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MULTIDIMENSIONAL SUSTAINABILITY ASSESSMENT OF RURAL TOURISM: A CASE STUDY OF LANAKILA LAKE AND LEMBAH AKASIA IN PRINGSEWU, LAMPUNG, INDONESIA

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ABSTRACT

This study evaluates tourism sustainability in two rural nature destinations in Pringsewu Regency, namely Lanakila Lake and Acacia Valley, using the Multidimensional Scaling (MDS)-based RAP-Tourism approach. Five sustainability dimensions were analyzed: ecological, economic, social, institutional, and infrastructure-technology. The results showed that Lanakila Lake recorded a higher sustainability index in most dimensions, with the highest scores in the ecological (83.38) and economic (78.10) dimensions, while Acacia Valley showed strength in ecology (54.17) but lagged behind in the economic (40.16) and social (35.60) dimensions. Leverage analysis revealed that the main lever attributes in the ecological dimension were bird conservation and waste management, while in the economic dimension, community welfare and MSME development were the main determinants. On the institutional side, public service policies and management regulations played a significant role. These results confirm that destination sustainability depends not only on natural attractions, but also on social, institutional, and infrastructure management capacity. Improving sustainability in Acacia Valley can be achieved through strengthening community participation, managing land use conflicts, developing the capacity of MSMEs, and improving accessibility and supporting facilities. Conversely, Lanakila Lake needs to maintain high levels of waste management and bird conservation to maintain its high sustainability status.

KEYWORDS: Sustainable Tourism, Rural Tourism Assessment, Multidimensional Scaling (MDS), Ecological and Economic Impacts, Local Community Engagement.

1. INTRODUCTION

Pringsewu Regency has tourism potential based on natural resources and rural landscapes that has developed in recent years. Two destinations that reflect this situation are Lanakila Lake and Acacia Valley. Lanakila Lake's main attraction is a dam with relatively good transportation access and more comprehensive supporting facilities. Acacia Valley offers panoramic views of rice fields but faces limited transportation access and basic infrastructure. These differences in characteristics create variations in environmental pressures, economic benefits, and social engagement of local communities. This situation demands a measurable and data-driven sustainability evaluation.

From an environmental science perspective, sustainability is understood as an effort to maintain a balance between natural resource utilization and environmental carrying capacity. Uncontrolled tourism activities can increase the risk of environmental degradation, such as water pollution, land use change, and the decline in local ecosystem quality (Buckley, 2020). Therefore, tourism development cannot be separated from the principles of sustainable environmental management. This approach emphasizes the need for a comprehensive assessment of tourism's impact on ecological systems.

Sustainable tourism is a direct derivative of the concept of sustainable development, which places environmental, economic, and social aspects as an interconnected whole. The United Nations World Tourism Organization emphasizes that sustainable tourism must meet the needs of tourists and destinations without compromising the opportunities of future generations (UNWTO, 2021). In practice, failure to maintain a balance between these dimensions often leads to unequal development benefits and long-term environmental damage.

Environmental issues in the tourism sector are becoming increasingly relevant as global pressure on natural resources increases. Empirical studies show that tourism growth contributes to increased carbon emissions, water consumption, and waste production, particularly in natural tourism destinations (Sun *et al.*, 2020). These impacts are more serious in areas with limited environmental capacity and suboptimal management systems. Therefore, quantitative evaluation of tourism sustainability is necessary to ensure that tourism activities do not exceed the environmental carrying capacity.

In addition to ecological aspects, the economic

dimension is a crucial pillar of sustainable tourism. Tourism is often positioned as a driver of local economies through job creation and increased community income. However, these economic benefits are not always distributed equitably. Research shows that without good governance, tourism can actually widen economic inequality and increase community dependence on sectors vulnerable to market fluctuations (Gössling *et al.*, 2021). Therefore, sustainability analysis needs to assess the extent to which tourism truly provides inclusive economic benefits.

The social dimension also plays a strategic role in sustainable tourism development. Local community participation, social acceptance, and the protection of cultural values are important indicators of social sustainability. Several studies have found that low community involvement in tourism management often triggers social conflict and reduces support for destination development (Nunkoo *et al.*, 2020). This situation confirms that tourism sustainability depends not only on environmental quality but also on the strength of local social structures.

In the context of sustainable development, the institutional dimension serves as a link between policy and practice. Weak institutions often lead to overlapping authority, weak oversight, and ineffective implementation of environmental policies. Previous research emphasizes that collaborative governance between the government, business actors, and local communities plays a crucial role in maintaining the sustainability of tourist destinations (Bramwell & Lane, 2021). Without strong institutional support, conservation and economic empowerment efforts are difficult to implement consistently.

Recent developments indicate that infrastructure and technology are increasingly determining tourism sustainability. Good transportation access influences tourist distribution and mobility efficiency, while information technology supports promotion, destination management, and tourism services. Recent studies have shown that destinations with adequate infrastructure and technological support tend to perform better in sustainability than destinations lagging behind in terms of accessibility (Figueroa & Rotarou, 2022). However, this dimension is often overlooked in tourism sustainability assessments.

