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Assessing the Sustainability of Organic Rice Farming in Kulonprogo Regency, Special Region of Yogyakarta, Indonesia

Eni Istiyanti*, Refrinata Adhitya Nugraha, Nur Rahmawati, Zuhud Rozaki

Department of Agribusiness, Faculty of Agriculture, Universitas Muhammadiyah Yogyakarta, 55183 Yogyakarta, Indonesia

* Correspondence: Eni Istiyanti (eniistiyanti@umy.ac.id)

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Abstract: Organic rice farming in Kulonprogo Regency, recognized by the Indonesian government as a pioneering region for organic agriculture, has been increasingly adopted as a sustainable agricultural practice. However, the implementation of organic rice farming systems continues to face significant challenges that hinder their full potential. This study evaluates the sustainability of organic rice farming in Kulonprogo Regency using the Multidimensional Scaling (MDS) technique, facilitated by the Rapfish application, across three critical dimensions: ecological, economic, and social. Data were collected from 70 respondents across three farmer groups—Srijati, Tegal Mulyo, and Jatingarang Lor—selected through a census method, all of which have fully transitioned to organic rice farming practices. The sustainability indices derived from the analysis revealed that the ecological dimension scored 87.79%, indicating a "sustainable" status, while the economic and social dimensions scored 52.35% and 71.61%, respectively, both categorized as "quite sustainable." These findings underscore the ecological robustness of organic rice farming in the region while highlighting the need for targeted interventions to enhance economic viability and social acceptance. Overall, the sustainability level of organic rice farming in Kulonprogo Regency was classified as "moderately sustainable." The validity of the analysis was confirmed through a Standardized Residual Sum of Squares (STRESS) value of 0.25%, which is categorized as "excellent," ensuring the reliability and accuracy of the results. This study provides critical insights into the sustainability dynamics of organic rice farming, offering a foundation for policymakers and stakeholders to develop strategies that address existing challenges and promote long-term sustainability in the region. These findings indicate the urgency of implementing sustainable agricultural practices in organic rice cultivation, as well as the strategic role of government support in price stabilization policies, waste management, and equitable program distribution to strengthen the economic, ecological, and social aspects of the sustainable agricultural system.

Keywords: Multidimensional scaling analysis; Organic rice farming; Rapfish; Sustainability assessment

1. Introduction

The agriculture, forestry, and fishery sectors play a strategic role in Indonesia's economy. In 2022, these sectors contributed 12.40% to the Gross Domestic Product (GDP) and served as pillars of economic stability, particularly during the COVID-19 pandemic (Siregar et al., 2024). Furthermore, these sectors are the primary source of employment, absorbing 28.18% of the national workforce (BPS, 2024). Beyond their economic significance, these sectors form the foundation for social welfare and community sustainability. Organic agriculture has gained increasing attention in recent decades due to its contributions to environmental sustainability and public health (Rempelos et al., 2021). This system eliminates the use of synthetic chemicals, replacing them with natural inputs that promote soil and plant health (Wijesinghe et al., 2023). Such an approach not only aims to enhance agricultural yields but also ensures ecosystem sustainability, a critical element in sustainable farming practices.

Rice, as Indonesia's staple food commodity, holds significant potential for organic cultivation (Dermiyati & Niswati, 2015). Organic rice farming focuses on environmentally friendly methods, avoiding chemical fertilizers and synthetic pesticides. In addition to producing healthy food, this practice preserves soil fertility and supports environmental sustainability, positioning organic rice as a strategic choice to promote sustainable agricultural systems (Asfawi et al., 2020). Sustainability in the agricultural sector aims to integrate three primary dimensions (Jamaludin et al., 2020): (a) the economic dimension, which involves optimizing resource efficiency, setting appropriate pricing, reducing production costs, increasing income, and achieving profitability; (b) the ecological dimension, which focuses on reducing pollution, improving soil quality, conserving biodiversity, and maintaining ecosystem balance; and (c) the social dimension, which includes improving community welfare, respecting local cultural values, providing safe and healthy products, creating decent working environments, and strengthening social harmony within communities.

Kulonprogo Regency, Special Region of Yogyakarta, is one of the regions that has successfully developed organic agriculture. There are 13 farmer groups in the area, three of which have obtained organic certification. These groups have implemented organic methods since 2008 and received official certification from the organic certification body (LeSOS) in 2020. As of September 2024, the certification has expired, requiring renewal that involves significant costs. This financial challenge is a major barrier to the development of organic farming systems, potentially hindering the long-term sustainability of organic rice farming from a social dimension. Economically, the operational costs of organic rice farming tend to be higher than conventional systems due to the nature of organic materials, which require repeated application for optimal results, thereby increasing farming expenses (Tashi & Wangchuk, 2016). From an ecological perspective, challenges include the irrigation system in Kulonprogo, which operates on a single-channel system, potentially contaminating organic rice fields due to water flow from conventional rice fields. These challenges pose significant threats to the development of organic rice farming in Kulonprogo as a pioneering organic area.

Research on the sustainability of organic rice farming has been widely conducted, with findings indicating that organic rice cultivation systems still face various challenges, particularly in technical aspects that are more complex compared to non-organic rice. However, previous studies have generally focused only on factors that hinder sustainability in a general sense (Humaidi et al., 2021; Heryadi & Rofatin, 2017; Permatasari et al., 2021). Therefore, this study aims to comprehensively evaluate the sustainability of organic rice farming using an MDS approach, which encompasses three key dimensions: economic, ecological, and social. The objective of this research is to assess the sustainability level of organic rice farming in Kulonprogo Regency based on these dimensions, thereby providing a more comprehensive understanding of the factors influencing sustainability and formulating strategic recommendations for improvement.

2. Methodology

2.1 Research Location

This research was conducted in Kulonprogo Regency, Special Region of Yogyakarta, as shown in Figure 1. The selection of this location was based on its designation as a pioneering organic area by the Kulonprogo government and its certification by the organic certification body (LeSOS).

