International Research Journal of Agricultural Science and Soil Science (ISSN: 2251-0044)Vol. 1(5) pp. 172-182 July 2011
Available online http://www.interesjournals.org/IRJAS

Full Length Research Paper

Change from conventional to organic rice farming system: biophysical and socioeconomic reasons

[1*]Sukristiyonubowo R, [1]Wiwik H, [2]Sofyan A, [3]Benito H.P, and [4]S. De Neve

[1]Indonesian Soil Research Institute, Jalan Juanda 98 Bogor, Indonesia
[2]Direktorat Jendral Prasarana dan Sarana Pertanian, Jalan M.T. Harjono, Jakarta Selatan
[3]Gadjah Mada University, Bulak Sumur, Jogyakarta
[4]Department of Soil Management and Care Ghent University, Coupure Link 653 B-9000 Ghent, Belgium

Accepted 13 July, 2011

Participatory Rural Appraisal was carried out in three sub districts namely; Gondang, Kedawung, and Sambirejo of Sragen District, Indonesia in October, 2008. These sites represented three rice farming namely conventional, low external input called semi organic and fully organic rice farming. The aim was to study biophysical and socioeconomic reasons of conversion from conventional to organic rice farming systems. Several methods of participatory rural appraisal were applied, namely historical land use, Venn diagram, field monitoring and ranking and scoring, besides direct interview in the field and visit farmers house. The results showed improving soil fertility, better selling price and income, better and healthier rice quality and less pest and diseases attack were the most benefits obtained from the conversion to semi and fully organic rice farming. Improving both chemical and physical soil fertility were put in the first and second rank for fully organic rice farming group, while better income and improving soil properties were for the semi organic rice farming group. The economic benefits were about 12,300,000 IDR (1,367 USD) and 14,400,000 IDR (1,600 USD) ha^{-1} season^{-1} with B/C ratio 4.5 and 6.0 for semi and fully organic rice farming, respectively. These systems are socially accepted encouraging communal works.

Keywords: Rice farming, conventional, low external input, fully organic, participatory rural appraisal

INTRODUCTION

In Indonesia, rice is not only a staple food, but also a source of income providing jobs for most villagers. Since the beginning of seventies through the First Long Term Development Program and it was executed by PELITA (*Pembangunan Lima Tahun* = Five Years Development Plan), increasing rice production has been one of the priorities of the Indonesian agricultural development. It is not only to meet the rice growing demand, but also to improve farmer income and to support food security. Like other rice producing countries, planting high yielding varieties and adding more mineral fertilisers are widely implemented to elevate rice and land productivities. Indonesia has been amazingly recognised in successful in increasing rice production and in 1984 reached rice self-sufficiency. This achievement was mainly due to application of a system of high external inputs (Green Revolution technology) including high yielding rice varieties and agrochemicals (Sukristiyonubowo, 2007).

It is also well known that fertilisers are the most functional input to replace nutrient removal and the high yielding rice varieties require more mineral fertilising to achieve their potential yields. Studies on the effect of mineral fertilisers on rice production conducted in many rice producing areas have tremendously increased in line with the development of high yielding rice varieties (Sukristiyonubowo and Tuherkih, 2009; Min et al., 2003; Cho et al., 2002; 2000; Soepartini, 1995; Adiningsih, 1992; Adiningsih et al., 1989; Prawirasumantri et al., 1983; Cooke, 1970; Uexkull, 1970). However, the use of agro-chemicals has been recognised as an important non-point source of surface and subsurface water contamination (Lal et al., 1998). Nutrients and pesticides residues carried away by eroded sediments and water

*Corresponding author email: sukristiyonubowo@yahoo.com
Tel: +6281226277259

run-off does not only reduce fertility of soil, but also degrade surface water qualities (Sukristiyonubowo, 2008; Sukristiyonubowo et al., 2003).

It is coming to realize that combination between high external input and high yielding variety is not sustainable in the long term. In many rice growing centres are showing a levelling-off, even a decline or loss in productivity. Many farmers are in fact failing to achieve a high level of production leading to sustain a profitable agriculture. Furthermore, most farmers felt that it is difficult to plough their soil and pest and diseases attack. Consequently, more production cost is spent to manage their soil and crop.

Driven by improving customers concern with good food quality and safety, increasing demand for organic products as well as increasing awareness to protect land resources, many farmer groups in the rice producing areas have converted to organic rice farming. Furthermore, improving healthier and tastier rice product, fast growing urban market for rice organic products, and the prospect of higher prices are also considered as the driving force in converting from the conventional to organic farming system.

By definition, the term organic agriculture refers to a process that uses methods respectful of the environment, from production stages through the handling and processing. Thus, it is not merely concerned with a product, but the whole system used to produce and deliver the product to the ultimate consumers (Anonymous, 2004). Consequently, organic farming systems avoid applications of chemical fertilisers and pesticides, rely on organic inputs and recycling for nutrient supply, and emphasize cropping system design and biological processes for pest management (Rigby and Cáceres, 2001). They may thus reduce some negative effects attributed to conventional farming (Oehl *et al.,* 2004; Mäder *et al.,* 2002; Reganold *et al.,* 1987). In some countries, research in organic farming system have been developed both in plot and farm scales with different purposes. (Chino et al., 1987) found that asparagine's content of plant phloem sap is significantly lower under organic cultivation. (Kajimura et al., 1995) reported that the low densities of BPH (Brown Plant Hopper) and White backed Plant hopper was observed in organically farmed fields. Similar finding was reported by (Alice *et al.,* 2004). Related to the milling and cooking quality of rice, (Prakhas et al., 2002) noted that rice planted in organic system significantly has better milling and cooking quality like total and head milled rice recovery, protein content, kernel elongation and lower in amylose content than cultivated with commercials fertilizers. Furthermore, (Zhang and Shao, 1999) reported that higher protein grains content will result in higher head rice recovery and lower amylose content. In line with soil aspects, So far, organic farming is usually associated with a significant higher level of biological activities and soil organic matter (Oehl et al. 2004; Mader et al*.,* 2002; Hansen *et al*., 2001; Stolze et al., 2000). In fact, there are still limited studies in comparing organic and conventional systems (Hasegawa et al., 2005).

