PUBLISHING
• ISSN 2720 - 9644 (print)
• ISSN 2721 - 0877 (online)
IJESSS
INTERNATIONAL JOURNAL OF ENVIRONMENTAL, SUSTAINABILITY AND SOCIAL SCIENCE
Indexed by : sinta 3 Crossref GARUDA Google scholar

SUSTAINABILITY STATUS OF UPPO'S ORGANIC FERTILIZER PRODUCTION IN KLATEN REGENCY

Volume: 7
Number: 5
Page: 1318 - 1336

Itsna Ayu Mustikaningrum[1], Maria Theresia Sri Budiastuti[2], Margaretha Maria Alacoque Retno Rosariastuti[3]
[1]Department of Environmental Science, Faculty of Mathematics and Natural Sciences, Universitas Sebelas Maret, Indonesia
[2]Department of Agrotechnology, Faculty of Agriculture, Universitas Sebelas Maret, Indonesia
[3]Department of Soil Science, Faculty of Agriculture, Universitas Sebelas Maret, Indonesia
Corresponding author: Margaretha Maria Alacoque Retno Rosariastuti
E-mail: retnobs@staff.uns.ac.id

Article History:
Received: 2026-07-02
Revised: 2026-09-14
Accepted: 2026-10-12

Abstract:
The Organic Fertilizer Processing Unit (Unit Pengolah Pupuk Organik - UPPO) is one of the Indonesian government's initiatives to support the supply of organic fertilizer and promote sustainable agricultural practices. However, the implementation of the UPPO program has yet to fully realize its intended potential. Various findings indicate that the constraints affecting the effectiveness of UPPO are multidimensional, encompassing technical, managerial, and institutional dimensions. Based on these conditions, this study was conducted to evaluate the sustainability status of organic fertilizer production within the UPPO program. This study was conducted in Klaten Regency, Central Java Province, Indonesia, from February to April 2026. This study employed a mixed-methods descriptive-evaluative research design involving 38 UPPOs selected through purposive sampling. Data were obtained through a structured questionnaire assessing the sustainability attributes of UPPO's organic fertilizer production across the ecological, social, economic, technological, and institutional dimensions, totaling 33 attributes. The sustainability index was analyzed using the Rapfish (Rapid Appraisal for Fisheries) approach based on Multidimensional Scaling (MDS), modified into the Rapid Appraisal for Organic Fertilizer Production (Raporganic). The findings revealed that the sustainability index for organic fertilizer production was 60.59%, which was categorized as fairly sustainable. The economic dimension emerged as the weakest, with a value of 46.22% (less sustainable), thereby warranting fundamental attention and substantive improvement. The key attributes selected for priority strategies were odor emission/liquid waste, type of organic raw material, variation in product types, stability of demand for organic fertilizer, profit per period, availability of main facilities and bookkeeping system.

Keywords: attribute, Multidimensional Scaling (MDS), organic fertilizer, sustainability, UPPO

INTRODUCTION

Land degradation resulting from the decline in soil organic matter poses a serious threat to agricultural sustainability, given its vital role in maintaining soil fertility and productivity (Lal, 2020). This phenomenon is clearly evident in Indonesia, where the average soil organic carbon content stands at only 2%. It frequently falls below 1% in intensively cultivated paddy fields across Java, figures markedly below the minimum threshold of 2.5% required to sustain optimal productivity (Simanungkalit et al., 2006). This low figure is closely linked to land intensification and excessive use of chemical fertilizers (Aprisal et al., 2019). Furthermore, the widespread adoption of monoculture practices, which deplete soil nutrients without adequate replenishment, exacerbates this condition, making it crucial for the sustainability of future food systems (Wei et al., 2022).

This open acces article is distributed under a
Creative Commons Attribution (CC-BY-NC) 4.0 licence

PUBLISHING
• ISSN 2720 - 9644 (print)
• ISSN 2721 - 0877 (online)
IJESSS
INTERNATIONAL JOURNAL OF ENVIRONMENTAL, SUSTAINABILITY AND SOCIAL SCIENCE
Indexed by :

The Indonesian government has implemented initiatives to promote organic fertilizer use and reduce reliance on chemical fertilizers. The Organic Fertilizer Processing Unit (UPPO) Program constitutes one of the government's assistance schemes aimed at supporting the independent provision of organic fertilizer at the farmer level. The program is implemented through assistance provided to Farmer Group Associations/Farmer Groups/Livestock Farmer Groups/other community groups in the form of an assistance package comprising a composting house, a fermentation tank, a livestock shed, an organic fertilizer processing tool/chopper, a three-wheeled motorcycle, and livestock in the form of cattle/buffalo. From 2009 to 2023, the Ministry of Agriculture has distributed a total of 11354 UPPOs throughout Indonesia. This program is projected to support the independent provision of organic fertilizer at the farmer level, reduce production costs, and strengthen sustainable agricultural practices (Andalasari et al., 2023). In addition, the conversion of organic waste into organic fertilizer contributes to waste reduction, resource recovery, and value creation within a circular economy framework (Imaningsih et al., 2026).

However, the implementation of the UPPO program has yet to fully realize its intended potential. An evaluation conducted by the Inspectorate General of the Indonesian Ministry of Agriculture (2015–2019) recorded that only 37% of UPPO groups were actively engaged in production, while the remaining 63% were inactive due to low motivation, limited market access, and inadequate group mentoring (Nattasya, 2021). Similar conditions were confirmed by Ramaiyulis et al (2020) those who found that 72% of UPPOs in West Sumatra Province operated below capacity, and Hendarliana et al (2021) by those who reported stagnation in manure production in Ciamis Regency due to a lack of growth in livestock populations. Meanwhile, Lestari & Purnamayani (2016) highlighted that the limited availability of raw materials is a major constraint, given that the required dosage of organic fertilizer is relatively high yet disproportionate to its actual availability in the field. These findings affirm that the barriers to UPPO's effectiveness are multidimensional, encompassing technical, managerial, and institutional issues.

Klaten Regency, as one of the national rice production centers covering 15 out of 26 sub-districts, or 57.70% of its total area (Auria et al., 2022), has actively implemented the UPPO program across various sub-districts. Nevertheless, land degradation occurring in several areas of Klaten has contributed to low food crop productivity (Sigit & Suharjo, 2007), as illustrated by a study in Tijayan Village, which revealed a low soil fertility status, with cation exchange capacity (CEC), total K_2O, and soil organic carbon (SOC) identified as the main limiting factors (Molle et al., 2021). The gap between the UPPO program's substantial potential and its implementation outcomes in Klaten Regency further underscores that its contribution to improving soil fertility has not yet been fully realized. This disparity between the concept of UPPO and its implementation outcomes underscores the need to examine the sustainability of the program across ecological, social, economic, technological, and institutional dimensions. This study aims to evaluate the sustainability status of UPPO's organic fertilizer production in Klaten Regency and identify indicators requiring improvement to support environmentally sustainable agricultural practices.

METHODS

This study was conducted in Klaten Regency, Central Java Province, Indonesia, geographically located at 7° 40' 60" S and 110° 37' 00" E. The research was carried out over three months, from February to April 2026. This study employed a mixed-methods descriptive-evaluative research design.

Population and Sample

This open acces article is distributed under a
Creative Commons Attribution (CC-BY-NC) 4.0 licence

PUBLISHING
• ISSN 2720 – 9644 (print)
• ISSN 2721 – 0877 (online)
IJESSS
INTERNATIONAL JOURNAL OF ENVIRONMENTAL, SUSTAINABILITY AND SOCIAL SCIENCE
Indexed by :

The population in this study comprised all UPPO recipient groups in Klaten Regency, totaling 109 units. The sampling technique used for the survey was purposive sampling (Sugiyono, 2017), involving 38 UPPO groups selected based on three criteria: (1) program implementation within the preceding four years, representing an active implementation period; (2) continuity of program implementation under updated policies; and (3) the availability and completeness of data to support reliable analysis. This approach is consistent with Patton (2015) who emphasizes the selection of participants capable of providing information-rich and relevant data. This sample size fulfills the minimum sample adequacy criterion suggested by Roscoe (1982) as cited in Sugiyono (2017) which requires a minimum of 30 samples. This sample size also represents more than 30% of the total population, in accordance with the recommendation by Gay & Diehl (1992) as cited in (Yusuf et al., 2021) that for descriptive research, the minimum sample size should be at least 10% of the population. The selected sample, distributed across 16 sub-districts, also allows for variability influenced by regional differences.