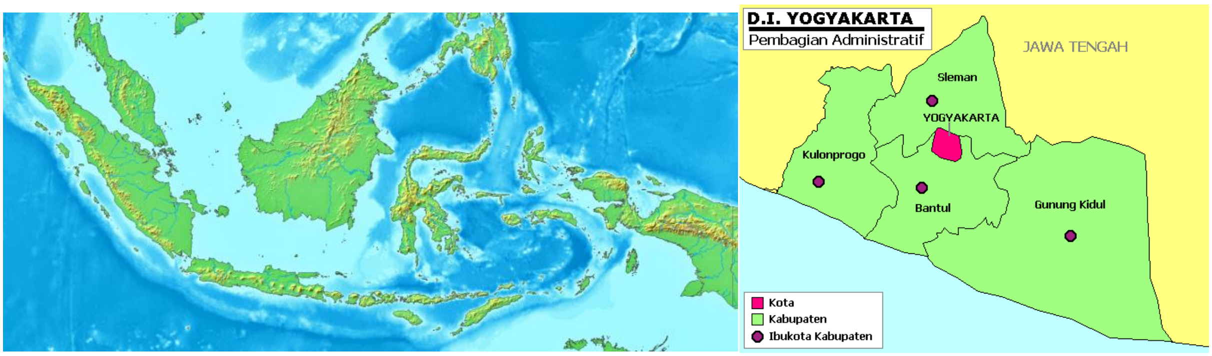

Figure 1. Research location
Source: Fitriah (2024).

2.2 Sample Procedures and Data Collection

The selection of informants in this study was conducted using the census method, in which data was collected from all members of the organic rice farmer group in Kulonprogo Regency, totaling 70 respondents. Data collection was carried out through structured interviews guided by a questionnaire. The number of respondents from each farmer group is presented in Table 1. The questionnaire was designed based on three main dimensions of sustainability (economic, ecological, and social), utilizing closed-ended questions on a Likert scale. Data collection took place from May to June 2024, focusing on factors influencing organic rice farming practices. The data collected was subsequently analyzed to evaluate the sustainability level based on the three key dimensions.

Table 1. Number of research respondents

Farmer Group	Number of Respondents (Farmers)
Srijati	24
Tegal Mulyo	21
Jatingarang Lor	25
Total	**70**

Source: Badan Pusat Statistik Kabupaten Kulon Progo (2023)

The total number of attribute statements in this study consisted of 21 attributes, evenly distributed across the three main dimensions (Melo, 2021): economic, ecological, and social, with each dimension encompassing seven attributes, as detailed in Table 2. The selection of these attributes was based on the study by Jamaludin et al. (2020). Initially, the Rapfish application, utilizing the MDS approach, was developed to analyze the sustainability of the fishery sector. However, it has since evolved to be applied across various sectors, including agriculture (Yusuf et al., 2021). Therefore, this study is relevant as a basis for determining the sustainability indicators of organic rice farming in Kulonprogo Region, Special Region of Yogyakarta, by assessing three key dimensions (economic, ecological, and social).

Table 2. Indicators of sustainability

Economy	Ecology	Social
Input utilization	Land suitability	Farmer membership
Market access	Fertilizer level	Role of farmer groups
Stability of selling price	Pesticide level	Role of farmer group leaders
Contribution of sales revenue	Pest control methods	Farmers’ activeness in communities
Capital assistance	Irrigation usage	Role of extension officers
Consumer interest	Waste management	Government programs
Selling price determination	Post-farming impact	Distribution of assistance

Source: Yusuf et al. (2021)

The economic dimension focuses on the efficiency of input utilization and the enhancement of farmers' incomes. The input utilization attribute evaluates how efficiently farmers use inputs to achieve optimal yields. Market access determines the distribution channels and farmers’ access to organic rice markets. Price stability assesses the fluctuations in organic rice prices in the market and their impact on farmers’ incomes. The contribution of sales revenue measures the extent to which organic rice sales contribute to farmers’ total income, both individually and collectively. Capital assistance evaluates farmers’ access to financial support from the government, cooperatives, or financial institutions, as well as its influence on the adoption of organic farming practices. Consumer interest assesses the level of consumer awareness and demand for organic rice products. Finally, selling price determination identifies the mechanisms used to set the selling price of organic rice, considering factors such as production costs, profit margins, and consumer purchasing power.

The ecological dimension emphasizes reducing pollution levels, improving soil quality, and maintaining ecosystem balance sustainably (Tagliani & Walter, 2018). Land suitability evaluates the compatibility of the land based on its physical and ecological characteristics to support organic rice production. Fertilizer application measures its sustainable use in maintaining soil fertility. Pesticide application assesses the reduction of chemical pesticide use to protect biodiversity. Pest control methods evaluate the techniques employed by farmers to maintain ecosystem balance. Irrigation usage examines water efficiency in organic rice farming. Waste management assesses how organic rice farmers manage waste to minimize pollution. Lastly, post-farming impacts evaluate the environmental and economic sustainability outcomes after harvest (Wang et al., 2024).

The social dimension focuses on the livelihoods and social well-being of farmers and farmer groups (Janker et al., 2019). Farmer membership evaluates whether all organic rice farmers are members of farmer groups. The role of farmer groups assesses their effectiveness in improving coordination, access to information, and technical assistance. The role of farmer group leaders evaluates their leadership in guiding and motivating members. Farmers' activeness in communities measures their contributions to social and farmer group activities. The role of agriculture extension officers assesses their effectiveness in providing technical guidance and innovative information to farmers. Government programs evaluate the success of initiatives aimed at supporting organic farming in Kulonprogo Regency. Finally, assistance distribution assesses the fairness and effectiveness of assistance distribution to ensure equitable support for farmers.

