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Towards Sustainable Agriculture: Assessment of Organic Salak Pondoh (Salacca edulis Reinw) Farming in Magelang Using the SAFA Framework

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Abstract

This study uses a quantitative descriptive approach with the SAFA Framework to assess the sustainability of organic agriculture in Magelang through three main dimensions: governance, environmental integrity, and economic resilience. The results show that the governance system has been running well with the application of ethical principles, accountability, participation, and strong management, although there is still room for improvement in compliance with regulations. The environmental aspect shows fairly good conditions with efficient natural resource management, but biodiversity remains an aspect that requires special attention. From an economic perspective, organic farming shows strong resilience through increased investment value, product quality, and contribution to the local economy. In general, organic farming practices in this region reflect a high level of sustainability with solid governance and resource efficiency. The highest overall holistic management score is 100%, reflecting strong ethics and management. However, soil conservation, with a score of 60%, requires attention. Continuous efforts to strengthen biodiversity, soil conservation, and risk mitigation are key to realizing a more adaptive and sustainable agricultural system.

Introduction

The sustainability of agricultural systems is an important issue in international forums as part of the transition to global sustainable development (Ferla et al., 2024). Concerns about the impact of modern agriculture have led to the emergence of various approaches to sustainability assessment that cover social, environmental, and economic dimensions through indicators such as biodiversity, climate change, and worker welfare (Zarbà et al., 2025). In Indonesia, the horticulture sub-sector plays a strategic role in agricultural and national economic development, particularly through high-value commodities such as fruits, vegetables, and ornamental plants (Romadhona & Puryono, 2024). One of the leading commodities, salak, has seen increasing demand in domestic and international markets, but production increases have not been optimal (Nurul H et al., 2018). This condition has encouraged farmers, especially in major producing areas such as Magelang, to implement more efficient, sustainable, and innovative cultivation practices.

The Sustainability Assessment of Food and Agriculture systems (SAFA) developed by the Food and Agriculture Organization of the United Nations (FAO) is a comprehensive framework for assessing the sustainability of different types of agricultural systems (FAO, 2013). SAFA covers four main dimensions of sustainability: economic, social, environmental and governance, with each dimension elaborated through various specific themes and indicators (Bonisoli et al., 2019). This research will not only provide insights into the effectiveness of different agricultural practices in the local context, but will also offer practical recommendations for improved sustainability in the agricultural sector (Gayatri et al., 2016). As such, the research is expected to contribute to the development of more sustainable agricultural strategies, both at the regional and global levels In the context of organic supply chains, the SAFA approach enables a more in-depth evaluation of organic farming practices, environmental sustainability, and the social and economic impacts of the companies involved. For example, SAFA can measure how companies maintain biodiversity, sustainably manage water resources, and ensure the well-being of farmers and workers throughout the supply chain (Cammarata et al., 2021).

Although the SAFA (Sustainability Assessment of Food and Agriculture Systems) Framework has been widely applied in various countries such as Ecuador, Sicily, Paraguay, Uganda and several other regions (Al Shamsi et al., 2019) (Ssebunya et al., 2019) (Bonisoli et al., 2019). Assess the sustainability of agricultural systems, to date there has been no study that specifically applies this approach to the context of small-scale tropical horticulture in Indonesia. In

