IMPLEMENTATION OF ORGANIC RICE CULTIVATION TO REALIZE SUSTAINABLE AGRICULTURE

SAMIDJO, G. S.[1*] – ISNAWAN, B. H.[1] – TRIYONO[2]

[1]*Agrotechnology Department, Faculty of Agriculture, Universitas Muhammadiyah Yogyakarta, Jalan Brawijaya Tamantirto Kasihan Bantul D. I. Yogyakarta 55183, Indonesia (phone/fax: +62-274-387656/+62-274-387646)*

[2]*Agribusiness Department, Faculty of Agriculture, Universitas Muhammadiyah Yogyakarta, Jalan Brawijaya Tamantirto Kasihan Bantul D. I. Yogyakarta 55183, Indonesia (phone/fax: +62-274-387656/+62-274-387646)*

**Corresponding author*
e-mail: supangkat@umy.ac.id

(Received 10th Jun 2023; accepted 22nd Aug 2023)

Abstract. The synthetic chemical residue-free rice cultivation technology is through organic rice cultivation technology. Organic plant cultivation technology started in 2007 and continues its expansion, even though not as expected. This research aims to study the development of community-based organic agriculture from the perspective of sustainable agriculture. In this study, the researchers used questionnaires and quantitative research approaches. The primary and secondary data were obtained through observation on rice cultivation land, then interviews were conducted with farmers managing rice cultivation in Yogyakarta, Indonesia. The data obtained descriptive-explanatory analysis was carried out. Based on the results, the development of organic farming in Yogyakarta, Indonesia, did not go well. The category of Moderately Sustainable in the perspective of sustainable agriculture was demonstrated with a Sustainability Value of 60.78%. The availability of production facilities independently, the perception and appreciation of the community towards organic agricultural products became obstacles and constraints of organic farming development. The contribution is beneficial for sustainable agriculture to achieve food security.
Keywords: *farmer perception, organic farming, organic products, integrated farming, sustainability value*

Introduction

Agricultural development must be carried out in a balanced manner adjusted to the supporting capacity of the ecosystem. Thus, production continuity can be maintained long-term with the lowest level of environmental damage possible. This study sees community-based organic farming from a sustainable agricultural perspective on rice commodities. The results are expected to contribute to sustainable agricultural development, especially rice, to achieve food security. This research used quantitative research methods with surveys. The primary and secondary data were obtained through observation on rice cultivation land.

This system has been introduced in Indonesia since 2007. The community expects an organic farming system because the products are healthy foodstuffs. The organic farming system has been developed by farmers supported and facilitated by the government for the last 20 years, but the development is not satisfactory. Such conditions occur in almost all districts in Indonesia, whereas the development of this agricultural system is expected to increase farmers' income significantly. The significance of the increase in revenue obtained from organic farming due to its healthy products is increasingly in demand by the market, while the cost of production is lower.

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/2105_49434955

Consumers still have a moderate category perception of organic farming practices. Organic produce is still perceived as a product with a high price. The perception of organic agriculture and natural ingredients, concern for environmental health, increased awareness and respect for the family, will increase consumer purchasing power interest in organic rice.

However, rice fields and dry lands in Indonesia that implement organic farming practices are still tiny. Moreover, many agricultural products are still exposed to pesticide chemicals. The slow development of organic farming programs can be caused by the community's physical, social, economic, and cultural factors. Physical factors about the initial productivity of agricultural systems are slow. Social factors related to the exaltation of the benefits of organic farm products are still common. Economic factors are related to the market, price, and continuity of the product. Cultural factors related to perception are expected to become commonplace with organic plant management patterns.

Organic farming system, especially rice in Indonesia refers to the organic products of the Indonesian National Standard (INS) to be guaranteed standards. It is necessary to observe the constituent components of organic farming systems, such as land, irrigation, production facilities, and protections that affect the quality and standards of organic products. The pattern of application, conformity of INS component management, the description of the system applied, and the perception of organic rice cultivation system is very important for the study.

Therefore, this paper examines the portrait of rice cultivation development and its constraints in the farming community. Previous results have not adequately described the development of organic agriculture in Indonesia. The program developed 22 years ago with little funds has not produced significant organic food products, both in quantity and quality. Studies conducted in previous studies have not been fundamentally about the description of organic farming that develops in the farming community in Indonesia and the accompanying constraint factors. Therefore, it is necessary to conduct an in-depth, comprehensive, integralists study to describe organic farming development, especially rice.

