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The Sustainable Forest Tourism Management Strategies: Case Study in Dumai City

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ABSTRACT

Dumai city tourism forest is part of the Sungai Dumai Nature Park, Riau province, Indonesia. The preservation of natural resources in this area was challenged by several issues, including forest and land fires, the shift of land uses to agriculture and oil palm plantations, and the slow performance of management institutions. Based on ecological, economic, social, and governance considerations, this study aimed to design a sustainable management strategy for Dumai city forest tourism. This research collected data from field observations, direct measurements, and interviews. The data were analyzed with a multidimensional scaling (MDS) using the rapid assessment technique for fisheries (RAPFISH) program and prospective analysis to determine a sustainability strategy. The ecological, economic, social, and governance parameters assessment showed that Dumai city forest tourism is less sustainable. Dumai city forest tourism management plan is to create scenarios to improve ecological, economic, social, and management aspects. The social dimension, which is growing most significantly, is the first to be enhanced by forming communities and increasing community participation in maintaining and developing forest areas.

1. INTRODUCTION

Forests have benefits as a source of life in terms of ecological, sociocultural, and economic sectors at a balanced and dynamic level. According to Siswantoro [1], the magnitude of forest benefits drives conservation efforts to function the forest sustainably. Many efforts can be made to achieve conservation, one of which is through ecotourism which highlights natural beauty as the main product and involves communities around the forest [2].

Ecotourism is a model of responsible natural tourism development in areas that are still natural or areas that are managed based on the nature concept; the aim of ecotourism is not only to enjoy the beauty of nature but also involves elements of education and support for conservation efforts and helping the local community's welfare [3]. Ecotourism is a link between tourism and conservation; this type of tourism is a form of alternative tourism that prioritizes environmental responsibility [3, 4]. Potential for ecotourism is an environmental development concept based on an approach to nature maintenance and conservation [5].

Forest tourisms are part of ecotourism in the form of forest areas specifically developed and maintained for recreational and cultural purposes [6, 7]. The principles of forest tourism are minimizing impacts, fostering environmental and cultural awareness, providing positive experiences for both tourists (visitors) and recipients (hosts), and providing benefits and empowerment for local communities [8]. In addition, tourism forests can also be used as a means of research, development, and problem-solving in the environment [9].

In 1990, the Indonesian government created Sungai Dumai Nature Park in Riau Province as a tourist forest area because it has supporting factors and criteria such as beautiful natural panoramas that can be used for tourism and natural recreation interests, easy-to-reach locations, the land area that guarantees the preservation of natural potential and government policies. However, several problems owned by Sungai Dumai Nature Park can disrupt the preservation of natural resources, such as forest and land fires, land conversion to agriculture and oil palm plantations, and hamper the performance of the nature park management institution. In 2016, there were forest fires in Riau Province, and 60.87% of cases of forest fires in Riau Province occurred in Dumai city Nature Park. The Dumai city Nature Park area burned 2,432.02 ha of the total conservation area in Riau Province, which was burnt, namely 3,995.40 ha. In addition, based on Gusliana [10] findings, the implementation of conservation forest management in Dumai city has not been appropriately implemented. Factors hindering this management include the lack of staff, the extent of the conservation forest area, and the low public awareness of the importance of conservation forests.

Dumai city needs a solution accommodating different interests to create sustainable forest tourism. The management plan must be all-encompassing and holistic and draw the interest of all parties interested in the continuation of Dumai forest tourism. Appropriate environmental development is expected to provide support for other sectors through the provision of ecological products and services, including environmental stability, protection of biodiversity, conservation and utilization of germplasm, and regulation of water and air systems [11]. Dumai forest tourism is a complex system with components that interact and are causally related to one another. A systematic approach is required to present a comprehensive picture of these interactions.

This study analyzes problems and offers appropriate and sustainable management strategies to improve the

sustainability of Dumai forest tourism. The novelty of this research lies in the use of sustainability and prospective analyses to develop a sustainable Dumai forest tourism management strategy so that it can still maintain the quality of forest resources and increase the economic vibrancy in the vicinity. The Dumai city tourism forest management strategy will focus on ecotourism aspects that will support the management of Dumai forest tourism.

2. METHODS

2.1 Research location and period

The research was conducted in the Forest tourism area in the Sungai Dumai Nature Park, Dumai city, Riau Province, with an area of ± 1.68 km^2 (Figures 1-3). Dumai forest tourism is monitored by the Regional III Conservation Section, Region II Natural Resources Conservation Division of Riau Natural Resources Conservation Center. The research flow can be seen in Figure 4.