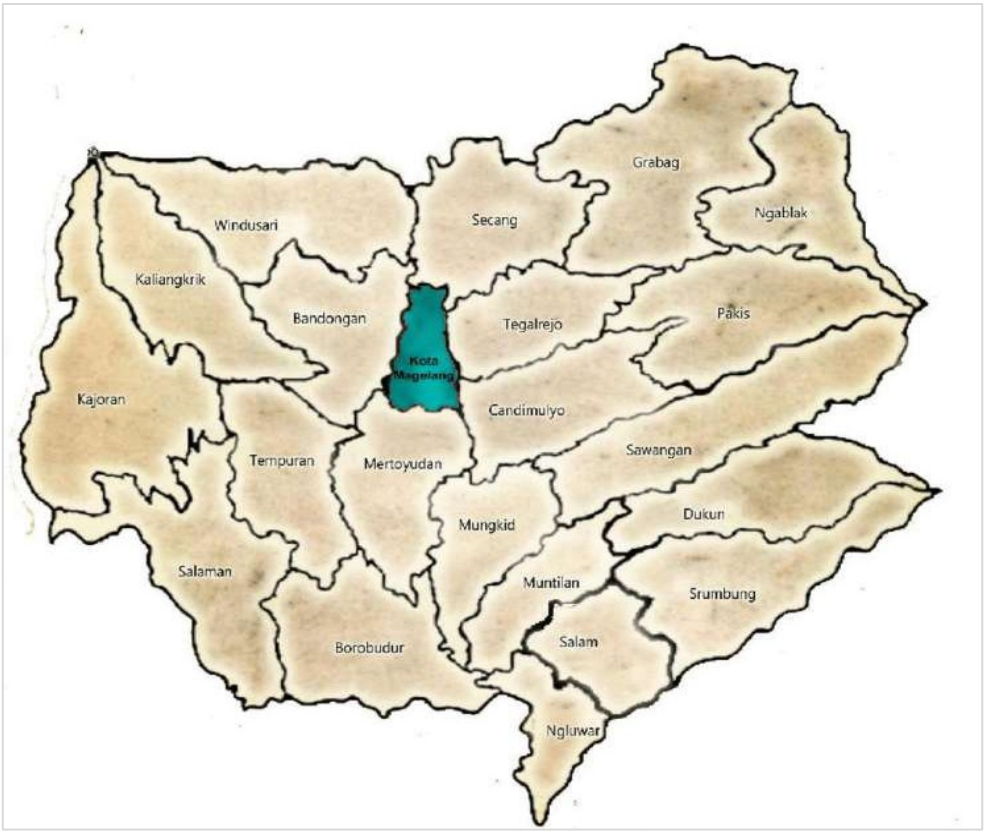
fact, Indonesia has agroecological, socioeconomic, and agricultural management systems that are significantly different from those of these countries. This condition makes the application of SAFA in the local Indonesian context interesting to study in more depth, especially in understanding how the dimensions of governance, environmental integrity, economic resilience, and social welfare interact in tropical horticultural agricultural systems.

Through the implementation of SAFA, companies in the organic supply chain can be identified and evaluated against broader sustainability practices (Heylen et al., 2019). This helps in identifying areas that require improvement and developing strategies to improve the overall sustainability of the company (Kaewchutima et al., 2025). As such, SAFA provides a more comprehensive and balanced framework for sustainability assessment, covering environmental, economic, social, and good governance aspects. In addition, SAFA not only assesses performance quantitatively, but also pays attention to governance processes and stakeholder engagement, resulting in a more realistic and contextual picture of sustainability (Romadhona et al., 2024).This study aims to: (1) measure sustainability through SAFA, (2) identify vulnerable points, (3) develop a replication roadmap for 372 villages in Magelang.

Methods

Location of the research conducted in this study is located in the district of Magelang This study was conducted in Magelang Regency, which is geographically located between 110°01'51"–110°26'58" E and 7°19'13"–7°42'16" S, with an area of approximately 108,573 hectares or 3.34% of the total area of Central Java Province. This region consists of 21 subdistricts and 372 villages, with Kajoran Subdistrict being the largest and Ngluwar the smallest. Morphologically, Magelang is a basin-shaped highland surrounded by the Merapi, Merbabu, Andong, Telomoyo, Sumbing, and Menoreh mountains, with an altitude of between 153 and 3,065 meters above sea level. The topography varies from flat to very steep, while the two main rivers, Progo and Elo, are important sources of water for agricultural activities. The agroclimatic conditions and fertile soil make Magelang a center for agricultural production, both food crops and horticulture, which plays an important role in meeting regional and provincial market needs..