Some research results mentioned that the Organic Rice Cultivation System developed since 2007 until now had not encouraged the results. Therefore, this research using quantitative research methods using surveys is vital to conduct. The study of its components and constraints can then be formulated as a Development of Community-Based Organic Rice Cultivation model as one of the Agricultural Systems in Yogyakarta, Indonesia. Research conducted was in the Province of Special Region of Yogyakarta, Indonesia. The aims of the research to study the development of community-based organic agriculture from the perspective of sustainable agriculture. The results are expected to contribute to sustainable agricultural development to achieve food security. This study will increase farmers' willingness to change by comparing yield, income, and profits.

Review of literature

Rice and wheat straw returning is necessary for the comprehensive and adequate agroecosystems to maintain a solid soil fertility cycle and sustainable agricultural development (Jin et al., 2020). Identification of good ecosystem constituent elements for agricultural development has been studied (Adamashvili et al., 2020). The

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/2105_49434955

continuous use of sole chemical fertilizers can affect the productivity of the soil involves its physical, chemical, and biological properties. Hence, sustainable agriculture needs the enhancement and maintenance of system productivity and resource (Panpluem et al., 2019).

Agricultural sustainability is a crop production system to continuously produce food without environmental degradation (Tahat et al., 2020). Organic farming systems have captured the world's attention to sustain soils, ecosystems, and people (Pinthukas, 2015). The benefit of organic farming is related to the economic facet and sustainable agricultural development (Ashari et al., 2018). Appropriate investment in agroecological research to improve organic management and establish a local market for organic crops can become a competitive alternative to conventional farming (Binta and Barbier, 2015). In comparison to conventional agriculture, organic farming uses non-renewable energy more effectively, maintains or improves soil quality, and has less of a negative impact on biodiversity and water quality (Clark, 2020).

An organic farming system is an agricultural system that manages crops by involving components of cultivation techniques, namely land, irrigation, production facilities, and protection (De Ponti et al., 2021). In addition, we predict that the yield gaps in organic agriculture could exceed 20% at higher system levels (De Ponti et al., 2021).

Therefore, organic farming is competitive compared to conventional farming, especially in its healthy products with no negative impact on the environment (Ashari et al., 2018). Therefore, organic farming is more profitable in improving the quality of organic products, environmental quality, and financial benefits (Ashari et al., 2018).

Education, money, and union membership had a negative impact on farmers' attitudes (Sevinç, 2021). The ability to produce crops depends on farmers' understanding and attitudes toward sustainable soil conservation practices (SSCP) (Luangduangsitthideth et al., 2019). The results of the double regression analysis indicated that the farmer's age, level of education, experience, and network of work or group membership significantly contributed to farmers' adaptation to organic vegetable production (Pinthukas, 2015).

Organic farming is growing fast in some countries (Rigby and Cáceres, 2001). According to protection motivation theory (PMT), Individuals confronted with a potential risk undergo threat assessment and coping assessment. Individuals perceive the severity and vulnerability to a threat during threat appraisal (Puntsagdorj et al., 2021). The perception of the ease or difficulty of complying with these requirements can be influenced by different actors and conditions (Leitner and Vogl, 2020).

The climate-smart agricultural technologies (CSATs) to cope with climate change are critical for restructuring the agriculture sector program of Vietnam (Tran et al., 2019). Grow Biointensive Sustainable Agriculture (GBSA) integrates eight sustainable concepts that could prevent soil nutrient loss, improve soil quality, and close the yield gap (Beeby et al., 2020).

Organic manure is an alternative fertilizer supply that helps to reduce CF usage in agriculture, reduce pollution, and maintain sustainable crop production (Iqbal et al., 2020). Socioeconomic factors such as farmer's income, area of farmland, and labor for Farmers' attitudes of rotating fallow as a sustainable agriculture strategy are influenced by agricultural yield and green manure planting (Ntakirutimana et al., 2019). Organic manure substitute decreased N loss but increased P loss from the surface runoff (Cui et al., 2020). The combination of little or no-tillage plus straw returning helps improve the content and quality of organic carbon in the soil (Jin et al., 2020). Slow-release

