Analysis of organic and conventional lowland rice (Oryza sativa L) cultivation in supporting environmentally friendly agriculture in the District Banyan tree, Deli Serdang Regency

Ichpan Zulfansyah[1], Jubelando O Tambunan[2], Melisa Nur Asima Sidabutar[3], Herna Jusnita Samosir[4], Alexander Samosir[5]
(Program Studi Agroteknologi, Universitas Al Washliyah)[2,3,4,5]
(Universitas Efarina, Pematangsiantar)1

*Correspondence: Ichpanzulfansyah11@gmail.com

Abstract

The application of organic farming to paddy rice farming is one of the interesting topics in an effort to reduce environmental pollution caused by the use of chemical fertilizers and pesticides. This study aims to determine the level of production and analyze the environmental impact of the soil from the application of organic and conventional farming in Beringin subdistrict, Deli Serdang district. The results showed that 1) There was a significant difference between the production of dry harvested grain (GKP) in organic paddy rice and the production of dry harvested grain (GKP) in conventional paddy rice. 2) The level of soil fertility in organic and conventional rice farming has low criteria.

Keywords: Organic Lowland Rice Farming, Conventional Lowland Rice, Environmentally Friendly Agriculture

INTRODUCTION

The implementation of lowland rice farming carried out by farmers in Indonesia still uses chemical fertilizers as a source of nutrition for plants. This has been going on continuously until now. The use of chemical fertilizers which is relatively high and continuously has a significant impact on growth and high production yields in paddy rice plants. On the other hand, the use of chemical fertilizers that have been carried out for many years can have a negative impact on the soil environment, thereby reducing the productivity of agricultural land.

The use of chemical fertilizers intended to supplement soil nutrients for plants has actually polluted the environment either directly or indirectly. The high level of plant productivity with the presence of superior seeds, the fertility of plants due to the use of chemical fertilizers, and the eradication of plant pests due to the efficacy of chemical pesticides have placed humans as winners against nature. Humans eventually become less wise, and become unfriendly to nature and the environment. Nature, which is the place where humans live, has been forgotten and its sustainability neglected by human carelessness and greed. As a result of this exploitation,

This condition raises the thought to re-implement organic farming. Organic farming as an agricultural production system based on biological recycling. Nutrient recycling can be through crop and livestock waste, as well as other wastes that can improve fertility status and soil structure.

So far, farmers have seen organic fertilizers and pesticides as something that is troublesome and requires more energy to manage and use them. Farmers still have concerns that they will experience difficulties in obtaining organic fertilizers and pesticides. Farmers have not been able to see the local potential in the form of abundantly available agricultural waste and livestock manure that can be managed into organic fertilizer. Likewise, various plants that can be used as organic pesticides are no longer widely used due to the limited knowledge of farmers. Awareness to better manage the environment is often overshadowed by considerations of technical convenience.

Looking at the long-term contribution of organic rice farming, it gives hope for sustainability for the environment because good soil ecosystems are maintained and nutrients are always available for paddy rice plants. Sustainable organic farming also plays an important role for crop productivity so that it continues to increase the growth and production produced from paddy rice plants.

PROBLEM

So far, farmers tend to use inorganic fertilizers continuously in paddy rice farming. The use of inorganic fertilizers which is relatively high and continuously has a significant impact on growth and high production yields in paddy rice plants. But in the cultivation process, if it is carried out for many years it can cause negative impacts on the soil environment thereby reducing the productivity of agricultural land. The use of inorganic (chemical) fertilizers intended to supplement soil nutrients for plants has actually polluted the environment either directly or indirectly.

In this study, we will look more deeply at the analysis of organic and conventional farming in paddy rice (Oryza sativa L), we will see how the actual effect of implementing conventional organic farming and the testing parameters. Is it influential in supporting environmentally friendly agriculture in Beringin District, Deli Serdang Regency.

METHODS

Research Description

This research will be carried out from September 2019 to May 2020 in Karang Anyar Village, Beringin District, Deli Serdang Regency, North Sumatra Province. The correspondents in this study are members of the Mekar Pasar Wire farmer group, Karanganyar Village, Deli Serdang Regency, which implements organic and conventional rice farming.

