public health [24–26]. In 2010, there were only 2,970 hectares of rice fields implementing the organic system in Indonesia, this figure increased to 53,974 Hectares in 2018 [27]. The implementation of organic farming that has begun since a long time ago should make farmers experienced in implementing Standard Operating Procedure-Good Agriculture Practice (SOP-GAP) for organic rice farming [28]. For the farmer that newly convert to organic farming, the adoption of SOP-GAP organic its not easy to deal. Farmers have different awareness and understanding on the SOP, especially when farmer just convert their land to organic. The difference in thoughts make different results in each process of organic rice production; for example in making organic fertilizers, some farmers apply starter bacteria from manure as recommended by SOP-GAP while some others only wait for the manure to dry after three months[29,30]. This problem may be the cause of differences in the production yields of organic rice farmers. Optimization by adjusting with SOP-GAP in each implementation of farming activities is needed in order to increase production yields and improve the cultivation quality of farmers [30].

This research aimed to find out the level of implementation of SOP-GAP for organic rice farming and the correlation between the implementation of SOP-GAP for organic rice farming and the increase of organic rice production in Indonesia. Research on the evaluation of SOP-GAP for organic rice was carried out by several researcher in Indonesia. The research conducted only focused on the factors that determine the farmers' decision to implement SOP-GAP in organic farming in various regency (Ponorogo [31] and Boyolali [32,33]).

Methods

The descriptive research on the evaluation of SOP-GAP for organic rice farming in Indonesia was conducted using survey method. The research location was determined by purposive sampling by selecting the main centre for developing organic rice in Indonesia (Sragen Regency, Boyolali Regency, Bantul regency and Wonogiri Regency). Sampling of farmers was conducted with random sampling. Total respondent were 321 organic farmer that newly convert their land to organic farming. The effect of implementing SOP-GAP in optimizing yields was tested by using Spearman's rank correlation analysis [34–37]. The implementation is based on the Indonesian National Standardization Agency on Organic Farming Systems. The implementation includes aspects of providing inputs [land, seedling, fertilizers, pesticide, and equipment) and cultivation techniques (soil cultivation, planting, fertilizing, irrigation, plant maintenance, PDO control, and post-harvest [38]. The variable of the implementation of SOP-GAP for organic rice farming is measured as follows:

1. The level of implementation is the intensity of the suitability of cultivation technique implementation with standard requirements seen from the frequency of suitability of the implementation carried out by farmers, measured by scores: 0 for never implementing SOP-GAP, 1 for rarely, 2 for occasionally, 3 for frequently, and 4 for always.
2. Optimization of organic rice production which is influenced by the implementation of SOP-GAP for organic rice farming is calculated by changes in rice production after the implementation of SOP-GAP. Changes in production yields were calculated by comparing the latest production yield of the third planting season (MT) in 2018 with that of the third MT in 2017. The production increase score was determined by measuring the percentage of production changes in the third MT in 2018 against the third MT in 2017. The scoring criteria are determined as follows: 0 for production changes of less than or equal to 0, 1 for production changes of 0 - 5%, 2 for production changes of

5% - 10%, 3 for production changes of 10% - 15%, and 4 for production changes greater than 15%. This division is based on the findings of Berkhout [39] and Chanda [40].

The level of implementation of SOP-GAP was analyzed by categorizing the level of implementation of SOP-GAP for organic rice farming. The level categorization was carried out using equation (1):

$$\text{Interval} = \frac{\text{Highest Score} - \text{Lowest Score}}{\text{Number of Score Category}}$$

If the score of SOP-GAP implementation is 0-10.4, then the implementation is very low. If the score is 10.41-20.8, the implementation is low. If the score is 20.81-31.2, the implementation is moderate. If the score is 31.21-41.6, then the implementation is high, and if the score is higher than 41.61, it means that the implementation is of very high value.

