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Farmer Behavior on Facing Production Risk of Organic Rice Farming in Indonesia

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Abstract
This study identified farmer behavior on facing production risk of organic rice farming in Dlingo Village, Mojosongo District, Boyolali Regency, Central Java Province, Indonesia. This research used Just and Pope's function model and statistical package for the social sciences method. The aim of this study is to determine farmer behavior and the most significant factor influencing production risk. The research was conducted on 216 organic rice farmers as a sample during two planting seasons with purposive sampling method. The result of the research shows that the most significant factor influencing production risk of organic rice farming is tractor's rental fee with coefficient of 0.310. The farmer behavior on facing production risk are 46,30% farmers (100 people) make risk averse decision (risk averse) and 53,70% other farmer (116 people) dare to face the risk (risk seeking).
Keywords: Farmer behavior, Organic rice farming, Production risk, Risk averse, Risk seeking
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1. Introduction

The environmental problems' issues related with water, soil, plants, and animals have become global problems and apprehensive topic since 1970s until now. The Stockholm Declaration emphasized the human responsibility to protect the environment and natural resources including water, soil, plants, and animals both renewable and non-renewable ones for the benefit in the present and the future (Sohn 1973). Agriculture is one of the areas of human life in which there are living creatures and nature (water, soil, air, etc.) which is essential for human survival in the future.

Related to the sustainable development, agriculture is a natural processing activity. The use of agricultural means of production input in enhancing productivity has impacts on the environment. Agriculture also can be defined as a sector processed and managed by human that leads to big impact on the environment. Las *et al.* (2006) explained there are three main impacts caused by human activities among the environmental problems existing, i.e.: 1) effects of the use of production inputs on the production of agriculture and the environment; 2) effects of the farming system on the emission of greenhouse gases; 3) effects of industrial activities and urban expansion in agricultural land. In modern agriculture, the use of the means of production inputs to trigger production such as fertilizer and chemical pesticides has big impacts on the degradation of environmental quality in agriculture. Modern agriculture which was rolled out as green revolution has strong correlation with the environmental issues.

Green revolution was initially able to bring Indonesia to rice self-sufficiency in 1984. After 1984, green revolution was unable to significantly increase rice production. It brought negative impact instead, especially on soil fertility and its ability to produce food with sufficient quality and quantity (Sudrajat 2018). Thus, based on the illustration, it can be inferred that activities in agricultural sector have negative impacts on the change of the environment condition. Therefore, activities in agricultural sector need to be directed into sustainable agriculture which then became an important part in sustainable development. Sustainable agriculture is a moral call to do well on the natural resources environment regarding three dimensions of environmental awareness, economic and social character. One of sustainable farming practices that consider those three aspects is organic farming system (Salikin 2003).

Organic farming is very important because it indirectly and in the long term, may be an alternative solution to the problem of rice production through natural recycling so as to increase the productivity of the soil. However, the fundamental problem in organic rice farming, besides the efficiency of farming, is also due to the high risks faced by farmers. Barry (1984) stated that the problem of risk and uncertainty in agriculture is not a new thing, because in fact, farmers have a lot of decisions relating to risks and uncertainties. Thus, identification of sources of risk is very important in the decision making process. The risk factors in agriculture comes from production, prices and markets, business and finance, technology, damage, social and legal, as well as humans (Robison & Barry 1987).

Harwood *et al.* (1999) and Moschini & Hennessy (1999) explained that some of the sources of risk that may be faced by farmers include: (i) the production risk; (ii) market or price risk; (iii) institutional risk; (iv) the risk of policy; and (v) financial risks. From several sources of these risks, the main risks faced by organic farmers in Boyolali, Central Java, Indonesia include production risk and market or price risk. Production risk occurs due to varied results of unpredictable factors, such as weather, disease, pests, genetic variation, and the timing of farming

activities. While the risk of price or market is usually associated with diversity and uncertainty of prices received by farmers and needs to be paid for production inputs, giving rise to uncertainty about the benefits to be obtained.

2. Literature Review

The earliest production risk model was initiated by Just and Pope. In the beginning, Just and Pope's model was used to determine the production risk of farming system. Just & Pope (1979); Bontems & Thomas (2000); and Bokhuseva & Hockmann (2004) explained that to analyze the agricultural sector, it is very important to consider the presence of risk factors, in particular the production risk. If production risk was not taken into account, it will be concluded that are not adequate. In every process of production, especially in agricultural production, the production risk seems to play very important role in the decision to use the inputs that affect the productivity (Just & Pope 1979). The analysis of production risk that developed by Just and Pope is very useful in the management of production risk, i.e. to decide whether a particular input used in farming need to be supplemented or reduced.