2.3 Analysis Techniques

2.3.1 Descriptive analysis

The quantitative method is a research approach that relies on numerical data to collect, analyze, and interpret information (Abdullah et al., 2022). The process of quantitative data analysis begins with preparing numerical data, which is subsequently analyzed using specialized software. In this study, the determination of class intervals was based on the highest and lowest scores, which were 5 and 1, respectively, using four categories. The division of class intervals was calculated using an evenly distributed class interval calculation. The formula used to determine the length of the class interval is as follows:

$$\text{Score} = \frac{\text{Highest Score} - \text{Lower Score}}{\text{Number of Categories}} = \frac{5-1}{5} = 0.8$$

Table 3 shows the range of indicator values for economic, ecological, and social dimensions.

Table 3. Range of indicator values for economic, ecological, and social dimensions

Score	Category
1.00 – 1.79	Bad
1.80 – 2.59	Less
2.60 – 3.39	Enough
3.40 – 4.19	Good
4.20 – 5.00	Very good

Source: Rozaki et al. (2024)

2.3.2 MDS

The MDS method is a multivariate analysis technique used to determine the position of objects based on their similarities or differences (Yusuf et al., 2021). MDS reduces the dimensions of multidimensional data to lower dimensions, with the aim of assessing the sustainability of each dimension and identifying imbalances between dimensions. Based on the study by Farid et al. (2024), data processing was performed using the Rapfish software in Microsoft Excel, resulting in a sustainability index with a range of 0-100% (Table 4).

Table 4. Sustainability index values and categories

Index Value (%)	Category	Description
0.00 – 25.00	Less	Unsustainable
25.01 – 50.00	Enough	Less sustainable
50.01 – 75.00	Good	Quite sustainable
75.01 – 100.00	Very good	Sustainable

Source: Farid et al. (2024)

The next step is to evaluate the adequacy of the analysis results by comparing them with actual data using the STRESS value. A STRESS value close to 0 indicates a more accurate model in reflecting the actual conditions, with an acceptable tolerance threshold of ≤ 20% (Huang et al., 2016). The STRESS value categories are divided into five groups, as shown in Table 5.

Table 5. Index and category of the STRESS value

STRESS Value (%)	Category
0.00 – 2.50	Excellent
2.51 – 5.00	Very good
5.01 – 10.00	Good
10.01 – 20.00	Enough
≥ 20.00	Less

Source: Yusuf et al. (2021)

In addition to testing the analysis results, the Rapfish application also generates leverage attributes that describe the sustainability level using the Root Mean Square (RMS) value (Yusuf et al., 2021). This value refers to the analysis results of the maximum and minimum values of a function within a specific interval. The analysis of leverage attributes aims to identify the indicators that have the greatest sensitivity to the sustainability level in each dimension of the organic rice farming study in Kulonprogo Regency.

3. Results

3.1 Characteristics of Farmers

Farmer identity refers to a set of characteristics, roles, and attributes attached to individuals working in the agricultural sector (Fauzi et al., 2024). In this study, respondents were selected from the members of the organic rice farmer groups: Srijati with 24 farmers, Tegal Mulyo with 21 farmers, and Jatingarang Lor with 25 farmers, resulting in a total of 70 respondents. The characteristics of farmers were categorized based on age, gender, highest education level, farming experience, land ownership status, and land area (Table 6).

Age refers to the amount of time calculated from an individual's birth date to the present day, typically represented in years (Ramos & Fooken, 2024). The organic rice farmers in Kulonprogo Regency recorded the youngest farmer at 42 years old and the oldest at 81 years old. The average age of respondents is 60 years, indicating that most respondents are elderly but still within the productive age category. Regarding gender, the majority are male, comprising 83%, while the remaining 17% are female, as shown in the table. Female organic rice farmers are typically the wives of male farmers who work together in managing the farm.

Table 6. Characteristics of organic rice farmers in Kulonprogo Regency

Characteristics	Number (person)	Percentage (%)
Age (years)		
42 – 50	12	17.14
51 – 58	24	34.29
59 – 66	13	18.57
67 – 74	15	21.43
≥ 75	6	8.57
Total	**70**	**100.00**
Gender		
Man	58	82.86
Woman	12	17.14
Total	**70**	**100.00**
Education		
Not in school	3	4.29
Elementary school	14	20.00
Junior high school	14	20.00
Senior high school	34	48.57
University	5	7.14
Total	**70**	**100.00**
Farming Experience (years)		
1 – 7	55	78.57
8 – 13	10	14.29
14 – 19	1	1.43
20 – 25	3	4.28
≥ 26	1	1.43
Total	**70**	**100.00**
Land Ownership Status		
Owned land	51	72.86
Rented land	6	8.57
Profit sharing	13	18.57
Total	**70**	**100.00**
Land Area (m^2)		
250 – 1.200	41	58.57
1.201 – 2.250	22	31.43
2.251 – 3.300	5	7.14
3.301 – 4.350	0	0.00
≥ 4.351	2	2.86
Total	**70**	**100.00**

Source: The authors

Educational level also influences the adoption of technology and agricultural knowledge among farmers (Ochieng et al., 2020). More than 50% of the organic rice farmers in Kulonprogo have an education level equivalent to high school or higher, while only 4% of respondents have never attended school. In addition to education, the farming experience of farmers also affects organic farming productivity, as experienced farmers are more skilled in applying techniques that support farming success (Wang et al., 2023). The farming experience of organic rice farmers varies, with the shortest experience being only one year and the longest reaching 30 years.

The average farming experience of the respondents is approximately seven years.

Land area is a crucial element that influences production potential, the types of commodities cultivated, and the management strategies applied. According to the table, the average land area for organic rice farming is 1,373 m², with the largest plot being 5,000 m² and the smallest only 250 m². This indicates that most farmers rely on organic rice as the main commodity in their agricultural business. This condition aligns with the designation of Kulonprogo as a pioneering organic farming area. The land under cultivation also has different ownership statuses.