Variables and Measurement

Data were collected using a questionnaire assessing UPPO production sustainability across five dimensions: ecological, social, economic, technological, and institutional. Each dimension comprises several attributes assessed using an ordinal scale of 0–3 or 0-2 based on the favorable scaling principle, which denotes a positive relationship between the quality of the assessed object and its quantitative score, such that higher quality corresponds to a higher score (Yusuf et al., 2021). A score of 0 represents the lowest condition, whereas the maximum score (2 or 3) represents the highest condition. Each dimension typically comprises 6–12 attributes, although fewer or more may be used. Attributes are selected based on theoretical basis or relevant references, and each attribute must exhibit variability, distinguish among objects within the population, and be measurable using either metric or non-metric scales (Yusuf et al., 2021). The attributes were derived from the theoretical framework of Rapfish (Pitcher & Preikshot, 2001; Pitcher et al., 2013) adapted for the agricultural sector, referring to national regulations related to UPPO and organic fertilizer (SNI 7763-2024; Decree of the Minister of Agriculture No 261/KPTS/SR.310/M/4/2019; Technical Guidelines for UPPO 2023), and further supported by findings from previous studies in accordance with actual conditions (Tan, 1994 in Simanungkalit et al., 2006; Santoso et al., 2023; Ramaiyulis et al., 2020; Huda & Wikanta, 2017; Adenuga & Jack, 2025). The details of the attributes for each dimension are presented in Table 1.

Table 1. Sustainability dimensions and attributes of organic fertilizer production

Dimension	Attributes
Ekological	1. Type of organic raw material; 2. Source of local raw material; 3. Composting duration; 4. Livestock manure management; 5. Odor emission/liquid waste; 6. Distance of UPPO from residential areas; 7. Clean water source
Social	8. Level of group activeness; 9. Training participation; 10. Activeness of group meetings; 11. Relationship with the community; 12. Regeneration rate of group management; 13. Group's understanding of organic fertilizer production; 14. Group's understanding of environmental conservation; 15. Distribution of economic benefits from organic fertilizer
Economic	16. Operational costs; 17. Sales volume of fertilizer per year; 18. Market access; 19. Profit per period; 20. Variation in product types; 21. Stability of demand for organic fertilizer; 22. Potential for business scale expansion
Technological	23. Availability of main facilities; 24. Use of production facilities; 25. Composting technique; 26. Product packaging; 27. Production capacity per year; 28. Technological innovation
Institutional	29. Availability of management regulations; 30. Bookkeeping system; 31. Government

This open acces article is distributed under a
Creative Commons Attribution (CC-BY-NC) 4.0 licence

PUBLISHING
• ISSN 2720 – 9644 (print)
• ISSN 2721 – 0877 (online)
IJESSS
INTERNATIONAL JOURNAL OF ENVIRONMENTAL, SUSTAINABILITY AND SOCIAL SCIENCE
Indexed by : sinta 3 Crossref GARUDA Google scholar

Dimension	Attributes
	support; 32. Post-establishment sustainability; 33. Long-term planning

The validity test of the research instrument using Pearson's product-moment correlation showed that all questionnaire items were valid (r-calculated > r-table), while the reliability test using Cronbach's alpha yielded a coefficient of 0.800.

Data Analysis

The sustainability index analysis was conducted using the Rapfish (Rapid Appraisal for Fisheries) approach, modified into the Rapid Appraisal for Organic Fertilizer Production (Raporganic). The stages of sustainability index assessment in this study comprised: 1) determination of attributes within the ecological, social, economic, technological, and institutional dimensions; 2) development of bad–good scoring for each attribute; 3) establishment of references (consisting of good, bad, up, and down conditions) and anchors as the boundary distances between objects, forming a full circle with a mirrored, inverse pattern; 4) assessment of the sustainability index and status for each dimension; 5) leverage analysis to determine the most sensitive leverage attributes within each dimension based on the highest RMS value, referring to the law of extreme values; 6) Monte Carlo analysis with a 95% confidence interval (Gaussian error) to examine the influence of error, in which the difference between the Monte Carlo value and the Rapfish ordination value does not exceed 5%; and 7) stress value analysis as a measure of the lack of fit between the model and the data, using the following formula:

$$\text{STRESS} = \left[\frac{\sum_{j=1}^{n} \sum_{i=1}^{n} (\delta_{ij} - \zeta_{ij})^2}{\sum_{j=1}^{n} \sum_{i=1}^{n} \delta_{ij}^2} \right]^{1/2}$$

as a lower stress value indicates a better model fit, with a threshold of <0,25 serving as an indicator of reliable ordination (Pitcher, 1999); and 8) Squared Correlation (R^2) analysis as a measure of goodness of fit, indicating the proportion of data variance explained by the MDS model, with an ideal value of >80%, although values above 50% may still be acceptable under certain conditions. Rapfish ordination represents the output of the Rapfish software, illustrating the sustainability index on a scale of 0% – 100% through two axes (x and y), where 0% represents the worst-case condition (bad) and 100% represents the best-case condition (good). The ordination index is interpreted into four categories of sustainability status, as follows:

Table 2. Classification of sustainability status based on the index score

Index Score (%)	Category	Description
0 - 25	Poor	Not sustainable
25.01 – 50	Fair	Less sustainable
50.01 – 75	Moderate	Fairly sustainable
75.01 - 100	Good	Sustainable

Source: Yusuf et al (2021)

RESULTS AND DISCUSSION

The results of the sustainability analysis of organic fertilizer production under the UPPO Program in Klaten Regency are presented in Table 3.

Table 3. Results of the sustainability analysis of UPPO's organic fertilizer production

No	Dimension	Index	Category	Stress Value	R^2 Value	Monte	Difference

This open acces article is distributed under a
Creative Commons Attribution (CC-BY-NC) 4.0 licence

PUBLISHING OKSI
• ISSN 2720 – 9644 (print)
• ISSN 2721 – 0877 (online)
IJESSS
INTERNATIONAL JOURNAL OF ENVIRONMENTAL, SUSTAINABILITY AND SOCIAL SCIENCE
Indexed by : sinta 3 Crossref GARUDA Google scholar

		Value (%)				Carlo (%)	(%)
1	Ecological	62.53*	Fairly sustainable	0.18	0.91	61.84	0.69
2	Social	62.43**	Fairly sustainable	0.23	0.91	61.74	0.69
3	Economic	46.22***	Less sustainable	0.22	0.91	46.48	0.26
4	Technological	54.41****	Fairly sustainable	0.16	0.93	54.17	0.24
5	Institutional	77.38*****	Sustainable	0.20	0.94	75.81	1.57
Average		60.59	Fairly sustainable	0.20	0.92	60.01	0.58

Source: primary data processed using the Microsoft Excel RAP Add-in (2026)

Notes:

* The results of the analysis are presented in Figure 2

** The results of the analysis are presented in Figure 3

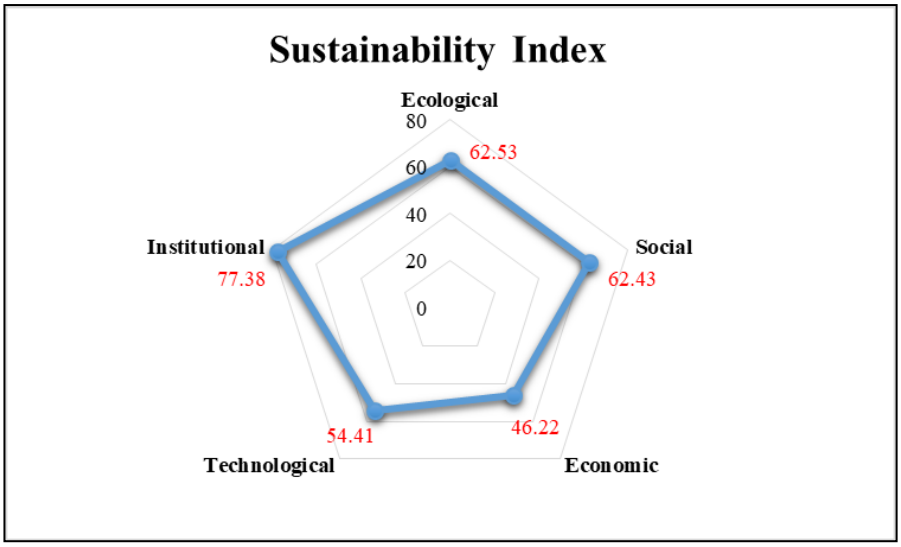
*** The results of the analysis are presented in Figure 4

**** The results of the analysis are presented in Figure 5

***** The results of the analysis are presented in Figure 6

Integration of the five sustainability dimensions through the Raporganic approach revealed a mean sustainability index of 60.59% on a scale of 0% – 100%, which was categorized as fairly sustainable. This mean value quantitatively reflects the heterogeneous conditions across the five dimensions. The variation in achievement across dimensions indicates that the sustainability of organic fertilizer production management has not been evenly distributed across all aspects. The kite diagram in Figure 1 presents a comparative visualization of the sustainability index values across the five analyzed dimensions.

Figure 1. The sustainability index of organic fertilizer production



Source: author's analysis (2026)

The asymmetrical configuration of the diagram, characterized by the institutional dimension extending markedly outward while the economic dimension is drawn inward, indicates that the sustainability of organic fertilizer production management has yet to be achieved in a balanced manner. The institutional dimension occupies the highest position, with an index value of 77.38%, thereby constituting the sole dimension classified as sustainable. This finding suggests that organizational governance represents a relatively robust foundation underlying the program. Meanwhile, the ecological and social dimensions exhibit nearly comparable achievements, both situated within the fairly sustainable category, with index values of 62.53% and 62.43%, respectively. This condition indicates that the environmental and social aspects of the groups have developed concurrently, although they remain at a moderate level.