Research about organic rice farming with production, cost or profit function approach is still limited compared to research about conventional rice farming. Several previous organic and conventional rice farming researchers with production function approach such as those done by (Baten *et al.* 2009; Kadiri *et al.* 2014; Kusnadi *et al.* 2011; Murniati *et al.* 2017; Prayoga 2016; Saeed & Khan 2007; Songsrirote & Singhapreecha 2007; Tien 2012). Several previous organic and conventional rice farming researchers with production cost function approach such as those done by (Ajoma *et al.* 2016; Ghosh & Raychaudhuri 2010 & 2015; Hidayah *et al.* 2013; Nandi & Basu 2013; Ouédraogo 2015; Rathnayake & Amaratunge 2016; Sudrajat *et al.* 2018). Several previous organic and conventional rice farming researchers with profit function approach such as those done by (Chang *et al.* 2017; Chowdhury *et al.* 2013; Galawat & Yabe 2012; Kaka *et al.* 2016; Karafilis & Papanagiotou 2009; Lestari & Suryana 2013; Mailena *et al.* 2014; and Sudrajat *et al.* 2017).

Several empirical studies on the behavior of rice farmers in the face of production risk can be seen that most of rice farmers studied prefer to avoid or fear of risk (risk averse). This is as researched by (Dillon & Scandizzo 1978) who examined the behavior of rice farmers in Brazil; Binswanger (1980) estimated production risk of conventional rice in India; Hutabarat (1987) conducted research on farmer behavior facing the risk in West Java, Indonesia; Syafaat (1990) conducted research on rice production risk in WKPP (Area of Agricultural Extension Workers) Manyeti, Subang Regency, West Java, Indonesia; Purwoto (1993) conducted research on farmer behavior on rice production risk in Boloh Village, Toroh District, Grobogan Regency, Central Java, Indonesia; Hartoyo *et al.* (2004) conducted research on rice production risk in Cisarua and Kemang, Bogor, West Java, Indonesia; Villano *et al.* (2005) and Villano & Fleming (2006) analyzed the behavior of rice farmers in lowland rainfed in Philippines.

In addition, Ningsih (2011) conducted research on production risk of upland rice in Sentol Village, Pademawu District, Pamekasan Regency, Indonesia; Rambe & Honorita (2011) conducted a research on the behavior of rice farmers in Rawa Lebak, South Sumatra, Indonesia; Wicaksono (2011) conducted a study on production risks and risks of paddy farm revenues in Kebumen Regency, Central Java, Indonesia; Ahyar *et al.* (2012) examined the behavior of rice farmers in Bima Regency, Indonesia; Yurisinthae (2013) analyzed production risks in Kubu Raya Regency, Indonesia; Zakirin *et al.* (2013) conducted a risk analysis of production rice in Pontianak Regency, Indonesia; and Suharyanto *et al.* (2015) analyzed the risk of rice production in Bali Province, Indonesia. Most of the researchers used production risk function approach with Just and Pope function model, but some are from Kumbhakar function model.

Kumbhakar (2002) stated that Just and Pope's model more focusing on production risk that is measured from the output variant and recommend using the specification on the production function that satisfies some properties that are used. The main focus from the specification of Just and Pope is the allocation of input can lead to increase or decrease the production risk. From some of the policies, the presence of such input can increase or decrease the production risk. It will be very useful, especially in the management of risk production. In the risk management, there are two types of risk faced by farmers, namely production risk and price risk (Patrick *et al.* 1985). Production risk is type of risk which is used in the analysis of the production function that inserts an element of risk in it. Price risk is often performed for the regression analysis separately. Thus, both production risk and price risk may cause the variability of the feasibility of a farming system which is run by the farmers.

In the analysis of production risk may need to do an analysis of farmer behavior in the face of risk. This is important because knowledge of the farmer behavior can provide the basis of a good understanding of the problems of organic farming system productivity. In addition, ignoring the existence of risk and risk behaviors can cause bias to the estimation of production parameters and technical efficiency, so that can lead to errors of interpretation toward the phenomenon of a decrease in productivity (Kumbhakar 1990). Research with the approach of production risk intends to analyze the extent of farmer behavior on making decisions facing the production risk and the kind of production risk of what that will be encountered in the organic rice farming system in Boyolali Regency, Central Java Province, Indonesia.