Most organic rice farmers manage their own land, with 51 farmers owning land of varying sizes. Additionally, there are 13 farmers who implement a profit-sharing system with a 50:50 distribution, where the tenant farmer covers all production costs for organic rice farming. Moreover, there are six farmers who rent land at a rate of IDR 1,500,000/1,000 m²/year. This rental system was chosen by farmers who do not own land but still wish to engage in organic rice farming.

3.2 Descriptive Analysis

The initial stage of sustainability analysis begins with evaluating the scores for each indicator within the dimensions used to analyze respondents' answers based on the available data (Pollesch & Dale, 2016). This evaluation aims to provide an initial overview of data distribution and the patterns formed without affecting the results in the Rapfish analysis. The obtained scores help identify indicators that have the greatest influence on sustainability in each dimension (Heydari & Osanloo, 2024).

Table 7. Descriptive analysis results of each dimension

	Economic Dimension	
Indicator	**Score**	**Category**
Input utilization	3.46	Good
Market access	3.53	Good
Stability of selling price	2.67	Enough
Contribution of sales revenue	3.26	Enough
Capital assistance	2.19	Less
Consumer interest	3.74	Good
Selling price determination	2.84	Enough
Average	**3.10**	**Enough**
	Ecology Dimension	
Indicator	**Score**	**Category**
Land suitability	3.96	Good
Fertilizer level	4.69	Very good
Pesticide level	4.69	Very good
Pest control methods	4.53	Very good
Irrigation usage	4.27	Very good
Waste management	4.59	Very good
Post-farming impact	4.56	Very good
Average	**4.47**	**Very good**
	Social Dimension	
Indicator	**Score**	**Category**
Farmer membership	5.00	Very good
Role of farmer groups	4.14	Very good
Role of farmer group leaders	3.96	Good
Farmers' activeness in communities	4.43	Very good
Role of extension officers	4.06	Good
Government programs	3.42	Good
Distribution of assistance	3.59	Good
Average	**4.09**	**Good**

Source: The authors

Based on Table 7, the highest indicator in the economic dimension is "consumer interest" with a score of 3.74, categorized as good. Field conditions show that organic rice has a segmented market, making it easier to sell the harvest. The farmer group leader acts as a collection point for processed organic rice to be sold. In contrast, the lowest score is found in the indicator of availability of capital/credit assistance for farming, with a score of 2.19. Field conditions indicate that there is no presence of credit institutions, which becomes a barrier for farmers facing challenges in starting agricultural activities. Overall, the economic dimension shows a sustainability level in the "enough" category.

In the ecological dimension, the highest indicator is "fertilizer and pesticide levels," with a score of 4.69, categorized as very good. Based on field conditions, all organic rice farmers already use organic fertilizers and pesticides. The raw materials come from kitchen waste and residues from organic rice waste itself, fermented with a mixture of other organic materials. Meanwhile, the lowest score is recorded in the "land suitability" indicator, with a score of 3.96, still within the "good" category. Field conditions show that farmers have gradually implemented the use of organic materials on the land over the last ten years, and some farmers have been doing so even earlier. As a result, the nutrient structure in the soil has been optimally formed, and the land used for farming activities is suitable. Therefore, overall, the ecological dimension shows a sustainability level in the "very good" category, making it the highest among the other dimensions.

In the social dimension, the highest-scoring indicator is “farmers' membership” in farmer groups, with a score of 5.00, reflecting the high level of farmer involvement in these groups. Based on field data, all organic rice farmers are members of farmer groups, including Srijati, Tegal Mulyo, and Jatingarang Lor. Farmer groups play a role encompassing the entire production chain, from input preparation and farming processes to the marketing of harvested products. The sale of organic rice is conducted through cooperatives, with the primary consumers being government institutions in Kulonprogo Regency.

Meanwhile, the lowest-scoring indicator is the implementation of “government programs”, which is rated as good with a score of 3.42. Although this is the lowest score, it still falls within the "good" category. The government programs implemented in Kulonprogo to support organic rice farming include the provision of seeds, fertilizers, and pesticides as production materials. In addition, there are also assistance programs from agricultural extension officers who provide technical guidance to organic rice farmers both in terms of materials and on-site assistance in the fields. Overall, based on the social dimension, organic rice farming in Kulonprogo Regency is categorized as "good."

3.3 Analysis Using Rapfish

3.3.1 Economic dimension

Based on the Rapfish analysis results for the economic dimension in Table 8, the lowest index is 31.24%, and the highest is 77.67%. Overall, the sustainability index for the economic dimension is 52.35%, which falls under the "quite sustainable" category. According to findings in the field, organic rice cultivation in Kulonprogo shows positive contributions to improving farmers' welfare, especially in economic aspects. However, the implementation of organic rice farming still faces various challenges that affect its sustainability. One of the primary challenges associated with organic rice production is its market instability. Although the price of organic rice is higher than that of conventional rice, the difference is not substantial enough to consistently incentivize farmers and consumers to prioritize its adoption.

Table 8. Sustainability index and STRESS value of the economic dimension

Economic Dimension	Index (%)	Category
Highest	77.67	Sustainable
Lowest	31.24	Less sustainable
Average	52.35	Quite sustainable
STRESS	0.25	Excellent

Source: The authors

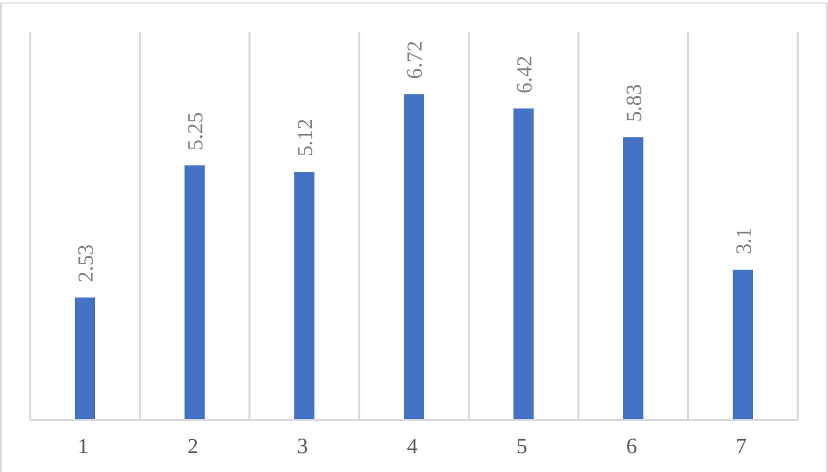

Figure 2. Leverage factors of the economic dimension
Note: 1: Selling price determination, 2: Consumer interest, 3: Capital assistance, 4: Contribution of sales revenue, 5: Stability of selling price, 6: Market access, 7: Input utilization

