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Development of Organic Rice Farming in a Rural Area, Bantul Regency, Yogyakarta Special Region Province, Indonesia

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Organic farming is a system of agricultural practice that utilizes natural materials, such as compost, biofertilizers and natural pesticides as well as locally adapted plant varieties. Organic products are safe for human beings, and organic farming contributes to environmental preservation. In Bantul regency, Indonesia, organic agriculture as an integrated movement began in the 2000s. This study examines the development of organic rice farming in 5 subdistricts of Bantul regency (Bantul, Pandak, Sanden, Piyungan and Banguntapan). The observations and data analysis showed that although the productivity of organic rice is increasing year by year in these subdistricts, the area of fields under organic cultivation and the yields of organic rice have remained low because of problems arising from farmers, extension workers, markets and local government. In order to further develop organic rice farming, it is recommended that the capacity of farmers be enhanced through field schools on organic rice farming, education and training for extension workers, increased guidance for farmers on exactly how much compost to add to soil as natural pesticides, and establishment of networks between local government and non-governmental organizations on both the technical and non-technical sides.

Key words: Extension, Field school, Organic farming, Rice, Rural area

1. Introduction

1.1 Background

The International Federation of Organic Agriculture Movements (IFOAM) defines organic agriculture as "... a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity, and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved" (IFOAM, 2008). Organic farming is one of several approaches to meet the objectives of sustainable agriculture (Narayanan, 2005). Many techniques used in organic farming, such as intercropping, mulching, and integration of crops and livestock, are not alien to various agriculture systems including traditional agriculture practiced in the past.

The Green Revolution was judged a technology that would save human beings from famine in Indonesia, the Green Revolution contributed to greatly increasing national rice production from 8 million tonnes in 1963 to 32 million tonnes in 2004 (Sumarno, 2006). From 1969 to 1988, rice production increased by an average of 4.5% per year (Antara, 2000). This success was brought about by a policy that focused on using high-yielding varieties and chemical fertilizers, together with improvement of irrigation channels. However, rice production was not stable and from 1994 rice imports started to increase dramatically (Table 1).

Productivity is related to the organic carbon content of the soil, and an organic carbon content

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Table 1. Production, changes in productivity (%), and import of rice in Indonesia, 1988-2000

Year	Rice Production (×1,000,000 t)	Productivity (%)	Imports (×1000 t)
1988	28.340	+3.98	314.00
1989	29.072	+7.32	427.00
1990	29.365	+1.01	0.00
1991	29.047	−1.09	198.00
1992	31.356	+7.95	634.22
1993	31.318	−0.12	0.00
1994	30.317	−3.19	876.24
1995	32.334	+6.65	3014.20
1996	33.216	+2.76	1090.26
1997	32.015	−3.64	526.63
1998	32.911	+2.80	5782.93
1999	33.714	+2.44	1702.91
2000	32.848	−2.57	2000.00

Source: Antara, 2000

of greater than 2.5% is needed for optimal productivity. According to Karama *et al.* (1990), of 30 randomly sampled paddy fields across Indonesia, 68% or 20 paddy fields had less than 1.5% organic carbon in the soil and only 9% or 3 paddy fields had more than 2%. Based on a soil test in the same areas and the same kinds of soil showed that the content of organic carbon less than 1% (Pramono, 2001). Soil degradation and declining soil productivity is particularly notable in the intensively farmed paddy fields on the island of Java where the carbon content in soil is less than 2% (Hartati and Widowati, 2006). Suriadikarta and Simanungkalit (2006) also indicated that soil degradation and decreased productivity has occurred in most of the intensively cultivated agricultural land in Indonesia.

In response to this decline in productivity, and to address the issues of environmental protection, farmer empowerment, and consumers' increasing awareness of food safety, the Ministry of Agriculture in 2000 launched the "Go-Organic 2010" program. Under this program, Indonesia was expected to become an organic producer (Apriyantono, 2007). The development of organic farming was planned to occur in 6 stages from 2001 to 2010:

1. 2001: focus on social activities
2. 2002: focus on social activities and establishment of regulations
3. 2003: focus on establishment of regulations and technical assistance
4. 2004: focus on technical assistance and certification
5. 2005: focus on certification and market promotion
6. 2006–2010: create industrial conditions and trade (Sulaeman, 2006)

It is estimated that around 41,431 ha or 0.99% of all agricultural land in Indonesia is currently registered as organic, and that 23,608 or 1.02% of the total number of farmers are registered as organic farmers (Anon, 2008).