Data Types and Sources

In this study there are two types of data, namely primary and secondary data. Primary data is data obtained from the results of direct observation and sampling at the research location, the results of laboratory test analysis, and also the results of direct interviews with farmers using a list of questions (questionnaire). The primary data consists of data on harvested dry unhusked grain (GKP), soil pH, nitrogen (N), phosphorus (P), potassium (K), and soil cation exchange capacity (CEC). Secondary data is data obtained from the report data of the Mekar Pasar Wire farmer group, data from the village head's office, the Deli Serdang agricultural service and other agencies that are still related to this research. Secondary data consists of the area of agricultural land, crop conditions, organizational structure and SOP (Standard Operational Procedure) of farmer groups.

Sampling Method

Determination and sampling in this study using purposive sampling method (deliberate sampling with a specific purpose) and proportional stratified random sampling (random sampling with balanced strata). There were two types of samples used in this study, namely soil samples from organic lowland rice farming in the 2010 transition year and conventional lowland rice farming as well as 10 organic lowland rice farmers in the 2010 transition year and 10 conventional lowland rice farmers.

Data Analysis

The data analysis method used in this study is the analysis method of the two-party average difference test (t-test) with the formula:

$$t - \text{count} = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\left(\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}\right)}}$$

$$S_1^2 = \frac{n.\sum X_1^2 - \left(\sum X_1\right)^2}{n(n-1)} \qquad S_2^2 = \frac{n.\sum X_1^2 - \left(\sum X_2\right)^2}{n(n-1)}$$

Where X1 is the average variable production or income of organic farmers, X2 is the average variable production or income of conventional farmers, S1 is the standard deviation of the X1 variable, S2 is the standard deviation of the X2 variable, n1 is the number of samples X1, n2 is the number of samples X2 . The hypothesis testing criteria uses the formula:

H0 is accepted if: $\frac{W1\ t1 + t2}{W1 + W2} < t - \text{count} < \frac{W1t1 + W2t2}{W1 + W2}$

H1 is accepted if: $\frac{W1\ t1 + t2}{W1 + W2} > t - \text{count} > \frac{W1t1 + W2t2}{W1 + W2}$

With :
W1 = S12/n1 ; W2 = S22/n2
t1 = t (1 - ½ α), (n1 - 1)
t2 = t (1 - ½ α), (n2 - 1)
At the 95% confidence level or α = 0.05

RESULTS AND DISCUSSION

Contents Results and Discussion

Analysis of initial soil fertility (pre-planting season I of 2019) organic lowland rice farming in the 2010 transition year and conventional lowland rice farming

The results of the analysis of initial soil fertility (pre-planting season I in 2019) organic lowland rice farming in the 2013 transition year and conventional lowland rice farming in Beringin District, Deli Serdang Regency are presented in table 1 below.

Table 1. Results of analysis of initial soil fertility (pre-planting season I of 2019) organic lowland rice farming in the 2013 transition year and conventional lowland rice farming

Results of analysis of initial soil chemical properties (pre-planting season I of 2019) organic lowland rice farming in the 2013 transition year and conventional lowland rice farming

No	Soil Properties	Organic paddy farming 2013 transition year	Conventional paddy rice farming
1	pH (H2O)	5,4	5,5
2	Nitrogen (%)	0.11	0.09
3	Phosphorus (P2O5-Bray)	16.01	40,6
4	Potassium (me/100g)	0.38	0.18
5	CEC (me/100g)	7,4	4.54