This condition creates disincentives for farmers to continue adopting organic farming systems. Additionally, the limited availability of financing institutions for organic rice farmers poses another significant barrier. The lack of access to adequate initial capital often hinders farmers from developing organic rice farming, thus obstructing the transformation from conventional agriculture to a more sustainable farming system. The validation test results for the economic dimension of organic rice farming in Kulonprogo Regency show an index of 0.25% and are categorized as excellent. The STRESS value, which approaches zero, reflects a decreasing level of analysis error, meaning the analysis results can be considered valid and accurate (Riad & Zhang, 2020).

Based on Figure 2, the leverage of attributes analysis for the economic dimension shows that the indicator "contribution of (organic rice) sales revenue" to farmers' income occupies the most extreme position in accordance with the law of value/extreme bar principle. This indicator has the highest RMS value of 6.72, which is higher than all other indicators. In the field, organic rice has its own distinct market. The farmer groups play a key role in marketing processed rice. Therefore, farmers do not need to sell their harvest independently. With this support, organic rice farmers have easier access to marketing their produce, ultimately helping to increase their income. Consequently, farmers are likely to continue implementing the organic rice farming system.

3.3.2 Ecological dimension

Based on the Rapfish analysis results for the ecological dimension in Table 9, the lowest index is 49.31% and the highest is 99.99%. Overall, the sustainability index for the ecological dimension is 87.79%, categorized as sustainable. This indicates that the sustainability of the farming practice is supported by favorable environmental conditions and facilities that promote eco-friendly practices. According to the conditions at the research site, all organic rice farmers in Kulonprogo fully utilize organic waste as additional nutrition for organic rice. Waste from the kitchen, such as onion skins, vegetable scraps, and leftover fruits, is mixed into the fertilizers and pesticides that the farmers use on their fields. The leftover harvest from organic rice, such as rice straw and husks, is returned to the fields as compost.

This waste utilization not only reduces production costs but also helps maintain environmental sustainability. Agricultural waste is processed and used as organic fertilizer and pesticide, which reduces the negative environmental impact. The validation test results for the ecological dimension in organic rice farming in Kulonprogo show an index of 0.24%, categorized as excellent. The smaller the STRESS value approaches zero, the lower the analysis error rate, indicating that the ecological dimension analysis results are valid and accurate (Wang et al., 2021).

Table 9. Sustainability index and STRESS value of the ecological dimension

Ecological Dimension	Score (%)	Category
Highest	99.99	Sustainable
Lowest	49.31	Less sustainable
Average	87.79	Sustainable
STRESS	0.24	Excellent

Source: The authors

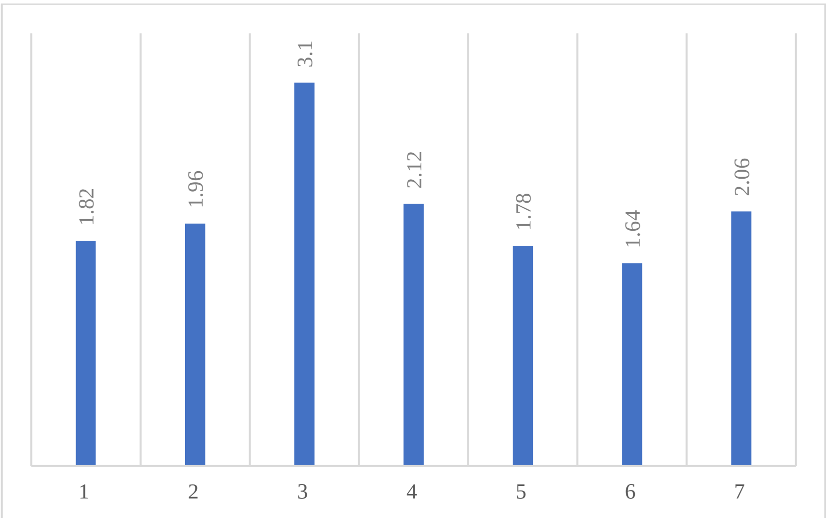

Figure 3. Leverage factors of the ecological dimension

Note: 1: Land suitability, 2: Fertilizer level, 3: Pesticide level, 4: Pest control methods, 5: Irrigation usage, 6: Waste management, 7: Post-farming impact

Based on Figure 3, the leverage of attribute analysis for the ecological dimension shows that the indicator "pesticide level" has the highest RMS value of 3.10, making it the most influential factor in ecological sustainability. On-site conditions indicate that the irrigation system in Kulonprogo Regency utilizes a primary channel sourced from the Progo River. This system is designed to distribute water evenly across the entire organic rice field, thereby promoting the efficient use of water resources. This efficiency is crucial in supporting the sustainability of organic rice farming in the area, given the significant water requirements in rice farming systems.

3.3.3 Social dimension

Based on the Rapfish analysis results for the social dimension in Table 10, the lowest index is 46.70%, and the highest is 95.22%. Overall, the sustainability index for the social dimension is 71.61%, which is categorized as quite sustainable. In the field, all organic rice farmers in Kulonprogo have become members of farmer groups that actively support their farming activities. Farmers who are not members of farmer groups do not have access to these facilities. Additionally, organic rice farmers have had their farmer cards deactivated by the Kulonprogo government, preventing them from purchasing subsidized fertilizers.