In Indonesia, particularly in Sragen District, organic agriculture has been introduced since 1999, when program of Go Organic *2010* was lunched by the government. It was promoted by the District office through the Extension Agency (the local named BAPELUH). The aims were to improve rice quality, improve farmer income, and to bring in the Sragen District both in the national and international level. This paper talks about the biophysical and socio-economic reasons of changing from conventional rice to semi organic and fully organic rice farming system in Sambirejo sub district, the Sragen District.

METHODOLOGY

Participatory Rural Appraisal (PRA) was conducted in the Sragen District, one of the rice growing areas in Central Java Province, in October 2008. It was carried out in three rice producing areas, namely the Kedawung, Gondang, and Sambirejo sub districts. These sites represent conventional, low external input management also called semi organic, and fully organic rice farming systems, respectively. In addition, they were selected because their average rice yields were always higher than the average yield of the Sragen District (Figure 1).

Some methods of PRA were mainly applied to collect data. However, direct interview in the fields (without questioner) and visit to the individual farmer house were also applied to get specific information related with their cultural practices being done, the history of land use, and socioeconomic data. Data were classified into biophysical and socio-economic aspects. Biophysical parameters included historical of land use, cultural practices, and rice production. The socio-economic data covered the perception of the farmers to the organic rice farming system, including social perception, cultural practices, marketing, production cost as well the rice selling price.

Techniques of PRA like historical land use; time trend, ranking and scoring, and Venn diagram were practiced. Historical land use was applied to collect data related with the development of land use in their village and cultural practices. Time trend was mainly focused to figure out the development of rice production for the long period.

In the low external input and fully organic rice farming, the data were gathered after their regular meeting organised every 35 days (in local named "*Selapanan"* meeting). Field visits were also carried out to see rice growth performance and take soil samples. In the conventional system, gathering data on agronomic and economic aspects to evaluate benefit-cost ration (B/C) were done by interviewing the farmers in the field

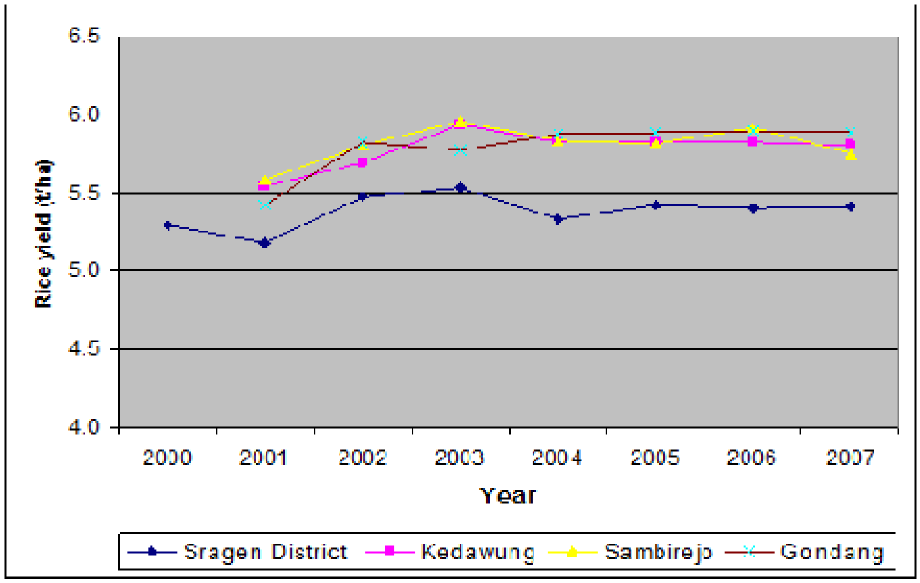

Figure 1. Average rice yield in three centers producing rice in the Sragen District, from 2000 to 2007 (Source: Sragen in figure 2000-2007)

and or in their house, since most of them were in the field for harvesting or land ploughing. The B/C ratio is calculated according to the formula below (Kadariah, 1998; Suriadikarta *et al.,* 2004)**:**

$$\textbf{B/C ratio} = \frac{\textbf{Benefit}}{\textbf{Production Cost}}$$

Production cost is sum of the labour cost and agricultural input cost, while benefit is the difference between the revenue and the production cost. When the B/C ratio is equal or higher than one, the rice farming system is efficient and gives more benefit. In contrast, when the B/C is lower than one, the system being done is not efficient.

Three rice farming systems, conventional, low external input management (semi organic) and fully organic rice systems were mainly distinguished according to the water sources, the fertilisers and pesticides being used. In the conventional system, the farmers applied mineral fertilisers, commercial pesticides, and the source of water originates from the irrigation water. In the low external input management or semi organic rice system only less nitrogen fertiliser (about 50 kg urea ha^{-1}), more organic fertiliser and bio pesticides are applied. In addition, the water source comes from spring water or deep well depending upon the topography of the land. The idea of semi organic rice farming system was just to make the product free from chemical input, commercial pesticides and less inorganic fertilisers. Fully organic rice farming system means the system completely free from inorganic fertilisers and commercial pesticides and the water source is fully from spring water. Thus, it was free from chemical product, the crop nutrients input and materials for pesticides must be coming from organically sources as well the water must be free from pollution.