1.2 Organic Farming in Indonesia

Scientists and farmers commonly apply the term 'organic' to food such as organic vegetables, organic rice, and organic fruit. In addition to food, 'organic medicine' derived from sources with organic characteristics is also well known. Most of the organic agriculture in Indonesia was originally centered on fruits and vegetables. However, production of organic rice has now begun in Malang (East Java), Magelang, Boyolali and Sragen (Central Java), and Bantul (Yogyakarta Special Region). The organic agriculture movement in Indonesia was introduced by a few farmers who considered the organic system of agriculture to be superior, for example Pastor Agatho in Cisarua, West Java who established the "Bina Sarana Sakti" Foundation in 1984. Now, there are many organic farmer organizations joined under the umbrella organization of the Indonesian Organic Farming Network (Jaker PO). The members of Jaker PO currently include more than 25 organizations spread across the islands of Java, Bali, Sumatera, and Nusa Tenggara (Surjadi, 2008). Total sales of organic products have exceeded 200 million US dollars for both horticulture and medicinal herbs (Anon, 2008).

Indonesia has great potential to develop organic farming, but people still do not realize the benefits that can currently be derived from organic farming. Even though the practice of organic farming has been promoted throughout the country, only a few farmers have changed to organic farming. Some activities that use organic materials can increase rice productivity. Sudadi *et al.* (1998) reported that usage of azolla in a dual system of rice cultivation in Surakarta with 150 kg/h urea gave a rice yield of 7.1 t/h, whereas 250 kg/urea produced 5.9 t/h rice. Beside that, the application of organic fertilizer such as "bio-guano-super" increased the yield of rice slightly. After using organic liquid fertilizer "biokom", rice production in Wonogiri regency increased from 6.0 to 8.5 t/ha, while in Karanganyar regency rice production increased from 5.0 to 8.3 t/ha (Widjayanto and Miyauchi, 2001). The practice of organic farming remains limited, although many experiments have been conducted by applying organic materials such as cover crops, green manure and crop residues, and the addition of organic matter and microorganisms (EM4). According to Kariada and Aribowo (2005) treatment with straw rice with decomposer EM4 gave the highest harvest of 7.04 t/ha unhulled dry rice. The results showed that the effects of mulching with rice straw and organic fertilizers on growth and yield of shallot were significantly different, except for 10 to 30 t/ha -1 fertilizer in which the treatment showed no effect on total leafs per hill without mulch. The highest yield of bulb was 7.78 q/ha without mulch and 12.27 q/ha with mulch. The effect of mulching increased the yield 35.13% (Mayun, 2007). The productivity of organic farming is often constrained by factors related to environmental impacts and sustainability, markets and farm productivity (Widjayanto and Miyauchi, 2001), and at first, farmers are generally reluctant to adopt new ideas of organic farming because they believe that chemical agriculture is more productive (Hsieh, 2005).

In 2002, the Ministry of Agriculture made basic arrangements to support organic farming in the Indonesian National Standard for Organic Food Systems (SNI 01-6729-2002). This national standard adopts materials from the Codex Alimentarius Commission's "Guidelines for the production, processing, labeling and marketing of organically produced foods" (CAC/GL 32-1999). The following modifications were made to suit Indonesian conditions (Husnain and Syahbudin, 2005; The Center for Soil Research, 2007):

- land used for organic farming must be free of pollution from both chemical fertilizers and pesticides, where the length of the conversion period to organic status depends on the history of land use, fertilizer and pesticide application, and kinds of plants;
- genetically modified organisms (GMOs) should be avoided, and use of organic seed encouraged;
- use of chemical fertilizers and growth hormones must be avoided, with soil fertility increased by addition of organic fertilizers, plant wastes, and rotation with legumes;
- chemical pesticides must be avoided, with pests and diseases controlled manually, or by use of biopesticides, natural agents, and plant rotation;
- indirect use of plant growth hormones and synthetic additives in livestock feed and organic fertilizers should be avoided; and
- the post-harvest handling and preservation of food substances must use natural methods

After this Standard was launched, differences in the understanding and application of organic farming became apparent among the producers; for example, farmers had previously felt that their product was organic simply because only organic fertilizer had been used with little chemical fertilizer. In order to overcome this phenomenon, the Ministry of Agriculture carried out extensive technical assistance, plot demonstrations, and guidance for organic producers beginning in 2003 (Directorate General of Plantations, 2007).