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/2105_49434955

compound fertilizer with urea (SRCF + U) and compound fertilizer with sulfur-coated urea (CF + SCU) enhanced the crop productivity, nutrient uptake, and utilization efficiency, and economic benefits compared with N100 (Yang et al., 2020). According to this study, more research is still needed to understand how sandy soil affects rice production and how to use adaptive management to support sustainable agriculture and long-term food security (Arunrat et al., 2020). An exhausted agricultural system based on rice could be supported by urea (N-fertilizer) and organic carbon sources like crop leftovers and animal manures (Amanullah et al., 2020). Through higher water quality and abundant microorganisms, co-culturing tilapia and rice improved tilapia's ability to grow and the quality of its muscles (He et al., 2020). Although it had no effect on soil microbial diversity, rice straw return increased soil microbial richness (Yan et al., 2020). In alternate wetting and drying (AWD) and in aerobic conditions (AR), plastic mulch is more effective than hay mulch in improving rice growth and quality (Jabran et al., 2015). As a paddy-adapted plant, rice is effective in uptake in the roots, thereby removing rice roots depletes efficiently bioavailable as from paddy soils (He et al., 2020). If these links are taken into consideration by the algorithm that recommends fertilizer, the SSNM technique can be more adaptable to farmer's fields (Rodriguez, 2020). The rice processing factories generate wastewater and low specification grains (Photphisutthiphong and Vatanyoopaisarn, 2020).

Symptoms of health, household size, farm size, water supply, market accessibility, income, labor related to the Technical Efficiency Score (TES), and the production of organic rice (Panpluem et al., 2019). In comparison to the old approach, the organic rice business is more profitable. Lack of market information, technical assistance, and accessibility to important purchasing sites are the main obstacles to converting traditional rice to organic (Dat et al., 2023). The study's findings give dry farming areas on the Loess Plateau a theoretical foundation for applying organic and inorganic fertilizers and support the long-term healthy development of the soil there (Liu et al., 2022).

Materials and methods

This research used quantitative research methods with surveys. The time of research was done from April to August 2021. Sixty-three (63) farmers were selected by purposive sampling as much as 10% of the number of rice farmers who manage organic rice cultivation in the districts of Yogyakarta, Indonesia. Research data came from farmers, among others, the variety of components of rice cultivation, cultivation according to environmental conditions, and analysis of farming. Three farmer groups chose each location for each category of representative rice cultivation. Each group consisted of 10% of farmers. In addition, each group had 3 (three) administrators, with 63 respondents for two example districts or representatives by the stipulated objectives, namely Bantul and Sleman Yogyakarta, Indonesia.

The data taken in this study were quantitative and qualitative. Quantitative data is numerical data obtained through observation, while qualitative data is obtained through categorical observation. Observations were made on land observation units with three categories studied. The types of data taken are primary and secondary data. Primary data is data obtained directly from the source. The primary data came from observations and interviews directly in rice cultivation land and farmers' management. The data obtained were analyzed descriptively to describe in detail organic rice cultivation. A

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/2105_49434955

score of financial feasibility one if R/C < 1.5; score two if R/C 1.5 - 2.5: score three if R/C = 2.5-3.5; score four if R/C 3.5 - 4.5; and score five if R/C > 4.5. Descriptive analysis was accompanied by comparison and explanation of the achievement of organic rice farming sustainability.

Results

The performance of sustainable agriculture in rice farming in the Special Region of Yogyakarta was analyzed based on three indicators: biophysical, economic, and social indicators. Biophysical indicators include soil fertility conditions, the proportion of internal inputs, length of application of organic farming, and rice production productivity. Economic indicators consist of the price of organic rice grain production and the financial feasibility of organic rice farming. Meanwhile, social indicators include farmers' participation in group activities and response to organic farming.

Bio-physical indicators: soil fertility, the proportion of internal inputs, length of application, and productivity of organic rice

Soil fertility condition is a physical, chemical, and biological condition of the soil that supports the availability of nutrients for the growth of rice plants. The content of organic matter is seen from the abundance of earthworms. The quantity of earthworms indicates fertile soil.

Based on the field survey results, the soil fertility is generally in good condition, with an average score of 4.17 (*Table 1*), while fertility is 83.4%. Thus, the soil is in a fertility condition that is close to ideal for the growth of rice plants.