Table 10. Sustainability index and STRESS value of the social dimension

Social Dimension	Score (%)	Category
Highest	95.22	Sustainable
Lowest	46.70	Less sustainable
Average	71.61	Quite sustainable
STRESS	0.26	Excellent

Source: The authors

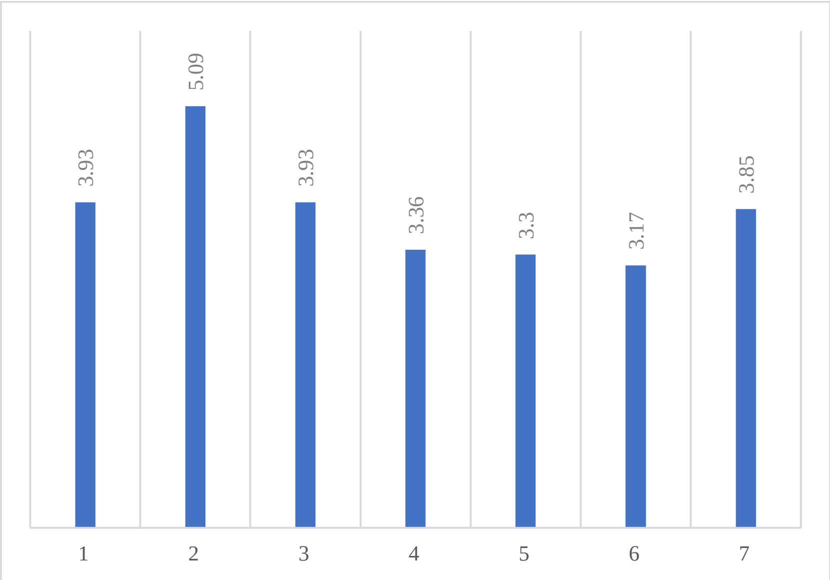

Figure 4. Leverage factors of the social dimension

Note: 1: Farmer membership, 2: Role of farmer groups, 3: Role of farmer group leaders, 4: Farmers' activeness in communities, 5: Role of extension officers, 6: Government programs, 7: Distribution of assistance

The obstacles from this government program are certainly hindrances to the sustainability of organic rice farming in Kulonprogo. The validation test results for the social dimension of organic rice farming show an index of 0.26% and are categorized as excellent. The STRESS value approaching zero indicates that the error in the analysis is increasingly low, making the results of the social dimension analysis valid and accurate.

Based on the analysis graph of leverage of attributes in the social dimension, the indicator "role of farmer groups" has the highest RMS value of 5.09, making it the most influential factor on social sustainability (Figure 4). According to the field conditions, the effective implementation of government programs reflects concrete support for organic rice farmers. These programs include assistance in the form of subsidies for seeds, fertilizers, and pesticides, as well as guidance for farmers. The success of these programs not only enhances public trust but also strengthens farmers' involvement and builds a closer working relationship between the government and farmers. Therefore, the sustainability of the social dimension heavily relies on the effectiveness of government programs (Vlasova & Loginovskikh, 2020).

4. Discussion

The study shows that the ecological dimension exhibits the highest level of sustainability, primarily influenced by using fully organic inputs. Additionally, the recycling of agricultural waste further supports the sustainability of organic rice farming in Kulonprogo Regency. Conversely, the economic dimension demonstrates the lowest level of sustainability, attributed to the limited government support in price regulation, as the price of organic rice remains relatively like that of non-organic rice. Furthermore, the low public interest in purchasing organic rice also contributes to the diminished sustainability within the economic dimension.

This study is in line with the research conducted by Pratama et al. (2024) that examines the sustainability level of rice cultivation systems using three different techniques: organic, semi-organic, and non-organic, where the findings indicate that organic rice cultivation exhibits the highest level of sustainability compared to the other two techniques across all dimensions. The socio-cultural dimension is classified as the most sustainable, followed by the ecological, legal-institutional, and economic dimensions, which fall into the "quite sustainable" category. Ristianingrum et al. (2016) found that the sustainability of organic rice cultivation in Cianjur Regency, West Java, is influenced by several factors. This study shows the same research results where the most significant factor is the contribution of sales revenue, including price, supply chain, and the distance and location of markets. This is due to the relatively limited demand, mainly from middle-to-upper-class consumers with high health awareness. The zoning of organic farmland also plays a crucial role in sustainability, as fields adjacent to conventional farms are at risk of contamination from chemical residues in fertilizers and pesticides, potentially hindering organic rice production.

The sustainability of organic rice farming in this study is supported by Rozaki et al. (2024) who found that the sustainability level of organic rice farming in Central Java and Yogyakarta falls within the quite sustainable category. The use of more modern agricultural tools has contributed to improving farming efficiency in these regions. Additionally, organic rice cultivation is influenced by water availability, although it requires less water than conventional methods (Johannes et al., 2020). Moreover, farmers' relationships with middlemen also impact organic rice sales (Abebe et al., 2016). The existence of a supportive system for organic rice farming is essential for ensuring its long-term viability. Another study by Rozaki et al. (2020) on farmers' responses to organic rice farming in Central Java and South Sulawesi indicates a more positive attitude across various aspects, including perceived benefits, social interactions, and government support, compared to conventional rice farmers. This finding suggests that despite challenges in organic rice farming implementation, such as access to technology and organic certification, increasing awareness of healthy food and growing market demand can serve as key drivers for this transition.

A study conducted in Ratchathani Province, Thailand, shows the sustainability comparison of four rice farming systems practiced by farmers: Organic Rice, Good Agricultural Practices (GAP), the Sustainable Rice Platform (SRP), and Conventional Production (Rattanacharoen et al., 2022). Farmers participating in the organic, GAP, and SRP programs demonstrate higher overall sustainability scores, indicating their compliance with specific standards related to environmentally friendly farming practices, resource utilization, and effective land management. Farm size, farming experience, and rice yield are significant factors influencing farmers' participation in sustainability programs. Notably, farmers with less farming experience tend to be more receptive to new innovations, such as organic practices.

