**Social, Economic, and Environmental Factors in Determining the Sustainability of Tourist Attractions: The Case of Strawberry Agro-tourism in Sembalun District, Indonesia**

**ABSTRACT**

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| Strawberry agrotourism is one of the flagship sectors promoted by the East Lombok Regency Tourism Office, located in the Highland Tourism Area of Sembalun District. The main attraction strawberry picking tourism faces sustainability challenges due to dynamic socio-economic and environmental changes. This study aims to assess the sustainability status of strawberry agrotourism in Sembalun District and to analyze the key attributes that influence its sustainability. Methodologically, this study contributes by applying the Multi-Dimensional Scaling (MDS) approach using Rapfish software modified into Rap-Agro to evaluate sustainability across five key dimensions: ecological, economic, socio-cultural, institutional, and technological. The findings not only offer scientific insight into the multidimensional assessment of rural agrotourism sustainability but also provide practical guidance for local governments, farmers, and tourism managers in designing strategies to strengthen institutional capacity, encourage technology adoption, and implement more effective policy interventions. The results show that strawberry agrotourism in Sembalun is classified as "quite sustainable," with a multidimensional sustainability index score of 50.51. The economic (53.51), ecological (52.29), and socio-cultural (50.93) dimensions fall under the "quite sustainable" category, while the institutional (46.35) and technological (49.48) dimensions remain in the "less sustainable" category. Leverage analysis identified the most influential attributes in each dimension, including the type of mulch used and waste utilization in the ecological dimension; product diversification and distribution channels in the economic dimension; and worker training and age in the socio-cultural dimension. |
| It can be concluded that the economic, ecological, and socio-cultural dimensions are the primary determining factors of strawberry agrotourism sustainability in Sembalun District. |

*Keywords: Strawberry Agrotourism, Sustainability, Multi-Dimensional Scaling (MDS), Sembalun, Sustainability Analysis*

1. **INTRODUCTION**

Indonesia, as an archipelagic country, possesses abundant natural potential that can be developed into attractive resources for tourism. In 2023, Indonesia’s tourism sector contributed 3.8% to the national GDP, and in the following year, this increased by 3.6%. One of the tourism potentials that can be further developed is agriculture-based tourism, commonly known as agrotourism. Agrotourism combines the agribusiness and tourism sectors, creating new economic opportunities, improving the welfare of rural communities, and strengthening Indonesia’s agricultural identity (Athallah et al., 2024).

The concept of agrotourism development aims to increase or optimize income in the agricultural sector, which can directly or indirectly benefit local communities, especially farmers (Saji et al., 2023). Palit et al. (2017), agrotourism consists of tourism activities that utilize agricultural potential as a main attraction. This potential may include natural landscapes within farming areas, the uniqueness and diversity of agricultural production techniques and technologies, and the cultural aspects of communities living in agricultural zones. Similarly, Aridiansari et al. (2015) defines agrotourism as a series of activities closely associated with rural life, including farming participation, cultural learning, enjoying scenery and biodiversity, practicing organic or conventional farming, and harvesting fruits and vegetables.

In Sembalun District, East Lombok Regency, there is a growing potential for agrotourism—particularly strawberry agrotourism. This area has become a key destination in the agrotourism sector, offering activities such as strawberry picking directly from the gardens. Strawberries, which are a signature commodity of the region, have significant prospects due to their limited cultivation areas and popularity among both local and international tourists (Statistics Indonesia East Lombok Regency, 2023).

With an area of 245.89 km² covering six villages, Sembalun District has strong potential as a strawberry production center in West Nusa Tenggara. Most farmers in the region cultivate land in highland areas with fertile soils and a cool climate, ideal for growing strawberries. Moreover, activities like strawberry picking offer a unique tourist experience that supports the local tourism economy (Statistics Indonesia East Lombok Regency, 2023). This highlights the rapid growth of strawberry farming in Sembalun and its important contribution to the local economy. Table 1 presents the strawberry planting areas and number of strawberry farmers in each village of the Sembalun District.

Table 1. Utilization of Cultivation Areas and Number of Strawberry Farmers Per Village in Sembalun District.