Figure 1.1 Research location map



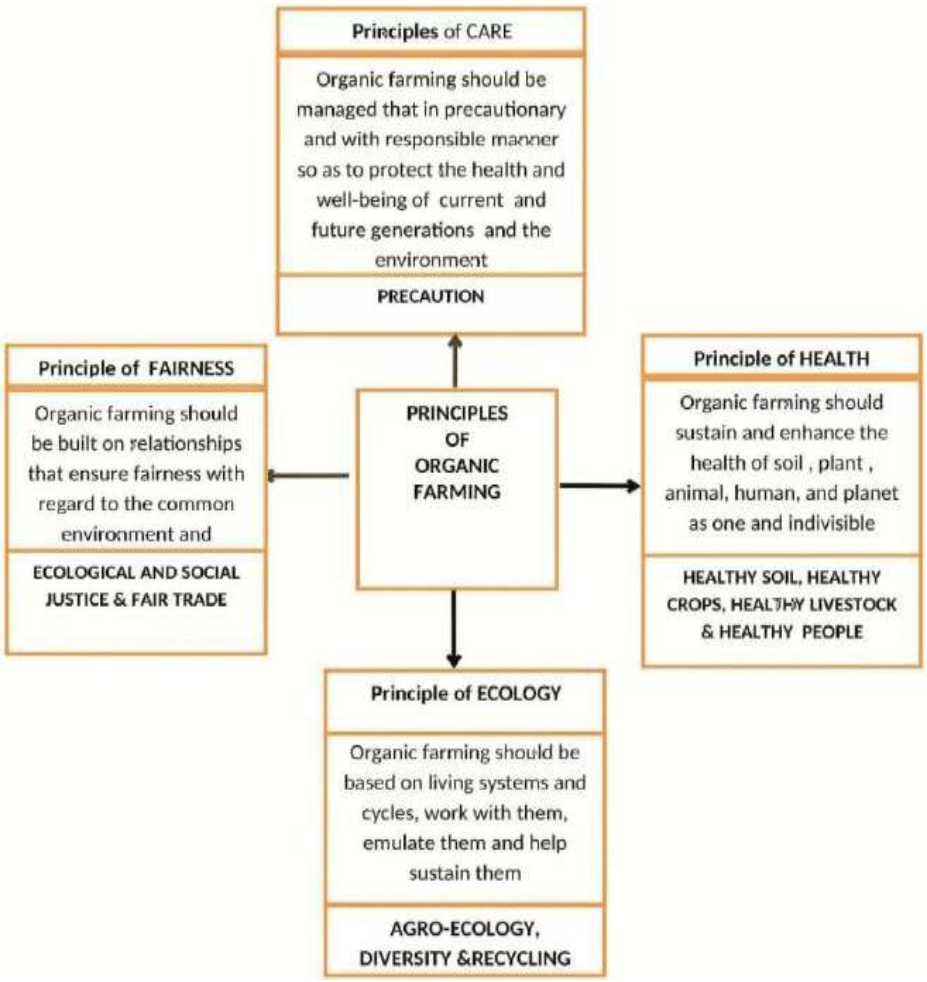
Certified organic snake fruit farms in Magelang Regency are generally located on volcanic slopes (including central areas such as Srumbung, Salam, and Dukun Districts), with undulating to hilly topography that provides good drainage and highly fertile soil rich in organic matter due to volcanic ash. These farms are managed by smallholder farmer groups that implement organic cultivation practices from nurseries, organic fertilization, biological control, to prohibitions on the use of pesticides and synthetic materials and some are registered/certified and meet export standards. Planting patterns tend to be dense with dense snake fruit clumps, light agroforestry practices (shade and buffer vegetation), and market-oriented business systems that are still structured on fragmented land patterns. Challenges include the need to increase registered land area, post-harvest management, and pest control, particularly fruit flies. Overall, land conditions indicate high potential for export-quality organic snake fruit production but depend on farmer group coordination, adherence to certification SOPs, and technical support to maintain organic standards.

Figure 1.2 Condition of certified organic salak land in Magelang Regency

This study used a quantitative descriptive design with a cross-sectional approach to analyze agricultural sustainability practices using the SAFA Framework. Quantitative descriptive research with a cross-sectional approach was chosen to provide a comprehensive picture of agricultural sustainability practices at one specific time. This approach allows researchers to collect data from different groups of farmers simultaneously. The implementation of SAFA (Sustainability Assessment of Food and Agriculture systems) is a structured process to evaluate the sustainability of food and agriculture practices .