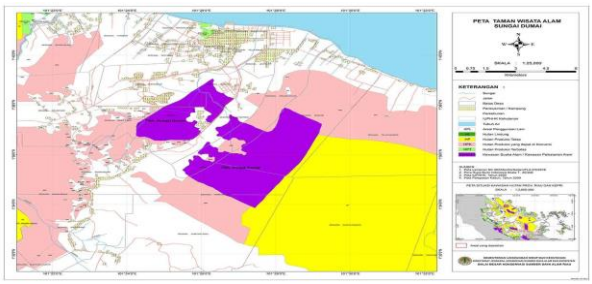

Figure 1. Map of Sungai Dumai Nature Park (Riau natural resources conservation center, 2018)

Figure 2. Landsat image of Dumai forest tourism (Google earth, 2022)

Figure 3. Dumai forest tourism, (A) Crossbar, (B) Inner area, and (C) Road access (personal documentation)

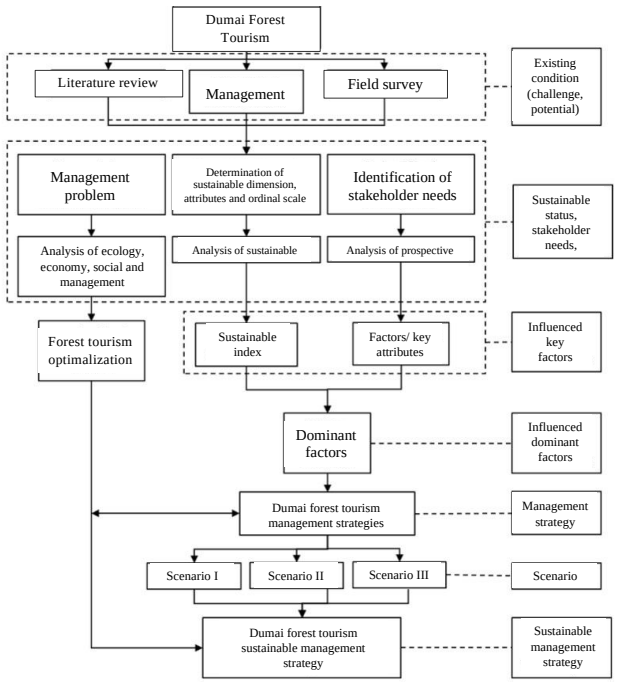

Figure 4. Research flow

2.2 Data collection

2.2.1 Ecological, economic, social, and governance aspects of Dumai forest tourism

For this investigation, both primary and secondary data were required. In-depth interviews, field observations, and measurements were used to gather primary data. The primary information gathered was:

(1) Ecological aspect

Vegetation includes composition, structure, diversity, and the Important Value Index (INP) of tree vegetation in Dumai forest tourism.

Animals species diversity index (H') included types, abundance, diversity, evenness, dominance, frequency of occurrence, social features, and description of their habitats in Dumai forest tourism.

(2) The economic aspects were analyzed quantitatively to determine the substance of the multiplier effect to measure the economic impact of Dumai forest tourism. The multiplier effect analysis used two types of multipliers, namely the Keynesian Local Income Multiplier (the amount of visitor spending) and the Ratio Income Multiplier (the impact of the local economy on the total visitor spending) [12].

(3) Social aspects include local community access to and dependence on the forest, public communication, conflict, community participation, community empowerment, community perception, and education levels.

(4) Governance includes planning, organizing, actuating, and controlling.

Geographical conditions, total area, air temperature, humidity, and rainfall intensity were included as secondary data. The data were obtained from related agencies, such as the Ministry of Environment and Forestry, the Development Planning Agency, Regional Research and Development, the Environment and Forestry Service, the Natural Resources Conservation Center, the Central Statistics Agency, and the sub-district and village offices in Dumai city. In addition, secondary data was also obtained from University of Riau, Bogor Agricultural University, and WWF Indonesia.

2.3 Analysis of the sustainability status of Dumai forest tourism management

An MDS technique using the RAPFISH program was used to analyze the sustainability state of Dumai forest tourism management. Based on the field observations and secondary data, a score of 0 to 3 was assigned to each attribute in each dimension. The analysis results were presented as an index scale with categories, as in Table 1.

