Productivity, profitability and marketing of vegetable organic products:lesson learnt from BangkitMerbabufarmer's group in Semarang, Central Java

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Abstract. BangkitMerbabu is a farmer's group which was developed in 2008 in Batur Village, Getasan Sub-district, Semarang Regency, Central Java, Indonesia. Farmers were working together to increase soil vertility and environmental health by developing vegetable organic farming. Their hard working on vegetable organic farming was regionally and nationally well-known after receiving organic certification in 2012. The Indonesian Soil Research Institute (ISRI), Bogor had developed mutual cooperation with this farmer's group in doing observation and research activities related to organic vegetable farming development. This cooperation activity was held in 2013–2015 and supported by Asian Food and Agriculture Cooperation Initiative (AFACI), Korea. This paper presents part of the activity results, in particular related to productivity, profitability and marketing of organic vegetable produced by farmer's group based on observation conducted in the last year of cooperation. It was observed that productivity and profitability of organic vegetable farming was relatively higher than non-organic vegetable farming. However, its marketing system was still a constraint in the development of organic farming. Biophysically, organic vegetable farming could increase soil chemical and biological fertility. Hence, it could improve land environment.

1. Introduction

Effort to improve food production is in line with responsibility to maintain environmentally safe agriculture. Organic agriculture is a production system that maintains the health of soils, ecosystems and people and without applying agrochemicals [1]. The total organic farm in 2013 was about 220,301 hectares and about 76,013 hectares were certified [2]. It decreased to about 215,176 hectares in 2014 and approximately 67,427 hectares were certified. However, the development of organic farming in Indonesia was growing rapidly. In 2015, it was about 251,147 hectares of organic farm area and 79,834 hectares were certified.

In Indonesia implementation of organic agriculture refers to regulation issued by the Minister of Agriculture (PermentanNo. 64/OT.140/5/2013) about organic farming system in Indonesia, with a framework to build organic farming systems to increase the added value, welfare of farmers and increasing competitiveness. It was supported by Indonesian National Standards (SNI 6729:2016) about organic farming systems.

The prospect of organic agriculture in Indonesia is still wide open. Land area available for organic farming in Indonesia is very large. There are about 75.5 million hectares of land that could be used for agriculture and only about 25.7 million ha have been utilized for agriculture [3]. Organic agriculture requires land that is uncultivated or is not being used or has not been contaminated by agro-chemicals.

Meanwhile, technology to support organic agriculture is available such as composting, biological pesticides and others.

In addition, the growth of the organic products market in Indonesia is quite rapid, marked by the increasing number of farmers and farmer's group who manage organic agriculture from year to year [4]. It also increased outlet organic supermarkets and restaurants, increased organizational lovers of organic products and NGOs and the institute of organic certification or LSO.

The Indonesian Soil Research Institute (ISRI), Bogor had developed mutual cooperation with Bangkit Merbabu farmer's group in doing observation and research activities related to organic vegetable farming development. The cooperation activity was held in 2013–2015 and supported by Asian Food and Agriculture Cooperation Initiative (AFACI), Korea. This paper presents part of the activity results, particularly in the socio economic and biophysical indicators of organic vegetable farming.

2. Material and Methods

Socio-economic data were gathered by interviewing the members and manager of the BangkitMerbabu farmer's group in July2015.There were 20 farmers involved in interviews, discussions and field observation during the monitoring activities. As comparison, 10 non-organic vegetable farmers were randomly selected from farmer's group of Jaya Abadi, Karya Muda, Lestari Makmur and Palatani. Those farmers were also interviewed using structural questioner. All farmer groups are located in Batur dan Wates Village, Getasan Sub-district, Semarang Regency, Central Java. Socio-economic indicators gathered consist of farmer's characteristics, land ownership, vegetable yield, farming income and marketing aspect. Data were processed and analyzed descriptively.

Besides, composite soil samples at 0–20 cm of soil depth were taken in 2014 and 2015 from the vegetable organic fields. The soil samples were analyzed for chemical [5] and biological properties [6] at the Indonesian Soil Research Institute laboratory to determine their soil fertility level. Data were presented descriptively.

3. Results and Discussion

The BangkitMerbabu farmer group was established in 2008 with a total of 20 farmers, as members and manager. The farmer group's business field was vegetable farming on dry land. The area managed for organic vegetable in 2008 was about 3 hectares and it increased to 5.5 hectares three years later or in 2011.