Table 1. *Descriptive statistics of soil fertility, the proportion of internal inputs, applied time of organic farming, and productivity of organic rice*

Descriptive statistics	Valid N (listwise)	Minimum	Maximum	Mean	Std. deviation
Soil fertility	63	2.00	5.00	4.17	0.84
Proportion of internal inputs	63	0.00	100.00	42.67	43.62
Applied time	63	4.00	28.00	16.67	4.00
Productivity	63	400.00	16,200.00	4,812.90	3,142.13

The proportion of internal input is the ratio between internal inputs to the total input used in rice farming. Internal inputs, especially organic fertilizers and pesticides made, are still relatively low. Almost all farmers still use external input, even around 49% of farmers use external input with 100% (total external input (*Table 1*). Conversely, only a small proportion (0.06%) of farmers use 100% internal input (complete internal) while others (50%) use internal inputs with varying proportions ranging from 1 - 99%.

For the most part, the distribution of organic rice productivity is still below 5 tonnes/ha (*Table 1*). Overall, the average productivity of organic rice is 4.8 tonnes/ha. However, some farmers achieve a productivity of 10 even 15 tonnes/ha. This figure shows that organic agriculture has a high enough potential for increased productivity. This indication is reinforced by the level of productivity with a positive and significant correlation with the proportion of internal input use, as shown in *Table 2*.

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/2105_49434955

***Table 2.** Rank Spearman correlation analysis between internal input proportions and organic rice productivity*

			P_Input internal	Productivity
Spearman's rho	P_Input internal	Correlation coefficient	1.000	0.447**
		Sig. (2-tailed)	.	<0.01
		N	63	63
	Productivity	Correlation coefficient	0.45**	1.00
		Sig. (2-tailed)	<0.01	.
		N	63	63

**Correlation is significant at the 0.01 level (2-tailed)

Economic indicators: distribution of farmers based on the price of products and the feasibility of agricultural financial

The price of organic rice production varies between Rp 3,500 – Rp. 13,000 per kilogram (*Table 3*).

***Table 3.** Descriptive statistics distribution of farmers based on product prices and financial feasibility of organic rice farming*

	Valid N (listwise)	Minimum	Maximum	Mean	Std. deviation
Product prices	63	3,500.00	13,000.00	7,084.92	2,899.99
Financial feasibility	63	1.04	9.53	3.30	2.08

The spread of eligibility values is almost entirely more than one. However, most of these values still range from 2 – 4, with an overall average of 3.3 (*Table 3*). Thus, the value is still relatively close to number one as a limiting number. The higher the feasibility value, of course, the higher the profit obtained by farmers. The highest feasibility score achieved was 9.53. Thus, the optimal allocation of resources can still increase the potential benefits of organic rice farming.

Social indicators: group participation and response to organic farming

Most farmers still have low participation in group activities. Overall the average participation score of 2.57 indicates low farmer participation in the group (*Table 4*). However, the answers shown by farmers are mostly still limited to those who agree with organic farming.

Sustainability value of organic rice farming

The highest bio-physical indicator value in organic rice farming is the soil fertility score. In contrast, the proportion score of input usage and application length is still low in the score. In general, bio-physical indicators are still low realistic with a score of 3.3 or 66% sustainability achievement (*Table 5*).

Economic indicators of sustainability value consist of product prices in 2020 and financial feasibility indicated by R/C ratio. Score 1 if R/C < 1.5; score 2 if R/C 1.5 - 2.5: score 3 if R/C = 2.5-3.5; score 4 if R/C 3.5 - 4.5; and score 5 if R/C > 4.5. These two indicators score does not differ much and is relatively low because it only ranges from 2 -3 score achievements obtained (*Table 6*).

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/2105_49434955

Table 4. *Descriptive statistics of farmer distribution based on participation in groups and response to organic farming*

	Valid N (listwise)	Minimum	Maximum	Mean	Std. deviation
Participation	63	2.00	4.00	2.57	0.80
Response to organic	63	1.00	5.00	3.22	1.13

Table 5. *Biophysical indicators of the sustainability of organic rice farming*

Sub indicator	Score
Soil fertility	4.17
Proporsi input internal	2.62
Implementation duration	2.70
Production	3.83
Total	13.32
Average	3.33

Source: Primary data analysis 2020

Table 6. *Economic indicators of sustainability of organic rice farming*

Sub indicators	Score
Product prices	2.38
Feasibility	2.82
Total	5.20
Average	2.60

Source: Primary data analysis 2020

The score of social indicators of the sustainability of organic rice farming is relatively low two sub-indicators of both group participation and farmers' response to organic farming show relatively low scores (*Table 7*). *Table 8* shows the sustainability value of organic rice farming in Yogyakarta.