To complete the biophysical data, soil samples were also taken in three rice farming systems including conventional, low external input, and fully organic rice farming. Composite samples of topsoil, 0-20 cm layers, were taken in October 2008 and August 2010, before land preparation. These samples were submitted to the Analytical Laboratory of the Indonesian Soil Research Institute at Laladon Bogor to determine chemical properties and texture of the soils. Soil chemical analyses included the measurement of pH (H_20 and KCl), organic matter (organic carbon and total nitrogen), phosphorus, potassium, base saturation and cation exchange capacity (CEC) as well as iron (Fe) and manganese (Mn) contents. Organic matter was determined using the Walkley and Black method, pH (H_2O and KCl) was measured in a 1:5 soil-water suspension using a glass electrode method, total P and available P were measured colorimetrically using HCl 25% and Olsen methods, respectively. The total potassium (K) was extracted using Chloride Acid 25 % (HCl 25%) and subsequently determined by flame-spectrometry (Indonesian Soil Research Institute, 2009).

Farmer group named Sri Makmur was representing group of fully organic rice farming located in Sambirejo and Sri Rejeki farmer group speak for low external input management or semi organic. Some farmers from

Gondang and Kedawung sites were interviewed and visited for conventional rice farming system. However, the discussion was focusing on fully and semi organic, while for conventional system was just emphasized on an economic analysis.

RESULTS AND DISCUSSION

History of Land Use and Cultural Practices

The farmers mentioned that rice fields, locally known as *sawah*, in their villages even in the district level have been taking place since long time ago. They do believe that wetland rice system has been the way to produce rice before Dutch colonization. The oldest farmer, 85 years old, stated that when he was in the childhood his parents have already been familiar with the rice farming. Furthermore, the farmers were also no doubt to say that before wetland rice system the land use was forest, although they could not distinguish whether the primary or the secondary forest. Being protected forest and many agro-forestry (*Karang kitri* or *taloon* in the local name) surrounding their village proved that forests were in their village. This opinion was supported by many scientists. According to (Bene et al., 1977; Lal, 1985) about one-third of the land surface of our planet is forested and more than half of these forests are in tropics.

From the beginning of working for wetland rice to 1973, called the first organic rice farming, they used to cultivate local rice verities, such as Bengawan, Raja Lele and Pandan Wangi, with only added organic fertilisers. No synthetic fertilisers and commercial pesticides were applied. The crop rotation was rice-rice meaning only two times planting rice per year. Green manure called "*aram-aram*" and cattle manure were used to be given in their lands. The "*aram-aram"* mainly originated from the leaves of both legumes shrubs and legumes tress grown surrounding the village, farm road and dykes. Thus, these communities have basically already been familiar with the organic system. With planting local varieties, pest and diseases attacks were less, even sometimes free from pest and diseases. When the pest and diseases attacked, they applied bio pesticides made of wild plant and species. This was combined with "*Suwuk"* and followed by village cleaning ceremony (locally known as "*upacara bersih deso*"). *"Suwuk"* is an indigenous knowledge or a local wisdom to protect the fields free from pest and diseases. *Suwuk* is only done by selected farmer via communicating with the most powerful thing (*God almighty*) and the pest being attacked, not to hit and not to damage the rice being planted. Principally, the selected farmer conducts directly in the fields with the "*sesaji*", not kill the pest, and just drive out the pest and disease. In a certain condition, this way is still applied mainly in low external input and fully organic rice systems. Currently, they sprayed organic pesticide made of the leave of wild plants for example *Titonia diversicola* combined with tobacco and "*rempah-rempah"* (spices). Organically sources for producing fertilisers and pesticides could easily be found in their surrounding fields or village.

During that period, the rice production varied from 1 to 2 tons ha^{-1} as genetically the potential yield of local varieties was also low. Although the rice yield was considered low, the farmers were felling favourable since no or merely little money was spent to manage rice fields. Other reasons were also mentioned (1) the soil was easy to be ploughed, (2) *aram-aram* and cattle manure were only applied once during land ploughing, (3) fewer agricultural practices were done, only weeding was carried out, and (4) the yield was also enough to support their carbohydrates demand, as they never faced famine. They did not only eat rice, but tuber crops like cassava, sweet potato and taro as well. Sometimes, they used to eat banana. All the crops were cultivated in the garden in the system of '*karang kitri*' (traditional agro forestry).

In 1973 the cultural practices drastically changed, when the high yielding rice varieties were introduced. Year 1973 was recognized as the starting time in changing to the conventional system (Green Revolution Technology). Variety of IR-27 was the first high yielding variety (HYV) planted in these villages. The mineral fertilisers and commercial pesticides were provided by the government through the credit scheme under the BIMAS program. All farmers had to take part in this program since the aims were to increase national rice production, to increase farmer income and to elevate prosperity. Consequently, during the period of conventional system, from1973 to 1999, high mineral fertiliser application rates have been adapted to the rice fields and the rice yields were tremendously enhanced by year. Nationally, it is noticed that in 1985 Indonesia achieved self-sufficient in rice. It can be said that the average yield increase varied from 25 to 100 %.

About 300 kg urea, 100 kg TSP and 100 kg KCl ha^{-1} season^{-1} (or the ratio was 3:1:1 for urea, TSP and KCl, respectively) were broadcasted to the field with the highest rice yield reached about 6 to 8 tons ha^{-1} depending on the variety being cultivated. However, the farmers were feeling not so delighted, with following reasons (i) they started borrowing the money from the government, (ii) had to purchase agricultural inputs every planting season, (iii) their land became hard to be ploughed, (iv) more time was allocated to manage their fields, (v) in fact not much profit was obtained as selling price standard was given by the government and considered low, and (vi) loss contact with the nature. Furthermore, for the land preparation, they did spend more time and budget to make the puddle structure. Considering that every activity for managing the rice field had to be paid with money and feeling that "*gotong royong*" (communal work) was no longer exist, therefore, introducing organic rice farming was easily accepted.