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| Village | Planted Area(ha) | Number of Strawberry Farmers(person) |
| Sembalun Bumbung | 10 | 26 |
| Sembalun Lawang | 3 | 22 |
| Sajang  | 0 | 0 |
| Sembalun  | 2 | 20 |
| Sembalun Timba Gading | 1 | 15 |
| Bilok Pitung | 0 | 0 |
| Amount | 16 | 83 |

*\*Source: BPP Sembalun District, 2025.*

Based on data from BPP Sembalun District (Table 1), there are a total of 83 strawberry farmers across six villages, cultivating a total of 16 hectares. Farmers generally make use of highland areas with favorable soil and climatic conditions. Apart from meeting local demand, strawberry production also supports agrotourism, allowing visitors to engage in strawberry picking. The increasing number of strawberry farmers demonstrates the promising potential of the agricultural sector and agrotourism in Sembalun.

The sustainability of strawberry agrotourism in Sembalun is crucial, as it provides multiple benefits. These include educational and recreational experiences for tourists, diversification of farmers’ income, promotion of local products, and the introduction of sustainable farming practices. Aini et al. (2023), emphasize that agrotourism, when integrated with education, recreation, and community participation, can stimulate the local economy and serve as a means to preserve both cultural heritage and the environment, thereby supporting sustainable regional development.

Nonetheless, strawberry agrotourism in Sembalun faces several challenges, such as declining production. Total strawberry output decreased from 6,592 quintals in 2019 to 2,045 quintals in 2020, and further declined to 418 quintals in 2021 (Statistics Indonesia East Lombok Regency, 2023). This decline is attributed to unfavorable weather, pest infestations, and improper harvesting practices by tourists. These issues threaten the sustainability and quality of the tourism experience. Additionally, strawberries are highly perishable and farmers' income is dependent on visitor numbers, resulting in income instability (Te'dang et al., 2024).

The objective of this study is to evaluate the sustainability status of strawberry agrotourism in Sembalun District and identify the key attributes that influence its sustainability. The research also considers the role of the government, non-governmental organizations (NGOs), and the private sector in supporting agrotourism through policy development, training programs, and improved access to markets and technology (Pradita et al., 2024).

The findings of this study are expected to serve as a reference for policymakers, particularly in designing targeted strategies to develop the strawberry agrotourism sector in Sembalun. Additionally, this research aims to provide valuable insights for stakeholders, enhance the appeal of strawberry agrotourism in East Lombok, and serve as a foundation for future research on the dynamics and sustainability of agrotourism development.

1. **MATERIALS AND METHODS**

This study employs a mixed-methods approach that integrates both quantitative and qualitative data. The rationale for using this combination lies in the complementary strengths of the two approaches, which allow researchers to obtain results that are objective, structured, and measurable, while also being in-depth and contextually accurate (Pradita et al., 2024).

Quantitative data, derived from interviews with respondents in the form of numerical values, are used alongside qualitative data, which includes descriptive information such as natural physical conditions, geographical features, rainfall, soil types, land cover, and land use. Both types of data are transformed into qualitative numerical values to serve as determinants for each sustainability indicator using the Multi-Dimensional Scaling (MDS) approach adapted from Rapfish.

These indicators are based on field observations and respondents' perceptions, categorized into interval classes that reflect actual conditions (Jasmawadi et al., 2022). The unit of analysis in this study consists of strawberry-farming households in Sembalun District, East Lombok Regency.

The sampling area was selected using purposive sampling, focusing on four villages with existing strawberry agrotourism potential: Sembalun Bumbung, Sembalun Lawang, Sembalun, and Sembalun Timba Gading. The sample size was determined using Slovin’s formula with a 10% margin of error, resulting in a sample of 45 respondents out of 83 strawberry farmers. Random sampling was then applied within each village to select respondents.

Two types of data sources were used in this research: primary and secondary.