1.3 The Potential of Organic Agriculture in Indonesia

In the international market, sales of organic products (coffee and herbal plants) have reached 5%–7% of the total sales of agricultural products from Indonesia. The potential of the international market for organic products has opened up for Indonesia, but if organic farming in Indonesia is to develop rapidly, it is necessary to increase the number of people working in the field of organic agriculture. However, to develop organic rice farming, farmers will need assistance in the form of technical guidance and financial credit to enable them to access the materials necessary for organic agriculture and increase their capability in the field (Husnain and Syahbudin, 2005).

The land available for organic agriculture in Indonesia is very large. Of 75.5 million ha of agricultural land, only 25.7 million ha has been used for rice fields (Biro Pusat Statistik, 2000). Organic agriculture demands land that is not polluted by chemicals and that has good accessibility. However, the quality and area of land are important factors when selecting land, and pure land that has never been used generally lacks fertility, whereas fertile land generally has been used intensively with chemical fertilizers and pesticides. Such land needs a long conversion period of approximately 2 years. Very few studies have presented data on organic rice farming and its contribution to rural areas. To fill this gap, studies are required on the current state of organic rice farming in rural areas and the problems faced in this field. Bantul regency in Yogyakarta Special Region province has 15,945 ha of cultivated fields (31% of the total area) and 318,908 farmers (58% of the population). Although Bantul regency has promoted organic farming since 2003 (Banendro, 2006), only a few farmers currently practice organic rice farming and the area under organic cultivation is limited to about 262.2 ha (Statistics Office of Yogyakarta, 2006; IOFC, 2007). The objectives of the present study were to observe the development of organic rice farming in Bantul regency, to identify current problems in organic rice farming, and to formulate an action plan to help future development of organic farming.

2. Methods

2.1 Study Area

Bantul regency is in the southern part of Yogyakarta Special Region (YSR) Province. It is surrounded by Yogyakarta city, Sleman regency, Gunung Kidul regency, Kulonprogo regency and the Indian Ocean (Fig. 1). Bantul regency is the center of agriculture in YSR, producing food and horticultural crops. Bantul regency lies between latitudes 07°44′04″S and 08°00′27″S and longitudes 110°12′34″E and 110°31′08″E, covering an area of 508.85 km² (15.9% of Yogyakarta Special Region). Topographically, lowlands account for 14% of the area, and more than half (60%) consists of infertile mountainous areas. The western part consists mostly of infertile sloping mountainous areas of 89.86 km² (17.7% of the regency). The middle part consists of fertile sloping and lowland areas of 210.94 km² (41.6%). The eastern part, consisting of sloping areas with foothills and precipitous areas of 206.05 km² (40.6%) is more fertile than in the western area. The southern part consists of the intersection between the middle part and the lagoon and sandy shores of the Srandakan, Sanden, and Kretek subdistricts.

According to Suharjo (2003), the area of Bantul has several agro-climatic zones: zone C3 (5–6 months wet and 3–5 months dry), zone D3 (3–4 months wet and 4–6 months dry), and zone D4 (3–4 months wet and >6 months dry). The metereo-

Fig. 1. Yogyakarta Special Region Province.

logical monitoring station in Bantul reported the amounts of rainfall and number of rainy days for 2006 as shown in Table 2. Average temperature ranges from 23℃ to 31℃.

The population of Bantul regency in 2005 was 809,971 distributed over 75 villages and 17 subdistricts (Statitsic Office of Bantul, 2005). Most of the population was in the 15-19 and 20-24 age groups. Based on the data from Statistics Office of Yogyakarta, 23.6% were in youth (0-14 years old), 67.8% in their productive years (15-64 years old), and only 8.5% in old age (65 years old and over). Geographically, the area of Bantul has 7 kinds of soil: 788 ha of Rendzina (1.5%), 1189 ha of Alluvial (2.3%), 7608 ha of Grumusol (15.1%) in the subdistricts of Sedayu, Pajangan, Kasihan, Pandak, Sanden, Bambanglipuro, and Srandakan; 6538 ha of Latosol (12.8%) in the subdistricts of Dlingo, Imogiri, Pundong, Kretek, Piyungan, and Pleret; 1564 ha of Mediteran (3.1%) in the subdistricts of Dlingo and Sedayu; 25,931 ha of Regosol (51.2%) and 7068 ha of Lithosol (14.0%) in the subdistricts of Pajangan, Kasihan, and Pandak. The area of agricultural fields in Bantul accounts for 31% of the total area, i.e. 15,945 ha, the majority of which (14,323 ha) was irrigated.