Table 1. Farmer groups in Sambirejo Sub District participating in semi and fully organic rice farming system

No	Farmer Group	Number of member	Rice farming system
1.	Sri Makmur	62	Fully organic
2.	Gemah Ripah	30	Semi organic
3.	Sri Rejeki	36	Semi organic
4.	Margo Rukun I	30	Semi organic
5.	Margo Rukun II	20	Semi organic

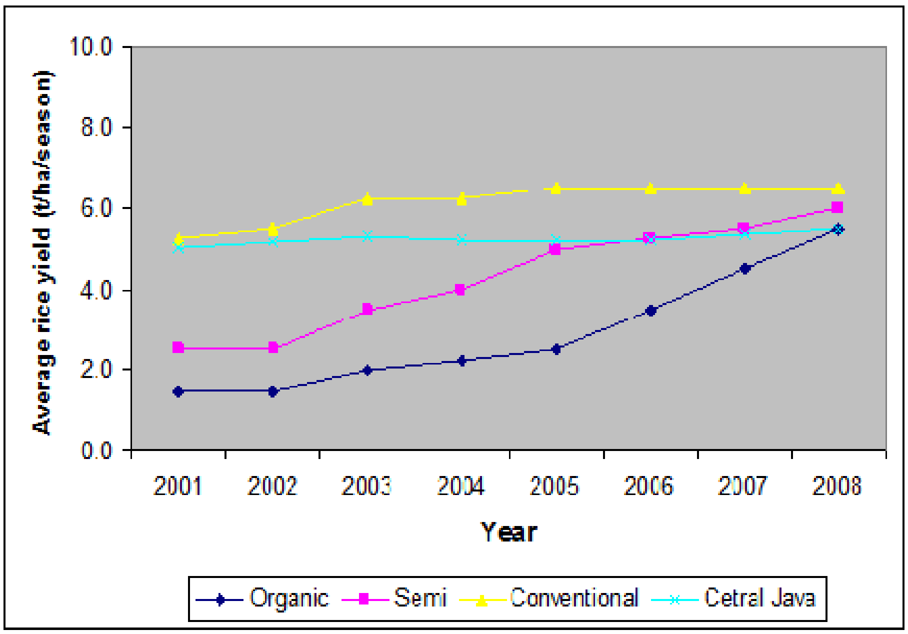

Figure 2. Average rice yield trend of three differences rice farming system in Sambirejo sub district (representing fully and semi organic rice farming system), Gondang and Dawung (for conventional system), the Sragen district compared to The Central Java Province (Where the Sragen District were administratively belong to)

Hence, it can also be said that curiosity in organic rice farming system is growing well, as there are evident degradation of land resources taken place in conventional rice farming system. During the conventional rice farming system, from 1973 to 1999, many high rice yielding varieties have already been cultivated for example IR-27, IR 36, IR 42, IR 64 and *Mentik Wangi*. The last two varieties are continuously farmed for the organic rice system.

In 2000, in Sukorejo Village, Sambirejo Sub District the farmers converted to the semi and fully organic rice farming system. It was encouraged by the district leader through the Extension Agency at the district level. The farmers were enthusiastic to take part in the regular meeting and to be guided by the leader of farmer and extension worker. Up to now, there are five farmers' groups in the Sambirejo Sub District as presented in Table 1.

The amount of compost added varies from 2 to 3 tons ha^{-1} $season^{-1}$ and the highest rate is always given to the dry season. However, during the three years doing organic farming, they used to apply compost up to 7 tons ha^{-1} $season^{-1}$ with the average yield of about 1.5 tons ha^{-1} $season^{-1}$. Furthermore, after the third year yield improvement was taken place in some farmers. So far, the trend of the rice yield can be illustrated as in Figure 2.

It is also interesting to note that the decomposer to foster composting was produced by the farmers. It was made from 10 litres rice washed water (in local called '*leri*'), one corm of banana tree, one kg sugar or "*tetes*" (the liquids coming out from pressed sugar cane) and rotten fruits usually jack fruit, pine apples or mango. All

Table 2. Soil chemical and physical propertis of conventional, low external input and fully organic rice farming in three sub district of Sragen Districts (Soil were sampled in 2008 and 2010)

Soil Parameters	Conventional		Low external input		Fully Organic	
	2008	2010	2008	2010	2008	2010
pH (H2O)	5.80	5.67	5.68	6.07	5.63	5.76
pH (KCl)	5.27	4.89	4.23	5.67	4.93	4.45
Organic Matter						
C (%)	1.21	1.17	1.52	1.67	1.58	2.29
N (%)	0.11	0.07	0.10	0.14	0.13	0.18
HCl 25 %						
P (ppm P_2O_5)	1605	836	1602	695	1640	1721
K (ppm K_2O)	79	17	27	110	68	100
P Bray I (ppm P_2O_5)	289	-	11	-	158	-
P Olsen (ppm P_2O_5)	-	105	-	31	-	82
Texture	clay	clay	silty clay	silty clay loam	silty clay	silty clay loam

materials were put together in the 25 litres plastic drum, afterward it was tightly covered, then, it allowed for one or two weeks. With this local decomposer, the process of composting took place about 21 to 30 days. The main materials for making compost were rice straw, cattle dung and sometimes added with banana steam.

When the question of will the farmers move to fully organic rice farming addressed to the group of semi organic, the main responses came up during the discussion was they will not. The reasons were the demand of semi organic products; the selling price and the income were higher than their expectations. In addition, semi organic still gives promise to conserve the land, to produce healthy food, and to get a better life.