Previous research on sustainable tourism in Indonesia has largely used

2. RESEARCH METHODS

2.1. Research Location

This research was conducted in Pringsewu Regency, Lampung Province, focusing on two natural tourism destinations with distinct characteristics: Lanakila Lake and Lembah Akasia. Lanakila Lake is a tourist destination with a dam as its main attraction and relatively good transportation access and more adequate supporting facilities. In contrast, Lembah Akasia is a rice paddy landscape-based tourist destination with limited transportation access and underdeveloped infrastructure. These differences in characteristics make the two locations relevant for comparative analysis in the context of tourism sustainability.

2.2. Research Type and Approach

This research is quantitative with an evaluative approach. The sustainability analysis was conducted using the RAP-Tourism (Rapid Appraisal for

Tourism) method based on Multidimensional Scaling (MDS). This method was chosen because it can assess sustainability status in an integrated manner through a numerical index that reflects the condition of each sustainability dimension (Purwaningsih et al., 2020). RAP-Tourism also allows for comparisons between destinations and the identification of attributes most sensitive to impacting sustainability.

2.3. Research Variables

The research variables consist of five dimensions of tourism sustainability: ecological, economic, social, institutional, and technological and infrastructure. Each dimension is operationalized into a number of attributes assessed using an ordinal scale of 0–3, where a score of 0 indicates the worst condition and a score of 3 indicates the best condition.

Table 1: Sustainable Dimensions and Attributes.

Dimensions	Assessed Attributes (Score 0–3)
Ecology	(1) Water availability & conservation; (2) Solid waste management; (3) Liquid waste management; (4) Wildlife conservation (especially birds); (5) River boundary protection; (6) Spring boundary protection
Economy	(1) Labor absorption; (2) Market potential; (3) Level of community welfare; (4) Promotion funding; (5) Level of tourist visits
Social	(1) Level of formal education; (2) Environmental knowledge & local wisdom; (3) Potential for conflict of use; (4) Role of local government; (5) Role of the private sector; (6) Role of community groups; (7) Level of hospitality
Institutions	(1) Availability of management regulations; (2) Implementation and supervision of regulations; (3) Public service policies; (4) Community participation; (5) Coordination between stakeholders
Infrastructure and Technology	1) Transportation conditions; (2) Availability of information & promotion via social media; (3) Supporting facilities and infrastructure.

(Figuroa & Rotarou, 2022).

3. DATA COLLECTION TECHNIQUES

Data were collected through attribute assessments by key respondents, including destination managers, local government officials, community leaders, and tourism business operators. Assessments were conducted based on actual field conditions, referring to established assessment criteria for each attribute. This approach is commonly used in RAP-Tourism studies to ensure objectivity in assessments based on local experience and knowledge (Rahmawati et al., 2023).

3.1. Data Analysis

Data analysis was conducted using the Multidimensional Scaling (MDS) method using the RAP-Tourism tool. Attribute scores for each dimension were processed to produce a sustainability index with a value range of 0–100. The index was then classified into sustainability status

categories: less sustainable and fairly sustainable.

The validity of the analysis results was tested using stress values and the coefficient of determination (R^2). A stress value below 0.25 indicates good and reliable ordination results, while a high R^2 value indicates the model's ability to accurately represent the data (Pitcher & Preikshot, 2001). Furthermore, a leverage analysis was conducted to identify the most sensitive attributes influencing sustainability values in each dimension. The results of this analysis were used as the basis for formulating recommendations for sustainable tourism management in Pringsewu Regency.

4. RESULTS AND DISCUSSION

4.1. Dimension Ekology

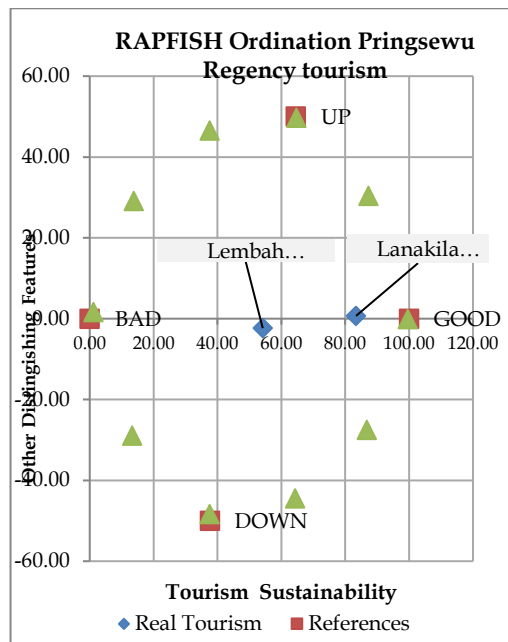


Figure 2. Ecological Dimension Sustainability Index.

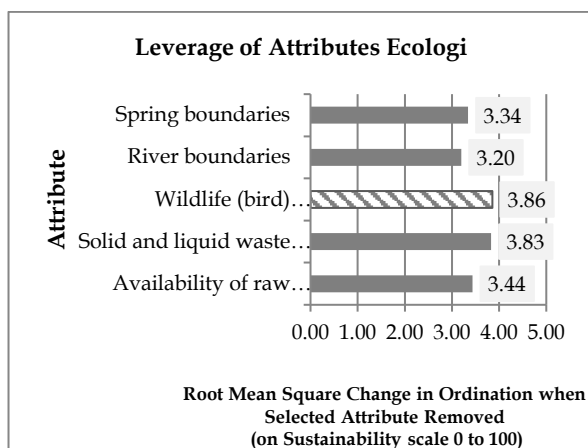


Figure 3: Ecological Dimension Leverage Analysis.