This open acces article is distributed under a
Creative Commons Attribution (CC-BY-NC) 4.0 licence

PUBLISHING
• ISSN 2720 – 9644 (print)
• ISSN 2721 – 0877 (online)
IJESSS
INTERNATIONAL JOURNAL OF ENVIRONMENTAL, SUSTAINABILITY AND SOCIAL SCIENCE
Indexed by :

On the other hand, the technological (54.41%) and economic (46.22%) dimensions show relatively lower sustainability index values in the diagram, with both dimensions positioned closer to the center than the other three dimensions. The economic dimension has the lowest index value and falls within the less sustainable category. This indicates that technical production aspects and business finances remain the most significant constraints on the system's overall sustainability. In general, the kite diagram shows that the sustainability of organic fertilizer production is predominantly driven by institutional strength. In contrast, the economic and technological aspects lag and may hinder further improvements in sustainability. These findings indicate that the sustainability of organic fertilizer production has considerable room for improvement, which can be achieved by enhancing the attributes that contribute to the sustainability index. As stated, by Santoso et al (2023) that sustainability can be enhanced through the identification of the most significant attributes within each dimension analyzed.

The validity of the sustainability index values was subsequently confirmed through a series of model feasibility tests. The stress value derived from the analysis reflects the magnitude of deviation (error) between the inter-point distances resulting from the two-dimensional ordination and the actual distances in the original multidimensional data. A lower stress value indicates that the ordination more accurately represents the actual data condition. The analysis results showed an average stress value of 0.20, which remains below the critical threshold of 0.25, as stipulated by Pitcher (1999) the feasibility limit for MDS ordination models. Accordingly, the resulting sustainability index can be considered accurate and suitable for further interpretation.

The coefficient of determination (R^2) serves to measure the proportion of variance in the original multidimensional data that can be explained by the two-dimensional ordination model, with values approaching 1 indicating a better representation of the data. The analysis results showed an average R^2 of 0.92, indicating that the ordination model explained approximately 92% of the variance in the analyzed attribute data, with the remaining 8% unexplained. This proportion, approaching 1 indicates that the ordination model exhibits a high degree of fit to the empirical data.

The Monte Carlo analysis, which examines the model's sensitivity to random error in the attribute-scoring process, resulted in an average index value of 60.01%. This value was subsequently compared with the MDS ordination index value of 60.59%, resulting in a difference of 0.58 points, equivalent to 0.58% of the full 0% – 100% scale. This difference lies well below the maximum tolerance threshold of 5%, which serves as the reference criterion for model stability, indicating that random error in the attribute assessment process has a relatively minor effect on the final sustainability index. The marginal magnitude of this difference demonstrates that the resulting sustainability index was robust rather than a product of chance, constituting instead a consistent estimate that remains stable even when subjected to simulated uncertainty in the attribute assessment process.

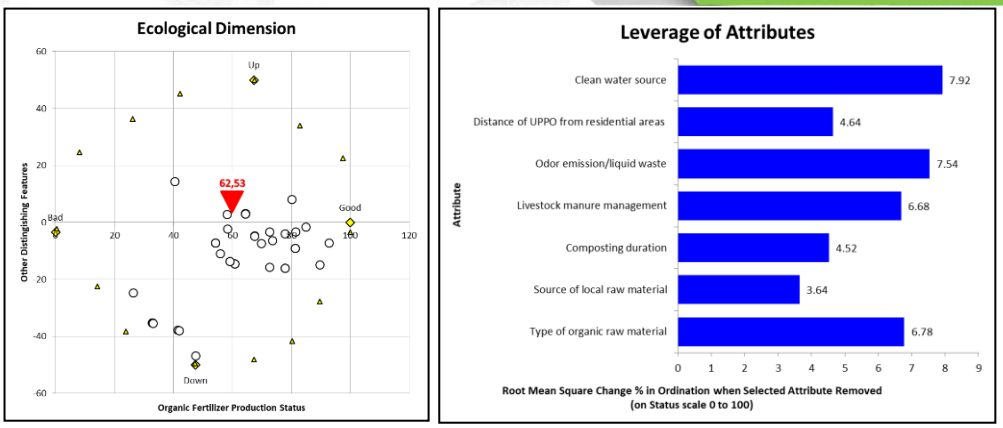
The following presents the results of the leverage analysis, which identified the attributes exerting the most significant influence on the index value within each dimension. For each dimension, the three attributes with the highest RMS values were selected to inform improvements in the sustainability of organic fertilizer production under the UPPO program.

a. Ecological Dimension

The results of the *Raporganic* analysis showed that the sustainability index of organic fertilizer production under the UPPO Program in Klaten Regency, within the ecological dimension, was 62.53%. Based on the sustainability index classification, this value indicates that the ecological dimension falls within the fairly sustainable category.

This open acces article is distributed under a
Creative Commons Attribution (CC-BY-NC) 4.0 licence

PUBLISHING
• ISSN 2720 – 9644 (print)
• ISSN 2721 – 0877 (online)
IJESSS
INTERNATIONAL JOURNAL OF ENVIRONMENTAL, SUSTAINABILITY AND SOCIAL SCIENCE
Indexed by :



Source: primary data processed using the Microsoft Excel RAP Add-in (2026)

Figure 2. Index value and sensitive attributes influencing the sustainability of the ecological dimension

Ecological sustainability emphasizes the capacity of the production system to maintain ecosystem functions and health, as well as the quality of natural resources, in order to meet present needs without compromising their availability for future generations (Storkey et al., 2024; Wang et al., 2025). In the context of sustainable agriculture, this concept underscores that the use of organic fertilizer helps preserve ecosystem functions. Liu et al (2024) stated that the application of organic fertilizer can enhance soil health and plant growth by improving soil organic matter, soil structure, aggregate stability, nutrient absorption, water-holding capacity, cation exchange capacity, nutrient use efficiency, as well as soil microbial activity. Based on these benefits, the existence of UPPO functions not only as an organic waste processing unit but also as a supporting facility for conservation.

Clean water source emerged as the attribute with the highest leverage value within the ecological dimension, recording a Root Mean Square (RMS) of 7,92. This finding indicated that the availability of clean water has the greatest influence on the sustainability index, positioning it as a key priority for enhancing ecological sustainability. Clean water is essential for livestock needs, shed sanitation, and manure management for organic fertilizer production, thereby playing a critical role in maintaining a hygienic livestock environment. Although nearly all UPPOs have access to groundwater, one unit remains constrained by limited water sources. It relies solely on rainwater collection, which warrants further attention to ensure sustainable water availability. Notably, the respondent of this unit reported that several livestock were currently affected by disease. This aligns with Taron et al (2025), who noted that the availability of clean water supports environmental sanitation practices and the provision of safe drinking water, thereby reducing the risk of disease transmission among livestock.

Odor emission and liquid waste was the attributes with the second-highest leverage values within the ecological dimension, at 7.54. This finding indicated that this attribute substantially influences changes in the sustainability index, thereby positioning the control of by-product impacts from organic material processing as a key priority in efforts to enhance the ecological sustainability of UPPO. Field observations revealed that nearly half of the UPPO units exhibited notably malodorous shed conditions and lacked urine collection systems, resulting in direct discharge of urine into waterways. Hamamoto and Uchida (2015) reported that direct cattle urine discharge can cause environmental pollution through nitrate leaching into groundwater and N_2O emissions. Fermentation helps stabilize these compounds, reducing their loss and environmental impacts. Therefore, proper management of solid manure and the use of urine as liquid fertilizer are essential for reducing odor and pollution risks while improving organic resource utilization. Saputra et al

This open acces article is distributed under a
Creative Commons Attribution (CC-BY-NC) 4.0 licence

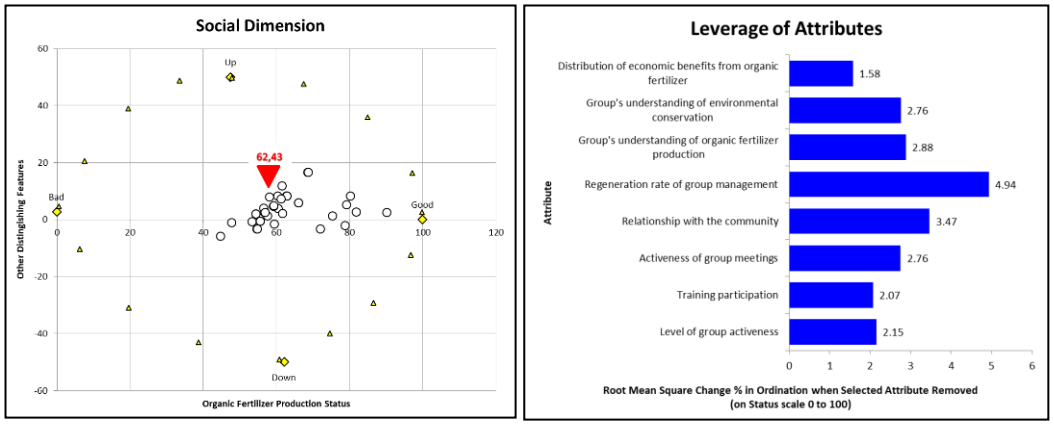
PUBLISHING
• ISSN 2720 – 9644 (print)
• ISSN 2721 – 0877 (online)
IJESSS
INTERNATIONAL JOURNAL OF ENVIRONMENTAL, SUSTAINABILITY AND SOCIAL SCIENCE
Indexed by :

(2025) concluded that modifying laying-hen housing to facilitate manure collection reduced waste discharge into rivers by 40% and generated economically valuable liquid fertilizer.