The testing of correlation (relationship) between production changes (Y) and the implementation of aspects in SOP-GAP for organic rice farming (X) was carried out by calculating Spearman's rank correlation coefficient as in the following equation (2):

$$\text{Rs} = 1 - \frac{6 \sum d^2}{n^3 - n}$$

Note:

Rs : Spearman's Rank Correlation Coefficient

d : Difference between x and y

n : Number of sample

Rs value must not be equal to 0, in order to show the correlation between production changes and the level of implementation of aspects in SOP-GAP for organic rice farming. Rs value can show a negative or positive correlation with y variable.

t-test was used to find out whether there was a real correlation or not between production changes (Y) and the level of implementation of aspects in SOP-GAP for organic rice farming (X). T-test formula is illustrated in equation (3):

$$t = \sqrt{\frac{n-2}{1-\text{Rs}^2}} \qquad (3)$$

Note:

t : number of t

Rs : Spearman-Rank Correlation Coefficient

n : Number of Sample

If the value of t is greater than t table, then there is a correlation between the level of implementation of aspects in SOP-GAP for organic rice farming (X) and production changes (Y).

Results And Discussion

Level of Implementation of SOP-GAP for Organic Rice Farming in Indonesia

Organic rice farmers in Indonesia in general have implemented the aspects and sub-aspects in SOP-GAP for organic rice farming. Based on the criteria for achieving the implementation of SOP-GAP for organic rice farming, the level of implementation of SOP-GAP for organic rice farming in Boyolali District is 66.7% while the high and moderate levels of implementation are 23.3% and 10% each, of the total respondents. The average score for the implementation of the SOP is 43.3, so in general the level of the implementation is very high. This condition naturally occurs when most farmers have more than 10 years of farming experience. The experience accumulated in everyday life makes organic farmers accustomed to implementing SOP-GAP. They are also aware of the benefits of organic farming in relation to their income, health, and sustainable environment.

Correlation between the Implementation of SOP-GAP for Organic Rice Farming and the Increase of Organic Rice Production in Indonesia

The implementation SOP-GAP for organic rice farming comprises of input preparation aspects and cultivation stages. The following is the correlation between the increase of organic rice production and each sub-aspect in the aspects of the SOP with Spearman's Rank analysis.

Table 1. Correlation of Aspects and Sub-Aspects of SOP-GAP with the Increase of Organic Rice Production in Indonesia

SOP-GAP Aspects	SOP-GAP Sub-Aspects	Correlation Coefficient	Criteria
Production Input Procurement	Land	0.495**	Significant
	Seedling	0.737**	Significant
	Fertilizer	0,355	Insignificant
	Pesticide	0,452.	Significant
	Equipment	0.758**	Significant
Cultivation Techniques	Land Cultivation	0,441.	Significant
	Planting	0,344	Insignificant
	Fertilization	0,355	Insignificant
	Irrigation	0,463.	Significant
	Plan Maintenance	0,430.	Significant
	PDO Control	0,377.	Significant
	Harvesting	0,134	Insignificant
	Post-Harvest	0.539**	Significant

Source: Primary data analysis, 2019

Note: *real with 95% of degree of confidence, **real with 99% of degree of confidence.

The nine sub-aspects, land suitability, seedling, pesticides, equipment, soil cultivation, irrigation, plant maintenance, PDO control, and post-harvest, are correlated and have a significant effect on the increase of organic rice production in Indonesia. This finding is in accordance with the research conducted by Kornginnaya [41], Adnan [42], and Walisinghe et al. [43]. There are only four factors that are not correlated and have no significant effect on the increase of organic rice production, namely fertilizer and fertilization, planting, and harvesting.

Discussion of the Result

Production Input Procurement

The correlation between land suitability and the increase of organic rice production obtained Rs value of 0.495 and moves to the positive. The correlation can be interpreted that the level of implementation of the land suitability sub-aspect in Indonesia strongly associated with the increase of organic rice production. This is because organic rice farming land in Sragen, Boyolali, Bantul and Wonogiri Regency, Indonesia is located in the uppermost of hilly area, so it is free from chemical contamination. The land of the research has been managed organically since the early 2000s, so that it is quite fertile. The research location has passed the conversion period, according to the Indonesian National Standardization Agency. The conversion period for paddy was two years[44,45]. If the paddy has passed though the conversion period, it can be declared as an organic product[46,47]. The sub-aspect which has a strong correlation with input procurement to the increase of production, in addition to land suitability, is the sub-aspect of pesticides (Rs value of 0.452). Organic rice farmers do not use pesticides from chemicals and genetic engineering products[48–56]. The pesticides used are from plants, so that they fulfil the requirements for organic rice [57–59].