The MDS-based RAP-Tourism results show that Lanakila Lake achieved an ecological sustainability index of 83.38 (highly sustainable/good), while Acacia Valley achieved 54.17 (moderately sustainable). This difference indicates that Lanakila Lake is relatively better able to maintain the biophysical quality of the area (cleanliness, water conditions, and habitat function), while Acacia Valley still faces limitations in managing ecological pressures and managing environmental carrying capacity. Conceptually, this gap is common in rural destinations where basic infrastructure and management capacity are unevenly distributed, resulting in less robust environmental protection efforts than in destinations that are more "prepared" in terms of governance and facilities.

The MDS-based RAP-Tourism results show that Lanakila Lake achieved an ecological sustainability

index of 83.38 (highly sustainable), while Acacia Valley scored 54.17 (moderately sustainable). This indicates that Lanakila Lake is better at maintaining biophysical quality (cleanliness, water, and habitat function), while Acacia Valley struggles with ecological pressures and managing environmental carrying capacity. This gap is common in rural destinations where infrastructure and management capacity are uneven, leading to weaker environmental protection efforts compared to more prepared destinations (Buckley, 2020).

This interpretation aligns with Figure 2 (RAPFISH/RAP-Tourism ordination), where Lanakila Lake is closer to the "GOOD" reference point, and Acacia Valley is between "BAD" and "GOOD." In the MDS framework, proximity to the "GOOD" point represents better ecological attributes, while distance to "BAD" reflects deficiencies in key attributes. Therefore, small improvements in certain attributes can significantly shift a destination's sustainability status, as confirmed by leverage analysis.

Figure 3 (Leverage of Ecological Attributes) shows that the most sensitive factors are wildlife (bird) conservation (RMS = 3.86) and waste management (RMS = 3.83). Other key factors include water availability (RMS = 3.44), spring boundary protection (RMS = 3.34), and river boundary protection (RMS = 3.20). A higher RMS indicates that removing an attribute causes a significant change in the ordination configuration, making it a key determinant of sustainability.

The prominence of bird conservation is consistent with the literature on recreation ecology, which suggests that recreational activities disturb wildlife through noise, proximity, and behavioral changes. Birds are often used as indicators of habitat quality and recreational pressure (Sun et al., 2020). Thus, even high-performing destinations like Lanakila Lake need disturbance mitigation measures, such as habitat zoning, noise control, and educational programs for visitors.

The second lever, waste management, underscores the ecological pressures from waste, wastewater, and uncontrolled visitor behavior. Studies show that waste mismanagement rapidly degrades environmental quality and tourist experiences, while increasing recovery costs (Gössling et al., 2021). Waste management can also follow a circular economy approach to reduce environmental impacts and management burdens.

The emergence of spring and riverbank protection as levers (RMS = 3.34 and 3.20) highlights the importance of riparian zone integrity for water-based

destinations. Recent studies emphasize that riparian buffers help retain sediment and nutrients, prevent erosion, and protect water quality—especially as tourism pressures increase (Buckley, 2020). Strengthening spatial planning around water bodies, such as defining clear boundaries, restricting waste disposal, and rehabilitating riparian vegetation, is a valuable strategy for maintaining ecological health.

Policy implications are clear and actionable. Priority interventions should include: (i) bird conservation through zoning and habitat corridors, (ii) improved waste management with source reduction, sorting, and recycling, and (iii) protection of riparian zones through clear boundaries and regulations on development and waste.

4.2. Economic Dimension.

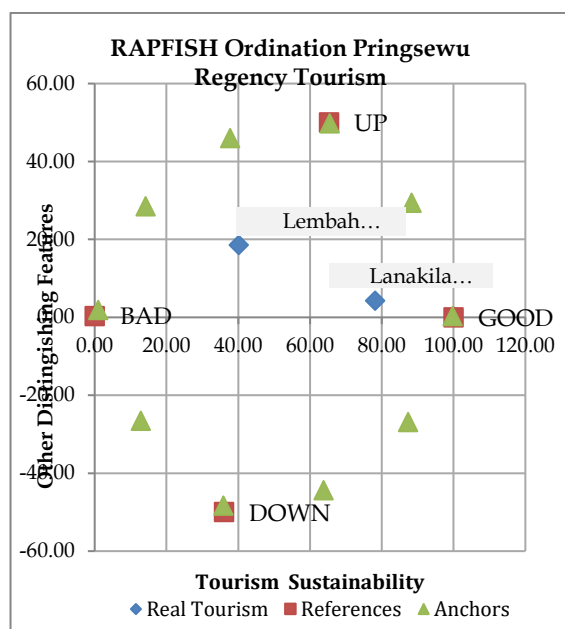


Figure 4: Economic Dimension Sustainability Index.