The type of organic raw material was the attribute with the third-highest leverage value within the ecological dimension, at 6.78. This finding indicated that this attribute exerts a considerable influence on changes in the sustainability index, thereby highlighting the characteristics of raw materials used in the decomposition process as a factor requiring attention in efforts to enhance the ecological sustainability of UPPO. Raw materials such as livestock manure and agricultural residues possess distinct physicochemical characteristics, including carbon and nitrogen content, moisture level, structure, and degree of decomposability. Imbalanced material composition may affect microbial activity and decomposition rate, consequently influencing composting duration and nutrient loss throughout the process (Shen et al., 2024; Huzir et al., 2026). Conversely, a proportional combination of carbon and nitrogen rich materials can create more favorable conditions for microbial activity, promote humic substance formation, and minimize carbon and nitrogen losses. The implementation of these management practices has the potential to improve compost quality and reduce environmental pollution during the composting process (Wen-Ming et al., 2021). This finding has important implications for organic fertilizer formulation under the UPPO program, as more UPPO units rely solely on livestock manure than on combinations of livestock manure and other organic waste materials.

Social Dimension

The results of the *Raporganic* analysis showed that the sustainability index of organic fertilizer production under the UPPO program in Klaten Regency, within the social dimension, was 62.43%. Based on the sustainability index classification, this value indicates that the social dimension falls within the fairly sustainable category.



Source: primary data processed using the Microsoft Excel RAP Add-in (2026)

Figure 3. Index value and sensitive attributes influencing the sustainability of

This value indicates that the social aspects of organic fertilizer production management have reached a relatively supportive condition for sustainability. However, aspects of social relations and human resource capacity still require strengthening. This pertains not only to member involvement or activeness in managing UPPO but also to institutional capacity, inter-actor relationships, and the group's knowledge and capability to carry out activities collectively and continuously.

The highest RMS value in the leverage analysis was recorded for the attribute **regeneration rate of group management**, at 4.94. This figure indicates that this attribute is the most determinant factor in shaping changes in the sustainability index within the social dimension, underscoring the

This open acces article is distributed under a
Creative Commons Attribution (CC-BY-NC) 4.0 licence

PUBLISHING
• ISSN 2720 - 9644 (print)
• ISSN 2721 - 0877 (online)
IJESSS
INTERNATIONAL JOURNAL OF ENVIRONMENTAL, SUSTAINABILITY AND SOCIAL SCIENCE
Indexed by :

need for attention to cadre development and leadership regeneration processes to sustain UPPO's continuity. The absence of systematic regeneration can weaken the sustainability of farmer groups through overreliance on incumbent officers and increased vulnerability during leadership transitions. Therefore, strengthening cadre development and the distribution of leadership roles are essential to maintain organizational capacity and continuity(Nangobi et al., 2024; Madarisa et al., 2026). At present, reorganization within UPPO groups has been conducted only on an as-needed or incidental basis. Although the sampled UPPO groups represent program implementers that have been in operation for merely the past six years, the processes of cadre development and knowledge transfer remain essential to ensuring the sustainability of program activities. The findings of Avian Pratama & Alfaricha (2026) indicate that knowledge management processes, identification, acquisition, development, distribution, preservation, and utilization constitute the key elements of a social system that governs youth engagement and intergenerational continuity within agricultural communities.

The attribute of **relationship with the community** ranked second, with an RMS value of 3.47. This value confirms that the social relationship between the managing group and the surrounding community contributes substantially to changes in the sustainability index within the social dimension. Accordingly, maintaining positive relationships with the community is essential to sustaining the program as a whole. Strong social relationships can reinforce community support and trust toward the group, thereby fostering program sustainability, whereas weak relationships may diminish community support and tolerance. Sugiarto & Nur Cahyo (2025) concluded that trust fosters cooperation and reduces conflict, social networks enhance communication and resource sharing, norms ensure group stability and alignment with shared objectives, while interpersonal relationships strengthen solidarity. Field observations indicated that the surrounding community exhibited an almost entirely accepting or neutral attitude, with no reported instances of rejection or disturbance. This outcome had been anticipated through site verification conducted by the UPPO Technical Team, the program's mentor at the outset of UPPO activities, underscoring the need for the managing group to maintain positive relationships with the surrounding community.

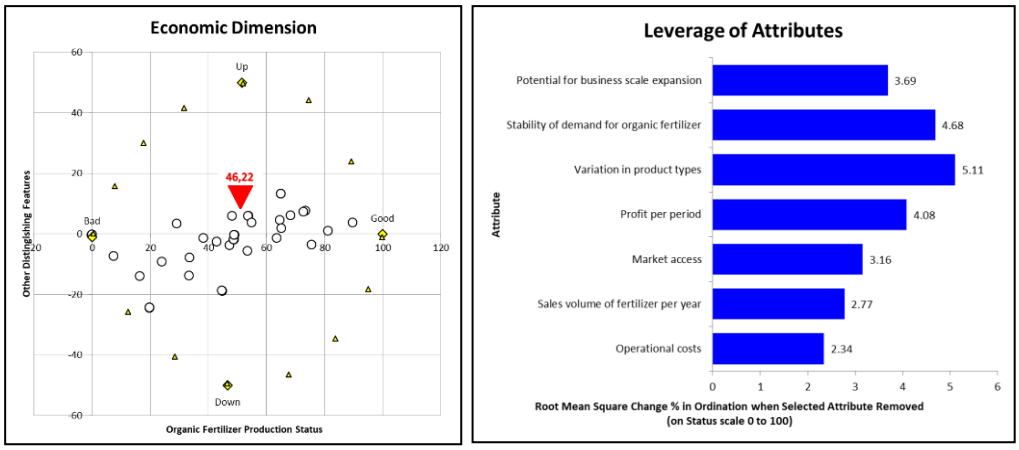
Ranked third, the attribute **group's understanding of organic fertilizer production** recorded an RMS value of 2.88. This value indicates that the group's technical understanding also plays a role in shaping changes in the sustainability index within the social dimension, underscoring the need for continued enhancement of the group's mastery of the production process to maintain product quality and operational efficiency. Sound understanding within the group supports raw material management, fermentation control, and product quality, thereby enhancing business sustainability. Conversely, limited understanding may reduce production effectiveness and adversely affect both economic and social aspects. This emphasizes the importance of higher education institutions in supporting educational and training programs on composting, with a focus on maintaining soil fertility, preserving natural resources, and advancing more sustainable agricultural practices. Survey results indicated that all UPPO management groups had a sound understanding of the organic fertilizer production process. However, its implementation has not always been optimal due to constraints on labor, time, and costs, as well as challenges in adapting to farmers' needs. Improvements can be pursued through clearer task allocation, adjustment of production schedules to labor availability, and consistent implementation of production stages tailored to each UPPO's capacity.

b. Economic Dimension

This open acces article is distributed under a
Creative Commons Attribution (CC-BY-NC) 4.0 licence

PUBLISHING
• ISSN 2720 – 9644 (print)
• ISSN 2721 – 0877 (online)
IJESSS
INTERNATIONAL JOURNAL OF ENVIRONMENTAL, SUSTAINABILITY AND SOCIAL SCIENCE
Indexed by :

Unlike the ecological and social dimensions, which fell within the fairly sustainable category, the economic dimension showed a considerably lower sustainability index of 46.22%, placing it in the less sustainable category.



Source: primary data processed using the Microsoft Excel RAP Add-in (2026)

Figure 4. Index value and sensitive attributes influencing the sustainability of the economic dimension

This value indicates that the economic aspects of organic fertilizer production management continue to face several fundamental constraints and are unable to make an optimal contribution to financial sustainability.

The highest RMS value within the economic dimension was recorded for the attribute **variation in product types**, at 5.11. This substantial value demonstrates that the diversity of organic fertilizer products generated is the most determining factor in changes to the economic sustainability index, such that limited product diversification poses a risk of constraining the group's capacity to reach broader market segments and respond to diverse consumer needs. This condition may affect the economic sustainability of UPPO, given that production sustainability is determined not only by the capacity to generate fertilizer, but also by the capacity to sustain market absorption and expand business scale. Santoso et al (2023) in their study on the sustainability of organic fertilizer production, they demonstrated that market absorption and the potential for business scale expansion constitute attributes influencing production sustainability. Field survey results revealed that nearly all UPPO units produced a single type of fertilizer, with only two producing two types. Therefore, the development of product variation in terms of type, form, and composition may be considered a strategic approach to expanding market reach and strengthening UPPO's business sustainability. Lestari et al (2024) posited that from a circular economy perspective, the development of organic fertilizer enterprises necessitates the reinforcement of customer segments, value propositions, marketing channels, and revenue streams as integral components of business model enhancement.