The correlation between seedling and the increase of organic rice production obtained Rs vale of 0.737 moving towards the positive, meaning that the level of implementation of seedling sub-aspect is strongly associated with the increase of organic rice production. Farmers generally use their own production seedling[60–63]. Farmers have never bought seedling from genetic engineering products (GMOs). Strong correlation moving towards the positive is also indicated by equipment sub-aspect (Rs value of 0.758]. The farming equipment used by the farmers was traditional equipment that is safe for the environment as it is not contaminated with chemicals[64–67].

Fertilizers and fertilization in organic farming play a role in providing safe nutrients and do not pollute the environment with hazardous residues. There is no correlation between the implementation of fertilizers and fertilizing sub-aspects with the increase of organic rice production. Despite the application of organic fertilizers, the method and dosage of the fertilizers are considered to be not optimal. The process of making organic fertilizers from manure through fermentation was not optimal either [68–73]. This resulted in the increase of production that is not optimal.

Cultivation Techniques

It is prohibited to prepare organic farming land by burning to prevent land degradation (erosion, sanitation, etc. [74–77]. The correlation between soil cultivation sub-aspect and the increase of organic rice production obtained Rs value 0.441 moving to the positive. It implies that the level of implementation of soil cultivation aspect in Indonesia is strongly associated with the increase of organic rice production. The land in Boyolali hills is cultivated using a terracing system that prevents erosion. Soil cultivation also uses environmentally friendly equipment such as traditional tools. In addition to soil cultivation, there are variables that correlate quite strongly with the increase of organic rice production in Indonesia, namely irrigation (Rs value of 0.463), plant maintenance (Rs value of 0.430), and PDO control (Rs value of 0.377). Water at the research location is available throughout the year and sourced from springs that are kept clean. Irrigation with good availability and quality can increase organic farming production. Plant maintenance (weed cleaning) was carried out by pulling the weed by hand so that it is guaranteed to be safe for the environment [78,79]. Land that is clean of weeds is able to increase paddy growth optimally. The process of controlling plant disturbing organisms (PDO) must take into account the potential impacts that can disrupt the biotic and abiotic environment and consumer health. Organic rice farmers have carried out methods of controlling pests properly and followed preventive recommendations in implementing PDO control. Biological pesticides were applied to get rid of stink bugs and planthoppers. The good habit of organic farmers in Indonesia is to directly kill pests by hand as soon as they see them in their farming fields. They also allow pest-eating insects on their farming land [80–82]. Such method ensures that organic rice production does not experience much production loss due to PDO attacks.

There is no correlation between planting and harvesting sub-aspects with the increase of organic rice production in Indonesia. Planting method using hands makes farmers' rice products free from chemical contamination. They have planted buffer plants around organic rice plants with a minimum width of two meters to avoid pollution from non-organic land [83–85]. As a crop rotation, the farmers usually plant organic rice with different varieties in turns. The most important thing to harvest organic products is not to damage and pollute the farming environment. The harvesting method will not increase production because good and right way of harvesting only reduces the potential production yield loss due to harvest loses. Post-harvest is strongly correlated with the increase of organic rice production (Rs value of 0.539 to positive). The integrity of organic food products must be maintained throughout the food chain stages from harvesting to packaging. Post-processing by farmers used appropriate and careful ways to minimize the use of chemicals. The integrity maintained in the post-harvest makes consumers believe in organic products and want to continue to consume them. This desire makes the demand for organic products even greater and influences farmers' decisions to increase the production of their organic rice farming, in addition to the price of organic rice than is higher than that of conventional rice.

Conclusion

The main finding in this research is that the level of implementation of SOP-GAP for Organic Rice Farming in Indonesia is very high. There are nine sub-aspects of SOP-GAP that are correlated and have a significant effect on the increase of organic rice production in Indonesia. The nine sub-aspects are land suitability, seedling, pesticides, equipment, soil cultivation, irrigation, plant maintenance, PDO control, and post-harvest. There are four factors that are not correlated and have no significant effect on the increase of organic rice production, namely fertilizer and fertilization, planting, and harvesting. It is necessary to increase the intensity of some sub-aspects of organic rice farming. The application of organic fertilizer needs to be increased in terms of quantity and quality. The making of organic fertilizers must use the recommended micro-organisms. Planting buffer plants needs to be carried out to maintain the quality of organic rice. This research is limited to the application of SOP-GAP. Further research is needed to determine the factors that influence farmers' decisions in implementing SOP-GAP.

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Conflict of interest

The authors declare no conflict of interest.

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