3. Methodology

3.1 Determination of Research Site

The study was conducted in Dlingo Village, Mojosongo District, Boyolali Regency, Central Java, Indonesia. Boyolali was chosen as a research area because there are still many farmers who run organic rice farming. The reasons for the study were conducted in the area were: (i) both groups are located in the same area, (ii) they have the same water source from soil water irrigation, (iii) they are separated from other farmer' groups, and (iv) they can carry out three planting seasons in a year.

3.2 Sample of Farmers

Total population of organic rice farmers with ICS (Internal Control System) and nationally certified from seven villages (Catur, Jatisari, Dlingo, Metuk, Andong, Wates, and Glonggong) and five districts (Andong, Simo, Mojosongo, Sambi, and Nagasari) in Boyolali Regency as many as 521 people. From the population of farmers, the sample of 216 (organic rice farmer with national certified) was taken through purposive sampling method during two planting seasons.

3.3 Data Analysis

To determine the farmer behavior on facing production risk on organic rice farming system in Boyolali Regency was used Just & Pope's production risk function model, i.e., production function plus the production risk function. Measurement of production risk (Just & Pope 1979) refers to the method of (Moscardi & de Janvry 1977). Measurements are made by selecting the most significant factors that influence the determination of regression results. The most significant influencing factor parameters are used to determine the level of farmer behavior on facing production risk based on econometric approach. The production risk function can be formulated as follows:

$$y = f_j(x, z) + u = f_j(x, z) + h_j(x, z)\,\varepsilon \quad (1)$$

where:

- y = the number of output
- x = vector of the number of variables input (x_i,..., x_j)
- z = vector of the number of quasi fixed input (z_i, ..., z_k)
- $f_j(x,z)$ = production function
- $h_j(x, z)\,\varepsilon$ = production risk function
- u = heteroskedastic error term with mean = nol and varians = $(h(.))^2$
- ε = homoskedastic error term with mean = nol and varians = 1

If $h_j(x,z)$ is positive, it means the addition of input j can raise the risk, on the contrary, if $h_j(x,z)$ is negative, it means the addition of input j can reduce the risk. The description of the translation of the formula is:

- $f_j(x,z)$ = production function
- Y = organic rice production (kg/ha/planting season)
- X_1 = land area used by the farmers in one planting season (ha/planting season)
- X_2 = the number of seeds (kg/ha/planting season)
- X_3 = solid organic fertilizer (kg/ha/planting season)
- X_4 = liquid organic pesticide (liter/ha/planting season)
- X_5 = liquid organic pesticide (liter/ha/planting season)
- X_6 = solid organic pesticide (kg/ha/planting season)
- X_7 = labor from outside the family (man days/ha/planting season)
- X_8 = labor within family (man days/ha/planting season)
- X_9 = tractor's rental fee (IDR/ha/planting season)

To calculate the farmer behavior on production risk is used a function of behavior on risk as follows:

$$f_j = \tilde{w}_j - h_j\theta_i \quad (2)$$

where:

$$\theta_i \equiv \frac{E\left[U'\left(\frac{\pi^e}{p}\right)\varepsilon\right]}{E\left[U'\left(\frac{\pi^e}{p}\right)\right]} \quad (3)$$

where:

- f_j = marginal product with input j
- w_j = normalized input price j
- h_j = first derivative of risk function to input j
- θ_i = production risk behavior

3.4 Hypotheses

Testing hypotheses about farmer behavior in dealing with risks and on choosing the level of production risk on organic rice farming in Boyolali Regency, Central Java, Indonesia is carried out in the form of the following

hypothesis:

If $h_j > 0$ and $\theta_i < 0$ => $f_j < \tilde{w}_j - h_j\theta_i$ => f_j should increase, so that $f_j = \tilde{w}_j - h_j\theta_i$, or x_j input should decrease. Therefore, if $h_j > 0$ and $\theta_i < 0$, it means the farmers are afraid facing the risk (risk averse). On the other hand, if $h_j > 0$ and $\theta_i > 0$ so the farmers are dare facing the risk (risk seeking).