Until October 2004, the majority of the regency's income (up to 35.5%) was from the agricultural sector. The great contribution of the agricultural sector was possibly related to the area of agricultural land, which is 31% in Bantul regency (Statistics Office of Yogyakarta, 2006). According to the Agriculture and Forestry Office, wetlands covered 16,034 ha of Bantul regency in 2005, whereas dry land areas (including housing compounds, dryland gardens, dykes/ponds/swamps) covered 34,651 ha. In 2005, wetland paddy production in the regency was 149,371 t with an average yield of 5.9 t/ha; upland paddy production or paddy "gogo" was 821 t with an average yield of 4.0 t/ha. Maize production was 21,426 t with an average yield of 4.2 t/ha. Cassava production was 47,357 t with an average yield of 1.67 t/ha. Sweet potato production was 319 t with an average yield of 9.9 t/ha. Peanut production was 1.1 t with an average yield of 0.98 t/ha and soybean production was 5,831 t with an average yield of 1.2 t/ha (Agriculture and Forestry Office of Bantul, 2006).

2.2 Data Collection and Analysis

Data on organic rice farming was collected by interview or questionnaire from August to November in 2007, from farmers in the subdistricts of Sanden, Piyungan, Bantul, Pandak and Banguntapan. These 5 subdistricts were chosen because farmers there have practiced organic rice farming since 2003, and it was considered that organic rice farming was more commonly practiced in those districts than in the other subdistricts. The total number of organic rice farmers surveyed was 150, of which 33 were in Bantul, 30 in Pandak, 30 in Sanden, 28 in Piyungan and 29 in Banguntapan.

Data on the yields of organic rice, the amounts of compost used, the number of organic rice farmers, the number of organic rice farmer groups, and the area of organic rice fields were collected from agricultural extension workers in those subdistricts (Tables 2 and 3). The data from agricultural extension workers were crosschecked with each of the farmers surveyed, and at the same time additional interviews were conducted to determine the ages of the farmers, education levels, use of natural pesticides, use of chemical fertilizers, other activities related to organic rice farming, and problems and

Table 2. Data on organic rice farming in Bantul, Pandak, Sanden, Piyungan and Banguntapan subdistricts from agricultural extension workers

Indicator	Year				
	2003	2004	2005	2006	2007
Number of organic rice farmers	159	197	243	260	285
Area of organic rice fields (ha)	111	133	166	198	209.9
Number of organic rice farmer groups	2	6	8	11	11
Yield of organic rice (t/ha)	2.01	2.51	3.15	2.99	3.86
Usage of compost (t/ha)	3.55	3.13	2.90	3.45	2.67

Table 3. Data on organic rice farms in 5 subdistricts of Bantul regency from agricultural extension workers and the questionnaire

Data	Subdistrict				
	Bantul	Pandak	Sanden	Piyungan	Banguntapan
1. Area of organic rice fields (ha)					
0.25-0.5	9	6	14	0	10
0.51-0.75	6	8	6	8	11
0.76-1	10	12	4	15	2
>1	8	4	5	7	5
2. Amount of compost (t/ha)					
1. <1	1	1	1	3	2
2. 1-2.0	8	7	13	13	14
3. 2.1-3.0	7	11	7	9	8
4. 1-4.0	12	11	6	4	2
5. >4	5	0	2	1	2
3. Number of farmers who still use chemical fertilizers (urea, TSP, KCl)	2	6	5	7	6
4. Farmers who use natural pesticides	31	25	26	25	22
5. Yield of organic rice	0	0	7	4	3
1.0-2.0 (t/ha)	12	12	12	16	15
2.1-3.0 (t/ha)	3	6	1	1	2
3.1-4.0 (t/ha)	18	12	9	9	8
>4 (t/ha)					
6. Age of farmers	5				
1. 20-29	8	3	2	—	1
2. 30-39	9	6	7	6	3
3. 40-49	4	7	8	6	5
4. 50-60	7	6	6	7	6
5. >60		7	7	9	12
7. Experience in farming system					
1. <5 years	5	2	2	—	—
2. 5-10 years	3	2	3	2	1
3. 10-15 years	11	6	6	5	6
4. >15 years	14	20	19	21	22

constraints faced (Tables 2 and 3).