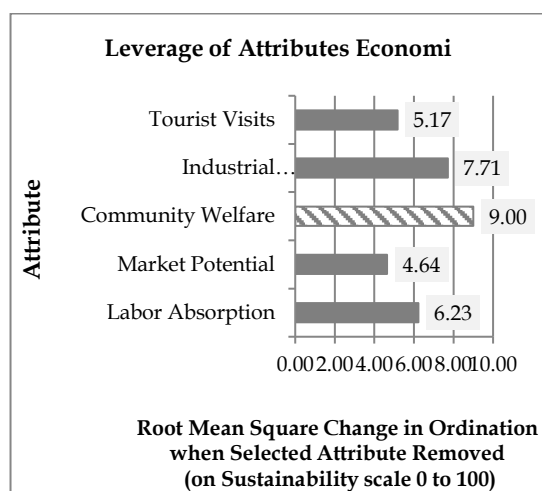


Figure 5: Economi Dimension Leverage Analysis

The MDS-based RAP-Tourism analysis results show an economic sustainability index of 78.10 for Lanakila Lake (highly sustainable), while Acacia Valley scored 40.16 (less sustainable). This difference indicates that economic benefits at Lanakila Lake have been relatively well established (e.g., through culinary tourism, services, and visitor spending), while Acacia Valley still faces challenges in converting its landscape appeal into stable economic value for the local community. This pattern is common in rural destinations: natural attractions can attract visitors, but without local business capacity, governance, and market connectivity, economic benefits tend to be suboptimal and unevenly distributed.

Visually, Figure 4 (RAPFISH/RAP-Tourism ordination of the economic dimension) shows Lanakila Lake's position closer to the "GOOD" reference point than Acacia Valley, which is further from the ideal point. In the MDS interpretation, proximity to "GOOD" represents a configuration of economic attributes that is closer to the desired condition, while Acacia Valley's position indicates that gaps in several key attributes remain that are holding back index improvement. Thus, the ordination results support the notion that the main problem with Acacia Valley is not simply the number of visits, but rather the destination's economic structure, which is not yet strong enough to retain and multiply economic benefits at the local level.

This gap in economic indices can also be explained by the issue of economic leakage, which occurs when a portion of tourism revenue "leaves" the region due to non-local supply chains, intermediary/platform commissions, or non-community-based business ownership. Recent studies have shown that reservation platforms can be a significant source of revenue leakage, as some transaction value (e.g., commissions) moves outside the local/national economy. In the context of rural destinations, leakage also often occurs through purchasing culinary ingredients from outside the village, using external suppliers, or a lack of local products capable of "capturing" tourist spending. Therefore, the interpretation "economic benefits are already underway but not optimal" can be emphasized: economic indicators may improve, but if local added value is low, economic sustainability remains low—especially in Acacia Valley.

The results of Figure 5 (Economic Leverage of Attributes) show that the most decisive economic lever attribute is community welfare (RMS = 9.00), followed by industrial/business development (RMS = 7.71), labor absorption (RMS = 6.23), tourist visits

(RMS = 5.17), and market potential (RMS = 4.64). The methodological significance is that changes in community welfare and local business development attributes will most rapidly shift the ordination configuration, making them the primary intervention priorities. This finding is important because it emphasizes that the strategy of simply "increasing visits" is not enough; what is more crucial is how these visits are translated into prosperity through strengthening local economic structures (MSMEs, supply chains, and decent work).

In policy terms, this leverage finding aligns with the direction of post-pandemic tourism recovery, which emphasizes a people-centered recovery approach and the strengthening of MSMEs/MSMEs as agents of tourism transformation. The UN Tourism (UNWTO) G20 Bali Guidelines place communities and MSMEs at the center of recovery, including through strengthening business capacity, market access, and supporting policies for more inclusive economic benefits. At the regional level, the ASEAN tourism recovery framework also promotes sustainable and inclusive recovery by strengthening business ecosystems and governance. In other words, this research's findings align with the international agenda: economic sustainability indicators improve most effectively when destinations strengthen the foundations of their local economies, rather than simply pursuing volume.

Furthermore, the high leverage on employment (RMS = 6.23) indicates that the quality of economic sustainability depends heavily on a destination's ability to create and retain jobs. This issue is relevant to post-pandemic dynamics: the tourism sector in many regions faces challenges related to workforce recovery, skills mismatches, and the need for decent work to strengthen destination economic resilience. Therefore, a more "sustainable" economic recovery strategy would be one that links job creation with training in service skills, hygiene management, digital marketing, and product innovation—especially for MSMEs.

The practical implication is that improving the economic index—especially for the Acacia Valley—is more appropriately directed at strengthening local linkages and supply chains.

4.3. Social Dimension.

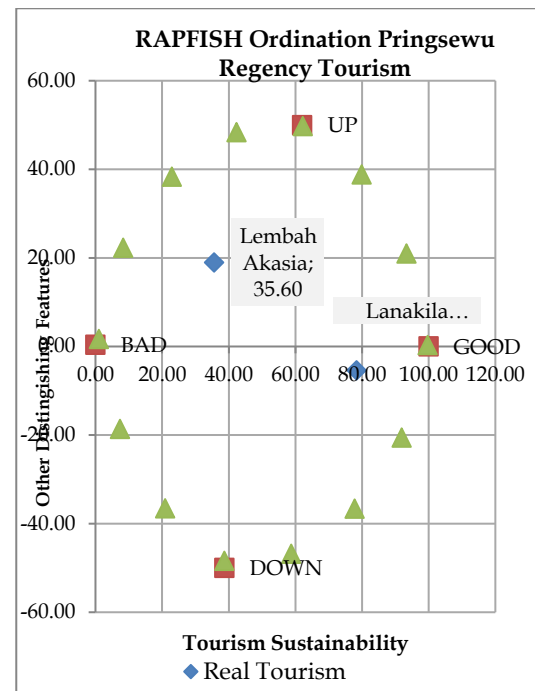


Figure 6: Social Dimension Sustainability Index.

