PRODUCTIVITY, SOIL FERTILITY, AND ECONOMIC BENEFIT IN CHANGES FROM CONVENTIONAL TO ORGANIC RICE FARMING SYSTEM AT SRAGEN DISTRICT

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ABSTRACT

Organic farming/products are becoming necessary in the world to control ecosystem health and to impart related human health benefits.The objective of this research was to increase production, improve soil chemical and physical properties and revenue and B/C ratio.The experiment was conducted at two sub-districts namely Ngrampal and Kobonromo, Sragen district, from November 2012 until March 2013. These sites represented three rice farming systems: conventional, semi organic and fully organic rice farming. Several investigation methods were applied, namely survey, and direct interview in the field; visit and discuss with farmers house.

The fully organic system in Ngrampal and Kebonromo produced un-productive tillers, the highest percent-recovery and the same weight of rice. The fully organic and semi-organic farming systems increase chemical such as organic matter and cation exchange capacity, better selling price and income compared with conventional, although the three farming systems have the benefit of farming and constantly viable. Be caused it has a value of B/C ratio and R/C ratio more than one.

Keywords: Organic farming, Rice farming, soil fertilities, and economic analysis

INTRODUCTION

Increasing food production through green revolution is inseparable from the use of modern technologies such as improved seeds, chemical fertilizers, pesticides, and herbicides. Conventional rice farming is only oriented to increase rice yield by encouraging on using inorganic fertilizer and pesticide and refused using organic ones. Heavy reliance on chemical fertilizers as nutrient sources potentially reduce soil productivity, and soil compaction. Both of them will reduce organic matter. The most real effect was the plant gradually unresponsive on fertilizing (Gunadi and Bostang, 1997). Though the dosage of fertilizer had been increased, plant productivity was not in balance with supplying additional fertilize (Padmini, 2007; Deore *et al.*, 2010). Dependence on high doses of chemical fertilizers and pesticides as well as potentially reduce the land productivity, and also caused leveling productivity. Rice productivity in Sragen

2005-2011 respectively 5,558 tons / ha, 5.184 tons / ha, 5.367 tons / ha, 5.267 tons / ha, 5.318 tons / ha 5.668 tons / ha and 5.812 tons / ha. (Department of Agriculture and Food Security Sragen, 2011). Department of Agriculture was making inroads Sragen use organic fertilizer that was triggered by movement healthy lifestyle that focuses on the importance of the foundation of life by "slogan Back to nature with vision Sragen Go Organic 2010" (Wiyono, 2007). Supported by the Ministry of Agriculture who agree that action must be performed, one of which increase agricultural production and maintain natural resources. In 2007 rice production increased 4.96% (Apriyantono, 2007). The basic principle of organic farming is the maintenance of good soil and following the philosophy that nature farming is how to give the soil life (Kosit, 2011). The aim of organic farming systems is improved agro-ecosystems healthty, biodiversity and biological activity (Dubey and Dubey, 2010).

Actually organic and semi-organic rice farming is profitable for farmers, this is due to organic rice production cost is lower and has a higher economic value than inorganic farming. The price organic rice in the market reached 9.000 IDR each kg, less than the price inorganic rice 8000 IDR each kg (Interviews with farmers, 2011) . Organic farming technology can be used as an alternative to reduce the dependence on inorganic fertilizers and pesticides. Organic farming emphasizes the use of organic fertilizers and pesticides that do not harm the soil, so that the farmland ecosystem in balance (Sukristiyonubowo, *et al*., 2011)

The farmers used to apply fertilizer N. P and K three times and the last application is conducted on three-weeks-old plants. At this time plants are still at the early tillering stage. Applying nutrient through the leaves to the next growth phase is very important. Organic fertilizers are applied through the leaves is more effective because it can be absorbed directly by the plant. Application organic liquid fertilizer combined with inorganic fertilizer provides better nutrient sufficiency. Based on the above problems will be very interesting to do research about productivity, soil fertility and Socioeconomic through changes from inorganic to organic rice farming systems in Sragen District.