Stability of demand for organic fertilizer was also identified as an attribute with a relatively high leverage value, with an RMS value of 4.68**.** This figure confirms that fluctuations in demand for organic fertilizer products contribute significantly to changes in the economic sustainability index, underscoring the need to maintain stable market demand to sustain group enterprises. Demand uncertainty is one of the principal factors complicating production planning and distribution (Avishan et al., 2025). Survey results revealed that the majority of UPPO units experienced fluctuating demand for organic fertilizer. This condition indicates the need for market-strengthening

This open acces article is distributed under a
Creative Commons Attribution (CC-BY-NC) 4.0 licence

PUBLISHING
• ISSN 2720 – 9644 (print)
• ISSN 2721 – 0877 (online)
IJESSS
INTERNATIONAL JOURNAL OF ENVIRONMENTAL, SUSTAINABILITY AND SOCIAL SCIENCE
Indexed by :

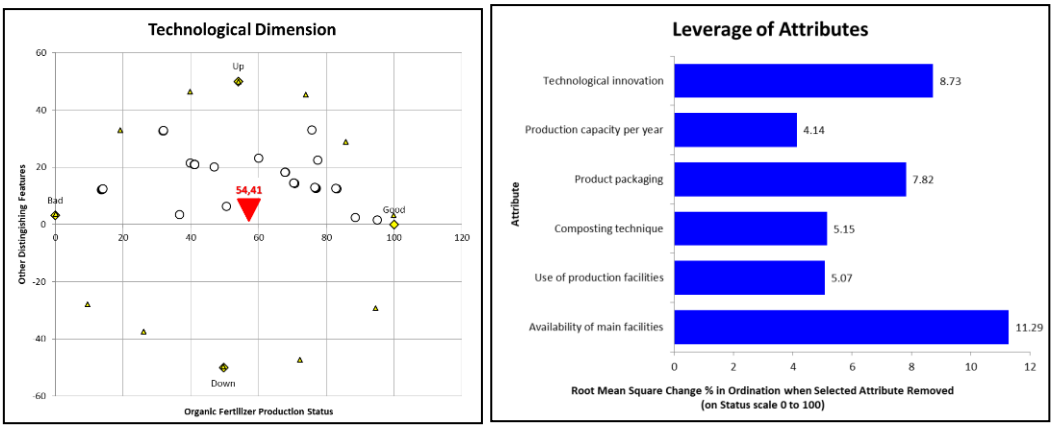
strategies, including partnerships with consumers to maintain demand stability. Maintaining organic fertilizer quality in accordance with government-established standards is also essential for preserving consumer trust and market continuity (Fitasari et al., 2018). This is further supported by Mahartajaya et al (2026) who found that product quality, price, and promotion simultaneously have a positive and significant effect on consumer purchase decisions.

The third highest attribute was **profit per period**, with an RMS value of 4.08. This finding indicates that the profit generated by the group in each production period is associated with variation in the economic sustainability index. Profit therefore represents a direct indicator of the economic performance of the organic fertilizer enterprise and an aspect that requires continuous improvement. Low profitability in organic fertilizer enterprises may constrain the group's capacity to expand its business, as profitability indicates the enterprise's ability to generate returns on invested capital (Hardiyanto, 2025). Meanwhile, the majority of UPPO units were found to operate at a break-even level, whereby the group allocates capital to production costs and receives returns solely from organic fertilizer products. This condition necessitates greater efficiency in production costs and an enhancement of product selling value, such that profits may be sustainably increased. This finding is consistent with the study by Andress et al (2023), which demonstrated that financial feasibility significantly influences the welfare of farmer groups managing UPPO. Financial aspects must therefore be duly attended to and professionally managed, thereby enabling more efficient production processes, continuous expansion of marketing networks, and increased sales performance.

c. Technological Dimension

The analysis resulted a sustainability index value of 54.41% for the technological dimension, placing it in the fairly sustainable category, albeit near the lower boundary.

Figure 5. Index value and sensitive attributes influencing the sustainability of the technological dimension



Source: primary data processed using the Microsoft Excel RAP Add-in (2026)

This condition indicates that the implementation of technological aspects in organic fertilizer production has not been evenly and consistently applied across the management units analyzed. This finding further suggests that, while technological aspects generally support business sustainability, several fundamental weaknesses persist that may impede future improvements in production quality and efficiency if left unaddressed.

Availability of main facilities constituted the attribute with the highest leverage value within the technological dimension, at 11.29. This value indicates that this attribute exerts the greatest influence on changes in the technological sustainability index, thereby positioning the availability

This open acces article is distributed under a
Creative Commons Attribution (CC-BY-NC) 4.0 licence

PUBLISHING
• ISSN 2720 – 9644 (print)
• ISSN 2721 – 0877 (online)
IJESSS
INTERNATIONAL JOURNAL OF ENVIRONMENTAL, SUSTAINABILITY AND SOCIAL SCIENCE
Indexed by :

of primary production facilities, such as APPO machines and composting equipment, as a key priority for enhancing technological sustainability. The absence or limitation of key facilities deprives the production factor of continuity and may even be a determining constraint on the operation of organic fertilizer production activities. According to the data, the majority of UPPO units possessed complete facilities, although not all were utilized optimally. Santoso et al (2023) noted that improvements in technology and production facilities have the potential to enhance the currently limited productivity of organic fertilizer while contributing to the sustainability of the economic dimension.

Technological innovation constituted the attribute with the second-highest leverage value within the technological dimension, at 8.73. This value indicates that this attribute exerts a considerable influence on changes in the technological sustainability index. This finding suggests that innovations such as adopting updated composting methods, using bioactivators, and varying product forms warrant attention, as they affect production time efficiency and the quality of the resulting organic fertilizer. Hang et al (2024) reported that raw materials, facilities, processing methods, scale of operation, and labor structure constitute critical factors influencing the quality of organic fertilizer. In practice, only a small proportion of UPPOs have implemented simple innovations, such as grinding and enrichment. Liu et al., (2022) and Li et al., (2024) noted that enhanced access to information, technical training, and understanding of the benefits and applicability of technology can encourage broader adoption of innovation in organic fertilizer production activities.

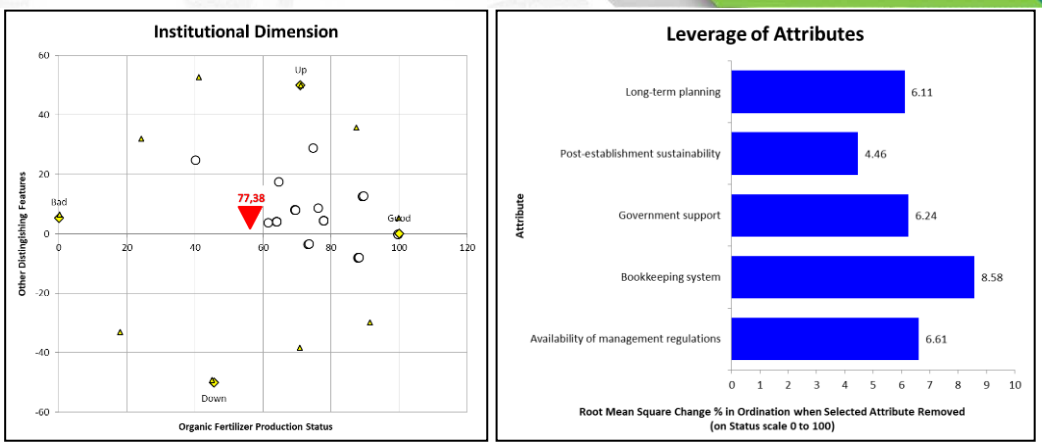
Product packaging constituted the attribute with the third-highest leverage value within the technological dimension, recording a value of 7. 82. This finding indicates that the attribute exerts a notable influence on changes in the technological sustainability index, consequently positioning packaging quality as a factor warranting attention in efforts to enhance the technological sustainability of UPPO's organic fertilizer production. Substandard packaging may diminish consumer appeal and perceived product quality, which in turn potentially undermines the competitiveness of organic fertilizer in the marketplace (Kim et al., 2024; Putra et al., 2025). Field observations revealed that 50% of the studied UPPO units did not package their products but instead transported them on three-wheeled motorcycles or pick-up trucks. Ramaiyulis et al (2020) found that plastic-bag packaging featuring branded labels and nutrient-content information enhanced the visual appeal and informativeness of organic fertilizer products, thereby improving their marketability. Furthermore, Selamet et al (2026) stated that strengthening production capacity, quality control, branding, packaging, and digital promotion is essential for enhancing the competitiveness of farmer-group enterprises.

Institutional Dimension

Among all the dimensions discussed previously, the institutional dimension recorded the highest index value at 77.38%. This value places the institutional dimension within the sustainable category, indicating that institutional aspects have been managed relatively well. Nevertheless, this high achievement does not imply that further improvement is unnecessary; continued efforts to enhance management remain essential to maintain, or even further improve, the index attained.