Based on the results of the initial soil laboratory analysis (pre-planting season I of 2019) (table 1), the soil pH at the study site has the criteria of slightly acidic to sour [4]. Organic lowland rice farming in the 2013 transition year had a pH level of 5.4 and conventional lowland rice farming had a pH level of 5.5. The nitrogen (N) content of the soil in the study area has very low to low criteria [4]. Organic lowland rice farming in the 2013 transition year had a nitrogen (N) content of 0.10% and conventional lowland rice farming had a nitrogen (N) content of 0.09%. The content of phosphorus (P-available) in the soil in the study area has high to very high criteria [4]. Organic lowland rice farming in the 2013 transition year had a phosphorus (available-P) content of 16. 01 ppm and conventional lowland rice farming has a phosphorus (available-P) content of 40.6 ppm. The content of potassium (K) in the soil in the study area has low to moderate criteria [4]. Organic lowland rice farming in the 2013 transition year had a potassium (K) content of 0.38 me/100gr and conventional lowland rice farming had a potassium (K) content of 0.18 me/100gr. The value of the cation exchange capacity (CEC) of the soil at the study site has low to very low criteria [4]. Organic lowland rice farming in the 2013 transition year had a soil cation exchange capacity (CEC) value of 7.4 me/100gr and conventional lowland rice farming had a soil cation exchange capacity (CEC) value of 4.54 me/100gr. The content of potassium (K) in the soil in the study area has low to moderate criteria [4]. Organic lowland rice farming in the 2013 transition year had a potassium (K) content of 0.38 me/100gr and conventional lowland rice farming had a potassium (K) content of 0.18 me/100gr. The value of the cation exchange capacity (CEC) of the soil at the study site has low to very low criteria [4]. Organic lowland rice farming in the 2013 transition year had a soil cation exchange capacity (CEC) value of 7.4 me/100gr and conventional lowland rice farming had a soil cation exchange capacity (CEC) value of 4.54 me/100gr. The content of potassium (K) in the soil in the study area has low to moderate criteria [4]. Organic lowland rice farming in the 2013 transition year had a potassium (K) content of 0.38 me/100gr and conventional lowland rice farming had a potassium (K) content of 0.18 me/100gr. The value of the cation exchange capacity (CEC) of the soil at the study site has low to very low criteria [4]. Organic lowland rice farming in the 2013 transition year had a soil cation exchange capacity (CEC) value of 7.4 me/100gr and conventional lowland rice farming had a soil cation exchange capacity (CEC) value of 4.54 me/100gr. The value of the cation exchange capacity (CEC) of the soil at the study site has low to very low criteria [4]. Organic lowland rice farming in the 2013 transition year had a soil cation exchange capacity (CEC) value of 7.4 me/100gr and conventional lowland rice farming had a soil cation exchange capacity (CEC) value of 4.54 me/100gr. The value of the cation exchange capacity (CEC) of the soil at the study site has low to very low criteria [4]. Organic lowland rice farming in the 2013 transition year had a soil cation exchange capacity (CEC) value of 7.4 me/100gr and conventional lowland rice farming had a soil cation exchange capacity (CEC) value of 4.54 me/100gr.

Analysis of the final level of soil fertility (post-harvest planting season II in 2019) for organic paddy rice in the 2013 transition year and conventional paddy rice

The results of the analysis of soil fertility at the beginning and end (post-harvest planting season II in 2019) for organic paddy rice in the 2013 transition year and conventional paddy rice in Beringin District, Deli Serdang Regency are presented in table 2 below.

Table 2. Results of analysis of final soil fertility (post-harvest planting season II in 2019) organic lowland rice farming in the 2013 transition year and conventional lowland rice farming

Results of analysis of final soil chemical properties (post-harvest planting season II in 2019) organic lowland rice farming in the 2013 transition year and conventional lowland rice farming

No	Soil Properties	Organic paddy farming 2013 transition year	Conventional paddy rice farming
1	pH (H_2O)	5,6	5,4
2	Nitrogen (%)	0.07	0.08
3	Phosphorus (P_2O_5-Bray)	17,41	38,73
4	Potassium (me/100g)	0.36	0.15
5	CEC (me/100g)	8.35	4.97

1. Soil pH

Based on the results of the final soil laboratory analysis (post-harvest planting season II in 2019) (table 2), organic lowland rice farming in the 2013 transition year had a soil pH with slightly acidic criteria [4] with a pH value of 5.7. The soil pH value has increased by

1.78% from the initial soil pH (pre-planting season I 2019). Conventional lowland rice farming has a soil pH with acid criteria with a pH level of 5.4. The soil pH value has decreased by 1.81% from the initial soil pH (pre-planting season I 2019). The increase and decrease in the pH value of organic paddy rice farming in the transition year 2013 and conventional is presented in Figure 1.