If $h_j < 0$ and $\theta_i > 0$ => $f_j < \tilde{w}_j - h_j\theta_i$ => f_j should increase, so that $f_j = \tilde{w}_j - h_j\theta_i$, or x_j input should increase. Therefore, if $h_j < 0$ and $\theta_i > 0$ so the farmers are afraid facing the risk (risk averse). On the other hand, if $h_j < 0$ and $\theta_i < 0$ so the farmers are dare facing the risk (risk seeking).

4. Results and Discussion

4.1 The Most Significant Factors Influence

The production of organic rice is determined by the use of its inputs, such as the area of land, the number of organic rice seeds, the amount of organic fertilizer (solid and liquid), the amount of organic pesticides (solid and liquid), wage labor (in the family and outside the family) tractor's rental fee. For the risk is caused by the production function by choosing the most significant factors that influence the determination of regression results. The most significant influencing factor parameters are used to determine the level of farmer behavior in facing production risk based on econometric approach. Table 1 shows the parameters of the most significant factors that influence the determination of regression results. These parameters will be used to determine the level of farmer behavior in facing production risk based on econometric approach.

Table 1. Most significant coefficient of production risk factors

Model	Unstandardized Coefficients		Standardized Coefficients	t-count	Significant
	β	Standard Error	β		
(Constant)	5.844	1.014		5.764	.000
X_9	.195	.074	.177	2.634	.009
(Constant)	4.791	1.067		4.489	.000
X_9	.342	.090	.310	3.799	.000
X_2	-.264	.095	-.227	-2.785	.006

Source: Analysis of Primary Data 2016

Based on Table 1, the most significant factor influencing and contributing greatly to the risk of organic rice production is tractor's rental fee with coefficient of 0.310. In order to match production function {f (x, z)} and production risk function {h (x, z) ε} it is necessary to look at the factor of production which has the greatest contribution to organic rice production, i.e. tractor's rental fee factor (X_9). Furthermore, it should be seen that f_j (marginal product with input j), w_j (normalized input price j), h_j (first derivative of risk function to input j) and θ_i (production risk behavior) from calculation result using SPSS (Statistical Package for the Social Sciences) method (Pallant 2010). As the most dominant factor, tractor's rental fee is very influential on organic rice production and production risk. If the tractor's rental fee is higher, the organic rice production will be greater; and if the tractor's rental fee is higher, then the behavior of farmers in making decisions facing production risk in terms of risk seeking will be even greater.

4.2 Farmer Behavior toward Organic Rice Production Risk

Farmer behavior towards organic rice production risk is assumed to maximize the expected utility from normalized profit with price. The attitude of organic rice farmers in Boyolali, Central Java, Indonesia on making decisions can be shown in Table 2 below:

Table 2. Farmer behavior on production risk of organic rice farming

Risk Averse Arrow-Pratt	Number of samples	Percentage
Risk Averse (RA)	100	46.30
Risk Seeking (RS)	116	53.70
Total	216	100.00

Source: Analysis of Primary Data 2016

In Table 2 can be seen that from the 216 samples, there are 46.30% of the farmers (100 people) making decisions are afraid of risk (risk averse). Organic rice farmer behavior shows that if there is an increase of variance in profit then the farmers will compensate by raising the expected profit and it is a measure of satisfaction level of the farmers. While 53.70% of other farmers (116 people) are dare to take risk (risk seeking). The farmer's behavior shows that if there is an increase in profit range, the farmers will compensate by lowering the expected profit. Furthermore, to see the level of risk faced by farmers, the coefficient of variation was used. The greater value of

coefficient of variation shows the greater risk of organic rice production and conversely, the smaller value of coefficient of variation shows the smaller risk of production risk of organic rice farming.

5. Conclusion

In this study, organic rice farming is very important because in addition to eco-friendly, indirectly it can be long term alternative solution for the next generation to increase environmental health. Organic rice farming system is expected to be more efficient by reducing the number of production risks, namely by identifying factors that influencing to the production risk and farmer behavior in the face of existing production risk.

The most significant factor that influencing and contributing greatly to the production risk of organic rice farming is tractor's rental fee with a coefficient of 0.310. As the most dominant factor, tractor's rental fee is very influential on organic rice production and production risk. Farmers behavior on facing production risk are 46.30% farmers make risk averse decision (risk averse) and 53.70% other farmers dare to face the risk (risk seeking). It's mean the farmers on organic rice farming in Boyolali, Central Java, Indonesia make risk seeking decision or more dare to face the production risk.

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