This open acces article is distributed under a
Creative Commons Attribution (CC-BY-NC) 4.0 licence

PUBLISHING
• ISSN 2720 – 9644 (print)
• ISSN 2721 – 0877 (online)
IJESSS
INTERNATIONAL JOURNAL OF ENVIRONMENTAL, SUSTAINABILITY AND SOCIAL SCIENCE
Indexed by :



Source: primary data processed using the Microsoft Excel RAP Add-in (2026)

Figure 6. Index value and sensitive attributes influencing the sustainability of the institutional dimension.

The bookkeeping system was recorded as the attribute with the highest leverage value within the institutional dimension, at 8.58. This substantial value demonstrates that the attribute exerts the greatest influence on changes in the institutional sustainability index, thereby positioning orderly administration and financial record-keeping as a key priority in efforts to enhance UPPO's institutional sustainability. A well-organized bookkeeping system enables groups to monitor their financial condition and business performance while simultaneously enhancing the transparency and accountability of group management (Wulandari et al., 2023). Survey results revealed that most UPPO units maintained only simple cash-based bookkeeping, with only a small proportion recording their organic fertilizer production outcomes. Groups with inadequate bookkeeping systems may face difficulties in monitoring their achievements and identifying business constraints, resulting in less objective and data-driven decision-making. This finding is consistent with Manuaba et al (2024), who identified limited financial record-keeping as a management constraint among farmer groups and emphasized the importance of simple bookkeeping for effective business management. Similarly, Yogatama et al (2024) reported that bookkeeping enables farmer groups to record transactions, understand financial reports, manage finances, optimize resources, and produce more accurate financial information to support the sustainability of farming enterprises.

Availability of management regulations was recorded as the attribute with the second-highest leverage value within the institutional dimension, at 6.61. This value indicates that the attribute exerts a considerable influence on changes in the institutional sustainability index, positioning the existence of clear management regulations as a factor warranting attention to strengthen group governance and organizational order. Rules that are well understood and consistently applied can serve as guidelines for role distribution, decision-making and the resolution of internal issues, which in turn support the group's institutional sustainability. Kusnandar et al (2023) concluded that decentralized governance represents a promising solution for developing farmer organizations. Regulations and technical guidelines for implementing the UPPO program have been made available and distributed to UPPO groups before the program launch.

Government support constituted the attribute with the third-highest leverage value within the institutional dimension, at 6.24. This value indicates that the attribute also contributes to changes in the institutional sustainability index. This is attributable to the fact that support from relevant agencies, in the form of mentoring, provision of facilities, and technical assistance, plays a significant role in strengthening the capacity of UPPO management groups. Based on actual conditions, almost

This open acces article is distributed under a
Creative Commons Attribution (CC-BY-NC) 4.0 licence

PUBLISHING
• ISSN 2720 - 9644 (print)
• ISSN 2721 - 0877 (online)
IJESSS
INTERNATIONAL JOURNAL OF ENVIRONMENTAL, SUSTAINABILITY AND SOCIAL SCIENCE
Indexed by :

100% of the groups reported consistently receiving support and guidance from the Department of Agriculture. Mungai et al (2024) emphasized that agricultural extension services play a critical role in equipping farmer groups with the knowledge needed to address production challenges, including soil management, innovative farming practices, and recommendations for organic fertilizer application. Similarly, Shodiq et al (2026) stated that effective training improves employee performance and strengthens performance management. Accordingly, sustained government support is essential for strengthening UPPO institutional sustainability, as high dependence on external support may increase vulnerability if such support declines.

Selection of Key Attributes for Priority Strategies

Key attributes were selected based on a combination of RMS sensitivity values, current conditions and opportunities for targeted improvement. The following attributes were identified as key priorities for intervention.

Tabel 4. Key Attributes and Recommended Strategies for UPPO Sustainability

No	Dimension	Attribute	Basis for Prioritization	Responsible Parties	Strategic Approach
1	Ecology	Odor emission/liquid waste	Odor problems and the discharge of uncollected livestock urine may adversely affect sanitation and the surrounding environment	UPPO groups	Install urine collection systems and process the collected urine into liquid organic fertilizer in accordance with appropriate procedures
2	Ecology	Type of organic raw material	The dominance of livestock manure as the sole raw material indicates untapped opportunities to utilize locally available agricultural waste	UPPO groups, Department of Agriculture	Incorporate other locally available organic waste materials into compost mixtures
3	Economy	Variation in product types	Reliance on a single product type limits consumer choice and business development opportunities	UPPO groups, Department of Agriculture	Diversify fertilizer products to support business development
4	Economy	Stability of demand for organic fertilizer	Fluctuating demand affects most UPPO groups and may undermine production continuity and sales	UPPO groups	Implement a pre-order system and expand market reach
5	Economy	Profit per period	Most UPPO groups operate at the break-even point, limiting economic benefits and financial incentives to sustain production	UPPO groups, Department of Agriculture	Calculate production costs per kilogram and evaluate operating expenses to improve profit margins
6	Technology	Availability of main facilities	Available equipment is not being used	UPPO groups, Department of	Optimize the use of production equipment

This open acces article is distributed under a Creative Commons Attribution (CC-BY-NC) 4.0 licence

PUBLISHING
• ISSN 2720 – 9644 (print)
• ISSN 2721 – 0877 (online)
IJESSS
INTERNATIONAL JOURNAL OF ENVIRONMENTAL, SUSTAINABILITY AND SOCIAL SCIENCE
Indexed by :

No	Dimension	Attribute	Basis for Prioritization	Responsible Parties	Strategic Approach
			optimally, limiting opportunities to improve production efficiency	Agriculture	and conduct regular maintenance
7	Institutional	Bookkeeping system	Limited production records hinder the evaluation of costs, productivity, inventory, and profitability	UPPO groups	Improve record-keeping by maintaining financial, production, inventory and sales records

Source: Authors' analysis based on leverage analysis results and field observations (2026)

As the economic dimension has the lowest sustainability index, a practical strategic approach was formulated based on the leverage analysis, actual field conditions, and adaptations of previous studies. The recommended strategy involves **developing the organic fertilizer business through product diversification and integrated marketing**. This strategy involves identifying consumer needs, optimizing the use of locally available raw materials to improve operational efficiency, and developing product variations tailored to market demand. Market expansion can be pursued through partnerships with farmer groups and agricultural businesses, demonstration plots to showcase product quality and benefits, and digital marketing to broaden market reach (Sari et al., 2025; Reswati et al., 2025). Furthermore, recording production costs, sales volumes, and profits for each period is necessary to evaluate business performance, improve operational efficiency, and identify products with the greatest potential for further business development. This integrated approach is consistent with previous research on organic fertilizer business development, which emphasizes strengthening business models, improving understanding of product quality, and expanding marketing activities (Lestari et al., 2024).

CONCLUSION

The sustainability index for UPPO's organic fertilizer production was 60.59%, which was categorized as fairly sustainable. The economic dimension was identified as the weakest, with a value of 46.22% (less sustainable), consequently requiring fundamental attention and improvement. A total of 15 sensitive attributes influencing the sustainability of organic fertilizer production were identified based on the highest RMS values, comprising the following dimensions: (1) ecological (clean water source, odor emission/liquid waste, type of organic raw material); (2) social (regeneration rate of group management, relationship with the community, group's understanding of organic fertilizer production); (3) economic (variation in product types, stability of demand for organic fertilizer, profit per period); (4) technological (availability of main facilities, technological innovation, product packaging); and (5) institutional (bookkeeping system, availability of management regulations, government support). The key attributes prioritized for strategy development, based on RMS sensitivity values, current conditions, and opportunities for improvement, were odor emission/liquid waste, type of organic raw material, variation in product types, stability of demand for organic fertilizer, profit per period, availability of main facilities and bookkeeping system. To improve the sustainability status from the fairly sustainable category to the sustainable category, improvements in the sensitive attributes identified above are required.