The score of social indicators of the sustainability of organic rice farming is relatively low.

Discussion

Bio-physical indicators: soil fertility, the proportion of internal inputs, length of application, and productivity of organic rice

The distribution of soil fertility values shows that most of them are in a relatively fertile and fertile range of conditions. This data illustrates that organic farming positively impacts soil fertility conditions, thus providing hope for sustainable agriculture in rice farming. Soil as a planting medium is one of the critical elements for sustainable agriculture. It is necessary to sustain soil fertility conditions through enhancing the soil's physical, biological, and chemical characteristics. Ideal conditions for soil properties will support optimal plant growth. Hence, the productivity and quality of crop yields will be better. High soil fertility is achieved by using soil

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/2105_49434955

conservation techniques, which also lower production costs (Luangduangsitthideth et al., 2019). Internal input is agricultural input that comes from the internal environment of cultivated organic rice farming. Internal inputs commonly used by farmers include Solid Organic Fertilizers (SOF) made from animal manure, compost (plant waste) made by farmers, and other natural materials such as vegetable pesticides. These internal inputs are generated from the remains of plant and livestock waste.

Table 7. *Social Indicators of sustainability of organic rice farming*

Sub indicators	Score
Group participation	2.57
Response to organic farming	3.22
Total	5.79
Average	2.90

Source: Primary data analysis 2020

Table 8. *Achievement of organic rice farming sustainability score*

Indicators	Score
Bio-physical	3.33
Economic	2.60
Social	2.90
Weighted average	3.04

Source: Primary data analysis 2020

Organic agriculture, which is ideal for sustainable agriculture, uses external inputs that are lower than internal inputs. Such a system is commonly referred to as low external input farming. In reality, not all farmers use internal input. Some farmers have not processed their organic materials into internal inputs. Meanwhile, some others do not have the organic material resources processed into internal inputs such as manure and compost. Fewer inputs needed and higher input prices resulting in a decrease in costs with Organic Farming (Perrin et al., 2020).

Organic agriculture has been introduced to rice farmers in Yogyakarta, Indonesia, for a long time. Organic agriculture has been introduced since the 1990s to a small number of farmer groups. Then, this introduction began to be widely implemented in the early 2000s, becoming a government program in 2007 until now. The average application of organic agriculture is 16.67 years. However, the application of organic agriculture takes place gradually, starting from the introduction of the transition period slowly so that organic agriculture does not fully use organic fertilizers and pesticides. The period of introduction and implementation also experiences ups and downs due to various external factors that can influence it. This condition cannot be separated from the existing socioeconomic and environmental conditions. Policy issues, unstable prices for products and inputs, and frequent erratic climate changes have contributed to the development of organic agriculture in Yogyakarta, Indonesia. In terms of boosting the buildup of soil organic carbon, concentrated ditch-buried straw returns over an extended time provide clear advantages over alternative approaches. Straw replacement and minimal or no tillage together enhance the quantity and quality of soil's organic carbon (Jin et al., 2020).

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/2105_49434955

Productivity is one of the strategic indicators for sustainable agriculture. This technical indicator will affect the economic indicator, which will affect the income and profit of farmers. This indicator is also a measure of the success of farmers in the application of organic agriculture.

The more significant the organic-based internal inputs are, the higher the potential for productivity improvement will be. Therefore, the use of internal inputs based on organic matter is one of the critical keys in applying sustainable agriculture in achieving the welfare of farmers.

Economic indicators: distribution of farmers based on the price of products and the feasibility of agricultural financial

In addition to product quality, the cost of organic rice is also highly determined by consumer preferences. In general, consumers will consume organic rice at a relatively higher price than other rice. Nevertheless, the choice of varieties also determines the price of organic rice products.

Based on the price range found in the field, organic rice has a high potential economic value. Therefore, it is essential to be further reviewed to identify varieties related to productivity and price. Furthermore, it is necessary to determine the types that consumers are interested in at a high price but still have increased productivity. Organic farming will ensure the welfare of farmers as the main culprit. The financial feasibility of organic rice farming is analyzed based on the ratio between the value of receipts from rice products and the total cost that farmers have incurred in one farming season. In general, farming is feasible if the financial feasibility value of the analysis results is more than one ($R/C > 1$).