5. Conclusions

The sustainability level of organic rice farming in Kulonprogo Regency, based on descriptive analysis, is classified as "very good" in the ecological dimension and "good" in the social dimension, while the economic dimension falls into the enough sustainable category. Overall, the farming system demonstrates a good level of sustainability. According to the Rapfish application, the overall sustainability of organic rice farming in Kulonprogo Regency, Special Region of Yogyakarta, is categorized as "quite sustainable." The ecological dimension exhibits the highest sustainability index, classified as "sustainable," whereas the economic and social dimensions are categorized as "quite sustainable."

These findings indicate that organic rice farming in the region has achieved a relatively good level of sustainability, particularly in ecological management. However, improvements are still needed in the economic and social dimensions to achieve optimal sustainability. Efforts to enhance the well-being of organic rice farmers in Kulonprogo should focus on stabilizing harvest prices through government-established pricing standards in the economic dimension, optimizing waste management to maintain soil fertility in the ecological dimension, and ensuring equitable implementation of support programs, including the distribution of seeds, fertilizers, and pesticides, in the social dimension. These efforts collectively contribute to the comprehensive sustainability of organic rice farming.

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Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare no conflict of interest.

References

Abdullah, K., Jannah, M., Aiman, U., Hasda, S., Fadilla, Z., Taqwin, Masita, Ardiawan, K., & Sari, M. (2022). *Metodologi Penelitian Kuantitatif*. Yayasan Penerbit Muhammad Zaini.

Abebe, G. K., Bijman, J., & Royer, A. (2016). Are middlemen facilitators or barriers to improve smallholders' welfare in rural economies? Empirical evidence from Ethiopia. *J. Rural Stud.*, *43*, 203-213. https://doi.org/10.1016/j.jrurstud.2015.12.004.

Asfawi, S., Probandari, A., Setyono, P., & Hartono. (2020). Health benefits impact of organic horticulture farming in Semarang Regency, Indonesia. *Pollut. Res.*, *39*(2), 202-206.

Badan Pusat Statistik Kabupaten Kulon Progo. (2023). *Kabupaten Kulon Progo dalam Angka 2023*.

BPS. (2024). Keadaan ketenagakerjaan Indonesia agustus 2024. *Badan Pusat Statistik*, *11*(84), 1-28.

Dermiyati, & Niswati, A. (2015). Improving biodiversity in rice paddy fields to promote land sustainability. In *Sustainable Living with Environmental Risks* (pp. 45-55). https://doi.org/10.1007/978-4-431-54804-1.

Farid, A., Ubaya, R. D. N., Arisandi, A., & Soecahyo, D. (2024). Sustainable fisheries management of flying fish (*Decapterus* spp.) with Rapfish analysis in pasongsongan waters, East Java, Indonesia. *Egypt. J. Aquat. Biol. Fish.*, *28*(3), 151-165. https://doi.org/10.21608/ejabf.2024.354882.

Fauzi, R. A., Setiawan, I., & Kurnia, R. (2024). Analisis Kelayakan usahatani padi organik di kecamatan Cihaurbeuti kabupaten Ciamis. *J. Ilm. Mhs. Agroinfo Galuh*, *11*(1), 251-259.

Fitriah, M. (2024). *Peta Indonesia Lengkap dengan Nama 38 Provinsi*. https://www.goodnewsfromindonesia.id/2024/07/29/jangan-sampai-salah-ini-peta-indonesia-lengkap-dengan-nama-38-provinsi-terbaru

Heryadi, Y. & Rofatin, B. (2017). Kajian keberlanjutan pelaksanaan pertanian padi S.R.I organik. *J. Siliwangi*, *3*(1), 172-178. https://doi.org/10.37058/jssainstek.v3i1.245.

Heydari, M. & Osanloo, M. (2024). A new comprehensive model for integrating environmental, economic, and social performance of deep and large-scale open-pit copper mines. *Int. J. Eng. Trans. A: Basics*, *37*(1), 1-13. https://doi.org/10.5829/ije.2024.37.01a.01.

Huang, L., Gao, C., Yan, L., Kasal, B., Ma, G., & Tan, H. (2016). Confinement models of GFRP-confined concrete: Statistical analysis and unified stress-strain models. *J. Reinf. Plast. Compos.*, *35*(11), 867-891. https://doi.org/10.1177/0731684416630609.

Humaidi, E., Asriani, P. S., & Priyono, B. S. (2021). Sustainability strategy for organic rice agribusiness. *J. Agrisep*, *20*(1), 207-226. https://doi.org/10.31186/jagrisep.20.01.207-226.

Jamaludin, N., Rochdiani, D., & Setia, B. (2020). Analysis of the sustainability of red chili farming (Case study in Maparah Village, Panjalu District, Ciamis Regency). *J. Agroinfo Galuh*, *8*(2), 588-602.

Janker, J., Mann, S., & Rist, S. (2019). Social sustainability in agriculture – A system-based framework. *J. Rural Stud.*, *65*, 32-42. https://doi.org/10.1016/j.jrurstud.2018.12.010.

Johannes, H. P., Priadi, C. R., Herdiansyah, H., & Novalia, I. (2020). Water footprint saving through organic rice commodity. *AIP Conf. Proc.*, *2255*, 040002. https://doi.org/10.1063/5.0013601.

Melo, M. C. F. (2021). Sustainability goals of organic rice value chain and its integration on food security in Oriental Mindoro, Philippines. *Rev. Integr. Bus. Econ.*, *10*(3), 324-337.

Ochieng, B. J. O., Nyongesa, D. N., & Odhiambo, S. A. (2020). Likely effect of gender and education on information adoption and utilization among sugarcane farmers in the Nyanza Region, Kenya. *J. Soc. Econ. Res.*, *7*(2), 72-82. https://doi.org/10.18488/journal.35.2020.72.72.82.