REFERENCES

This open acces article is distributed under a
Creative Commons Attribution (CC-BY-NC) 4.0 licence

PUBLISHING
• ISSN 2720 – 9644 (print)
• ISSN 2721 – 0877 (online)
IJESSS
INTERNATIONAL JOURNAL OF ENVIRONMENTAL, SUSTAINABILITY AND SOCIAL SCIENCE
Indexed by :

Adenuga, A. H., & Jack, C. (2025). The role of farmer discussion groups in promoting sustainable farming practices: Drivers of participation and environmental impact. *Ecological Indicators*, *177*. https://doi.org/10.1016/j.ecolind.2025.113714

Andalasari, R., Lubis, Y., & Kardhinata, H. (2023). The role of the organic fertilizer processing unit (UPPO) on rice farmers' income in Deli Serdang District. *Journal of Integrated Agricultural Socio-Economics and Entrepreneurial Research (JIASEE)*, *1*(2). https://doi.org/10.26714/jiasee.1.2.2023.36-46

Andress, S., Sumarji, & Mulyaningtiyas, R. . (2023). Pengaruh kelayakan finansial terhadap kesejahteraan Kelompok Tani berbasis program Unit Pengolah Pupuk Organik (UPPO) di Kabupaten Madiun. *Ekonomi Pertanian Dan Agribisnis (JEPA)*, *7*(4), 1473–1486. https://doi.org/10.21776/ub.jepa.2023.007.04.24

Aprisal, Istijono, B., Juniarti, & Harianti, M. (2019). Soil quality index analysis under horticultural farming in Sumani upper watershed. *International Journal of GEOMATE*, *16*(56), 191–196. https://doi.org/10.21660/2019.56.8212

Auria, R. S., Puspitaningrum, D. A., & Widayanto, B. (2022). Potensi subsektor tanaman pangan komoditas padi di Kabupaten Klaten Provinsi Jawa Tengah. *AGRIFITIA : Journal of Agribusiness Plantation*, *2*(1). https://doi.org/10.55180/aft.v2i1.199

Avian Pratama, W., & Alfaricha, T. (2026). Strengthening youth farmer regeneration through knowledge management practices in farmer communities. *Electronic Journal of Knowledge Management*, *24*(2), 33–52. https://doi.org/10.34190/ejkm.24.2.4588

Avishan, F., Yanıkoğlu, İ., & Soysal, M. (2025). Adaptive optimization approach for production and distribution planning of perishable food products under demand uncertainty. *Annals of Operations Research*. https://doi.org/10.1007/s10479-025-06552-5

Badan Standardisasi Nasional. (2024). Pupuk organik padat. In *Badan Standardisasi Nasional*.

Direktorat Jenderal Prasarana dan Sarana Pertanian. (2022). *Petunjuk teknis kegiatan pupuk menuju pertanian organik melalui Unit Pengolah Pupuk Organik tahun anggaran 2023*.

Fitasari, F., Hapsari, T. D., & Kuntadi, E. B. (2018). Efisiensi biaya produksi pupuk organik pada unit pengelola pupuk organik (UPPO) tani mandiri IB di desa Lombok Kulon kecamatan Wonosari kabupaten Bondowoso. *Jurnal Agribisnis Indonesia*, *5*(1), 11. https://doi.org/10.29244/jai.2017.5.1.11-26

Hang, S., Wang, Y., Wei, Y., Wang, B., Peng, B., Hao, Z., Wu, L., Zhang, L., Ding, G., & Li, J. (2024). Essential role of composting industry in achieving China's dual-carbon goals: Case studies from Chinese composting companies. *Bioresource Technology*, *410*, 131305. https://doi.org/10.1016/j.biortech.2024.131305

Hardiyanto, T. (2025). Analisis rentabilitas ekonomi agroindustri pupuk organik cair di Desa Cicalengka Wetan. *AGRITEKH (Jurnal Agribisnis Dan Teknologi Pangan)*, *6*(1), 45–52. https://doi.org/10.32627/agritekh.v6i1.1546

Hendarliana, A. N., Heryanto, M. A., Natawidjaja, R. S., & Pardian, P. (2021). Pertanian konvensional dan pupuk organik : implementasi program Unit Pengolah Pupuk Organik (UPPO) di Kelompok Tani Silih Asih. *Mimbar Agribisnis: Jurnal Pemikiran Masyarakat Ilmiah Berwawasan Agribisnis*, *7*(2). https://doi.org/10.25157/ma.v7i2.5490

Huda, S., & Wikanta, W. (2017). Pemanfaatan limbah kotoran sapi menjadi pupuk organik sebagai upaya mendukung usaha peternakan sapi potong di Kelompok Tani Ternak Mandiri Jaya Desa Moropelang Kec. Babat Kab. Lamongan. *AKSIOLOGIYA : Jurnal Pengabdian Kepada Masyarakat*, *1*(1), 26–35.

Huzir, N. M., Asmadi, A. A., Rosly, M. B., Tamunaidu, P., & Amin, A. N. R. (2026). Composting as a pathway for organic waste valorization: substrate performance, process strategies, and quality

This open acces article is distributed under a
Creative Commons Attribution (CC-BY-NC) 4.0 licence

PUBLISHING
• ISSN 2720 – 9644 (print)
• ISSN 2721 – 0877 (online)
IJESSS
INTERNATIONAL JOURNAL OF ENVIRONMENTAL, SUSTAINABILITY AND SOCIAL SCIENCE
Indexed by :

benchmarks. *Journal of Material Cycles and Waste Management*, *28*(2), 815–833. https://doi.org/10.1007/s10163-025-02460-9

Imaningsih, E. S., Ramli, Y., & Yusoff, Y. M. (2026). Implementation Of circular economy through organic and anorganic waste management in green MSME. *Akuntansi Dan Humaniora: Jurnal Pengabdian Masyarakat*, *5*(2), 290–297. https://doi.org/10.38142/ahjpm.v5i2.2053

Kementerian Pertanian. (2019). *Keputusan Menteri Pertanian Republik Indonesia Nomor 261/KPTS/SR.310/M/4/2019 tentang persyaratan teknis minimal pupuk organik, pupuk hayati dan pembenah tanah*.

Kim, Y., Kim, Y., & Kim, H.-J. (2024). Impact of product packaging messages on consumer perceptions and choice: The role of health claims and bonus pack promotions. *Appetite*, *200*, 107555. https://doi.org/10.1016/j.appet.2024.107555

Kusnandar, K., van Kooten, O., & Brazier, F. M. (2023). Supporting self-organisation in farmer organisations in developing countries: A case with a group of farmer groups in Indonesia. *Journal of Co-Operative Organization and Management*, *11*(2), 100214. https://doi.org/10.1016/j.jcom.2023.100214

Lal, R. (2020). Soil organic matter content and crop yield. *Journal of Soil and Water Conservation*, *75*(2). https://doi.org/10.2489/JSWC.75.2.27A

Lestari, D. T., Aminah, M., & Munandar, J. M. (2024). Circular economy business strategy of organic fertilizer in parikesit farmer group. *Indonesian Journal of Business and Entrepreneurship*. https://doi.org/10.17358/ijbe.10.2.400

Lestari, W., & Purnamayani, R. (2016). Analisis SWOT strategi pengembangan pupuk organik melalui pengadaaan UPPO (Unit Pengolahan Pupuk Organik) di Provinsi Jambi. *Seminar Nasuional Membangun Pertanian Modern Dan Inovatif Berkelanjutan Dalam Rangka Mendukung MEA*, 913–924.

Li, L., Han, J., & Zhu, Y. (2024). Empowering sustainability: How digital agricultural extensions influence organic fertilizer choices among Chinese farmers. *Journal of Environmental Management*, *371*, 123340. https://doi.org/10.1016/j.jenvman.2024.123340

Liu, Y., Lan, X., Hou, H., Ji, J., Liu, X., & Lv, Z. (2024). Multifaceted ability of organic fertilizers to improve crop productivity and abiotic stress tolerance: review and perspectives. *Agronomy*, *14*(6), 1141. https://doi.org/10.3390/agronomy14061141

Liu, Y., Shi, K., Liu, Z., Qiu, L., Wang, Y., Liu, H., & Fu, X. (2022). The effect of technical training provided by agricultural cooperatives on farmers' adoption of organic fertilizers in China: based on the mediation role of ability and perception. *International Journal of Environmental Research and Public Health*, *19*(21), 14277. https://doi.org/10.3390/ijerph192114277

Madarisa, F., Basyar, B., Arif, E., Azrifirwan, A., Putra, R. A., & Saputra, R. T. (2026). Organizational capabilities and social enabling factors in sustaining livestock farmer groups in West Sumatra, Indonesia. *Advances in Animal and Veterinary Sciences*, *14*(6). https://doi.org/10.17582/journal.aavs/2026/14.6.1112.1123

Mahartajaya, G. ., Laksmi, A. ., & Ningsih, N. L. A. . (2026). Analysis of factors influencing consumer purchase decisions for subak timbul rice. *Journal of Entrepreneurial and Business Diversity*, *4*(2), 490–494.

Manuaba, I. B. M. P., Sanjaya, I. K. P. W., & Ganawati, N. (2024). Improvement of performance lemon farmer group in Marga Dajan Puri Village Marga District Tabanan Regency. *Community Services: Sustainability Development*, *2*(1), 121–125. https://doi.org/10.61857/cssdev.v2i1.85

Molle, E. S., Setiawan, A. W., & Sutrisno, A. J. (2021). Penilaian status kesuburan tanah Desa Tijayan Kecamatan Manisrenggo Kabupaten Klaten. *Agrotechnology Research Journal*, *5*(2). https://doi.org/10.20961/agrotechresj.v5i2.54230

This open acces article is distributed under a
Creative Commons Attribution (CC-BY-NC) 4.0 licence

PUBLISHING
• ISSN 2720 – 9644 (print)
• ISSN 2721 – 0877 (online)
IJESSS
INTERNATIONAL JOURNAL OF ENVIRONMENTAL, SUSTAINABILITY AND SOCIAL SCIENCE
Indexed by :

Mungai, L. M., Messina, J. P., Zulu, L. C., Chikowo, R., & Snapp, S. S. (2024). The role of agricultural extension services in promoting agricultural sustainability: a Central Malawi case study. *Cogent Food & Agriculture*, *10*(1). https://doi.org/10.1080/23311932.2024.2423249

Nangobi, R., Mshenga, P. M., & Mugonola, B. (2024). Sustainability of farmer organizations in Uganda: the role of organizational and institutional factors. *Discover Sustainability*, *5*(1), 259. https://doi.org/10.1007/s43621-024-00403-2

Nattasya. (2021, October). UPPO tepat sasaran, tapi produksi kurang berkelanjutan. *Tabloid Sinar Tani*. https://tabloidsinartani.com/detail/indeks/agri-sarana/18569

Patton, M. Q. (2015). *Qualitative research & evaluation methods*. SAGE Publications.