Crop Rotation and Rice Yield

The crop rotation in the conventional, low external input and fully organic rice farming systems is rice-rice-rice with two rice varieties namely IR-64 and Mentik Wangi were cultivated. In fully organic rice farming system, these varieties are simultaneously grown in every cropping season to fulfil their own and market demands. It was also mentioned that the areas planted for Mentik Wangi was wider than for IR 64. This is due to Mentik Wangi was for sale and the price was higher than IR-64 variety. The qualified seeds for next planting were coming and selecting from their harvest.

The first cropping period was started in the rainy season, the second was in the end of wet season and the last cropping was in the dry season. The planting time of the rainy season is usually started from November to December, the second planting time from March to April, and for the dry period is between July and August. The planting time is arranged in different time to continuously supply the local and national market, like the producer of baby foods, and sometimes the international demand.

In the beginning of doing semi and fully organic rice farming, the first season (wet season) yielded of about 1-2 tons ha^{-1}, the second season 1.5 to 2.0 tons ha^{-1} and in the dry season reached 2.5 tons ha^{-1}. Since they have already been familiar with the organic rice farming before, lower rice yields during the first three years doing organic farming did not make the farmers panic and quit from the system. Furthermore, given support from the local government (a guarantee that the products were bought by the local government with the selling price of rice grains was 1000 to 2000 IDR higher than the price of conventional system) and the farmer group' leader, they kept on practicing organic rice farming systems. After three years, the rice yield continuously enhanced about 25 – 30 % as illustrated in Figure 2. In farmers opinion, the reasons were closely related with the improvement of the soil fertility (biological, physical and chemical), besides less pest and disease attacked. Increasing soil fertility may result from enhancing microorganism activities due to better soil environmental system. To prove this opinion the soil were sampled in 2008 and 2010 and the results of soil analysis are given in Table 2.

Application of organic fertiliser of about 3 tons ha^{-1} $season^{-1}$ both in low external input (semi organic) and fully organic improved soil chemical and physical properties, especially improved pH, C-organic and total nitrogen content in the soil. While for texture, it became lighter as the farmers' feel. Whereas, in the conventional the pH become more acid showed by reducing value from 5.80 to 5.67 due to the acidic effect of using intensive mineral fertilisers and less or no recycling organic matter or straw. So far, the available major nutrient also reduced, it may be due to 1) the amount of

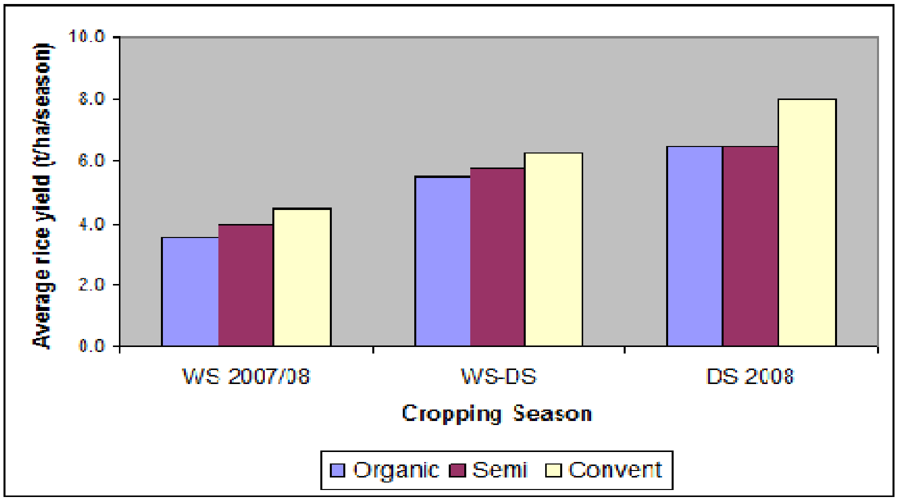

Figure 3. The average rice in three differences rice farming system in Sambirejo (representing fully and semi organic farming), Gondang and Dawung (representing conventional system) sub district, the Sragen District. Data were gathered in 2008 with the PRA method and interviewed

mineral fertiliser added was beyond the recommended rate and 2) the soil organic matter reduced.

Compared to the conventional rice system, in the beginning of doing the semi and fully organic rice system the rice yield were lower about 3 – 4 tons ha^{-1} $season^{-1}$. However, after eight years the rice productions were relatively comparable with the conventional system (see Figure 2). Tremendous increase of rice yield starting in year 2006 may be also due to application of '*growth regulator*' produced by the farmers, besides regular application of organic fertilizers/compost. Growth regulator was made of 10 eggs, 5 tea spoons honey, 1 can milk and 1 kg sugar. It is weekly applied from heading stage to milky stage.

Looking at the yield by season, in all systems the rice yield tended to increase and the highest rice grain yield was achieved in the dry season (Figure 3).

Compared to the organic rice farming period before 1973 and after 2000, it can be concluded that the recent organic rice farming mainly apply compost (sometimes combined with liquid organic fertilizer made by the farmers) and grow high yielding rice varieties, while the period before 1973 used to apply '*aram-aram*' (green manure) and cultivate local variety. These made big different in planting intensity, in period before 1973 only two times planting leading to rice production.

Biophysical and Socioeconomic Reasons Change to Semi and Fully Organic Rice Farming

The main topic to be discussed during the PRA was why the farmers like to convert from conventional to organic rice farming (semi organic and fully organic rice farming system)? By using scoring and ranking method the answers could be summarized in term of soil (physical and chemical properties), yield quality (taste, cooking quality and physical rice performance), economical and practical agronomic aspects as presented in Table 3 and 4.