Data on organic farming such as development of organic farming in Yogyakarta special region province, statistic data of Yogyakarta and Bantul, agriculture condition in Bantul, soil character and monthly rainfall average in 2006 were also collected by interview from other sources such as NGOs, the Indonesian Organic Farming Community (IOFC), and the Agriculture and Forestry Office and the Statistics Office of Yogyakarta and Bantul. Additional information was collected from the literature published by related organizations. All data were statistically analyzed by using Excel 2003.

3. Results and Discussion

3.1 Development of Organic Rice Farming

The collected data showed that the development of organic rice farming in the 5 rural subdistricts of Bantul regency was still low (Tables 3 and 4). In order to the amount of compost used was only 2.67 to 3.55 t/ha, and the average yield of organic rice from 2003 to 2007 was only 2.90 t/ha compared to the conventional rice yield of 6.5 t/ha over the same period (Table 4). More precise information on organic rice farming from the questionnaire and the interviews is shown in Table 5.

3.2 Cultivation Techniques and Product Marketing

Much of the organic agriculture in Bantul regency only started after 2003. By 2007, the area of organic rice fields in Bantul had reached 262.2 ha (IOFC, 2007). In some subdistricts of Bantul, both paddy rice and soybeans (both white and black) are farmed organically. In the village of Serut, Bantul subdistrict, only organic paddy fields are cultivated. In addition to organic paddy farming, some farmers in Bantul are cultivating organic upland rice i.e. at Wijirejo and Gilangharjo in Pandak subdistrict, Palbapang, Ringinharjo and Trirenggo in Bantul subdistrict, Sitimulyo in Piyungan subdistrict, Baturetno in Banguntapan subdistrict, and at Sri Gading in Sanden subdistrict. Organic rice farmers received substantial help from the Indonesian Organic Farming Community, an NGO that helps the farmers technically in the field, , certifies the product, and markets the product.

Farmers practicing organic rice farming engaged in many related activities, such as production of compost and making natural pesticides. Unfortunately, these activities were still on a small scale, sometimes on the order of only 1 to 3 t of compost. In addition, farmers often used straw after harvest

Table 4. Conventional rice production in 2003-2006 in Bantul, Pandak, Sanden, Piyungan and Banguntapan subdistrict based on data from agricultural extension workers

Production	Year			
	2003	2004	2005	2006
1. Wetland paddy/ padi sawah				
- Production (ton)	14,164.5	14,625.2	12,739.8	13,785.2
- Average (ton/ha)	6.7	6.9	6.0	6.5
2. Dryland paddy/ padi ladang (gogo)				
- Production (ton)	197.2	217.1	191.5	192.3
- Average (ton/ha)	3.8	4.2	3.8	3.9

Table 5. Education levels of farmers based on the questionnaire

Subdistrict	Number of farmers				
	No school	Primary school	Junior high school	Senior high school	University
Bantul	3	5	8	11	6
Pandak	5	4	9	10	2
Sanden	8	9	6	5	1
Piyungan	9	8	5	7	1
Banguntapan	11	4	5	7	1
Total	36	30	33	40	11
Percentage	24.0	20.0	22.0	26.7	7.3

to add organic material to the soil (Fig. 2). Unfortunately, the amount of straw was less than that harvested, because rice straw was also used as cattle feed. To overcome pests that carry diseases such as Tungro and Sundep, farmers also made natural pesticides from raw materials such as red pepper, jatropha or "jarak", and herbal plants. The farmers themselves made natural pesticides, because they are difficult to find in the market and relatively expensive with a price of 0.1$ per kg.

3.3 Education

Farmers with low levels of education are dominant; 44% had low education levels (no school 24%, primary school 20%), while 22% had finished junior high school, 26.7% had finished senior high school and only 7.3% graduated from a university. Table 6 shows the number of farmers engaging in activities to increase their capabilities by attending farmer field schools on organic farming and routine meetings on organic farming. Out of 150 respondents, 100 farmers (66.7%) attended these activities. Applying analysis of variance to the questionnaire data by using Fisher's protected-least-significant-difference test revealed that education level was not positively and significantly associated with adoption of organic farming practices (Fig. 3).

Fig. 2. Rice straw as additional organic matter.