* Primary data were collected through direct observation, surveys, and in-depth interviews. Observations involved direct examination of strawberry agrotourism sites. Surveys were conducted through structured questionnaires administered in face-to-face interviews with farmers. In-depth interviews were held with agricultural extension officers in Sembalun and officials from the East Lombok Tourism Office to enrich and verify the findings (Tajidan et al., 2025).
* Secondary data were obtained from the Central Statistics Agency (BPS) of East Lombok and reports from the Agricultural Extension Agency (BPP) of Sembalun District.

The sustainability of strawberry agrotourism in Sembalun District was analyzed using the Multi-Dimensional Scaling (MDS) approach, adapted from the Rapfish (Rapid Appraisal for Fisheries) method developed by (Pitcher and Preiksho, 2001) at the University of British Columbia (Yusuf et al., 2023).

The adapted version used in this study is known as Rap-HG Agrotourism (Rapid Appraisal for Home Garden Agrotourism), a statistical tool designed to reduce multi-dimensional data into simpler dimensions. Originally created for evaluating fisheries sustainability, Rapfish has been successfully modified for use in other fields, including agriculture. The MDS technique facilitates the ordination of attributes, meaning it ranks variables based on perceived sustainability, covering five key dimensions: ecological, economic, technological, socio-cultural, and institutional. (Trisnanto et al., 2023).

Each dimension includes 6–10 attributes deemed critical for assessing the sustainability of strawberry agrotourism, based on stakeholder consultations and interpretive qualitative analysis. The selection of attributes was guided by prior literature, previous studies on agrotourism sustainability (Pitcher & Preikshot, 2001; Elvira et al., 2022), and expert input from agricultural and tourism stakeholders. Attributes were selected based on their relevance, measurability, and contextual importance to highland strawberry agrotourism.

Scoring was conducted using a 1–4 scale: 1 (least sustainable condition) and 4 (optimal sustainable condition). Scores were determined based on farmer responses, field observations, and expert evaluations.

To assess the stability of the MDS results, a Monte Carlo analysis with 25 iterations was performed. The results showed minimal variation in stress values (<1%), indicating that the model is robust and statistically reliable.

The overall MDS results are presented visually in a two-dimensional sustainability index graph, with a scoring range of 1% to 100%, categorized as follows:

Table 2. Categories of Sustainability Level of Strawberry Agrotourism.

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| Mark | Category | Sustainability Status |
| < 25 | Not Good (Bad) | Unsustainable |
| >25 – 50 | Not enough | Less Sustainable |
| >50 – 75 | Enough | Quite Sustainable  |
| >75 – 100 | Good | Very Sustainable |

*\*Source: (Dzikrillah et al., 2017).*

The following are the stages of the MDS method for this research presented in Figure 1.

Classification of attributes and scoring criteria

Scoring

Input data

MDS analysis

Run monte carlo

Run leverage

Run rapfish

Sustainability analysis

**\****Figure 1. Stages of using MDS Analysis of Sustainability Status of Strawberry Agrotourism in Sembalun District* (Parmawati *et al*., 2020)*.*

The following steps were followed for the MDS analysis (see Figure 1):

1. Identification of sustainability indicators, based on interpretive qualitative analysis with key stakeholders.
2. Field assessment and scoring of these indicators through surveys and discussions with strawberry farmers.
3. MDS and Monte Carlo analysis, conducted using the modified Rapfish software to produce a sustainability index and identify leverage factors—i.e., sensitive attributes with the most influence on sustainability outcomes.
4. **RESULTS AND DISCUSSION**

The sustainability of an agricultural system, including strawberry agrotourism, is significantly influenced by key attributes within each sustainability dimension. To achieve effective sustainability in the future, it is crucial to identify and improve the sensitive attributes across all five dimensions: ecological, economic, socio-cultural, institutional, and technological. Enhancing these attributes is expected to significantly improve the sustainability status of each dimension. This effort not only supports agricultural sustainability but also contributes to community welfare and environmental conservation, thereby creating a more balanced and sustainable ecosystem (Afrianto et al., 2024).

The sustainability analysis was conducted using the Multi-Dimensional Scaling (MDS) approach with the Rapfish method, complemented by Monte Carlo analysis to assess the accuracy of the ordination results. The analysis is considered valid when the difference between the Monte Carlo and the MDS ordination results is less than 5%. In addition, the validity of the model is measured using the S-stress value and the coefficient of determination (R²). An S-stress value lower than 0.25 indicates a low error rate and a good model fit, while an R² value close to 1 shows that the data closely represent actual field conditions, thus making the analysis results reliable.