Pitcher, T. J. (1999). *Rapfish: A rapid appraisal technique for fisheries, and its application to the code of conduct for responsible fisheries*.

Pitcher, T. J., Lam, M. E., Ainsworth, C., Martindale, A., Nakamura, K., Perry, R. I., & Ward, T. (2013). Improvements to Rapfish: A rapid evaluation technique for fisheries integrating ecological and human dimensionsa. *Journal of Fish Biology*, *83*(4). https://doi.org/10.1111/jfb.12122

Pitcher, T. J., & Preikshot, D. (2001). RAPFISH: A rapid appraisal technique to evaluate the sustainability status of fisheries. *Fisheries Research*, *49*(3). https://doi.org/10.1016/S0165-7836(00)00205-8

Putra, G. A., Wiraguna, D., Saputra, Z. H., Azhari, D., Nur'aini, H., & Fariadi, H. (2025). Pengembangan desain kemasan pupuk untuk meningkatkan daya saing di Desa Mekar Sari. *Jurnal Dehasen Mengabdi*, *4*(1). https://doi.org/10.37676/jdm.v4i1.7903

Ramaiyulis, Nilawati, Yulia, E., & Novia, R. (2020). Empowering of communities receiving aid of organic fertilizer processing units ("UPPO") with quality and packaging improvement in Indonesia. *International Journal of Scientific and Technology Research*, *9*(1).

Reswati, R., Afriyani, T., Hafizah, D., Muhadzid, F. A., Kamila, A., & Aulia, R. (2025). Pemberdayaan kelompok tani Mubarakah di Kabupaten Agam melalui pengembangan usaha pupuk kompos. *Jurnal Hilirisasi IPTEKS*, *8*(4), 441–455. https://doi.org/10.25077/jhi.v8i4.927

Santoso, A. D., Arianti, F. D., Rohaeni, E. S., Haryanto, B., Pertiwi, M. D., Panggabean, L. P., Prabowo, A., Sundari, S., Wijayanti, S. P., Djarot, I. N., Kurniawati, F. D., Sahwan, F. L., Prasetyo, T., Barkah, A., Adibroto, T. A., Ridlo, R., Febijanto, I., Wasil, A. A., Lusiana, S., … Heryanto, R. B. (2023). Sustainability index analysis of organic fertilizer production from paunch manure and rice straw waste. *Global Journal of Environmental Science and Management*, *9*(SI). https://doi.org/10.22034/GJESM.2023.09.SI.12

Saputra, K. A. K., Laksmi, P. A. S., Sancaya, I. W. W., Pramaiswari, M. A. A. D., & Pratika, I. G. C. A. (2025). Simplifying the blue economy for msmes in the riverbank and coastal areas of Kerobokan, Buleleng: A sustainable approach to community empowerment. *Akuntansi Dan Humaniora: Jurnal Pengabdian Masyarakat*, *4*(2), 58–64. https://doi.org/10.38142/ahjpm.v4i2.1545

Sari, M. I., Sundari, S., & Rizal, R. (2025). Analisis strategi bauran pemasaran pupuk organik komplet pada kelompok tani Mekar Sari Dua di Kabupaten Jember. *Jurnal Ilmiah Inovasi*, *25*(3), 234–247. https://doi.org/10.25047/jii.v25i3.6182

Selamet, I. ., Jayanti, I. G. P. S. ., Rustini, N. ., Purnami, A. A. ., Anjani, K. W. ., Pratiwi, N. G. A. A. W. ., Agastira, G. N. ., & Darmayoga, I. M. . (2026). Empowering coffee farmer groups through post-harvest standardization, business management, and technology transfer in Belantih Village, Kintamani. *Community Services: Sustainability Development*, *3*(3), 40–46.

Shen, B., Zheng, L., Zheng, X., Yang, Y., Xiao, D., Wang, Y., Sheng, Z., & Ai, B. (2024). Insights from meta-analysis on carbon to nitrogen ratios in aerobic composting of agricultural residues. *Bioresource Technology*, *413*, 131416. https://doi.org/10.1016/j.biortech.2024.131416

This open acces article is distributed under a
Creative Commons Attribution (CC-BY-NC) 4.0 licence

PUBLISHING
• ISSN 2720 – 9644 (print)
• ISSN 2721 – 0877 (online)
IJESSS
INTERNATIONAL JOURNAL OF ENVIRONMENTAL, SUSTAINABILITY AND SOCIAL SCIENCE
Indexed by :

Shodiq, M. Z. S. I., Fitridiani, M., Brilliant, S., Tyas, S. D. W., & Suhartini, T. (2026). The effect of training on employee performance. *Journal of Entrepreneurial and Business Diversity*, *4*(1), 504–508. https://doi.org/10.38142/jebd.v4i1.401

Sigit, A. A., & Suharjo, S. (2007). Analisis proses degradasi lahan dan dampaknya terhadap produktifitas lahan pertanian di Kabupaten Klaten. *Forum Geografi*, *21*(2). https://doi.org/10.23917/forgeo.v21i2.10174

Simanungkalit, Suriadikarta, D. A., Saraswati, R., Setyorini, D., & Hartatik, W. (2006). *Pupuk organik dan pupuk hayati*. Balai Besar Penelitian dan Pengembangan Sumberdaya Lahan Pertanian.

Storkey, J., Maclaren, C., Bullock, J. M., Norton, L. R., Redhead, J. W., & Pywell, R. F. (2024). Quantifying farm sustainability through the lens of ecological theory. *Biological Reviews*, *99*(5), 1700–1716. https://doi.org/10.1111/brv.13088

Sugiarto, M., & Nur Cahyo, D. (2025). The influence of social capital on the group dynamics of Kebumen Ongole Crossbred (POKebumen) cattle farmers, Central Java Province, Indonesia. *Buletin Peternakan*, *49*(1), 376. https://doi.org/10.21059/buletinpeternak.v49i1.100507

Sugiyono. (2017). *Metode penelitian kuantitatif, kualitatif dan R & D*. Alfabeta.

Taron, A., Sathiskumar, A., Mateo-Sagasta, J., Singha, R., Dejen, Z. A., Chipatecua, G. P., & Bastidas, R. R. (2025). *Resource recovery from livestock waste: cases and business models from the Global South*. https://doi.org/10.5337/2025.215

Wang, H., Guo, R., Xu, J., Yang, T., Wang, M., Zhang, L., Jiang, L., Gao, Y., Guo, J., Shi, L., Gao, Y., Sun, M., & Zhang, T. (2025). Organic fertilizer enhances crop yield and soil health by increasing arbuscular mycorrhizal fungi species richness. *Functional Ecology*, *39*(11), 3210–3224. https://doi.org/10.1111/1365-2435.70151

Wei, Z., Wang, H., Ma, C., Li, S., Wu, H., Yuan, K., Meng, X., Song, Z., Fang, X., & Zhao, Z. (2022). Unraveling the impact of long-term rice monoculture practice on soil fertility in a rice-planting meadow soil: a perspective from microbial biomass and carbon metabolic rate. *Microorganisms*, *10*(11). https://doi.org/10.3390/microorganisms10112153

Wen-Ming, Z., Xu-Jie, W., Si-Qian, Y., Xin-Yi, C., & Long, H. (2021). C/N ratio-induced changes in predominant bacteria affected carbon / nitrogen losses and humus synthesis in composting. *Chinese Journal of Applied Ecology*, *32*(11), 4119–4128.

Wulandari, E., Karyani, T., Ernah, & Alamsyah, R. T. P. (2023). What makes farmers record farm financial transactions? empirical evidence from potato farmers in Indonesia. *International Journal of Financial Studies*, *11*(1), 19. https://doi.org/10.3390/ijfs11010019

Yogatama, A. N., Hanif, R., Sidi, A. P., Anjaningrum, W. D., Cahyaningtyas, F., & Dura, J. (2024). Simple bookkeeping training at the Rembun Village Farmer Group, Dampit, Kabupaten Malang. *Jurnal Pengabdian Masyarakat*, *5*(1), 221–228. https://doi.org/10.32815/jpm.v5i1.2052

Yusuf, M., Wijaya, M., Surya, R. A., & Taufik, I. (2021). *MDS-RAPS teknis analisis keberlanjutan*. CV. Tohar Media.

This open acces article is distributed under a
Creative Commons Attribution (CC-BY-NC) 4.0 licence