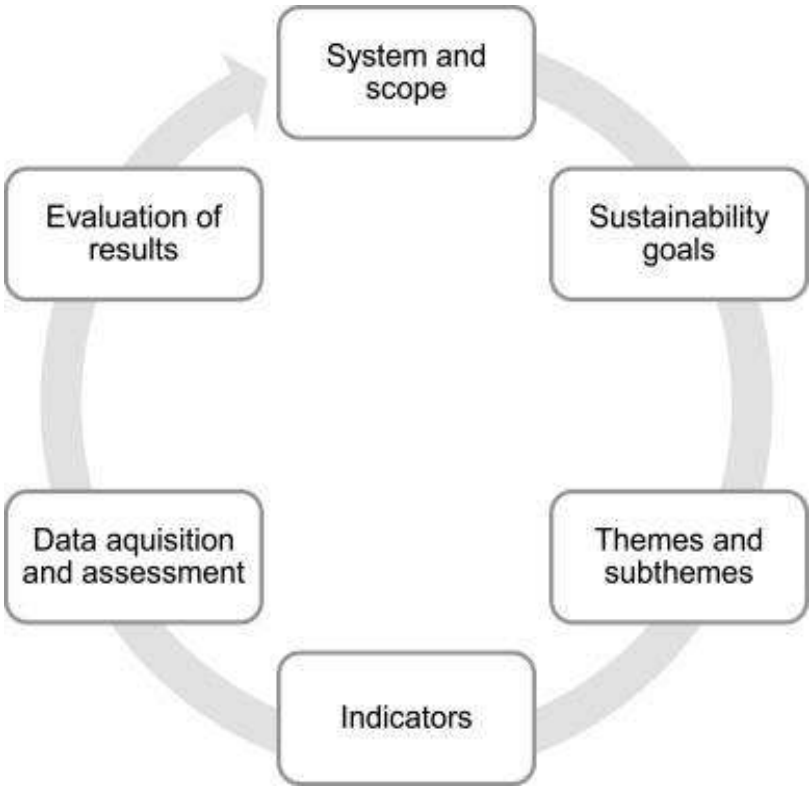
The first stage is understanding the context and scope of the assessment, which involves identifying the entities to be assessed, defining the objectives and identifying the resources needed. It also includes the division of responsibilities within the assessment team. The second stage is data collection, which involves gathering information related to pre-defined sustainability indicators. The third stage is data analysis, where the collected data is analyzed to identify the assessed entity's sustainability performance. The fourth stage is the reporting and communication of results, which results in the SAFA Performance Report. This report contains a descriptive and analytical overview of the entity's sustainability based on the predefined indicators.

Figure 1.3 Principles of Organic Farming



SAFA provides specific goal definitions for agricultural businesses, taking into account the impacts of sourcing, management and sales decisions (Wadghane et al., 2025). This allows agricultural companies to assess the extent to which they are meeting these sustainability objectives. The indicators suggested in SAFA can be both qualitative and quantitative, allowing for a comprehensive and detailed assessment. Qualitative indicators typically focus on harder-to-measure aspects such as governance and social welfare, while quantitative indicators often relate to directly measurable data such as greenhouse gas emissions and water use efficiency.

Figure 1.4 Overview of assessment method development.



SAFA aims to provide a comprehensive tool for agricultural companies to assess and improve their sustainability performance (Bhérer-Breton et al., 2025). Using SAFA, companies can identify areas where they excel as well as areas that require improvement, and subsequently take the necessary steps to achieve long-term sustainability. The framework also helps companies to communicate with stakeholders about their sustainability efforts, providing transparency and building trust among consumers, investors, and society at large. Population in research is the whole of the characteristics or units of measurement that become the object of research, which fulfils certain conditions related to the research problem (Curran et al., 2020). In the context

of this study, the population refers to all farmer groups in Magelang district that belong to the Madya cluster. The selection of the Madya cluster as the population is based on the high complexity and various indicators that will be assessed in the sustainability assessment using the SAFA Framework . The Madya cluster is considered well-established, with good production to post-harvest processes, thus providing a more accurate and comprehensive picture of sustainable agricultural practices.