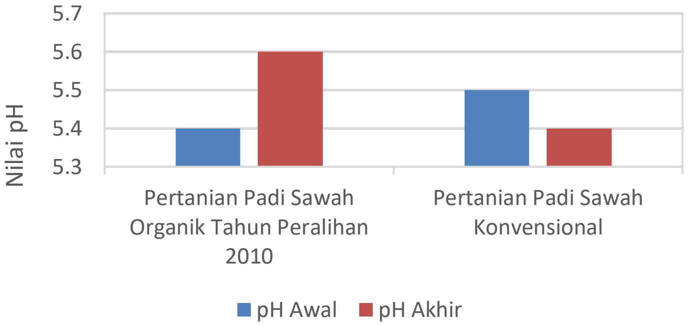

Figure 1. Increase and decrease in final soil pH values (post-harvest planting season II in 2019) for organic lowland rice in the 2013 transition year and conventional lowland rice farming

The increase in soil pH that occurred in organic lowland rice farming in the 2013 transition year was due to the activity of adding organic matter in the form of manure during the processing of agricultural land. The decrease in soil pH values that occurs in conventional lowland rice farming is thought to be due to the addition of nitrogen (N) through the use of ZA fertilizer by conventional farmers, the use of ZA fertilizer to add nitrogen (N) can actually acidify the soil.

2. Cation Exchange Capacity (CEC)

Based on the results of final soil laboratory analysis (post-harvest planting season II in 2019) (table 2), organic lowland rice farming in the 2013 transition year had a soil cation exchange capacity (CEC) value with low criteria [4] with a cation exchange capacity value (CEC) land of 8.35 me/100gr. The soil cation exchange capacity (CEC) value has increased by 2.49% from the initial soil cation exchange capacity (CEC) value (pre-planting season I 2019). Conventional lowland rice farming has a very low cation exchange capacity (CEC) value [4] with a cation exchange capacity (CEC) value of 4.97 me/100gr. The cation exchange capacity (CEC) value of the soil has decreased by 16.66% from the initial soil cation exchange capacity (CEC) value (pre-planting season I of 2019).

Figure 2. Increase in the value of cation exchange capacity (CEC) at the end of (post-harvest planting season II in 2019) organic lowland rice farming in the 2013 transition year and conventional lowland rice farming

The increase in soil cation exchange capacity (CEC) in organic farming in the 2013 transition year was due to the influence of the addition of organic matter given as fertilizer. The addition of organic fertilizers gives a negative charge reaction in the soil. The negative charge comes from the carboxyl (COO-) and hydroxyl (OH-) groups contained in organic matter. Dissociation of carboxyl and hydroxyl groups from organic compounds can increase the negative charge in the soil [7]. The increase in the value of cation exchange capacity (CEC) due to the provision of biochar can increase the availability of nutrients needed by plants. In conventional lowland rice farming, an increase in soil cation exchange capacity (CEC) also occurs, but it still cannot offset the value of the soil cation exchange capacity (CEC) of organic lowland rice farming. This is because in the farming process conventional rice farmers use chemical fertilizers as basic fertilizers so that the availability of organic matter is limited. Around 20 – 70% of soil exchange capacity is generally sourced from humus colloids, so there is a correlation between organic matter and soil CEC. Soepardi (1983) added that organic materials greatly affect the size of CEC and become a source of energy for the bodies of microorganisms.