The reason of increasing chemical soil properties was the most important benefit obtained from changing to fully organic rice faming with the total score of 48 (38 %) followed by improving physical soil fertility with total score of 27 (21 %). The farmers do believe that improving soil fertility is a form of natural investment for their rice sustainability since they think also that better soil will result in better income and life. It is also interesting to note that although the selling price and their income increased by year, the farmers did not put them into the most benefit gained from changing to fully organic rice system. The farmers do believe improving soil fertility will produce better rice yield, in term of quantity and quality of yield. Finally, it makes a good selling price leading to income. Therefore, the farmers preferred not to put them into the first rank, but it was placed into third rank with only supported by 19% of the members. Their long experiences in doing organic rice farming, since the farmers were younger up to 1973 as well from 2000 up to now, have also made them sensitive in differentiated the quality, especially in taste and cooking quality. In addition, with the organic farming less broken rice is produced.

Similar reasons were also mentioned by the group of semi organic rice farming system. However, only the rank and score given by the participants were different as presented in Table 5. In this group, improving selling

Table 3. The reasons, scoring and ranking of converting from conventional to fully organic rice farming system represented by *Sri Makmur* Farmer Group in Sambirejo sub district, the Sragen District

No	Reasons	Rank	Score
1	The soil chemical fertility is getting improved	I	48 (38%)
2	Physically, their plowing layer is getting thicker and easier to be plowed	II	27 (21%)
3	The selling price and income is getting better	III	24 (19%)
4	Less pest and disease attack	IV	15 (12%)
5	The rice yield is more healthier and in term of quality is better	V	13 (10%)

Note: score from 1 (for the lowest score) to 5 (for the highest score Rank from I (is the best) to V (the lowest)

Table 4. The reasons, scoring and ranking of converting from conventional to semi organic rice farming system represented by *Sri Rejeki* farmer group in the Sambirejo sub district, the Sragen District.

No	Reasons	Rank	Score
1	The selling price and income is getting better	I	46 (26 %)
2	The chemical soil fertility is getting improved	II	44 (25 %)
3	Physically, their plowing layer is getting thicker and easier to be plowed	III	34 (19 %)
4	The rice yield is more healthier, free from commercial pesticides and in term of quality is better	IV	32 (18 %)
5	Less pest and disease attack	V	20 (12 %)

Note: Score from 1 (for the lowest score) to 5 (for the highest score) Rank from I (is the best) to V (the lowest)

price leading to better income was the most important aspect in converting to the semi organic rice system. It was given score 46, meaning that 26 % of the members mentioned improving selling price leading to better income was the most benefit got from semi organic.

Simple Economic Analysis

Average data of the Dry Season 2008 including the average rice yield and labour cost collected during PRA and interviewed were used for constructing economic analyses. Two simple economic analyses were made namely (a) when the family labours were not considered as the production cost (presented in Table 5) and (b) when they considered as production cost (presented in Table 6). Some assumptions were considered including:

- The common labour cost of Rp 20.000 IDR day^{-1} was considered.
- The agricultural input originating from their belonging was not considered as the production cost, for example seed, compost and bio pesticides.
- Growth regulator was considered as the expenses as the eggs, milk, and honey were bought from the shop.
- Expense for producing bio pesticides of about Rp 90.000 IDR year^{-1} was considered covering for buying tobacco and spices.
- The selling prices for every farmer in the same group were considered the same, since they were selling to the same rice stocker, except for the conventional system. It was sold by '*tebasan*' system to rice trader. That the reason why in the conventional farming system did not pay for the harvest labour.
- The highest rice selling prices of semi organic and fully organic rice were applied. The price for the semi organic product was Rp 2.500 IDR kg^{-1}, and for fully organic system was Rp 2.800 IDR kg^{-1}.
- To simplify the calculation, the analysis was done for the hectare basis.
- The price of synthetic fertilisers and commercial pesticides were the marketplace price. The price of Urea was Rp 2000 IDR kg^{-1}, SP-36 Rp 4000 IDR kg^{-1}, KCl 12.000 IDR kg^{-1}, respectively. While for pesticides were Rp 50.000 IDR can^{-1}.
- The revenue was mainly calculated from the rice grain yield. The *bekatul*: a powder originated from the skin of rice grain was not considered, although in term of price, it is more expensive than the rice ('*beras*')
- 1 US dollar equal to Rp 9.000 IDR.

In general, the analysis showed that in term of labour cost, the conventional system spent the biggest expenses, particularly for land preparation. About 1,200,000 IDR was allocated for it, about 1.5 to 2.0 times higher than in the semi and fully organic system (Table 5 and 6). The reason may relate with the soil, which was hard to be ploughed in the conventional system. Hence, this data also proved that in the low external input farming system and fully organic rice farming, the soil is

Table 5. Simple economic analysis for three differences rice farming system including conventional, semi and fully organic rice farming in the Sragen District, Indonesia for the dry season 2008 (in IDR) when the family labours were not considered as the production cost

No.	Parameters	Conventional	Semi organic	Fully Organic
1.	**Production Cost**			
	✣ Labor cost:	4,700,000	2,540,000	2,340,000
	➢ Land preparation	1,200,000	800,000	600,000
	➢ Planting	800,000	600,000	600,000
	➢ Fertilization	200,000	-	-
	➢ Weeding	800,000	600,000	600,000
	➢ Pest and diseases control	200,000	40,000	40,000
	➢ Watering	1,500,000	-	-
	➢ Harvest	-	500,000	500,000
	✣ Agricultural input cost:	2,300,000	160,000	60,000
	➢ Mineral fertilizers	2,200,000	100,000	-
	➢ Organic fertilizer	-	-	-
	➢ Commercial Pesticides	100,000	-	-
	➢ Bio pesticides			
	➢ 'Scorr'	-	30,000	30,000
		-	30,000	30,000
	Total Cost	7,000,000	2,700,000	2,400,000
2.	Revenue	15,000,000	15,000,000	16,800,000
3.	Benefit	8,000,000	12,300,000	14,400,000
4.	B/C ratio	1.13	4.55	6.00

Note: The labor cost for fertilization in the semi and fully organic systems was included in Land preparation.