MATERIALS AND METHODS

The experiment was conducted at two sub-districts namely Ngrampal and Kobonromo, Sragen district, Central Java in two cropping seasons: the rainy season (MH) I November 2012-March 2013. Assessment at the rice farming systems were done with Participatory Rural Bener Apprisial. Number of farmer cooperators from Bener and Kebonromo villages for each of farming system three people. Land area studied between 0.5-2 acres. To complete data on production and socio-economic evaluation conducted in several investigation methods were applied, namely survey, and direct interview in the field, visit and discuss with farmers house. and coordination with local authorities (village chief)

The three rice farming systems (confencional, semi-organic and fully organic) were mainly distinuised according to the labour cost and agricultural input cost. The labour cost consist of land preparation, planting, fertilization, weeding, pest and diseases control, watering and harvest. Agricultural cost consist of mineral fertilizers, powder organic fertilizer, LOF, Bio pesticides, Commercial pesticides, and ‘Scorr’The conventional systems, the farmers applied NPK (450 kg

urea/ha+300 kg SP-36/ha+150 kg/ha KCl) and commercial pesticides. The semi organic system only less NPK fertilizers (150 kg urea/ha+100 kg SP-36/ha and 75 kg/ha KCl) + 2 tons/ha organic fertilizers. The fully organic farming system, the farmer used 3 tons/ha organic fertilizers and liquid organic fertilizers (LOF "Plus" and Bacteria fertilizer). The LOF "Plus" was prepared in our field using agricultural waste (rotting/over ripened fruits and vegetables , and neem leaves extract enriched with rice sprout. The bacteria fertilizer contains 1) major microbes as providers of N, P, K elements through biosynthetic, bio enzymatic and fixation so they are available to plants; 2) secondary microbes that produce a food source for the proliferation of all microbes in the biotic associations; 3) and create ideal soil conditions for development of all microbes (Ngrembakatingkir.blogspot.com, 2011). The three kinds of ferming systems used the source of water original from irrigation water.

In the farming system, we gathered data of production and economic to evaluate benefit cost (B/C ratio). The B/C ratio is calculated to the formula below (Sukristiyonubowo, *et al.*, 2011)

$$\frac{\text{B}}{\text{C}}\text{ratio} = \frac{\text{Benefit}}{\text{Production cast}}$$

Production cost is sum of the labour and agricultural input cost, while Benefit is the different between the revenue and the production cost. When the B/C ratio is ≥ 1, the rice farming systems is efiicient and gives more benefit. In contrast when the B/C ratio ≤ 1, the system farming is not efficient.

Observation about soil fertility by taking soil samples were done in three rice farming systems. Composited samples of top soil, 0-20 cm layers, were taken in November 2012 before starting experiment and Maret 2013 after experiment. These soil samples were analyzed in Analytical laboratory of the soil science at Faculty of Agricultural UPN "Veteran" Yogyakarta. Determining chemical included the measurement of pH (H_20), was measured in 1:5 soil water suspension using a glass electrode method; Cation Exchange Capacity (CEC), Organic matter (Organic Carbon was determined by using the walkley and total Nitrogen by using Kjeldahl), Phosphorus (available P) were measured colorimetric using Olsen methods.

RESULTS

1. Component Yields

Observation to the yield components, included the number of tillers, number of panicles, length of panicles, number of grain per panicles. Also observations to the un-productive tillers, weight of grains per hill and per hectare, and percent-recovery (Table 1 and 2).

Table 1. The yield components for three differences rice farming system in the Sragen District, Indonesia for the wet season 2013

Village	Treatmens	Yield components			
		Number of tillers	Number of panicles	Length of panicles (cm)	Number of grain/ panicles
Kebonromo	Conventional	22,67 a	18,33 a	24,67 b	103,67 c
	Semi organic	21,33 a	18,33 a	26,70 a	114,67 b
	Fully organic	16,33 b	15,67 b	25,17 ab	117,00 b
Ngrampal	Conventional	23,50 a	18,83 a	23,17 b	117,00 b
	Semi organic	23,33 a	19,83 a	27,33 a	127,67 a
	Fully organic	17,45 b	15,33 b	25.67 ab	124,25 a

Source : Data were gathered in the wet season 2013 with PRA methods and interviewed

The result showed that the number of tillers and panicles on the conventional and semi-organic systems from both of Kebonromo and Ngrampal villages were not different, but both of them were higher than fully organic system.