The main objective of farmer groups was to restore soil fertility, preserve the agricultural environment, increase land productivity and the welfare of the farmers by applying organic farming system. Further, the manager of this farmer's group stated that in the long run the farmers will be building vegetable based environmentally friendly organic farming.

In 2012 this farmer group obtained a national organic food certificate from Inofice, the Nastional Organic Certification Institute in Bogor. After receiving organic certificate, BangkitMerbabu farmer's group developed other organic farmings categorized as followers and beginners called as organic vegetable group union of BangkitMerbabu. This farmer's group union consists of six farmer groups, including BangkitMerbabu as group leader. BangkitMerbabu applied Internal Control System (ICS) in developing and enlarging vegetable organic farming in the Getasan Sub-district area. Moreover, based on the latest information from the manager of farmer's group they have obtained international organic certification from Organic EU Vegetables. It indicated that organic vegetables could be developed in this area through farmer's groups and farmers' group union.

3.1. Socio economic aspects

3.1.1. Farmer's characteritics

Two farmer's characteristics were analyzed, namely age and level of education. The farmers were still productive as their age was about 46 and 42 years old for organic and non-organic vegetable farmers, respectively. Productive farmers will be more responsive to the demand of organic vegetables which continues to increase.

The education level of farmers was diverse, especially organic farmers. Most of the organic vegetable farmer (65.2%) educated from elementary school. The remaining were junior high school or Grade 9 (30%) and senior high school or Grade 12 (4.8%). On the other hand, almost 100% of non-organic vegetable farmer educated from elementary school (Grade 6). Based on the level of education it could be understood that farmers of BangkitMerbabu group have the potential to move forward and develop. The level of education was positively correlated to the response of farmers in dealing with or implementing new agricultural technologies, including organic farming techniques [7].

3.1.2. Land ownership and type of crops
Dry land cultivated for vegetable crops was relatively narrow. It was about 0.275 ha/household for organic farmers and 0.300 ha/household for non-organic farmers, respectively. Status of land tenure was owned by farmers, either for organic or non-organic vegetable farmers.

Farmers cultivated various types of vegetables on his farm land. During the period of one year there were approximately 20 and 7 types of vegetables that were managed by organic and non-organic farmers, respectively (table 1). According to farmers the types of vegetables grown was very dependent on market demand, availability of capital and the consensus of farmers' group members.

Table 1. The main vegetable crops cultivated by organic and non-organic farmers, Getasan Sub-district, Semarang Regency, Central Java, 2015.

Organic farmer		Non-organic farmer	
Vegetable crops	Cultivated farners (%)	Vegetable crops	Cultivated farners (%)
Broccoli	61	Chili	80
Cabbage	56	Cabbage	80
Chili	35	Broccoli	40
Chinese cabbage	35		
Beet	22		
Pakchoy	22		
Lettuce	22		

3.1.3. Organic vegetable farming practice
The cultural practices of organic vegetable farming could be separated as follows: soil and water, seeds/seedlings, cropping system, inputs (organic fertilizers and bio-control), harvesting and post-harvest.All of those aspects were relatively similarly done by organic and non-organic vegetable farmers, unless the input aspect was very different.

Agricultural inputs for organic vegetable farming were manure, ash of rice husk, dolomite, liquid organic fertilizer (LOF) and bio-pesticides. LOF and bio-pesticides were made of several materials which were mixed together, such as rice water, coconut water, molasses, cow urine, pineapple, fermented rice and others. The composition and amount of material to make LOF and bio-pesticides were very diverse among farmers. These two inputs were generally made by farmers themselves.

Organic vegetable farmers applied chicken manure on average as much as 14,167 $kg{\cdot}ha^{-1}$, dolomite 297.5 $kg{\cdot}ha^{-1}$, LOF 23.8 $L{\cdot}ha^{-1}$ and bio-pesticides 8.1 $L{\cdot}ha^{-1}$ (100 ml diluted with 13 L of water). The manure, ash of rice husk, dolomite and LOF were not applied every planting season but once application for 2–3 times of planting or crop season. Meanwhile, bio pesticides were applied 10–15 times for one cropping season by spraying it with the frequency of 7–15 days continuously. Farmers believed that the use of manure will have an impact on soil fertility and health, positively [8, 9].