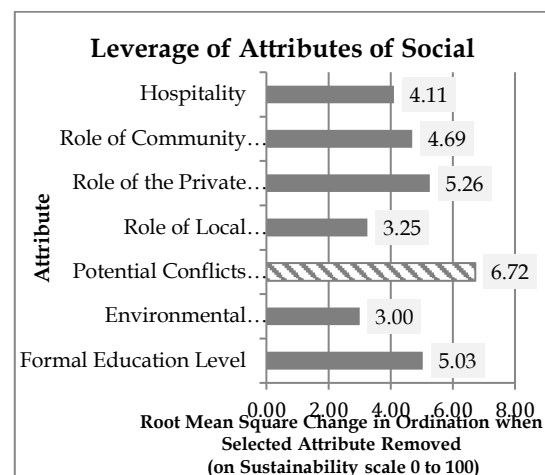


Figure 7: Social Dimension Leverage Analysis.

The results of the MDS-based RAP-Tourism study indicate that Lanakila Lake's social sustainability index is 78.38 (moderately sustainable), while Acacia Valley's is 35.60 (less sustainable). This difference indicates that Lanakila Lake is relatively better able to manage the social dynamics of tourism (e.g., community acceptance, the quality of host-guest interactions, and actor coordination), while Acacia Valley still faces challenges in building stable social conditions to support destination sustainability. Conceptually, sustainable tourism requires a balance of economic, socio-environmental, and environmental impacts, as well as respect for host communities, making the social dimension the foundation of a destination's social legitimacy and sustainability (UNWTO, 2021).

Visually, the RAPFISH ordination on the social dimension places Acacia Valley closer to the "BAD" reference point than Lanakila Lake, which is relatively close to "GOOD." Within the MDS framework, this position reflects the presence of social attributes that "restrain" index improvement; that is, social improvements are ineffective if implemented partially, but rather need to be focused on the most sensitive attributes, as determined by the leverage analysis.

Leverage results indicate that the most sensitive attribute is the potential for land use conflict (RMS = 6.72). The next most important levers are the role of the private sector (RMS = 5.26), formal education level (RMS = 5.03), the role of community groups (RMS = 4.69), and hospitality (RMS = 4.11). The dominance of land use conflict as a primary lever indicates that the social sustainability of rural destinations is largely determined by the certainty of spatial use regulations, clear access, and equitable distribution of business opportunities. This aligns with bibliometric findings showing that rural tourism development is often associated with land use changes and competition for space, potentially triggering social tensions if not accompanied by an adequate regulatory and control framework (Gedecho et al., 2025).

The high leverage of the private sector and community groups demonstrates the importance of collaborative governance. In the destination context, social sustainability is enhanced when there is a clear division of roles and transparent coordination mechanisms between communities, businesses, and the government. A recent research review on rural tourism emphasizes a shift from top-down governance to a more participatory approach, as stakeholder collaboration contributes to increased perceived value and reduced social friction (Reina-Usuga et al., 2024). Therefore, the weak social dimension in Acacia Valley can be interpreted as a signal for the need to strengthen the collaborative architecture of actors (e.g., communication forums, participation-based public service standard operating procedures, and measurable benefit sharing).

Furthermore, formal education and hospitality as leveraging attributes indicate that the social dimension is also related to human capacity. Education influences communities' ability to access economic opportunities, negotiate spatial use, and manage tourism services; while hospitality influences the quality of the tourism experience and host-guest relationships. From a Social Exchange Theory perspective, community support for tourism

emerges when perceived benefits outweigh its social costs; conversely, when social costs (e.g., conflict, activity disruption, or distributional inequity) increase, support tends to weaken (Han et al., 2023). Therefore, strategies to enhance the social dimension need to combine conflict management with increased service capacity and social literacy.

Based on this leverage pattern, the most appropriate policy implications—particularly for Acacia Valley—include: (1) preventing and resolving land use conflicts through simple zoning, establishing access/activity rules, citizen forums, and complaint channels; (2) strengthening community-private-government collaboration to ensure fair and transparent management of business opportunities and services; and (3) strengthening social capacity through hospitality training, tourism literacy, and environmental education based on local wisdom. These steps are consistent with the direction of rural tourism research and practice, which emphasizes stakeholder participation as a prerequisite for social sustainability (Reina-Usuga et al., 2024) and the principles of sustainable tourism, which place local communities at the heart of destination management (UNWTO, 2021).