Table 6. Simple economic analysis for three different rice farming systems including conventional, semi and fully organic rice farming in the Sragen District, Indonesia for the dry season 2008 (in IDR) when the family labours were considered as the production cost

No.	Parameters	Conventional	Semi organic	Fully Organic
1.	**Production Cost**			
	✣ Labor cost	5,000,000	3,330,000	3,240,000
	➢ Land preparation	1,200,000	800,000	700,000
	➢ Planting	800,000	800,000	800,000
	➢ Fertilization	300,000	-	-
	➢ Weeding	900,000	800,000	800,000
	➢ Pest and diseases control	300,000	200,000	140,000
	➢ Watering	1,500,000	-	-
	➢ Harvest	-	700,000	800,000
	✣ Agricultural input cost	2,300,000	160,000	60,000
	➢ Mineral fertilizers	2,200,000	100,000	-
	➢ Organic fertilizer	-	-	-
	➢ Commercial Pesticides	100,000	-	-
	➢ Bio pesticides			
	➢ 'Scorr'	-	30,000	30,000
		-	30,000	30,000
	Total Cost	7,300,000	3,460,000	3,300,000
2.	Revenue	15,000,000	15,000,000	16,800,000
3.	Benefit	7,700,000	11,540,000	13,500,000
4.	B/C ratio	1.05	3.34	4.09

Note: The labor cost for fertilization in the semi and fully organic systems was included in Land preparation.

easier to be ploughed as mentioned by the farmers (see table 2, 3 and 4). It was lucky that in the conventional system there was no budget spent for the harvest labour as the rice was sold by '*tebasan*' system. The buyer came to field, bargained the price, and when they agreed on it, the buyer harvested the rice.

In the aspect of agricultural input cost, the data also showed that the budget to purchase the mineral fertiliser, such as urea, SP-36 and KCl were the highest (about 43 % of total cost). In addition, recently it is not easy to get the fertilizers and many false fertilisers bringing about the prices were getting increase. In contrast, there was no money spent for buying fertilisers in the fully organic rice farming. Only less money, about 100.000 IDR, was allocated to buy urea in the semi organic rice system. Therefore, the total cost (sum of labour cost and agricultural input cost) in the conventional system was also higher than in the semi and fully organic rice farming.

From the point of revenue, the fully organic rice system gave the biggest income although in term of yield quantity the conventional rice system indicated the highest yield, about 8 tons ha^{-1} $season^{-1}$ (see Figure 3). Consequently, the fully organic rice farming system provided the highest benefit, followed by the semi organic and conventional systems. The benefits were 14,400,000 IDR (equal to 1600 USD), 12,300,000 IDR (1367 USD) and 8,000,000 IDR (889 USD) for fully organic rice, semi organic and conventional rice farming system, respectively. Looking at the B/C ratio values, all rice farming systems were higher than one, meaning that rice farming gave an efficiency leading to more profit.

Social Perceptions

From the Diagram Venn drawn by farmers, it can be said that the relationship among farmers was very close. Furthermore, the relationships among farmers with the local government and extension workers were also very near. The farmers stated that their traditional farming system, indigenous knowledge system (making decomposer with local microorganism for composting) and local wisdom have been ignored and disregarded for a long time, from 1973 to 1999 when they applied green revolution technology, was accepted. In addition, most of the farmers also mentioned that social spirit and values are never seen. Therefore, return to the organic rice farming indeed is highly appreciated. Communal work such as *gotong royong* for *bersih desa* (to make village clean from problems) and making compost, which were no longer exists, step by step are applied, as well as *gotong royong* for helping in a certain cultural practices and in managing rice field. The farmers also mentioned that selling the product was easy and the price also considered high.

CONCLUSION

Improving soil fertility, better selling price and income, better and healthier rice quality and less pest and diseases attack were the most benefits got from the conversion to semi and fully organic rice farming system. Among these reasons, improving both chemical and physical soil fertility were the most advantage and put in the first and second rank for the fully organic rice farming group, while better income and improving soil fertility were for the group of semi organic rice farming. In these sites rice fields have been existing since long time ago and they becomes the way to produce rice. Up to 1973, the farmers used to farm organic rice system, to cultivate local varieties and to apply green manure. The yields were considered low, varying from one to two tons ha^{-1}. From 1973 to 1999, they have been doing conventional system (green revolution technology) applying high mineral fertilizers and planting high yielding varieties. The average yield varied between 5 and 7 tons ha^{-1} with the highest yield reached about 8 tons ha^{-1}. Since 2000 the farmers in the Sambirejo sub District have been working for the semi and fully organic rice farming. These systems gave benefits about 12,300,000 IDR (1367 USD) ha^{-1} $season^{-1}$ and 14,400,000 IDR (1600 USD) ha^{-1} $season^{-1}$, with the B/C ratio was 4.5 and 6.0 for the semi and fully organic rice farming, respectively. Socially, these systems are highly accepted encouraging the social spirit, values and indigenous knowledge, like communal work, village clearness, and composting.

REFERENCES

Adiningsih J (1992). Peranan efisiensi penggunaan pupuk untuk melestarikan swasembada pangan. Orasi pengukuhan Ahli Peneliti Utama. Badan Litbang Pertanian, Jakarta. 25 p.