Farmers spread manure and soil ameliorant, such as rice husk ash and dolomite on the soil surface in the beds and covered with soil. Some farmers let these conditions for 2–3 days before applying

MOL or locally microorganism, over the surface of the soil. The next step was to close the beds with plastic mulch, followed by making planting holes and let it for 5–15 days. The final stage was planting seeds or seedlings. Most of organic vegetables farmers added manure to the planting hole before planting.

As presented in table 2, organic farmers did not apply chemical fertilizers, instead of non-organic farmers. Chemical fertilizers were commonly applied by non-organic vegetable farmers included NPK Phonska, urea, SP36 and KCl.

Table 2. Agricultural input applied by farmers on vegetable farming (various crops within 1–3 months), Getasan Sub-district, Semarang Regency, Central Java, 2015.

Input/material	Organic farmer		Non-organic farmer	
	Average rate	Applied farmers (%)	Average rate	Applied farmers (%)
Manure ($kg{\cdot}ha^{-1}$)	14,167	100	10,775	100
Ash ($kg{\cdot}ha^{-1}$)	6,250	34		
Dolomite ($kg{\cdot}ha^{-1}$)	297.5	65	300	50
LOF ($L{\cdot}ha^{-1}$)	23.8	100	15.4	100 *)
Bio-pesticides ($L{\cdot}ha^{-1}$)	8.1	100	-	-
Phonska/NPK ($kg{\cdot}ha^{-1}$)			500	100
Urea ($kg{\cdot}ha^{-1}$)			150	100
SP36 ($kg{\cdot}ha^{-1}$)			163	50
KCl ($kg{\cdot}ha^{-1}$)			75	25

Note: *) Most non-organic farmers used commercial brands of LOF

3.1.4. Productivity and profitability

Productivity of vegetables was varied among the farmers. In the organic farming the highest productivity of vegetable achieved by radish (17.5ton$\cdot$ha^{-1}), cabbage (10.6 ton$\cdot$ha^{-1}) and beet root (5.875 ton$\cdot$ha^{-1}). The lowest vegetable productivity (<2.75 ton$\cdot$ha^{-1}) was lettuce, broccoli, french beans, spinach and mustard spoon. The level of vegetable productivity was obtained from the polyculture (mix cropping) system. In fact, vegetables grown by a farmer on his farm land could reach as much as 8 species or 2–3 types of vegetables per bed. Some combinations of vegetable crops grown by organic farmers in the plots of land were as follows: brocolli + radish + french beans; brocolli + beet root; beet root + spinach; cabbage + mustard spoon + lettuce.

Based on financial analysis, the organic vegetable farming benefited farmers or financially feasible (table 3). It was characterized by R/C and B/C ratios which more than 1.0 and 0, respectively. The criteria of feasible is if the ratio of R/C >1.0 or the ratio of B/C > 0. Similarly, non-organic vegetable farming was also financially feasible, but with less value of R/C and B/C ratios. In relative terms the organic vegetable farming was more viable or efficient in the use of capital than non-organic vegetable farming. Hence, the productivity and provitability of organic vegetable farming were higher that non-organic one.

Table 3. Financial analysis of organic and non-organic vegetable farming, GetasanDistrict, Semarang Regency, 2015 (US $/ha/3 months).

Vegetable farming	Material Cost	Wage Cost	Total Cost	Revenue	Net Benefit	Ratio of R/C	Ratio of B/C
Organic	1,429	1,378	2,807	9,836	7,029	3.50	2.50
Non-Organic	1,554	1,292	2,846	4,775	1,929	1.68	0.68

Source: primary data, 2015. Note: cost of certification was not included.

It was stated by the manager of BangkitMerbabu farmer's group that the development of organic vegetable farming required a relatively high investment and operational cost for land preparation, agricultural inputs, processing and marketing activities, and organic certification. Operational cost and investment for the development of 5.5 hectares of organic vegetable farming land was about US $ 21,767. That cost allocation was for the conversion of conventional to organic farming system for 2–3 years(13.4%), national organic certification and surveillances (14.8%), international organic certification (29.2%), processing unit and storages (36.9%) and others, such as internal and external coordination (5.7%). The sources of certification expenditure were provided by the local and provincial government.