Table 1. SAFA score results

FARMER GROUP	STATUS	COMMODITY	COORDINATES
KT Mekar Lestari	Certified Organic	Horticulture (Salak)	110° 25' 22.571"" E,7° 36' 43.361"" S
KT Sicantik,	Certified Organic	Horticulture (Salak)	110° 21' 23.731"" E,7° 38' 50.776"" S
KT Gemilang,	Certified Organic	Horticulture (Salak)	110° 27' 43.494"" E,7° 40' 0.490"" S
KT Rukun Tani	Certified Organic	Horticulture (Salak)	110° 17' 40.038"" E,7° 48' 42.782"" S
KT Gemah	Certified Organic	Horticulture (Salak)	110° 28' 14.702"" E,7° 45' 27.181"" S
KT Barokah	Certified Organic	Horticulture (Salak)	110° 15' 3.974"" E,7° 46' 12.960"" S

Source: SIMLUHTAN 2024

This study uses a mixed method that combines qualitative and quantitative approaches to obtain a comprehensive picture of the sustainability of organic salak farming in Magelang Regency. The qualitative approach was conducted through field observations and in-depth interviews with farmer group members to understand cultivation practices, land management, and the socio-economic dynamics of farmers. Meanwhile, the quantitative approach was conducted using the SAFA Framework checklist to assess sustainability performance in various dimensions, including governance, environmental integrity, economic resilience, and social welfare. The research population consisted of six certified organic salak farmer groups, which were purposively selected based on regional representation and consistency in the implementation of sustainable agricultural practices.

Result

1. SAFA Result

The findings should be articulated concisely and clearly. The discussion should focus on In recognition of the multifunctional nature of agriculture, the Food and Agriculture Organization (FAO) developed the SAFA (Sustainability Assessment of Food and Agriculture systems) guidelines as a normative framework to guide the sustainability assessment of agricultural enterprises. SAFA aims to provide a holistic and universally relevant sustainability framework, consisting of 21 themes and 58 subthemes. The framework covers four main dimensions: economic, social, environmental and governance. Each theme and subtheme in SAFA is designed to measure different aspects of sustainability relevant to agricultural enterprises.

Table 2.1 SAFA score results

THEME	SUBTHEME	VALUE	RATING
Good Governance	G1 Corporate Ethics	70%	Good
	G2 Accountability	72%	Good
	G3 Participation	75%	Good
	G4 Rule of Law	68%	Good
	G5 Holistic Management	100%	Best
Environmental Integrity	E1 Atmosphere	74%	Good
	E2 Water	75%	Good
	E3 Land	70%	Good
	E4 Biodiversity	60%	Moderate
	E5 Materials and Enegy	83%	Best
	E6 Animal Welfare	85%	Best
Economic Resilience	C1 Investment	87%	Best
	C2 Vulnerability	80%	Good
	C3 Product Quality and Information	88%	Best
	C4 Local Economy	90%	Best
Social Well-Being	S1 Decent Livelihood	80%	Good
	S2 Fair Trading Practices	82%	Best
	S3 Labour Rights	87%	Best
	S4 Equity	87%	Best
	S5 Human Safety and Health	62%	Moderate