Table 3. results of Rapfish's Multi Dimensional Scaling (MDS) analysis of the sustainability of strawberry agrotourism in Sembalun District, 2025.

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| Dimension | S-Stress | RSQ | Ordination Result | Monte Carlo | Difference |
| Ecological | 0.14 | 0.95 | 52.29 | 52.63 | 0.34 |
| Economic | 0.13 | 0.95 | 53.51 | 54.28 | 0.77 |
| Socio-Cultural | 0.14 | 0.94 | 50.93 | 51.63 | 0.70 |
| Institutional | 0.13 | 0.95 | 46.35 | 46.87 | 0.52 |
| Technological | 0.14 | 0.95 | 49.48 | 50.10 | 0.62 |
| Multidimensional | 0.14 | 0.95 | 50.51 | 51.10 | 0.59 |

Source: Processed Primary Data, 2025

Based on Table 3, it is known that the analysis results are valid and have met the requirements that have been set. These requirements are the s-stress value of less than 0.25 and the RQS value approaching the value of 1 (Kavanagh, 2001) and the difference between the ordination results and the Monte Carlo value is less than 5%. These requirements indicate that the results of the analysis test carried out are consistent and valid or the validity of the calculation can be trusted. Based on this, an overall recapitulation of the sustainability status value of strawberry agrotourism in Sembalun District can be made, which is 50.51. Based on the sustainability index, the sustainability status of strawberry agrotourism in Sembalun District is in the “quite sustainable” category. To become a very sustainable category, it is necessary to improve the application of the attributes of each dimension and it is necessary to carry out several activities and agricultural policy programs based on sustainable tourism so that they can increase the sustainability index value so that it can be categorized as very sustainable.

* 1. **Ecological Dimension of Sustainability**

The ecological dimension in the sustainability of strawberry agrotourism in Sembalun District refers to efforts aimed at maintaining and preserving the natural environment to ensure that agrotourism activities can proceed sustainably without causing harm to the local ecosystem. Based on the analysis using the Multi-Dimensional Scaling (MDS) Rapfish method, the ecological dimension of strawberry agrotourism in Sembalun District achieved a sustainability index score of 52.29 (see Figure 2), which falls within the "quite sustainable" category. This value indicates that environmental management in the area is progressing in a positive direction towards sustainability. However, improvements are still needed, particularly in adopting more environmentally friendly cultivation practices. When compared to the study by *Elvira et al.* (2022), entitled “Analysis of Sustainability Status of Sustainable Agriculture-Based Agrotourism: Case Study of Upang Strawberry Garden”, a notable difference can be observed. In that study, the ecological dimension received a sustainability index score of 48.38, which was categorized as "less sustainable." This comparison highlights that although both studies focus on strawberry agrotourism, variations in environmental conditions, land management practices, and the implementation of sustainable agriculture principles at each location contribute to different sustainability outcomes. Thus, the results from Sembalun indicate relatively better ecological conditions compared to those in the Upang Strawberry Garden, while also underscoring the need for continual improvements in environmental management across agrotourism sites to achieve higher levels of sustainability.

Leverage analysis of the ten attributes influencing the ecological dimension identified those with the highest Root Mean Square (RMS) values as the most critical factors. The three attributes with the largest RMS values (1) type of mulch used, (2) utilization of damaged or rotten strawberry waste, and (3) post-harvest land management play a major role in determining the ecological sustainability level of strawberry agrotourism in Sembalun District (see Figure 3).