3. Nitrogen (N)

Based on the results of final soil laboratory analysis (post-harvest planting season II in 2019) (table 2), organic lowland rice farming in the 2013 transition year had a low nitrogen (N) content [4] with a nitrogen (N) content of 0.07% . The nitrogen (N) content of the soil has decreased by 33.33% from the initial soil nitrogen (N) content (pre-planting season I 2019). Conventional lowland rice farming has very low nitrogen (N) content [4] with a nitrogen (N) content of 0.08%. The nitrogen (N) content of the soil has decreased by 11.11% from the initial soil nitrogen (N) content (pre-planting season I 2019). The decrease in the nitrogen (N) content of organic paddy rice farming in the transition year of 2013 and conventional is presented in Figure 3.

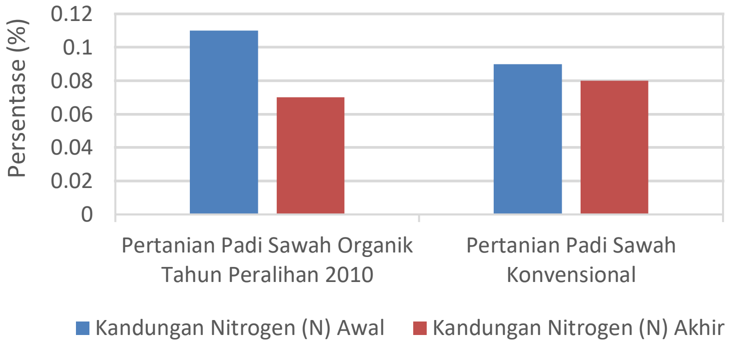

Figure 3. Decrease in final (post-harvest MT II 2019) soil nitrogen (N) content for organic lowland rice farming in the 2013 transition year and conventional lowland rice farming

The decrease in soil nitrogen (N) content that occurred in organic lowland rice farming in the 2013 transition year and conventional lowland rice farming was due to absorption by the plants themselves and also due to the highly mobile nature of nitrogen (N) so it is easily lost due to leaching. Nitrogen is lost in the form of NO3 because it is easily washed off by rainwater (leaching) and cannot be held by soil colloids, especially in soils with low cation exchange capacity (CEC) values [9]. These results are supported by the results of other studies which state that in general the fertility of paddy fields is relatively diverse, the loss of nitrogen (N) nutrients due to absorption by plants, transported by harvest and washing by rainwater.

4. Phosphorus (P)

Based on the results of final soil laboratory analysis (post-harvest planting season II in 2019) (table 2), organic lowland rice farming in the 2013 transition year had a high criterion phosphorus (P) content [4] with a phosphorus (P) content of 17.41 ppm . The phosphorus (P) content of the soil has decreased by 13.32% from the initial soil phosphorus (P) content (pre-planting season I 2019). Conventional lowland rice farming has very high phosphorus (P) content [4] with a phosphorus (P) content of 38.73 ppm. The phosphorus (P) content of the soil has decreased by 4.60% from the initial soil phosphorus (P) content (pre-planting season I 2019). The increase and decrease in the phosphor (P) content of organic lowland rice farming in the transition year of 2013 and conventional is presented in Figure 4.

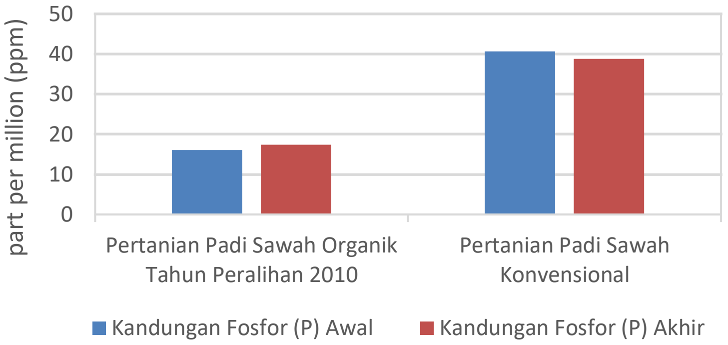

Figure 4. Increase and decrease in soil phosphorus (P) content at the end of (post-harvest planting season II in 2019) organic lowland rice farming in 2013 and conventional lowland rice farming

The increase and decrease in soil phosphorus (P) content that occurred in organic lowland rice farming in the 2013 transition year and conventional lowland rice farming is strongly suspected to be closely related to the increase and decrease in initial and final soil pH. In most soils the maximum availability of phosphorus (P) is found in the pH range between 6.0 – 7.0. The availability of phosphorus (P) will decrease if the soil pH is lower than 6.0 or higher than 7 [11]. The final soil phosphorus (P) content, which is still in the high to very high criteria, illustrates that the need for phosphorus (P) for rice planted in paddy fields does not require input from outside anymore. The nutrient element phosphorus (P) in the soil is classified as slow moving and generally can only take place through the mechanism of root interception and diffusion over short distances.