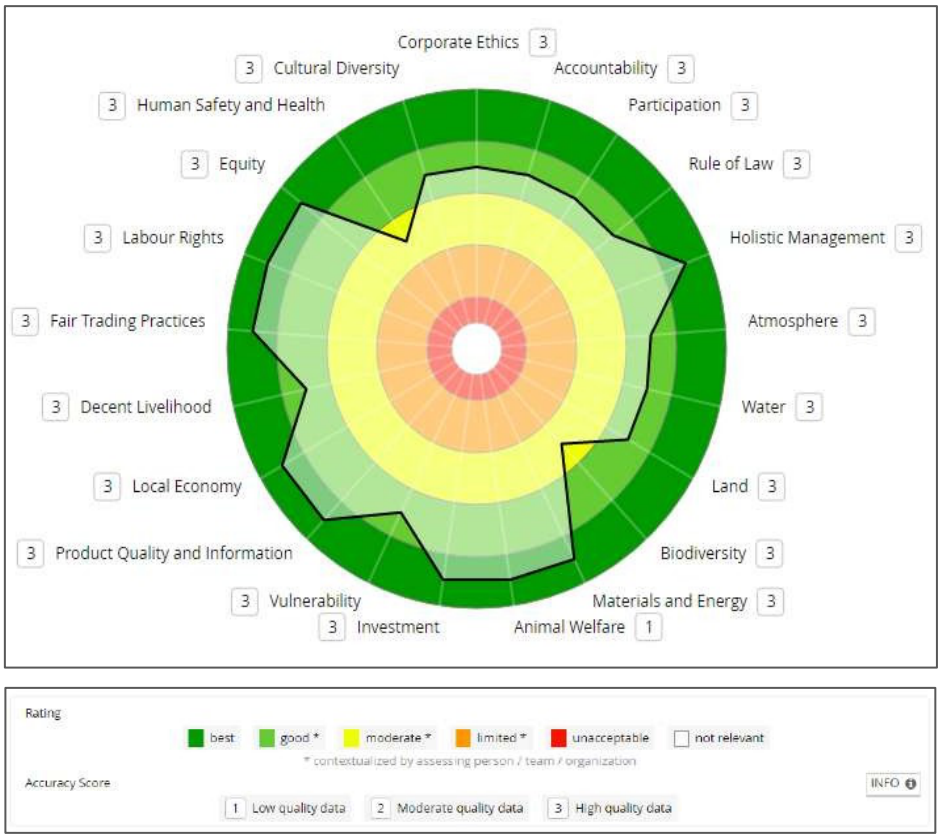


Figure 2.1 SAFA radar map of the Organic salak Farmer Group

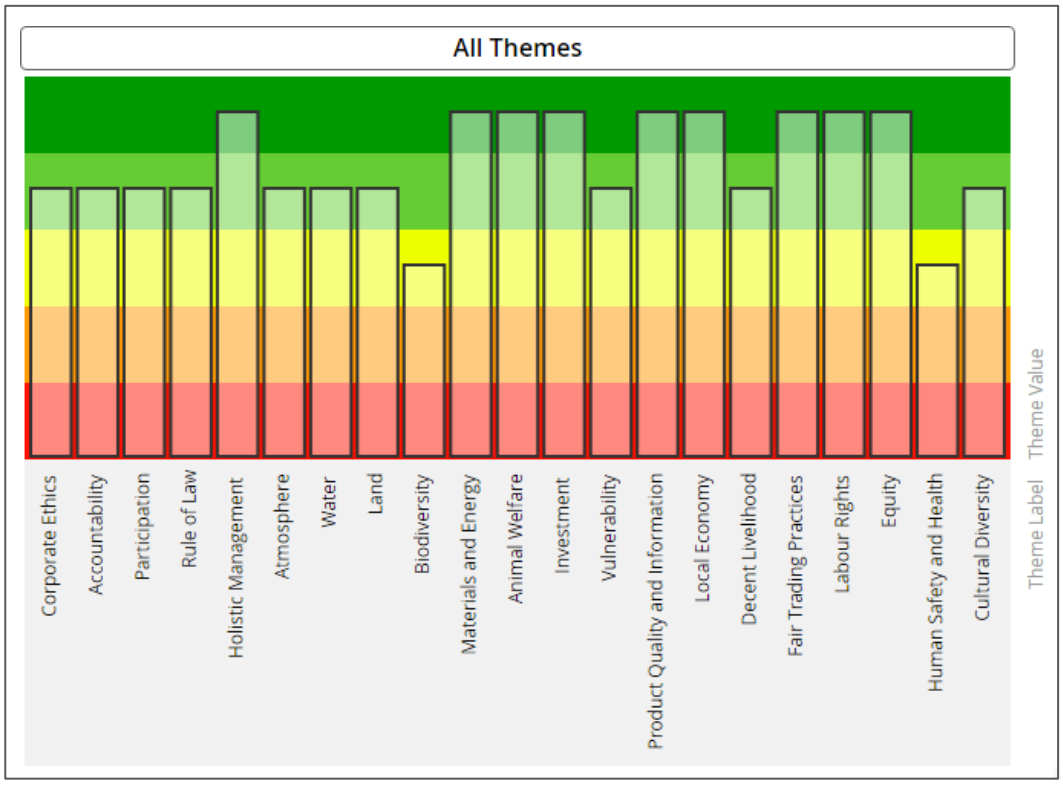


Figure 2.2 SAFA Chart on Organic Salak Farmer Group

1.1 Good Governance

The assessment of the sustainability of organic salak farming practices in Magelang using the SAFA Framework shows that governance in the aspect of corporate ethics scored 70% with a rating of "Good". This reflects that organic salak farmers in Magelang have implemented good ethical practices in their farming operations, although there is still room for improvement in upholding ethical values. In the Accountability subtheme, the score obtained is 72% with a rating of "Good", indicating that there is a fairly effective accountability mechanism but needs improvement to achieve more optimal accountability. Furthermore, participation scored 75% with a rating of "Good", indicating that there is a good level of participation from various related parties in the decision-making process and implementation of organic salak farming activities. In the aspect of compliance with the law (Rule of Law), the value achieved is 68% with a rating of "Good", indicating that although there are efforts to comply with applicable legal regulations, strengthening is still needed in a more consistent implementation of the law. Meanwhile, in the Holistic Management subtheme, organic salak farming practices in Magelang received a perfect score of 100% with a rating of "Best", reflecting that a comprehensive and integrated management approach has been implemented very well, covering economic, environmental, social, and governance aspects. This assessment shows that the overall practice of organic salak farming in Magelang is in a good category but still needs improvement in several aspects to achieve more optimal sustainability.

1.2 Environmental Integrity

Analysis of the SAFA framework on organic salak farming in Magelang shows quite positive results on various environmental themes. In theme E1 (Atmosphere), the farm scored 74%, which is categorized as good, showing practices that minimize greenhouse gas emissions and air pollution. Theme E2 (Water) scored 75%, which was categorized as good, demonstrating efficient water management and practices that prevent contamination of water sources. In theme E3 (Soil), the score of 70% is good, indicating soil management practices that support soil fertility and health. However, in theme E4 (Biodiversity), the score only reached 60% with a moderate category, indicating that despite efforts to protect and promote biodiversity, there is still room for improvement. Planting local buffer zones is a strategic effort to protect