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| *\*Figure 2. Ecological Dimension Sustainability Ordination* | *\*Figure 3. Results of Ecological Dimension Leverage Analysis* |

Based on Figure 3, the most influential attribute in the ecological sustainability of strawberry agrotourism in Sembalun District is the type of mulch used, with the highest Root Mean Square (RMS) value of 5.04. All business actors in the area use plastic mulch because it helps regulate soil moisture, reduces evaporation, and maintains water availability for plants. However, improper management of plastic mulch can lead to environmental pollution. Therefore, alternatives such as biodegradable mulch or the implementation of recycling systems should be considered to minimize environmental impact. The second most influential attribute is the utilization of damaged or rotten strawberry waste, which has an RMS value of 2.78. Generally, business actors either resell the waste after it has been cleaned and frozen or dispose of it directly on the land as a natural fertilizer without undergoing a composting process. Although this practice provides both economic value and organic benefits, the potential for processing waste into compost has not been fully maximized. The application of more systematic and technology-based waste management is necessary to enhance ecological efficiency and sustainability. The third influential attribute is post-harvest land management, with an RMS value of 2.70. Post-harvest land management practices remain limited, which can reduce soil fertility and increase the risk of environmental degradation. Therefore, education and support for business actors in implementing sustainable land management practices are essential to maintaining ecosystem balance and ensuring long-term agricultural productivity.

* 1. **Economic Dimension of Sustainability**

The economic dimension in the sustainability of strawberry agrotourism in Sembalun District refers to the extent to which this activity provides stable and sustainable financial benefits for business actors, particularly farmers and the surrounding community. Based on the results of the Rapfish Multi-Dimensional Scaling (MDS) analysis, the economic dimension of strawberry agrotourism in Sembalun shows an index value of 53.51 (see Figure 4), placing it in the “quite sustainable” category. This indicates that agrotourism activities in Sembalun have made a positive contribution to increasing community income and strengthening the local economy. However, there is still room for improvement, especially in farming efficiency, market access, and the development of the product value chain. These findings align with those of Elvira et al. (2022), in the study “Analysis of Sustainability Status of Sustainable Agriculture-Based Agrotourism: Case Study of Upang Strawberry Farm”, where the economic dimension also achieved an index score of 53.61, categorized as “quite sustainable.” The similarity in values suggests that strawberry agrotourism in both Sembalun and Upang has had a meaningful economic impact on local communities. Nonetheless, both studies highlight the need for a long-term strategy to strengthen the economic foundation of agrotourism, including product diversification, entrepreneurship training, and improved access to regional and national markets.

Leverage analysis of the ten attributes influencing the economic dimension identified the three most influential factors based on their Root Mean Square (RMS) values. These are: (1) diversification of strawberry products, (2) strawberry distribution channels, and (3) financial management (see Figure 5). These attributes play a significant role in determining the level of economic sustainability in strawberry agrotourism in Sembalun District.

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| *\*Figure 4. Economic Dimension Sustainability Ordination*  | *\*Figure 5. Results of Economic Dimension Leverage Analysis* |

Based on Figure 5, the most influential attribute in the sustainability of strawberry agrotourism in Sembalun District within the economic dimension is product diversification, with a Root Mean Square (RMS) value of 6.82. Product diversification has the potential to increase added value and expand market reach. However, most business actors currently still rely on selling fresh strawberries through pick-your-own tourism due to limited processing facilities. This dependency makes businesses vulnerable to price fluctuations and inconsistent harvest yields. Therefore, the development of processed strawberry products such as jams, juices, and snacks supported by training and access to processing facilities, is essential to enhance the competitiveness and economic resilience of local entrepreneurs. The second most influential attribute is distribution channels, with an RMS value of 5.38. At present, distribution is mainly conducted directly to tourists or through middlemen. While this approach allows the products to reach a wider market, it also creates dependency and contributes to price instability. Improving the distribution system through digital marketing platforms or partnerships with modern retail outlets can increase market efficiency and farmer income. The third key attribute is financial management, with an RMS value of 4.72. The majority of business actors have not yet adopted sound bookkeeping or financial planning practices, resulting in difficulties in managing revenue, allocating resources, and planning for long-term business growth. Therefore, financial literacy education and the implementation of structured financial systems are crucial to enhance the financial stability of strawberry agrotourism businesses and ensure their long-term sustainability in Sembalun District.