3.4 Extension Activities

Many organic farmer groups have been founded in Bantul. These include "Langgeng Mulyo", "Lembu Luhur", and "Retno Tani Rukun" in Banguntapan subdistrict; "Ngudi Rahayu" and "Bareng Mukti" in Bambanglipuro subdistrict; "Tani Rejo" and "Tani Makmur" in Pandak subdistrict; "Andini Mukti" in Srandakan subdistrict; "Karya Manunggal" and "Tani Manunggal 1" in Sanden subdistrict; "Sidodadi" and "Harapan" in Bantul subdistrict; "Tani Rejo" in Sedayu subdistrict; and "Ngudi Makmur" in Dlingo subdistrict (IOFC, 2007). The largest of these is "Harapan" in the village of Serut in Bantul subdistrict, comprising a group of 161 families organically farming on 50 hectares of fields. This group succeeded with practices for organic rice with some members producing 7.2 t/ha in 2007.

3.5 Problems in Organic Rice Farming

Development of organic rice farming in rural areas still faces problems arising from farming techniques, organization, marketing and training and experience of agricultural extension workers (Table 7).

3.6 Effect of Compost on Rice Yield

Compost is organic matter such as leaves, straw, grass, rice bran, corn stover, vines, tendrils, and animal waste that is decomposed by microorgan-

Table 6. Activities followed q/haby farmers based on the questionnaire

Activities	Number of farmers
Farmer field school on organic farming	34
Regular meetings on organic farming	49
Regular meetings on organic farming and farmer field school	17
Total	100
Percentage	66.7%

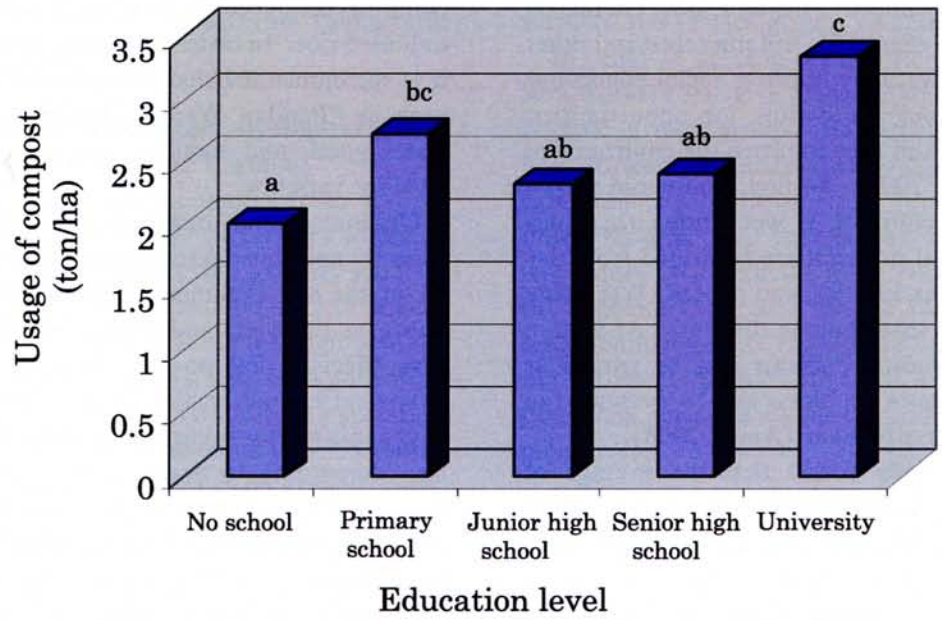

Fig. 3. Education level of farmers and usage of compost.

Table 7. Problems regarding the development of organic rice farming based on the questionnaire

Farming technique	Market	Extension workers	Organization
Inadequate ability to carry out organic farming. Farmers still use chemical fertilizer to get high yields. Lack of awareness in using organic fertilizers and natural pesticides	Market opportunities (80.67% of farmers) because the price of product determined by direct trader who visit them. Organic fertilizers and natural pesticides not yet easily commercially obtained. The price of organic products is still low at the farmer level. Inadequate campaigns for consumers to buy organic products. Market for organic products is not available yet.	Research on organic farming and soil condition is still lacking. Inadequate ability in organic farming technology. Farmer organizations do not yet exist.	Farmer level organizations are still few. There is no network of local government or NGOs to help marketing of organic rice Efforts to establish partnerships between farmers and entrepreneurs were started many years ago, but have not yet given farmers the expected results.

isms and used by farmers to improve soil health and fertility. Generally, compost or organic fertilizers have relatively low levels of macro- and micronutrients; they provide limited nutrients and release available nutrients slowly. However, organic fertilizers have numerous benefits: they improve the physical characteristics of the soil (bulk density, aeration, porosity, soil density), they improve the chemical characteristics of the soil (cation exchange capacity, macro- and micronutrients, organic acids), they improve the biological characteristics of the soil (energy for soil microbes and other biological activity), they improve social conditions (recycling of municipal wastes, job opportunities, public income), and they improve the environment (Setyorini *et al.,* 2006). In fact, household wastes can be used as compost, if wet wastea (organic) such as daily food or drink are separated from dry waste such as cans, plastics, and papers. Wet waste can be piled in a small hole in the yard. At certain times the underneath portions can be spread as compost, thus waste problems can be overcame in the household environment (Anon, 2008).