4.4. Institutional Dimension

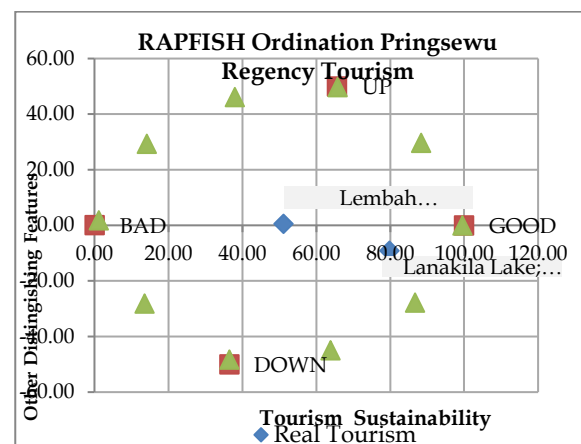


Figure 8. Institutional Dimension Sustainability Index.

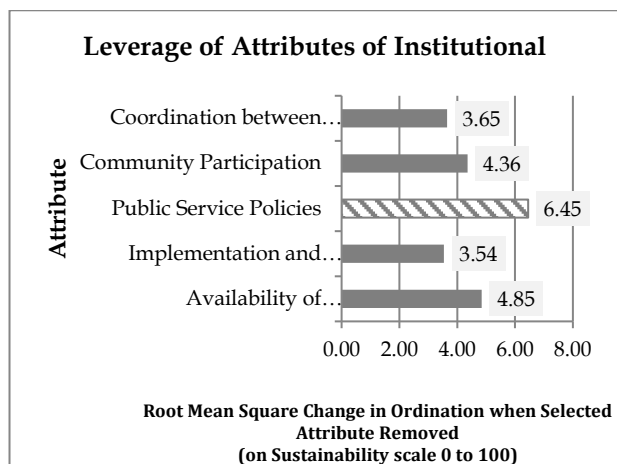


Figure 9. Institutional Dimension Leverage Analysis.

The MDS-based RAP-Tourism results show that Lanakila Lake's institutional sustainability index is 79.75 (highly sustainable), while Acacia Valley's is 51.11 (moderately sustainable). This indicates that Lanakila Lake has more effective governance mechanisms, including service arrangements, policy support, and management coordination. In contrast, Acacia Valley is still in the phase of strengthening institutional mechanisms for more consistent governance. Institutions are critical to sustainability, linking policy with operational implementation (Bramwell & Lane, 2021). When institutions are weak, management becomes sporadic, dependent on individuals, and unable to maintain long-term sustainability.

Visually, the RAPFISH ordination places Lanakila Lake closer to the "GOOD" reference point, while Acacia Valley is between "BAD" and "GOOD." A position closer to "GOOD" reflects well-established regulations, functioning public services, and strong coordination. Conversely, Acacia Valley's position suggests several institutional attributes remain underdeveloped, hindering improvements, and requires targeted interventions on key leverage points (Reina-Usuga et al., 2024).

The leverage analysis identifies public service policies (RMS = 6.45) as the most sensitive attribute, followed by management regulations (RMS = 4.85), community participation (RMS = 4.36), stakeholder coordination (RMS = 3.65), and implementation and supervision of regulations (RMS = 3.54). Methodologically, attributes with higher RMS values drive changes in ordination and are key to improving the institutional dimension's sustainability status.

Public service policies are the primary drivers of institutional quality, as they ensure consistent and accountable services such as cleanliness, security, parking, visitor flow management, and complaint

handling. These services act as a "social contract" between management, government, communities, and tourists, ensuring order and comfort, supporting both socio-ecological sustainability and destination competitiveness (OECD, 2024). When public services fail, it leads to increased waste, inconvenience, and a decline in the quality of the tourist experience.

The importance of management regulations and implementation oversight highlights that strong institutions require both clear rules and enforcement. This aligns with sustainability literature, which stresses that policy success depends on compliance, institutional capacity, and effective oversight (UNWTO, 2021). Acacia Valley, still in the "adequate" category, needs to focus on establishing and updating SOPs for services such as cleanliness, security, space utilization, and activity management, supported by monitoring mechanisms like staff schedules, inspections, and periodic reports.

Community participation and stakeholder coordination demonstrate that institutional strength is also about effective collaboration among actors. Research on rural tourism governance shows that collaborative governance enhances policy legitimacy and effectiveness, aligning decisions with local interests, reducing resistance, and boosting social compliance (Reina-Usuga et al., 2024). Low community participation and weak coordination risk undermining sustainability.

Based on the leverage structure, Acacia Valley's institutional strengthening should prioritize: (1) enhancing public service policies through service standards for cleanliness, security, parking, and information, (2) developing and updating management regulations/SOPs for operational consistency, and (3) fostering collaboration and participation among stakeholders to enhance governance and improve service delivery.

4.5. Infrastructure and Technology Dimensions.

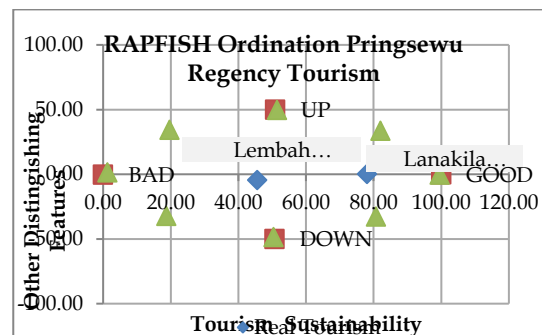


Figure 10.3.5. Infrastructure and Technology Dimension Sustainability Index.