5. Potassium (K)

Based on the results of the final soil laboratory analysis (post-harvest planting season II in 2019) (table 2), organic lowland rice farming in the 2013 transition year had a low potassium (K) content [4] with a potassium (K) content of 0.36 me /100gr. The potassium (K) content of the soil has decreased by 20.53% from the initial soil potassium (K) content (pre-planting season I 2019). Conventional lowland rice farming has a low potassium (K) content [4] with a potassium (K) content of 0.15 me/100gr. The potassium (K) content of the soil has decreased by 16.66% from the initial soil potassium (K) content (pre-planting season I 2019). The decrease in potassium (K) content of organic paddy rice farming in the transition year of 2013 and conventional is presented in Figure 5.

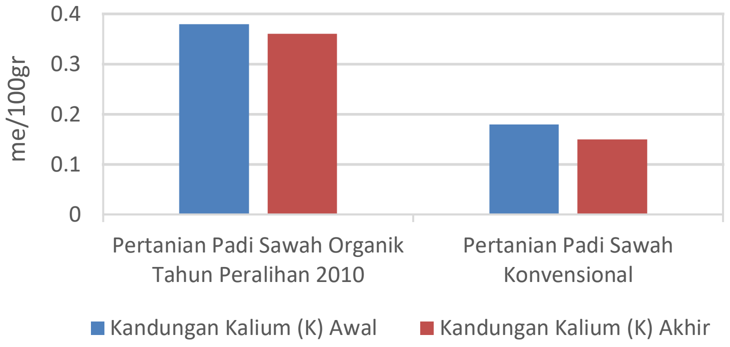

Figure 5. Decrease in potassium (K) content in the final (post-harvest planting season II 2019) organic lowland rice farming in the 2013 transition year and conventional lowland rice farming

The decrease in potassium (K) content that occurred in organic lowland rice farming in the transition year of 2013 and conventional lowland rice is thought to be due to absorption by plants and plant demand is still higher than the availability of potassium (K) from soil and fertilizers. Nearly 80% of the potassium (K) absorbed by rice plants is in the straw [13]. So it is recommended to return straw to paddy fields as a source of soil potassium (K) after the rice is harvested [13]. In addition, the decrease in potassium (K) content is also due to the easily leached element of potassium in the soil and the level of its content which is strongly influenced by pH and the value of cation exchange capacity (CEC). At low pH (acid) and low cation exchange capacity (CEC), potassium is easily leached [11].

3.3 Analysis of different tests of harvested dry grain production (GKP) for organic lowland rice farming in the 2013 transition year and conventional lowland rice farming in the 2019 planting season

The results of the different test results for harvested dry grain production (GKP) obtained by organic rice farmers in the 2013 transition year and conventional ones can be seen in the following table 3:

Table 3. The results of the average difference test of harvested dry grain production (GKP) for organic lowland rice farming in the 2013 transition year and conventional lowland rice farming in the 2019 planting season

2019 Planting Season	Production of GKP Organic Lowland Rice 2013 Transitional Year (Kg)	GKP Production of Conventional Lowland Rice (Kg)	Results of Significance of the Mean Difference Test (Test – t)	Information
I	838.47	782.97	26.57	Significant
II	793,17	742.89	14.86	Significant

Based on the results of the average difference test on the yield of dry unhulled grain (GKP) production of organic and conventional paddy rice (Table 3), it shows that there is a significant difference between the production of dry unhulled grain (GKP) of organic paddy rice in the transition year of 2013 and the production of dry unhulled paddy. (GKP) conventional lowland rice at the 95% confidence level. This is based on the results of different tests on the average dry grain production (GKP) of organic paddy rice in the 2013 transition year which has a t Stat value (26.57) in the first planting season and t Stat (14.86) in the II planting season in 2019 where the t value both stats are greater than the two-tailed Critical t value (2.26). The difference in the production of dry harvested grain (GKP) for organic paddy rice in the transition year of 2013 and conventional is presented in Figure 6.