The present study found that the average of compost used by organic rice farmers was small (3.14 t/ha in 2003 to 2007). According to JICA (2007), the amount of compost required to get a high rice yield is approximately 20 t/ha. This amount is equivalent to 225 kg/ha of urea, 125 kg/ha of Triple Super Phosphate (TSP), and 75 kg/ha of KCl (Husnain and Syahbudin, 2005). The use of compost as a source of organic material for soil has been widely reported. Based on JICA's Mpigi Poverty Eradication Programme/Mpepu Self-Help Projects, farmers in Limpopo province, South Africa completely stopped the use of chemical fertilizers and began using compost made from chicken manure. After 2 years of spreading compost, soil quality improved by becoming more friable (JICA, 2007). The results of experiments show that 30 t/ha Siam Weed compost application gave higher yield (1.53 t/ha), but was not significantly different with 10 and 20 t/ha. The growth and yield of black soybean was not significantly different after spraying of biopesticides. Interaction of both factors was significantly affected stem diameter, plant height and leaf area age 7 weeks after planting (Kastono, 2005).

Based on analyses of soil organic matter, application of compost at 1 to 2 t/ha could increase rice yield by 0.64 to 0.95 t/ha, although the efficiency of the additional organic inputs in the promotion of productivity depends on the original organic content of the soil like in dryland areas. Usage of compost combined by local varieties in dryland areas also gave good results (Krismawati, 2007), the results indicated treatment of the local adaptive variety of rice "Situpatenggang" with 200 kg of urea + 50 kg SP 36 + 50 kg of KCl + 1,000 kg of compost produced a yield of 4.65 t/ha of dried unhulled rice. In order to achieve better rice yields, it is recommended that farmers use local varieties such as "Pandan Wangi" that has a good yield, tastes good, and requires less water than higher yielding varieties.

Organic matter increases the cation exchange capacity and thus increases the pH buffering capacity of the soil (Pramono, 1988). Organic matter improves rice yield and quality because of the positive effects it has on the physical, chemical and biological characteristics of the soil. The amount of organic matter is important to increase soil fertility. According to Souri (2001), use of biofertilizers, 20 t/ha on porous soil, where soil organic matter is low can increase rice productivity to 4.5 t/ha. Hernawardi (2007) reports that organic fertilizers applied five times a season or for 2.5 years can restore fertility to the land. Mezuan *et al.* (2002) reported thatapplication of rice straw gave a significant difference in stem height, tiller number, 100 g weight and grain weight/pot. Green manure derived from soybeans increased the steam hieght (106.4 cm), 100 grain weight (3.96 g) and grain weight/pot (5.88 g). Combinations of organic input and fertilizers also significantly affect tiller number, soil bioactivity and aggregate activity.

Many organic farming principles are practiced in traditional agriculture, and farmers have long used rice straw in soil to add organic matter after harvest. Arafah (2003) states that to increase rice production, perpetuation of the production environment is needed, including preservation of soil organic matter by use of paddy straw. Arafah (2004) also reported that use of paddy straw gave higher yields than without it, and Adiningsih (1984) reported that application of 5 t/ha rice straw during 4 cultivation times for 2 years could add 170 kg/ha K, 160 kg/ha Mg and 200 kg/ha Si to the soil. This means paddy straw can supply 80% of the necessary potassium (Rochayati, 1991). According to Sharma and Mittra (1991), paddy straw is a very effective source of potassium. This is supported by Dobermann and Fairhust (2000) and Arafah (2004) who report that paddy straw contains Si (4%-7% by weight), K (1.2%-1.7% by weight), N (0.5%-0.8% by weight), P (0.07%-0.12% by weight) and S (0.05%-0.10% by weight). Organic matter also improves plant growth by enhancing the efficiency of P absorption (Suhartatik and Sismiyati, 2000).