* 1. **Socio-Cultural Dimension of Sustainability**

The socio-cultural dimension in the sustainability of strawberry agrotourism in Sembalun District refers to the impact of agrotourism activities on the community’s quality of life, local values, and the preservation of local culture and wisdom. This dimension is crucial to ensure that the development of agrotourism not only seeks economic gains but also strengthens the social and cultural identity of the local community. Based on the results of the Rapfish Multi-Dimensional Scaling (MDS) analysis, the socio-cultural dimension in the sustainability of strawberry agrotourism in Sembalun District obtained an index value of 50.93, as shown in Figure 6, which falls into the “quite sustainable” category. This value indicates that socio-cultural aspects in the Sembalun area have shown positive progress, such as increased community participation in agrotourism activities, preservation of local cultural values, and contributions to social welfare. However, these findings also suggest the need for further strengthening, particularly in expanding community involvement, protecting cultural heritage, and ensuring equitable distribution of the economic and social benefits derived from agrotourism. When compared with the study by Elvira et al. (2022), In “Analysis of Sustainability Status of Sustainable Agriculture-Based Agrotourism: Case Study of Upang Strawberry Garden”, the socio-cultural index in that case was 51.21, which also falls under the “quite sustainable” category. The similarity in these scores indicates that both Sembalun and Upang have made relatively strong progress in the socio-cultural dimension. Nonetheless, both face common challenges in achieving long-term sustainability, especially concerning social equity and the preservation of inclusive and sustainable local culture.

Leverage analysis of the eight attributes influencing the socio-cultural dimension highlights those with the highest Root Mean Square (RMS) values. The three most influential attributes those with the highest RMS values are: (1) the age of workers involved in strawberry agrotourism, (2) participation in agrotourism counseling or training, and (3) the perceived positive social impact of agrotourism, as shown in Figure 7. These attributes significantly contribute to determining the socio-cultural sustainability level of strawberry agrotourism in Sembalun District.

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| *\*Figure 6. Socio-Cultural Dimension Sustainability Ordination* | *\*Figure 7. Results of Socio-Cultural Dimension Leverage Analysis*  |

Based on Figure 7, the most influential attribute affecting the socio-cultural sustainability of strawberry agrotourism in Sembalun District is the age of workers, with an RMS value of 8.17. Currently, the majority of workers involved in this sector are over 40 years old, indicating a low level of youth participation. This condition poses a threat to the long-term sustainability of the production system and labor force stability. Therefore, the involvement of younger generations is crucial and can be facilitated through targeted education, training programs, and attractive incentive schemes to encourage youth engagement in agrotourism activities. The second most influential attribute is participation in counseling and training on agrotourism sustainability, which recorded an RMS value of 5.36. Although such programs are essential for enhancing the knowledge and competencies of business actors in managing agrotourism, marketing, and business innovation, the current focus of training is still limited to technical agricultural practices. The lack of comprehensive education on tourism and sustainability has constrained the sector's potential to grow optimally. The third influential attribute is the positive social impact of strawberry agrotourism, with an RMS value of 5.32. Agrotourism has contributed significantly to job creation, improved community welfare, and strengthened social cohesion. However, the limited availability of trained tour guides and the suboptimal integration of local cultural elements have hindered effective knowledge transfer to tourists and reduced exposure to local traditions. Therefore, it is necessary to implement tour guide training, develop educational programs, and promote culture-based activities to enhance local identity and sustainably increase the appeal of strawberry agrotourism in the region.

* 1. **Institutional Dimension of Sustainability**

The institutional dimension in the sustainability of strawberry agrotourism in Sembalun District refers to the extent to which institutions or organizations involved in agrotourism management are able to function effectively, participatively, and in a structured manner. This includes the organizational structure and the role of farmer groups in fostering participation and learning, both of which are essential to the sustainable development process (Rusdiani et al., 2024), as well as government support, stakeholder partnerships, and the existence of clear regulations and coordination mechanisms. Based on the results of the Rapfish Multi-Dimensional Scaling (MDS) analysis, the institutional dimension in the sustainability of strawberry agrotourism in Sembalun District obtained an index value of 46.85 (see Figure 8), which falls into the “less sustainable” category. This score indicates that the institutional system supporting strawberry agrotourism management in the Sembalun area still faces various challenges, particularly in terms of inter-institutional coordination, policy implementation, and regulatory support for local business actors. Similar conditions were also identified in the study by Elvira et al. (2022), entitled “Analysis of Sustainability Status of Sustainable Agriculture-Based Agrotourism: Case Study of Upang Strawberry Garden”, where the institutional dimension received an index value of 49.19 also categorized as “less sustainable.” Both studies highlight the weak role of local institutions in promoting the sustainability of agrotourism, despite differences in regional context. These findings underscore the urgent need to strengthen institutional capacity and foster greater collaboration among stakeholders to establish more effective, adaptive, and sustainable agrotourism governance across various regions.