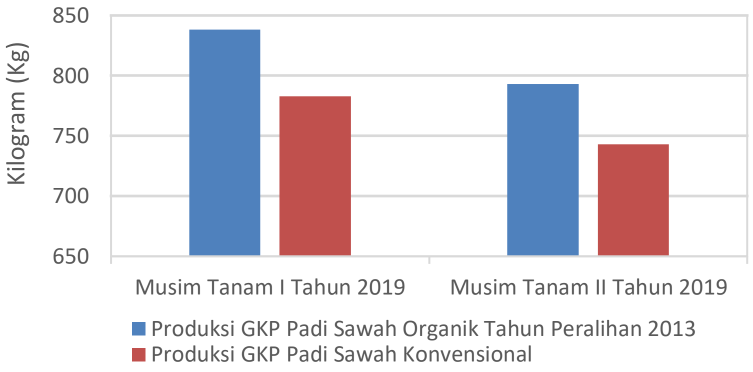

Figure 6. Differences in harvested dry grain production (GKP) for organic lowland rice farming in the 2013 transition year and conventional lowland rice farming in the 2019 planting season

The higher production of dry unhusked rice (GKP) in organic lowland rice farming in the 2013 transition year when compared to the production of conventional lowland rice farming is thought to be due to the level of soil fertility itself. Sources of organic farming nutrients are obtained from natural organic materials such as compost. Sutedjo and Kartasaputra (1993) stated that compost contains macro nutrients such as N, P, and K and micro nutrients such as Mn, Fe and Zn. The use of compost can physically increase soil porosity, biologically it can increase the activity of organisms so that the process of decomposing organic matter occurs more quickly [14]. This result is supported by the results of another study which found that the yield of organic rice using manure in the Sambirejo sub-district during the 2003/2004 planting season (MT) II was 5.

The use of organic materials as a source of nutrients also improves the quality of agricultural soil with an organic system and can continue to increase along with the continuous application of organic farming. The elements of nitrogen and phosphorus which are much needed by plants in the vegetative phase are quite a lot contained in chicken manure. This condition also has an impact on plant height growth, maximum number of tillers and productive tillers which require nutrients, especially N and P. Phosphorus functions to stimulate the growth and formation of tillers or shoots in rice plants. One of the functions of the nitrogen element absorbed by plants is to help the growth of plant vegetative growth. The use of materials that are still natural (organic) in the application of organic farming actually provides an opportunity for decomposing microorganisms found in the soil to grow optimally. Organic matter is able to function as a source of energy and food for soil microorganisms in the process of overhauling organic matter. Along with the overhaul of organic matter carried out by microorganisms, there will be a release of nutrients such as N, P and K which are needed by plants.

In contrast to organic farming nutrient sources, conventional agricultural nutrient sources actually come from artificial chemicals. The use of chemicals that are continuously used in a field has a negative impact, such as making soil particles bond tightly together so that the soil can become very hard. This has an impact on plant roots which will become difficult to penetrate to carry out the nutrient absorption process. Land conditions in rice-producing countries including Indonesia are identified as experiencing soil fertility deterioration or what is known as sick soil (Soil sickness). The cause of soil sickness is poor land management. The results of other studies also stated that Indonesia's land and water resources experienced quality deterioration due to the excessive use of chemical fertilizers. The accumulation of chemical fertilizers results in a lot of toxic content because the soil pH becomes acidic, so that the diversity of soil microbes becomes very small. Thus the process of decomposition of organic matter does not go well.