Table 2. The yield components for three differences rice farming system in the Sragen District, Indonesia for the wet season 2013

Village	Treatmens	Yield components				
		Un-productive Tillers %	Weight of grains per hill (kg)	Weight of grains/ha (ton)	Recovery (%)	Weight of rice
Ngrampal	Conventional	19,14 a	34,15 ab	7,28 a	61.07 b	4.45 a
	Semi organic	14,06 b	36,75 a	7,37 a	62.95 b	4.64 a
	Fully organic	10,17 c	33,23 b	6,52 b	64.97 a	4.24 a
Kebonromo	Conventional	19,63 a	34,75 ab	7,27 a	61.78 b	4.49 a
	Semi organic	15,29 b	37,00 a	7,10 a	62.20 b	4.42 a
	Fully organic	12.85 c	33,45 b	6,53 b	64.81 a	4.23 a

Source : Data were gathered in the wet season 2013 with PRA methods and interviewed

The conventional and semi organic farming system in both villages have a higher yield but the conventional system produced the biggest percent-un productive tillers, the shortest length of panicles, the lowest number of grain/panicles and the smallest percent- recovery. The fully organic system produced the smallest un-productive tillers, the highest percent-recovery and the same weight of rice with the semi-organic system

Observation to the Soil chemical and physical properties from three rice farming systems in sub district of Sragen Districts presented in the table 3.

Table 3. Soil chemical properties from three rice farming systems in sub district of Sragen Districts (Soil were sampled in the wet season 2013)

Soil Parameters	Conventional		Semi organic		Fully organic	
	Ngrampal	Kebonromo	Ngrampal	Kebonromo	Ngrampal	Kebonromo
pH (H2O)	6,11	6,01	6,35	6,23	6,64	6,31
C (%)	0,79	0,76	0,85	0,85	1,71	0,18
N-total (%)	0,09	1,12	1,02	1,21	1,05	1,12
P Olsen (ppm P2O5)	85,15	46,82	58,27	41,26	36,70	20,49
CEC (me%)	12,63	10,84	13,43	15,42	19,46	17,79
Soil depth (cm)	17,50	15.50	30.00	28.50	33,50	30.00

Source : Analytical laboratory of the soil science at Faculty of Agricultural UPN "Veteran" Yogyakarta

Application soil having a pH (H2O) 6.64 and pH (KCl) 5.99. The pH is included in rather acid . Soil analysis results by conventional in both villages Ngrampal and Kebonromo have a pH (H2O) 6,11 and 6,01. Content of organic matter was very low was 0,79 % and 0,76 %, Cation Exchange Capacity (CEC) was 12,63 me% and 10,84 me%. Content of total-N 0.09 % and 1,02 %. Levels of P-available was 85,15 ppm and 46,82 ppm. Application of organic fertilizer 3 tons.ha^{-1}. Season $^{-1}$ both in semi organic and fully organic can increase soil fertlity, especially soil pH, C-organic, CEC and deeper, whereas reduce in P-available.

Economic analysis for three differences rice farming system presented in the table 4

Table 4. Simple economic analysis for three differences rice farming system in the Sragen District, Indonesia for the wet season 2013 (in IDR) per hectare

Parameters	Conventional		Semi organic		Fully organic	
Production Cost	Ngrampal	Kebonromo	Ngrampal	Kebonromo	Ngrampal	Kebonromo
Land leases	6,500,000	6,500,000	6,500,000	6,500,000	6,500,000	6,500,000
A. Labor cost:						
Land preparation	1,500,000	1,800,000	1,500,000	1,800,000	1,500,000	1,800,000
Planting	1,575,000	1,800,000	1,800,000	2,025,000	1,800,000	2,025,000
Fertilization	540,000	540,000	300,000	300,000	180,000	180,000
Weeding	900,000	900,000	600,000	600,000	500,000	500,000
Pest and diseases control	600,000	600,000	150,000	150,000	100,000	100,000
Watering	120,000	150,000	120,000	150,000	120,000	150,000
Harvest	1,800,000	1,950,000	1,800,000	1,950,000	1,800,000	1,950,000
B. Agricultural input cost:						
Mineral fertilizers	2,250,000	2,250,000	175,000	175,000	-	-
Organic fertilizer	-	-	300,000	300,000	300,000	300,000
LOF	-	-	-	-	-	-
Commercial Pesticides	150,000	150,000				
'Scorr'	150,000	150,000	-	-	-	-
Total Cost	16,085,000	16,790,000	13,245,000	13,950,000	12,800,000	13,505,000
Revenue	35,556,800	36,115,200	39,466,350	37,485,000	38,389,760	38,448,640
Benefit	19,471,800	19,325,200	26,221,350	23,535,000	25,589,760	24,943,640
R/C ratio	2.21	2.15	2.97	2.68	2.99	2.85
B/C ratio	1.21	1.15	1.98	1.69	2.00	1.85