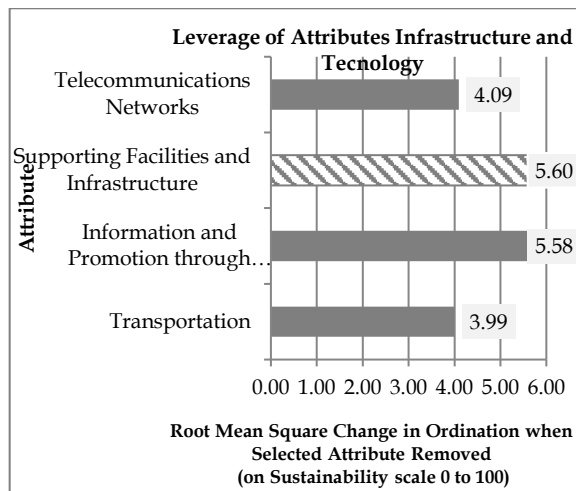


Figure 11: Infrastructure and Technology Dimension Leverage Analysis.

The results of the MDS-based RAP-Tourism assessment on the infrastructure and technology dimensions indicate that Lanakila Lake achieved an index of 78.09 (categorized as moderately sustainable), while Acacia Valley achieved an index of 45.62 (categorized as less sustainable). This difference indicates a capacity gap in accessibility, availability of supporting facilities, connectivity, and destination promotion/information capabilities. In the context of nature-based rural destinations, infrastructure and technology act as enablers, bridging landscape appeal with tourism experiences, management efficiency, and destination competitiveness (Figuerola & Rotarou, 2024). Therefore, Lanakila Lake's higher performance can be interpreted as reflecting relatively better service support and connectivity compared to Acacia Valley. Visually, the RAPFISH ordinate places Lanakila Lake (78.09) closer to the "GOOD" reference point, while Acacia Valley (45.62) is in the intermediate position and further away from the ideal condition. In the MDS interpretation, a position closer to "GOOD" indicates that the combination of infrastructure-technology attributes at Lanakila Lake is more consistent with expected conditions—for example, adequate supporting facilities, easier access, and a more effective information/promotion system—while Acacia Valley's position indicates that there are still attributes holding back index improvement.

The leverage results confirm that the main lever attributes in this dimension are Supporting Facilities and Infrastructure (RMS = 5.60) and Information and Promotion through Social Media (RMS = 5.58). The next attributes are Telecommunications Networks (RMS = 4.09) and Transportation (RMS = 3.99). Methodologically, a high RMS value indicates that changes in these attributes most strongly influence

the ordination configuration; that is, improving supporting facilities and strengthening digital promotion/information will have the most immediate impact on increasing the infrastructure-technology index.

The dominance of supporting facilities and infrastructure as the main levers is consistent with the literature that positions infrastructure as a fundamental prerequisite for destination competitiveness and sustainability. Destinations with adequate facilities (sanitation, trash receptacles, parking areas, walkways, signage, rest areas, and safety) tend to be better able to manage visitor flows, reduce externalities (e.g., waste and space conflicts), and enhance the quality of the tourist experience. From a "smart destination" perspective, physical infrastructure remains a foundation that cannot be replaced by technology; technology works optimally when basic infrastructure meets service standards (Figuerola & Rotarou, 2024).

The attributes of information and promotion through social media, as a secondary lever, indicate that the performance of this dimension is also significantly influenced by a destination's ability to build visibility and image through digital channels. Systematic studies have shown that social media plays a crucial role in destination branding and shaping tourist perceptions; digital content and social interactions can increase interest, visit intention, and loyalty, which in turn strengthens the destination's economic sustainability (Mariani et al., 2022). Furthermore, research confirms that social media marketing strategies can be integrated with sustainable tourism agendas, for example through educational messages promoting responsible behavior and promoting local products, rather than simply promoting visits (Zarezadeh et al., 2021). Thus, the low Acacia Valley index can be understood as a signal of the need to improve the destination's digital readiness and communication strategy to compete and capture the market more effectively.

Furthermore, the leverage of telecommunications networks indicates that the quality of digital connectivity impacts destination operations and the tourist experience. Connectivity enables navigation, digital transactions, real-time information dissemination, and complaint/service management. Literature on tourism digitalization emphasizes that digital transformation can be a catalyst for sustainable development by improving destination management efficiency, service quality, and business innovation—although its implementation requires institutional readiness and infrastructure investment (Buhalis et al., 2022). In rural areas, digital

connectivity is also linked to strengthening the local economy and social capital, so digital and physical investments are often viewed as a package of rural development levers (Pezzi & Pociovalisteanu, 2025).

The transportation attribute ($RMS = 3.99$) indicates that accessibility remains a significant factor, although its leverage is slightly lower than that of digital facilities and promotions. Transportation performance influences ease of access, travel costs, and visitor distribution. Studies on rural mobility and tourism emphasize that improving greener and more integrated mobility services can strengthen the sustainability of rural tourism, including through reducing dependence on private vehicles, improving accessibility, and managing tourist flows (Bergantino et al., 2023). Therefore, strategies to strengthen access to Acacia Valley (e.g., improving access points, parking management, route information, and transportation connectivity) will contribute to improving the index, especially when combined with improvements to supporting facilities.