CLOSING

Conclusion

Based on the results of the study it can be concluded that 1) The production level of harvested dry grain (GKP) in organic lowland rice farming in the 2013 transition year was greater than the production level of dry harvested grain (GKP) in conventional lowland rice. 2) In general, the soil fertility status of organic and conventional lowland rice farming is still in the low criteria [4]. However, the results of laboratory analysis showed that the values of pH, cation exchange capacity (CEC), nitrogen (N), and potassium (K) of organic lowland rice farming in the transition year of 2013 were higher than conventional lowland rice farming.

Acknowledgments

The author would like to thank the supervising lecturer and all related parties for the moral and material support that has been given to the writer so that he is able to complete this research.

REFERENCES

Avelinus, AS (2008), Analysis of Organic Agriculture Development in Magelang Regency. Thesis, graduate program UNDIP.

Adiningsih, S. 2004. Nutrient Dynamics in Soil and Nutrient Uptake Mechanisms. Soil Research Centre. Ministry of Agriculture, Jakarta.

Brady, NC and RR Weil. 2002. The Nature and Properties of Soils. 13th ed. Pearson Education, Inc., New Jersey, USA.

Buckman, H.O and NC Brady. 1983. Geology. Bharata Literature Works. Jakarta.

Budianto, J. 2002. Challenges and Opportunities for Rice Research and Development in an Agribusiness Perspective in Rice Policy Proceedings and Rice Technology Innovation. Food Crops Research and Development Center. Bogor.

Dierolf, T. 2000. Soil fertility kit: a toolkit for acid upland soil fertility management in Southeast Asia. Gesellschaft für Technishe Zusammenarbeit (GTZ) GmbH, FAO, PT. Katom, PPI, PPIC. 131 pages.

De Datta, SK 1981. Principles and Practices of Rice Production. John Wiley and Sond. New York.

Dermiyati. 1997. The Effect of Mulch on Soil Microorganism Activity and C-1 Hybrid Corn Production. Tropical Soil Journal.

Fardiaz, S. 1992 Food Microbiology and Soil Fertility I. PT. Main Library Gramedia. Jakarta. 320 pages.

Hardjowigeno, S. 2003. Soil Classification and Pedogenesis. Jakarta: Academica Pressindo. 250 pages.

Hanafiah. 2008. Basics of Soil Science. Raja Grafindo Persada, Jakarta. 360 pages.

Kartasapoetra and Sutedjo, MM 1993. Fertilizer and fertilization methods. Jakarta: Bhineka Cipta.

Nurmegawati, W. Wibawa, E. Makruf, D. Sugandi, and T. Rahman. 2012. Fertility Rates and Recommendations for N, P and K Fertilization of Soil in South Bengkulu Regency. J. Solum, IX (2):61-68.

Sutanto and Rahman. 2002, Organic Farming Towards Alternative and Sustainable Agriculture. Kanisius Publisher, Yogyakarta.

Soil Research Centre. 1995. Term of reference type A. P3MT Publisher. Soil Research Centre. Bogor.

Suwandi & Hilman, Y 1992, 'Use of N and TSP fertilizers on shallots', Bul. Penel. Hort., vol. 22, no. 4, pages 28- 40.

Soepardi. Goeswono. 1983. The nature and characteristics of the soil. Department of Soil Science. Bogor Agricultural Institute.

Suhartini, Widodo. S, Irham and Hartanto S, 2006. Sustainable Attitudes and Behaviors of Organic and Non-Organic Farmers in Sragen Regency and Their Implications for Land Quality, Biodiversity, and Rice Productivity. Agros Vol. 8, No. 1. January 2006 : 90-102. ISSN 1411-1072

Siregar, H. 1980. Rice Cultivation in Indonesia. Hudaya Literature. Bogor.

Satari, G., Sadjad, S. and Sastrosoedardjo. 1999. Utilization of dry land for food crop cultivation answered the 2000 challenge. Agronomy Congress, Indonesian Agronomy Association. Jakarta.

Tan, KH 1993. Environmental Soil Science. Marcel Decker. Inc. New York