The calculation of the efficiency and benefit farming showed that the fully organic and semi organic rice in Ngrampal villages had more efficiency and benefit with the value of R / C ratio 2.99 and 2.97, and B / C ratio 2:00 and 1.98 respectively, followed by the fully organic and semi organic rice in Kebonromo villages with the R / C ratio 2.85 and 2.68, and B / C ratio 1.85 and 1.69 respectively. The lowest efficiency and benefit farming value found in conventional rice farming.

DISCUSION

Soil fertility in research area were dominated by conditions very low, so the soil was categorized less fertile. The semi-organic and fully organic rice farming increase of the soil dept and chemical soil properties, especially increase the organic matter content, CEC, whereas reduce P-available. Organic matter as an indicator in determining soil fertility. Increased in organic matter correlated with increased cation exchange capacity. Formation of organic matter helps soil particles aggregation that can create a system that both air and water, thereby increasing the population of microorganisms in the soil. Nitrogen and phosphate in soil following with the organic matter content. If the levels of N> 2.6% and C / N <15/1 it will take the mineralization process, resulting in the release of N. Instead immobilization occurs when the levels of N <1.2% and C / N> 33/1. Microorganisms utilize nitrogen to proliferate, resulting in competition between plants to microorganisms (Anonim, 2005).

The fully organic system technology produced the smallest un-productive tillers, the highest percent-recovery and the same weight of rice. Although the conventional and semi organic farming system have a higher yield but the conventional system produced the biggest percent-un productive tillers, the shortest length of panicles, the lowest number of grain/panicles and the smallest percent-recovery. The role of organic fertilizer in semi organic systems can substitute NPK fertilizer, respectively 60 % urea and SP-36, 50 % KCl for improving the highest yield.

The economic analysis in this study is empirical and is conducting comparative analysis between three treatments, i.e. treatment with three rice farming systems (conventional, semi-organic and fully organic. Table 6 shows that both treatments are financially efficient and profitable to manage. The criterions used for analyzing are Revenue Cost Ration (R/C) and Benefit Cost Ratio (B/C). The difference in input usage affects the cost of the productivity of the land (Gittinger, 2008). The conventional system technology costs more than the reduced one. In market, the price of NPK (inorganic fertilizers) is higher than the organic fertilizer, because the inorganic fertilizer is produced by factories (Purcell, 2009). On the other hand, the organic rice gets higher price than the rice produced by conventional farming using inorganic fertilizer. The price rice in Sragen Regency, Rp. 8000/kg (conventional rice), Rp. 8500/kg (rice semi organic) and Rp. 9000,-/kg (rice fully organic). It makes that the R/C and B/C of rice cultivation with the semi and fully organic systems were higher than conventional system.

In the recent years, the consumers' preference for healthy food tends to increase. They select healthy and delicious food including organic rice. In this condition the higher price of food including rice (organic/semi organic) becomes negligible. As shown in Table 7, R/C and B/C of rice by fully and semi organic were higher than conventional. Be caused the selling price of that rice were higher than conventional system, while organic fertilizer was still cheap. Therefore, economically, rice produced with semi and fully organic ware very profitable.

CONCLUSION

The fully organic system in Ngrampal and Kebonromo produced un-productive tillers, the highest percent-recovery and the same weight of rice. The fully organic and semi-organic farming systems

increase chemical such as organic matter and cation exchange capacity, better selling price and income compared with conventional, although the three farming systems have the benefit of farming and constantly viable. Be caused it has a value of B/C ratio and R/C ratio more than one.

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