Leverage analysis of 10 attributes influencing the institutional dimension is marked by the highest Root Mean Square (RMS) values. The two most influential attributes in determining the sustainability level of strawberry agrotourism in Sembalun District under this dimension are: (1) financial assistance, and (2) the function and benefits of farmer group organizations (see Figure 9).

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| *\*Figure 8. Institutional Dimension Sustainability Ordination* | *\*Figure 9. Results of Institutional Dimension Leverage Analysis* |

Based on Figure 9, the most influential attribute in the institutional sustainability of strawberry agrotourism in Sembalun District is financial assistance, with an RMS value of 4.48. Financial assistance is crucial in supporting infrastructure development, human resource training, and product diversification all of which contribute to enhancing competitiveness. However, the majority of business actors in Sembalun have never received assistance from the government, NGOs, or the private sector. As a result, agrotourism development remains limited and heavily dependent on personal capital. This condition hinders business expansion, sustainable land management, and innovation in product marketing and processing. Therefore, access to funding is essential for strengthening institutional capacity and ensuring the sustainable growth of strawberry agrotourism. The second most influential attribute is the institutional function of farmer groups, with an RMS value of 2.15. Currently, there is no dedicated farmer group specifically responsible for managing strawberry agribusinesses in Sembalun. Existing groups tend to focus on general horticultural commodities, such as onions and chilies. The absence of specialized institutions limits strawberry farmers' access to targeted assistance and training that meet their specific needs. In fact, establishing a dedicated strawberry farmer group would serve as a platform for coordination, information sharing, market network development, and improving farmers’ bargaining power in the supply chain. The formation of such a group is urgently needed to enhance institutional support and strengthen the economic and social sustainability of strawberry agrotourism in Sembalun District.

* 1. **Technology Dimension of Sustainability**

The technological dimension in the sustainability of strawberry agrotourism in Sembalun District refers to the extent to which technology is effectively utilized to improve productivity, efficiency, competitiveness, and the overall quality of agrotourism services. This dimension encompasses not only agricultural technologies but also includes digital promotion, information systems, and product innovation. Based on the results of the Rapfish Multi-Dimensional Scaling (MDS) analysis, the technological dimension in the sustainability of strawberry agrotourism in Sembalun District shows an index value of 49.48, as shown in Figure 10. This score places the dimension in the “less sustainable” category, indicating that the integration of technology into the agrotourism system in Sembalun is still suboptimal. The limited adoption of modern agricultural technologies, the absence of robust information systems, and constraints in using innovation-based production facilities are the main challenges hindering improvements in efficiency and productivity. This finding aligns with the results of the study by Elvira et al. (2022), in the study “Analysis of Sustainability Status of Sustainable Agriculture-Based Agrotourism: Case Study of Upang Strawberry Garden”, which recorded a technology sustainability index value of 46.42—also categorized as “less sustainable.” Both studies highlight that the technological aspect remains one of the weakest dimensions in the development of strawberry agrotourism across different regions. Therefore, improving access to appropriate technologies, providing innovation-based training for farmers and agrotourism business actors, and developing locally-adaptive technological systems are essential strategies to support the comprehensive sustainability of this sector.

Leverage analysis on eight attributes that influence the technological dimension identifies the most influential ones based on the highest Root Mean Square (RMS) values. The two attributes with the largest RMS values are the availability of strawberry processing and the harvesting industry, as shown in Figure 11. These attributes play a significant role in determining the sustainability level of strawberry agrotourism in Sembalun from a technological standpoint.