Based on this leverage structure, the most prioritized policy implications—particularly for Acacia Valley—are: (1) improving supporting facilities and basic service infrastructure (sanitation, cleanliness, parking, signage, security), (2) strengthening targeted information and social media promotion (destination branding, educational content on sustainability, promotion of local products/MSMEs), (3) strengthening telecommunications connectivity as an enabler of digital services, and (4) improving transportation access and managing visitor mobility. This strategy aligns with the direction of destination transformation towards smart and sustainable destinations, namely the integration of physical infrastructure, technology, and governance to support local quality of life and sustainability (Figueroa & Rotarou, 2024; Buhalis et al., 2022).

4.6. Multidimensional Sustainability

Tabel 2. Nilai stress dan r^2 analisis rap-tourism.

No	Dimensions of Sustainability	Stress	R^2
1	Ecology	0.176	0.935
2	Economy	0.161	0.932
3	Social	0.150	0.944
4	Institutions	0.173	0.933
5	Infrastructure and Technology	0.189	0.926

The RAP-Tourism analysis results show that all sustainability dimensions have stress values <0.25 , with a range of 0.1835–0.2111. This relatively low stress value indicates that the ordination results are

stable and reliable, and adequately represent the sustainability conditions of tourism destinations (Kavanagh & Pitcher, 2004; Pitcher & Preikshot, 2001).

The coefficient of determination (R^2) across all dimensions ranges from 0.926–0.944, indicating that more than 92% of the data variation can be explained by the RAP-Tourism model. The high R^2 value reflects the model's accuracy and robustness in explaining sustainability patterns across the ecological, economic, social, institutional, and infrastructure and technology dimensions. Therefore, the results of this analysis can serve as a strong basis for formulating policies and strategies for sustainable tourism management. Overall, the combination of low stress values and high R^2 confirms the suitability of the RAP-Tourism approach as a multidimensional sustainability evaluation tool in the tourism sector.

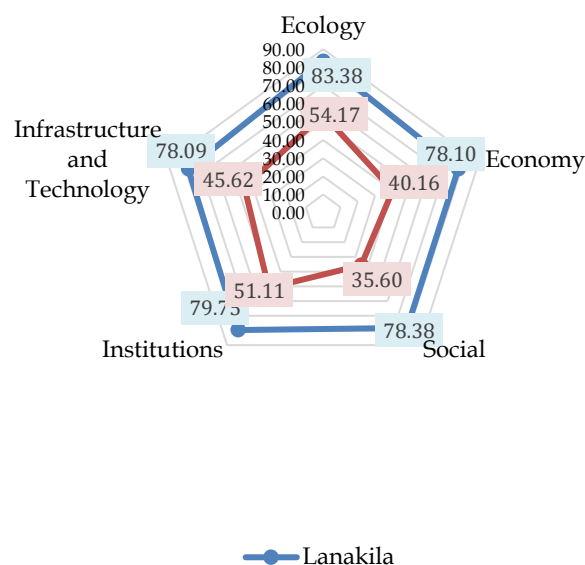


Figure 11. Multidimensional sustainability

A multidimensional analysis of tourism sustainability at Lanakila Lake and Acacia Valley revealed significant differences across the five dimensions tested. Lanakila Lake scored higher on almost all dimensions, particularly ecological (83.38) and economic (78.10), indicating better environmental management and economic benefits at this destination. In contrast, Acacia Valley faced challenges on the economic (40.16) and social (35.60) dimensions, indicating a need to enhance community participation and the distribution of economic

benefits. This aligns with findings that destination sustainability depends not only on natural attractions but also on strong institutional capacity, infrastructure, and social participation (Figueroa & Rotarou, 2024).

In terms of institutional and infrastructure, Lanakila Lake demonstrated a more mature management system and greater technological readiness, while Acacia Valley still needs to improve access and supporting facilities to achieve optimal sustainability. Therefore, improvements at Acacia Valley should focus on strengthening local management capacity, developing basic facilities, and managing community participation to achieve a better social and economic balance.

5. CONCLUSION

This study concludes that Lanakila Lake and Acacia Valley have significant differences in terms of tourism sustainability, as reflected in the analysis of five key dimensions: ecological, economic, social, institutional, and infrastructure-technology. Lanakila Lake performed better in almost all dimensions, with the highest indexes in the ecological dimension (83.38) and the economic dimension (78.10), indicating good environmental

management and economic benefits. On the other hand, Acacia Valley demonstrated strength in the ecological dimension (54.17) but lagged behind in the economic (40.16) and social (35.60) dimensions, indicating significant challenges in distributing economic benefits to the community and improving social engagement.

From the leverage analysis, leveraging attributes such as bird conservation (ecological), community well-being (economic), and public service policies (institutional) were shown to have a significant impact on improving destination sustainability. Therefore, Acacia Valley needs to focus interventions on strengthening community participation, developing the capacity of MSMEs, and improving infrastructure to enhance access and supporting facilities, so that this destination can optimize economic and social benefits for the local community.

Sustainable rural tourism requires a holistic approach, involving collaborative governance among stakeholders, strengthening institutional capacity, and developing infrastructure that supports a better and more inclusive tourism experience. This research provides a strong foundation for sustainable tourism policies in rural areas to maximize economic and social potential while preserving the environment.

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