Social indicators: group participation and response to organic farming

The involvement of farmers in group activities has an essential role in sustainable agriculture. Agricultural information and technology dissemination activities are usually carried out through actions that take place in farmer groups. These activities are generally in counseling and training of appropriate technology to support sustainable agriculture.

This condition will hinder the adoption process of organic farming technology innovations related to sustainable agriculture. In more detail, it appears that a small percentage of active farmers are the caretakers of farmer groups and a combination of farmer groups. Therefore, it is essential to review the framework of strategies to encourage farmers’ participation in the development of sustainable agriculture.

Farmers’ response to organic farming is one of the essential aspects of the development of sustainable agriculture. In general, the farmers’ responses are relatively good. Related to the practice of applying organic agriculture, they are still reluctant or have not been fully executed. Therefore, it is necessary to educate and empower farmers so that organic agriculture can continue to develop to lead to sustainable agriculture.

Sustainability value of organic rice farming

An essential key to this condition is the proportion of internal input usage that can still be increased to impact soil fertility rates and increased organic rice production. In general, the average score of new economic indicators reaches 52% achievement of its sustainability value. However, economic indicators that are strategic indicators become

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/2105_49434955

urgent because they directly affect the welfare of farmers. Therefore, policy interventions related to prices and subsidies are essential to note). Group participation is one of the strategic sub-indicators in improving the farmers' sustainable agriculture because group participation can be a driver in agricultural development. If the group's participation can be increased, farmers' responses will also increase. Thus, sustainable agriculture can be improved.

Two sub-indicators of both group participation and farmers' response to organic farming shows relatively low scores. Group participation is one of the strategic sub-indicators in improving sustainable agriculture because group participation can be a driver in agricultural development. If the group's participation can be increased, farmers' responses will also increase. Thus, sustainable agriculture can be improved. Organic farming as sustainable agriculture can contribute to achieving food security, although organic farming yields are lower. It can be done to achieve food security by increasing the crop index.

The sustainability value of organic rice growing in Yogyakarta, Indonesia, can be determined by using the following formula to the success score of the industry's sustainability:

$$\text{Sustainability value} = \frac{\text{score achievemet}}{\text{maximum score}}\ x\ 100\% \\ = \frac{3{,}3039109}{5}\ x\ 100\% = 60{,}78\ \%$$

The sustainability value of 60.78% shows that the sustainability level of organic rice farming is sustainable.

Conclusion

The organic farming development in Yogyakarta, Indonesia, has not gone well or Moderately Sustainable in sustainable agriculture, as indicated by a Sustainability Value of 60.78%. The production facilities independently, the perception and appreciation of the community towards organic agricultural products become obstacles and constraints of organic farming development. This study contributes to the sustainable agriculture to achieve food security.

Acknowledgments. Thank you to The University of Muhammadiyah Yogyakarta for providing internal funding to implement non-collaborative Basic research in 2020.

REFERENCES

[1] Adamashvili, N., Fiore, M., Contò, F., La Sala, P. (2020): Ecosystem for successful agriculture. Collaborative approach as a driver for agricultural development. – Eur. Countrys. 12(2): 242-256. DOI: 10.2478/euco-2020-0014.

[2] Amanullah et al. (2020): Nitrogen contents in soil, grains, and straw of hybrid rice differ when applied with different organic nitrogen sources. – Agric. 10(9): 1-14. DOI: 10.3390/agriculture10090386.