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| *\*Figure 10. Technology**Dimension Sustainability Ordination* | *\*Figure 11. Results of Technology**Dimension Leverage Analysis* |

Based on Figure 11, the most influential attribute on the sustainability of strawberry agrotourism in Sembalun District within the technological dimension is the availability of a strawberry processing industry, with an RMS value of 6.09. The existence of such an industry is crucial for increasing production efficiency, expanding market reach, and reducing reliance on fresh fruit sales, which are highly susceptible to price and quality fluctuations. Currently, there are no processing facilities available in Sembalun. Previous initiatives, such as those led by the Women Farmer Group (KWT) Putri Rinjani, were discontinued due to limited technical knowledge and capacity. By adopting appropriate technologies—such as automated washing machines, pasteurization systems, freeze-drying units, and vacuum packaging—business actors can create value-added products like strawberry jam, juice, frozen strawberries, or strawberry powder. Developing this processing industry represents a strategic step toward enhancing competitiveness and ensuring the long-term economic sustainability of strawberry agrotourism in the region. The second most influential attribute is the harvesting process, with an RMS value of 5.40. Harvesting plays a vital role in maintaining fruit quality and ensuring production efficiency. Currently, harvesting is conducted manually. While this method helps preserve fruit quality, it is labor-intensive and time-consuming. Delays in harvesting can result in losses due to overripe or spoiled fruit. The introduction of modern harvesting technologies—such as automated pickers, fruit ripeness sensors, or in-field packaging systems—can improve efficiency, reduce post-harvest losses, and increase the competitiveness of strawberry products. The adoption of these technologies is essential to enhance productivity and support the overall sustainability of strawberry agrotourism in Sembalun.

1. **CONCLUSIONS AND RECOMMENDATIONS**

Based on the research results, it can be concluded that strawberry agrotourism in Sembalun District, East Lombok Regency, is in the “quite sustainable” category with a multidimensional sustainability index value of 50.51 on a scale of 50.01–75.00. The economic, ecological, and socio-cultural dimensions show a level of sustainability in the “quite sustainable” category with index values ​​of 53.51, 52.29, and 50.93, respectively. Meanwhile, the institutional and technological dimensions are still in the “less sustainable” category, with index values ​​of 46.35 and 49.8. The most influential attributes in each dimension include: type of mulch use, utilization of strawberry waste, and land management for the ecological dimension; product diversification, distribution channels, and financial management for the economic dimension; age of workers, participation in extension, and positive social impacts of agrotourism for the socio-cultural dimension; financial assistance and the function of farmer groups for the institutional dimension; and the availability of processing industries and harvesting systems for the technological dimension. Therefore, efforts to improve sustainability need to be focused on strengthening institutions and technology, as well as optimizing key attributes in each dimension so that strawberry agrotourism in Sembalun District can develop more sustainably and provide long-term benefits for local communities.

This study has several limitations. First, the sustainability assessment was based on cross sectional data collected at a specific time, which may not capture seasonal variations or long term trends. Second, the use of the MDS-Rapfish method relies on ordinal scoring, which is sensitive to subjectivity despite efforts to validate scores through expert input. Third, while the study included four villages with active agrotourism, findings may not be generalizable to other rural areas with different ecological or socio economic conditions. Future research should consider longitudinal approaches and include a broader stakeholder base for attribute validation.

**DISCLAIMER (ARTIFICIAL INTELLIGENCE)**

The authors hereby declare that No generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators were used during the writing or editing of this manuscript.

**ACKNOWLEDGEMENTS**

The author would like to thank all parties who have provided support and contributions in completing this research. Special thanks are given to the strawberry farmers and agrotourism actors in Sembalun District who have been willing to take the time and provide valuable information during the data collection process. The author also expresses appreciation to the relevant agencies in East Lombok Regency for their assistance and cooperation. The author would also like to thank the supervising lecturers and all parties who have provided direction, input, and encouragement during the implementation of the research until the preparation of this journal. Hopefully the results of this study can provide benefits for the development of sustainable agrotourism in the future.

**COMPETITION INTERESTS**

Authors have declared that No competing interests exist.

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