3.1.5. Marketing

Currently, the organic vegetables produced by Bangkit Merbabu farmer's group have been accepted by supermarkets such as Gelael, Hypermarket, Sri Ratu, ADA, Java Mall, and Paragon. As an example the daily schedule of vegetable deliveries that must be kept by the Bangkit Merbabu farmer's group was as follows (farmer's group log book):

Monday : 80 kg destination to Gelael and Kudus City Hypermarket
Tuesday : 80 kg destination to Sri Ratu, ADA and Java Mall
Wednesday : 80 kg destination to Gelael and Paragon
Thursday : 60 kg destination to Kudus city Hypermarket
Friday : 100 kg destination to Gelael, Sri Ratu, ADA and Paragon
Saturday : 80 kg destination to Java Mall, PekalonganCity Hypermarket

The selling price of organic vegetables received by farmers from these modern market was relatively good, for example broccoli US $ 1.40/kg, baby bean US$ 1.44/kg, spring onion US$ 0.88/kg, carrot US$ 1.04/kg, tomato US$ 1.00/kg and cabbage US$ 0.56/kg.Those selling price was about 50% to 180% or at average 101.4% higher compared to selling price at traditional markets. However, the absorption of those modern markets was only 20% of the total production of organic vegetable of the Bangkit Merbabu farmer's group. Therefore most organic vegetable produced was still sold in traditional markets. In relation to that farmer's group manager keep trying to find organic vegetable market, including cooperating with agency of co-opertive service of Semarang Regency in developing such market coordinated by the respected local goverment.

3.2. Biophysical aspects

Soil fertility in organic farming system can be improved by the use of organic materials, such as cattle manure, compost, green manure, etc. Improvement of soil fertility in organic farming systems can be seen from the changes in some soil chemical properties, such as cation exchange capacity, organic carbon content, available phosphorous level and calcium and magnesium contents (table 4). These soil chemical properties increased due to the application of organic inputs for 2 years. Organic farming system might be useful tool for improvement of soil chemical and physical properties in view of sustainability of agriculture [10].

Table 4. Characteristic of soil chemical properties in the vegetables organic farming of Bangkit Merbabu farmer's group, Batur village, Getasan Sub-district, Semarang Regency, Central Java.

Soil property	2014	2015
Cation Exchange Capacity (cmol(+)·kg^{-1})	17.03	18.86
Organic Carbon (%)	2.43	2,69
Available Phosphorous (mg·kg^{-1})	120	132
Exchangeable Calcium (cmol(+)·kg^{-1})	7.75	10.04
Exchangeable Magnesium (cmol(+)·kg^{-1})	1.67	2.80

The use of organic agricultural inputs in organic vegetable farming increased microbial population in the soil.Results of soil biological analysis showed that total bacteria before planting about $7.16x10^9$Cfu·g^{-1}soil increased to $4.85x10^{11}$Cfu·g^{-1} soil after planting. Similar feature for nitrogen-fixing bacteria ($2.49x10^9$ increased to $7.16x10^9$Cfu·g^{-1} soil) and solvent phosphate bacteria ($1.30x10^3$ increased to 6.69x 10^7Cfu·g^{-1} soil).

Nitrogen fixation was influenced by indogenous N-sources, such as soil N mineralization and irrigation [12]. An increased in the number of solvent P bacteria could be caused by soil P mineralization from the existing sources. The P requirement was available sufficiently high then the solvent P bacteria would use it as available P source [12]. Organic P mineralization plays an important role in the soil P cycle with organic farming systems. Almost most soil microbes and plant roots have potential P mineralization through phosphatase enzyme activity [13]. The mechanism of conversion of organic P into PO_4^- ionscan be through the activity of alkaline enzyme and acid phosphatase, organic acid and siderophore [14]. However, most of the enzyme phosphatase was produced by microbes [15].

4. Conclusion

Productivity and profitability of organic vegetable farming was relatively higher than non-organic vegetable farming. The level of education of farmers was an important social factor in the development of organic agriculture in the study site.Organic vegetable marketing system was still a constraint in the development of organic farming since market absorption was only 20% of the total production of organic vegetable.Organic cultures on vegetable farming could increase soil chemical and biological fertility. Hence, it could improve biophysical factors of the land environment.

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