[3] Arunrat, N., Kongsurakan, P., Sereenonchai, S., Hatano, R. (2020): Soil organic carbon in sandy paddy fields of Northeast Thailand: a review. – Agronomy 10(8. DOI: 10.3390/agronomy10081061.
[4] Ashari, N., Sharifuddin, N., Abidin, M. Z. (2018): Factors determining organic farming adoption: international research results and lessons learned for Indonesia. – Forum Penelit. Agro Ekon. 35(1): 45. DOI: 10.21082/fae.v35n1.2017.45-58.
[5] Beeby, J., Moore, S., Taylor, L., Nderitu, S. (2020): Effects of a one-time organic fertilizer application on long-term crop and residue yields, and soil quality measurements using biointensive agriculture. – Front. Sustain. Food Syst. 4(June. DOI: 10.3389/fsufs.2020.00067.
[6] Binta B. A., Barbier, B. (2015): Economic and environmental performances of organic farming system compared to conventional farming system: a case farm model to simulate the horticultural sector of the Niayes Region in Senegal. – J. Hortic. 02(04. DOI: 10.4172/2376-0354.1000152.
[7] Clark, S. (2020): Organic farming and climate change: the need for innovation. – Sustain. 12(17. DOI: 10.3390/su12177012.
[8] Cui, N. et al. (2020): Runoff loss of nitrogen and phosphorus from a rice paddy field in the east of China: effects of long-term chemical N fertilizer and organic manure applications. – Glob. Ecol. Conserv. 22: e01011. DOI: 10.1016/j.gecco.2020.e01011.
[9] Dat, T. T., Truong, D. D., Huan, L. H., Hang, N. D. (2023): Cost–benefit analysis of organic and traditional rice production in Mekong River Delta: the case of Ca Mau Province, Vietnam. – Appl. Ecol. Environ. Res. 21(2020): 503-518. DOI: http://dx.doi.org/10.15666/aeer/2101_503518.
[10] De Ponti, T., Rijk, B., Van Ittersum, M. K. (2012): The crop yield gap between organic and conventional agriculture. – Agric. Syst. 108): 1-9. DOI: 10.1016/j.agsy.2011.12.004.
[11] He, J. et al. (2020): Effect of a fish–rice co-culture system on the growth performance and muscle quality of tilapia (Oreochromis niloticus). – Aquac. Reports 17(February): 100367. DOI: 10.1016/j.aqrep.2020.100367.
[12] He, S., Wang, X., Wu, X., Yin, Y., Q. L., Ma (2020): Using rice as a remediating plant to deplete bioavailable arsenic from paddy soils. – Environ. Int. 141(February) 105799. DOI: 10.1016/j.envint.2020.105799.
[13] Iqbal, A. et al. (2020): Manure combined with chemical fertilizer increases rice productivity by improving soil health, post-anthesis biomass yield, and nitrogen metabolism. – PLoS One 15(10 October): 1-24. DOI: 10.1371/journal.pone.0238934.
[14] Jabran, K., Ullah, E., Akbar, N. (2015): Mulching improves crop growth, grain length, head rice and milling recovery of basmati rice grown in water-saving production systems. – Int. J. Agric. Biol. 17(5): 920-928. DOI: 10.17957/IJAB/15.0019.
[15] Jin, Z., Shah, T., Zhang, L., Liu, H., Peng, S., Nie, L. (2020): Effect of straw returning on soil organic carbon in rice–wheat rotation system: a review. – Food Energy Secur. 9(2): 1-13. DOI: 10.1002/fes3.200.
[16] Leitner, C., Vogl, C. R. (2020): Farmers' perceptions of the organic control and certification process in Tyrol, Austria. – Sustain. 12(21): 1-18. DOI: 10.3390/su12219160.
[17] Liu, Q., Yu, Z. Y., Wang, X. M., Zhao, S. L. (2022): Organic fertilizer increases soil organic carbon and crop yield in four-year tillage and crop rotations on the Loess Plateau, China. – Appl. Ecol. Environ. Res. 20(5): 4271-4282. DOI: 10.15666/aeer/2005_42714282.
[18] Luangduangsitthideth, O., Limnirankul, B., Kramol, P. (2019): Farmers' knowledge and perceptions of sustainable soil conservation practices in Paklay district, Sayabouly province, Lao PDR. – Kasetsart J. Soc. Sci. 40(3): 650-656. DOI: 10.1016/j.kjss.2018.07.006.
[19] Ntakirutimana, L., Li, F., Huang, X., Wang, S., Yin, C. (2019): Green manure planting incentive measures of local authorities and farmers' perceptions of the utilization of

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/2105_49434955

rotation fallow for sustainable agriculture in Guangxi, China. – Sustain. 11(10. DOI: 10.3390/su11102723.

[20] Panpluem, N., Mustafa, A., Huang, X., Wang, S., Yin, C. (2019): Measuring the technical efficiency of certified organic rice producing farms in Yasothon Province: Northeast Thailand. – Sustain. 11(24. DOI: 10.3390/su11246974.