3.7 Effect of Education and Agricultural Extension Services on Organic Farming

In the target area, questionnaires from 150 respondents showed 66 or 44% of farmers with low levels of education (no school and primary school), 73 farmers or 48.7% with a middle level of education (junior high school and senior high school) and 11 farmers or 7.3% with a level high education (university) of education. To increase capacity a lot of respondents (100 farmers or 66.7%) joined activities such as weekly meetings on organic farming facilitated by agricultural extension workers (49 farmers), farmer field school was 34 farmers participated in farmer field school and 17 in both of activities. In these activities, farmers learned how to make compost and liquid organic fertilizers (Table 6). Therefore, these agricultural extension services had a good impact on farmers with regard to the usefulness of organic matter.

Meetings with farmer extension agriculture workers are one approach for agricultural extension. Agricultural extension is expected to change behavior of the farmers themselves, and their attitudes, knowledge and skills. In this case, most of the education of farmers was primary school level before the activities of farmer field school for organic farming and the routine meetings on organic farming. In conclusion, high and low levels of formal education do not have a real influence on the level of technology adoption (Purwoko, A and Sumantri, B, 2007), whereas Gultom *et al.* (1997) and Zulfikri (2003) concluded that experience in a farming business has a real effect on the adoption of agricultural technology. In this study, 130 farmers (86.7%) had more than 10 years experience in farming (Table 3). These results are contrary to the results of Sukartawi (1993) and Pramastiwi (1997), which showed that higher education caused more response to agriculture technology by farmers and a low level of education becomes an obstacle in the process of technology adoption. Agricultural extension is an important and strategic activity that plays an integral part for development in the agricultural sector. Agricultural extension is also the spearhead of the agricultural development in the field that determines the farming system to run the farmers and farmer groups (Kapitan, 2006).

In order to develop organic rice farming, extension workers also give guidance to farmers through organic farmers groups. Farmers groups that have been formed and instructed by agricultural extension staff can be expected to become models for other villages. By this means, organic farming techniques could spread from village to village at the regional level, and thus in the future form a large number of environmentally friendly villages, the activities of which function within the natural potentials for continuous environmental development.

5. Conclusions

Organic rice farming in 5 subdistricts in Bantul regency was limited. Organic rice fields accounted for only 209.9 ha or 9.9% of the total area of agricultural fields (2120.8 ha), and the number of organic farmers was 285 or 0.7% of the total number of farmers (41,524). In addition, the average use of compost by the organic farmers surveyed was 3.14 t/ha and the rice yield was 2.90 t/ha, which was 48% of the yield of rice grown by conventional methods (6.5 t/ha) (Table 4). A survey of farmers by questionnaire and interview showed that there were problems with the farmers' cultivation techniques, farmer's organization, markets, and the training and experience levels of agricultural extension workers. Education levels played an important role: the farmers with higher education levels adopted organic farming techniques better than did those with lower education levels. However, farmer field schools increased the capacity of farmers with lower education levels to adopt organic farming techniques.

6. Recommendations

6.1 Farmers Technique

In order to increase the capacity (knowledge and skill) of farmers in organic rice farming, it is recommended that:

1. Farmers be involved in farmer field schools on organic rice farming technology to learn how to make good compost and natural pesticides
2. Farmers be involved in workshops, education, and training to enhance their entrepreneurial skills with regard to organic prod-

ucts
3. Farmers groups receive guidance on how to manage administrative affairs, group finance, and technical activities in order to become stronger in the field of management
4. Farmers should use local varieties such as 'Pandan wangi" in practices on organic rice farming

6.2 Agricultural Extension Workers

In order to increase the capacity of agriculture extension workers giving guidance to farmers in organic farming techniques, it is recommended that:

1. Agricultural extension workers be allowed to join in education and training on organic farming techniques
2. Agricultural extension workers be involved in workshops and seminars to enhance their entrepreneurial skills
3. Agricultural extension workers develop methods of participatory guidance through a bottom-up guidance and experiential learning cycle

6.3 Organization

It is recommended that there be:

1. Enhanced and more integrated guidance between local government agencies, in this case the office of the Department of Agriculture, and NGOs in techniques of organic farming and marketing
2. Enhanced cooperation with market participants for market organic products
3. Intensified community campaigns about organic farming

6.4 Marketing

It is recommended that there be:

1. Reductions in the price of commercial organic fertilizers and natural pesticides by mass-producing them in organic factories
2. Construction of show rooms, restaurants, and markets for organic products from farmers
3. Establishment of a certification system for organic products at the farmer level

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