core ecosystems from external pressures by planting adaptive vegetation suited to local environmental conditions. These zones serve as ecological barriers that enhance biodiversity. Furthermore, theme E5 (Materials and Energy) recorded a score of 83% which is in the best category, indicating efficient use of material and energy resources and implementation of sustainable practices. Theme E6 (Animal Welfare) scored the highest at 85%, also in the best category, reflecting high attention to animal welfare in the farming system. Overall, this SAFA analysis indicates that organic salak farming in Magelang has made significant efforts in environmental aspects, although improvement is still needed in biodiversity aspects. The findings are relevant for continuous improvement and strategic decision-making in managing organic farming to be more environmentally friendly and sustainable.

1.3 Economic Resilience

The results of the analysis using the SAFA Framework on organic salak farming in Magelang show a very good performance in economic aspects. In indicator C1 (Investment), the highest score of 87% was recorded, indicating that the level of investment in this sector is very strong and supports long-term sustainability. Indicator C3 (Product Quality and Information) scored 88%, indicating that organic salak products in Magelang have high quality and clear information, which are important factors in building consumer and market trust. In addition, the C4 (Local Economy) score reached 90%, reflecting the significant contribution of organic salak farming to the local economy, both in creating jobs and supporting other local businesses. However, there are challenges in indicator C2 (Vulnerability) which scored 80%, although it falls into the good category, it still indicates a potential risk that needs to be managed. These vulnerabilities may be related to external factors such as climate change, market fluctuations, or dependence on external inputs. By maintaining high investment and focusing on improving product quality and transparent information, organic salak farming in Magelang can continue to strongly support the local economy. Risk management and increased resilience are important steps to ensure the long-term sustainability.

1.4 Social Well-Being

The assessment results on the theme of Social Well-Being show that, in general, social conditions in the agricultural system are in the good to very good category, although there are still aspects that need to be improved. The sub-theme of Decent Livelihood scored 80% (Good), indicating that farmers' livelihoods are relatively decent but not yet fully optimal. The aspects of Fair Trading Practices (82%), Labor Rights (87%), and Equity (87%) are in the Best category, reflecting fair trading practices, respect for workers' rights, and equitable distribution of benefits within the agricultural community. However, the main weakness is seen in Human Safety and Health with a score of 62% (Moderate), which indicates that there are still occupational safety risks and health issues that have not been fully addressed. Thus,

although the aspects of fairness, labor rights, and trading practices are already very strong, improving the quality of occupational health and safety needs to be a priority in order to strengthen the holistic dimension of social welfare.