[21] Perrin, A., Milestad, R., Martin, G., (2020): Resilience applied to farming: organic farmers' perspectives. – Ecol. Soc. 25(4): 1-17. DOI: 10.5751/ES-11897-250405.

[22] Photphisutthiphong, Y., Vatanyoopaisarn, S. (2020): The production of bacterial cellulose from organic low-grade rice. – Curr. Res. Nutr. Food Sci. 8(1): 206-216. DOI: 10.12944/CRNFSJ.8.1.19.

[23] Pinthukas, N. (2015): Farmers' perception and adaptation in organic vegetable production for sustainable livelihood in Chiang Mai Province. – Agric. Agric. Sci. Procedia 5: 46-51. DOI: 10.1016/j.aaspro.2015.08.007.

[24] Puntsagdorj, B., Orosoo, D., Huo, X., Xia, X. (2021): Farmer's perception, agricultural subsidies, and adoption of sustainable agricultural practices: a case from Mongolia. – Sustain. 13(3): 1-16. DOI: 10.3390/su13031524.

[25] Rigby, D., Cáceres, D. (2001): Organic farming and the sustainability of agricultural systems. – Agric. Syst. 68(1): 21-40. DOI: 10.1016/S0308-521X(00)00060-3.

[26] Rodriguez, G. D. P. (2020): An assessment of the site-specific nutrient management (SSNM) strategy for irrigated rice in Asia. – Agric. 10(11): 1-28. DOI: 10.3390/agriculture10110559.

[27] Sevinç, M. R. (2021): Farmers' perception of agricultural cooperatives: the case of Şanlıurfa, Turkey. – Ciência Rural 51(3): 1-11. DOI: 10.1590/0103-8478cr20200445.

[28] Tahat, M. M., Alananbeh, K. M., Othman, Y. A. Leskovar, D. I. (2020): Soil health and sustainable agriculture. – Sustain. 12(12): 1-26. DOI: 10.3390/SU12124859.

[29] Tran, N. L. D., Rañola, R. F., Sander, B. O., Reiner, W., Nguyen, D. T., Nong, N. K. N. (2019): Determinants of adoption of climate-smart agriculture technologies in rice production in Vietnam. – Int. J. Clim. Chang. Strateg. Manag. 12(2): 238-256. DOI: 10.1108/IJCCSM-01-2019-0003.

[30] Yan, S. et al. (2020): Changes in soil organic carbon fractions and microbial community under rice straw return in Northeast China. – Glob. Ecol. Conserv. 22: e00962. DOI: 10.1016/j.gecco.2020.e00962.

[31] Yang, G. et al. (2020): Assessment of productivity, nutrient uptake and economic benefits of rice under different nitrogen management strategies. – PeerJ 8: 1-23. DOI: 10.7717/peerj.9596.

APPENDIX

Questionnaire

Note: Answer each question or statement below by marking (√ or O) and marking (X) if you want to change the answer.	
A. Biophysical indicators	
Soil fertility	
1. The content of organic matter seen from the number of earthworms indicates fertile soil	1 Nothing at all 2 Little 3 Enough 4 Many 5 Very much
2. Fertilizer use in the field use	1 Without farm fertilizer without organic 2 Yes, inorganic only 3 Yes, inorganic fertilizer > organic fertilizer 4 Yes, inorganic fertilizer < organic fertilizer 5 Yes, organic fertilizers only
3. Duration of fertilizer use Organic	1 Never 2 Less than 1 year 3 1–3 years 4 3–5 years 5 More than 5 years
4. Impact of organic farming on production	1 Production down 2 Fixed production 3 Production increased slightly 4 Production has increased considerably 5 Production increased significantly
B. Economic indicators	
1. Higher organic rice harvest prices	1 Strongly disagree 2 Disagree 3 Don’t know 4 Agree 5 Totally agree
2. High profits will be obtained by organic farming (financial feasibility)	1 Strongly disagree 2 Disagree 3 Don’t know 4 Agree 5 Totally agree
C. Social indicators	
1. Farmers always participate in activities, farmer group association or other organizations	1 Strongly disagree 2 Disagree 3 Don’t know 4 Agree 5 Totally agree
2. I feel that I have received good support and response from my neighbors with/if I farm rice organically	1 Strongly disagree 2 Disagree 3 Don’t know 4 Agree 5 Totally agree

http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/2105_49434955