Adiningsih J, Moersidi S, Sudjadi M, dan Fagi AM (1989). Evaluasi keperluan fosfat pada lahan sawah intensifikasi di Jawa. *In:* Prosiding Lokakarya Nasional Efisiensi Penggunaan Pupuk. P: 5-10

Anonymous (2004). The promise of organic farming. FFTC News Letter 146.

Alice J, Sujeetha RP, Venugopal MS (2003). Effect of organic farming on management of rice brown plant hopper. IRRN 28 (2): 36-37

Bechstedt Hans Dieter (1997). Training manual on participatory research and technology development for sustainable land management. IBSRAM, Bangkok. 199 p.

Bene JG, Beall HW, Cote A (1977). Trees, food and people: Land management in the tropic. International Development Research Council, Ottawa, Canada. 52 p.

Chino M, Hayashi H, Fukumato T (1987). Composition of rice phloem sap and its fluctuation. Journal of Plant Nutrient. 16: 1651-1661

Cho JY, Han KW, Choi JK, Kim YJ, Yoon KS (2002). N and P losses from paddy field plot in Central Korea. Soil Science and Plant Nutrition. 48: 301-306

Cho JY, Han KW, Choi JK (2000). Balance of nitrogen and phosphorus in a paddy field of central Korea. Soil Science and Plant Nutrition. 46: 343-354

Cooke (1970). Soil fertility problems in cereal growing in temperate zones. In: International Potash Institute (Eds.), Symposium role of fertilisation in the intensification of agricultural production.

Proceedings of the 9th Congress of the International Potash Institute. Antibes. pp. 123-313
Hansen B, Kristensen ES, Grant R, Hogh H, Jensen SE, Simmelsgaard JE, Olesen (2000). Nitrogen leaching from conventional versus organic farming systems- a system modelling approach. European J. Agronomy. 13: 65 – 82.
Hasegawa H, Furukawa Y Kimura SD (2005). On farm assessment of organic amandments effect on nutrient status and nutrient use efficiency of organic rice fields in Northeastern Japan. Agricilture ecosystem and Environtment Journal. 108: 350 -362 Provide page
Kadariah (1988). Evaluasi proyek analisis ekonomi. Edisi ke dua. Universitas Indonesia, Jakarta (*in Indonesian*).
Kajimura T, Fujisaki K, Nagasuji F (1995). Effect of organic rice farming on leafhoppers and plant hoppers and amino acid contents in rice phloem sap and survival rate of plant hoppers. Applied Entomology J. 30: 12 - 22
Lal R (1998). Soil erosion impact on agronomic productivity and environment quality. Critical Reviews in Plant Sciences. 17 (4): 319-464
Lal R (1985). Need for, approach to, and consequences of land clearing and development in the tropics. IBSRAM Proceeding No 3 : 15 – 27
Mäder P, Fliessbach A, Dubois D, Gunst L, Fried P Niggli U (2002). Soil fertility and biodiversity in organic farming. *Science*, 296, 1694-1697.
Oehl F, Sieverding E, Mäder P, Dubois D, Ineichen K, Boller T Wiemken A (2004). Impact of long-term conventional and organic farming on the diversity of arbuscular mycorrhizal fungi. Oecologia 138: 574-583.
Prakhas YS, Bhadoria PBS, Rakshit A (2002). Relative efficacy of organic manure in improving milling and cooking quality of rice. IRRN. 27 (1): 43 - 44
Prawirasumantri J, Sofyan A, Sudjadi M (1983). Pembandingan efisiensi tiga pupuk nitrogen untuk padi sawah IR-36 pada tanah Grumusol dan Regosol. Pemberitaan Penelitian Tanah dan Pupuk 2: 35-38
Reganold JP, Elliott LF, Unger YL (1987). Long-term effects of organic and conventional farming on soil erosion. Nature 330: 370-372.
Rerkasem B (2005). Transforming subsistence cropping in Asia. *Plant Production Science* 8: 275-287.
Rigby D, Cáceres D (2001). Organic farming and the sustainability of agricultural systems. *Agricultural Systems* 68: 21-40.
Soil Research Institute (2009). Analisis kimia tanah, tanaman, air dan pupuk (*Procedure to measure soil, plant, water and fertilisers*). Soil Research Institute, Bogor. 234 p. (in Indonesian)
Stolze M, Piorr A, Harring A, Dabbert S (2002). The environmental impact of organic farming in Europe. Organic farming in Europe: Economics and Policy. Vol 6. University of Hohenheim, Germany.
Sukristiyonubowo, Tuherkih E (2009). Rice production in terraced paddy field systems. Jurnal Penelitian Pertanian Tanaman Pangan. 28(3): 139-147
Sukristiyonubowo (2007). Nutrient balances in terraced paddy fields under traditional irrigation in Indonesia. PhD thesis. Faculty of Bioscience Engineering, Ghent University, Ghent, Belgium. 184 p.
Sukristiyonubowo RL, Watung T, Vadari, Agus F (2003). Nutrient loss and the on-site cost of soil erosion under different land use systems. In: Maglinao, A.R, Valentin, C., and Penning de Vries, F.W.T. (Eds.), From soil research to land and water management: Harmonizing People and Nature. Proceedings of the IWMI-ADB Project Annual Meeting and 7th MSEC Assembly. pp. 151-164
Soepartini M (1995). Status kalium tanah sawah dan tanggap padi terhadap pemupukan KCl di Jawa Barat. Pemberitaan Penelitian Tanah 13: 27-40 (in Indonesia)
Suriadikarta, Didi Ardi, Setyorini D, dan hartatik W (2004). Uji mutu dan efektivitas pupuk alternatif anorganik. Balai penelitian Tanah. 41 p.
Uexkull HR von (1970). Role of fertiliser in the intensification of rice cultivation. In: The International Potash Institute (Eds.), Proceedings of the 9th congress of the International Potash Institute. pp. 391-402