Permatasari, P., Winarno, J., Anantanyu, S., Wibowo, A., Suwarto, S., & Suryono, S. (2021). Analisis keberlanjutan program padi organik di desa pereng kecamatan mojogedang kabupaten karanganyar (Studi

Kasus Kelompok Tani Rukun Makaryo). *J. Membangun Desa Pertan.*, *6*(4), 113-124. https://doi.org/10.37149/jimdp.v6i4.19439.
Pollesch, N. L. & Dale, V. H. (2016). Normalization in sustainability assessment: Methods and implications. *Ecol. Econ.*, *130*, 195-208. https://doi.org/10.1016/j.ecolecon.2016.06.018.
Pratama, I. A., Suryantini, A., & Perwitasari, H. (2024). Sustainability of the different rice cultivation practices in Yogyakarta, Indonesia. *Caraka Tani, 39*(2), 321-342. https://doi.org/10.20961/carakatani.v39i2.85817.
Ramos, A. C. & Fooken, I. (2024). Age matters: Linking age-related concepts in childhood and ageing research. In *Linking Ages: A Dialogue between Childhood and Ageing Research* (pp. 19-34).
Rattanacharoen, N., Caldwell, J. S., & Ryuichi, Y. (2022). Assessment of the sustainability of rice cultivation practice of farmers in three certified programs compared with conventional farmers in ubon Ratchathani Province, Thailand. *J. Int. Soc. Southeast Asian Agric. Sci.*, *28*(2), 1-16.
Rempelos, L., Baranski, M., Wang, J., Adams, T. N., Adebusuyi, K., & et al. (2021). Integrated soil and crop management in organic agriculture: A logical framework to ensure food quality and human health? *Agronomy*, *11*(12), 2494. https://doi.org/10.3390/agronomy11122494.
Riad, B. & Zhang, X. (2020). Analysis of the oedometer test results using a new method. In *Geo-Congress 2020 GSP 320* (pp. 321-331). https://doi.org/10.1061/9780784482803.035.
Ristianingrum, A., Chozin, M. A., Machfud, M., Sugiyanta, S., & Mulatsih, S. (2016). Optimalisasi keberlanjutan pengembangan usaha padi organik di kabupaten Cianjur, Jawa Barat. *J. Manaj. Agribisnis*, *13*(1), 37-49. https://doi.org/10.17358/jma.13.1.37.
Rozaki, Z., Triyono, Indardi, Salassa, D. I., & Nugroho, R. B. (2020). Farmers' responses to organic rice farming in Indonesia: Findings from central Java and south Sulawesi. *Open Agric.*, *5*(1), 703-710. https://doi.org/10.1515/opag-2020-0070.
Rozaki, Z., Yudanto, R. S. B., Triyono, Rahmawati, N., Alifah, S., Ardila, R. A., Pamungkas, H. W., Fathurrohman, Y. E., & Man, N. (2024). Assessing the sustainability of organic rice farming in Central Java and Yogyakarta: An economic, ecological, and social evaluation. *Org. Farming*, *10*(2), 142-158. https://doi.org/10.56578/of100205.
Siregar, A. P., Darwanto Irham, D. H., Mulyo Jamhari, J. H., Utami, A. W., Sugiyarto, A. P., Perwitasari, H., Wirakusuma, G., Widada, A. W., Fadhliani, Z., & Widjanarko, N. P. A. (2024). The trend of agricultural sector resilience in Indonesia during 2008-2020. *J. Agric. Sci. Sri Lanka*, *19*(2), 336-357. https://doi.org/10.4038/jas.v19i2.10154.
Tagliani, P. R. A. & Walter, T. (2018). How to assess the significance of environmental impacts. *WIT Trans. Ecol. Environ.*, *215*, 47-55. https://doi.org/10.2495/EID180051.
Tashi, S. & Wangchuk, K. (2016). Organic vs. conventional rice production: comparative assessment under farmers' condition in Bhutan. *Org. Agric.*, *6*, 255-265. https://doi.org/10.1007/s13165-015-0132-4.
Vlasova, N. & Loginovskikh, A. (2020). Social dimensions of municipal sustainability: Guidance for strategic planning. *E3S Web Conf.*, *208*, 04008. https://doi.org/10.1051/e3sconf/202020804008.
Wang, P. C., Liu, F. C., Lee, D. C., & Lin, M. Y. (2023). Environmental knowledge, values, and responsibilities help to enhance organic farming intentions: A case study of Yunlin County, Taiwan. *Agriculture*, *13*(8), 1476. https://doi.org/10.3390/agriculture13081476.
Wang, P., Yang, Q., Gao, B., Yi, F., & Meng, S. (2021). Quantification method for extrapolation errors of constitutive models and a demonstration on C/SiC composite. *Compos. Struct.*, *273*, 114286. https://doi.org/10.1016/j.compstruct.2021.114286.
Wang, Y., Akpa, F. A., Matthew, O., Ahsraf, J., Ogunbiyi, T., & Osabohien, R. (2024). Maximizing environmental sustainability: Strategies for reducing carbon emissions and post-harvest losses. *Appl. Ecol. Environ. Res.*, *22*(5), 4913-4930. https://doi.org/10.15666/aeer/2205_49134930.
Wijesinghe, J., Botheju, S. M., Nallaperuma, B., & Kanuwana, N. (2023). Organic farming: The influence on soil health. In *One Health: Human, Animal, and Environment Triad* (pp. 185-197). https://doi.org/10.1002/9781119867333.ch14.
Yusuf, M., Wijaya, M., Surya, R. A., & Taufik, I. (2021). *MDS-RAPS Teknik Analisis Keberlanjutan*. CV. Tohar Media. https://books.google.co.id/books?id=7mpCEAAAQBAJ&printsec=frontcover&hl=id&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false