Discussion

The interpretation of the sustainability assessment of organic salak farming in Magelang indicates that the practices implemented are consistent with previous research findings, particularly regarding the contribution of organic farming to strengthening governance, maintaining environmental integrity, and improving local socio-economic well-being. The "Good" score in governance confirms the consistency with the literature that emphasizes the importance of transparency, accountability, and compliance with the law in sustainable agriculture (see FAO, 2014). Meanwhile, the "Best" score in holistic management supports the hypothesis that an integrative approach combining economic, social, environmental, and governance dimensions is key to achieving a resilient organic farming system. However, weaknesses in health and safety as well as biodiversity conservation suggest that the sustainability transition remains partial and has not yet been fully comprehensive.

From an economic perspective, the results reinforce the working hypothesis that high investment and strong product quality can drive the sustainability of organic farming, both by expanding market share and strengthening the local economy. This aligns with previous studies highlighting that organic products tend to have higher added value and offer opportunities for rural community empowerment through job creation and business diversification. Nevertheless, the "Good" score in vulnerability underscores that external factors such as climate change, price volatility, and dependence on external inputs remain significant challenges. Thus, strengthening risk mitigation strategies such as market diversification, adoption of climate-smart technologies, and strengthening farmer institutions is essential to ensure that organic farming systems are more resilient to shocks.

Application of the SAFA framework to three different locations and commodities in Indonesia compared with previous research conducted by this study shows specific variations in sustainability aspects. In Magelang Regency, the use of SAFA for organic snake fruit emphasized the dimensions of economic resilience and social welfare, especially in strengthening farmer institutions and adding value to agro-ecotourism-based products. In Sleman Regency, for example, the SAFA assessment of organic rice emphasized environmental integrity aspects, such as soil and water conservation, reducing chemical inputs, and improving agro-ecological

practices in wetlands (Romadhona et al., 2024). Meanwhile, in Bogor Regency, the application of SAFA to organic vegetables focused on good governance and market stability, with an emphasis on certification, short supply chains, and urban farming marketing innovations (Rahmatullah et al., 2024). These differences reflect that the local biophysical, social, and economic contexts significantly influence the dominant dimensions of sustainability measured by SAFA in each region and commodity.

The implications of these findings for future research highlight the need for an interdisciplinary approach to strengthen weaker dimensions, particularly those related to occupational safety and biodiversity conservation. Future research could focus on comparative analysis between certified and non-certified organic farming to identify differences in governance and social welfare, as well as develop community-based intervention models to improve farmer occupational safety. In addition, research on the integration of local policies with sustainable agricultural practices needs to be improved, as government regulations and incentives play an important role in ensuring the successful implementation of SAFA in the Indonesian context based on the results of this study. Policies are needed to develop local buffer zones around organic salak plantations by planting native vegetation and shade trees that support ecosystem sustainability. This policy focuses on improving the biodiversity theme score (E4) of the SAFA through natural habitat conservation and integrated biological control. On the economic theme, local governments need to establish green investment incentive policies for organic salak farmers and businesses through access to environmentally friendly financing, agribusiness risk management training, and product diversification. This policy aims to strengthen local economic resilience.

Conclusion

Based on the results of an assessment using the SAFA (Sustainability Assessment of Food and Agriculture Systems) framework, organic salak farming practices in Magelang Regency demonstrate good to very good sustainability performance across the four main dimensions, namely good governance, environmental integrity, economic resilience, and social well-being. High scores in holistic management, product quality and information, contribution to the local economy, and fair trade practices reflect the success of this agricultural system in implementing integrated sustainability principles. However, there are still weaknesses in biodiversity conservation and occupational safety and health, indicating the need to strengthen adaptive capacity to address environmental and social risks. Overall, organic salak farming in Magelang has played an important role in promoting sustainable agricultural development through increased economic, social, and ecological value. To strengthen these achievements, three strategic steps are recommended: (1) farmer groups should plant at least 10 buffer trees per hectare to maintain ecosystem function and mitigate erosion, (2) the district government conducting occupational safety and health (OSH) training every semester to improve farmers' welfare,

and (3) replicating the SAFA model to 50 villages in Central Java during the 2026–2028 period to expand the implementation of sustainable agriculture.

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