Table 1. Categories of sustainability status of Dumai forest tourism management

Index	Category	Sustainability Status
00.00 – 20.00	Poor	Unsustainable
20.01 – 50.00	Inadequate	Less Sustainable
50.01 – 75.00	Adequate	Adequate
75.01 – 100.00	Excellent	Sustainable

Source: Kavanagh and Pitcher (2001)

The scores for each attribute were analyzed to determine the position of sustainable management of forest tourism to two points, namely the "excellent" point and "poor" point. This position visualization was obtained from the ordinance analysis using RAPFISH [13].

2.4 Prospective analysis

A prospective analysis is employed to plan the necessary strategic activities and determine whether future changes are required [14]. The key elements in the sustainable development of Dumai forest tourism can also be identified using this technique.

According to Hardjomidjojo [15], the stages of the prospective analysis include: (1) equating the views of all experts who will be consulted regarding the scope and objectives of the system to be studied; (2) identifying the factors that influence the achievement of these goals, which are usually the needs of stakeholders. At this point, each element must be defined in clear and specific terms, where the integration of expert opinion is carried out by taking the mode value; (3) assessment of direct influence between factors.

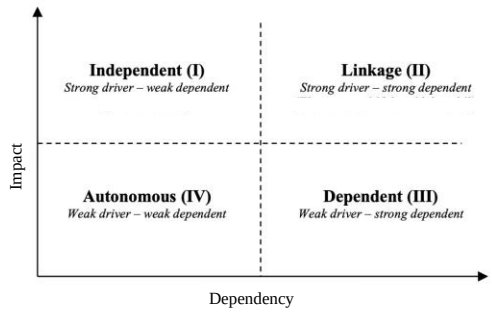

Figure 5. Determination of the level of influence and dependence between factors

The prospective analysis will be used to identify the dominant factors (key factors) that influence the management of forest tourism in Dumai city. The analysis was carried out in three stages, including (1) analysis of the dominant and sensitive variables obtained from the analysis of the status of sustainability; (2) analysis of dominant variables and needs analysis or important variables from representative respondents; (3) analysis of the combined variables in the first and second quadrants. The model analysis used the results of quadrant one and two variables. Assessment has done by giving a score of 3 if the direct influence between factors was very strong; a score of 2 if the direct effect between the factors was moderate; a score of 1 if the direct effect between factors was small, and a score of 0 if there was no direct influence between factors. After obtaining the key factors, an influence and dependency matrix analysis was carried out to see the position of each factor in Dumai city forest tourism development strategy using prospective analysis software, shown in Figure 5.

3. RESULTS AND DISCUSSION

3.1 Ecological, economic, social, and governance aspects of Dumai forest tourism

3.1.1 The ecology of Dumai forest tourism

Vegetation Structure. The transect method was used to gather information on the vegetation on the Dumai forest tourism. Based on the survey, Dumai forest tourism has trees belonging to 23 families, 56 species, and 825 individuals. Each transect has a different number of families, ranging from 11-13, as presented in Table 2.

Table 2. Composition of trees on each transect in Dumai forest tourism

No	Transect	Family	Species	Individual
1	I	12	20	208
2	II	12	21	195
3	III	11	20	120
4	IV	12	18	94
5	V	13	20	208

The vegetation with the most species found in the Dumai forest tourism was from the Dipterocarpaceae family. The Dipterocarpaceae family is a group of plants with tall trees that grow slowly, have a large height and diameter with a canopy, and its wood is used for construction. Dipterocarpaceae grow in the lowlands and become food for many animals [16]. Dipterocarpaceae wood is extensively used because it has a high economic value. The International Union for Conservation of Nature (IUCN) has listed several significant members of this family as endangered species [17]. Currently, superior wood-producing species are experiencing a decline in the forest due to rampant excessive and illegal logging and forest encroachment by surrounding communities [18]. Plant species belonging to the Dipterocarpaceae family found in Dumai city forest tourism are presented in Table 3.

The structure and diversity of vegetation play a vital role in the sustainable management of Dumai city Forest Tourism (Table 4).

The value of vegetation density in Dumai city forest tourism is 515.63 ind/ha. Indriyanto [19] stated that a vegetation density of more than 60% or 240 ind/ha is considered a good density. Odum [20] defined density as the number of species in a particular area unit.

Macaranga triloba had the highest density in the Dumai forest tourism. This demonstrates that Macaranga triloba is more suitable for Dumai forest tourism than other varieties. Amirta et al. [21] explain that Macaranga is frequently the first plant to emerge following forest fires, the opening of logging or skid trails, and the clearing of old fields since it is a pioneer

plant that grows and develops quickly. Moreover, Macaranga triloba had the highest frequency with 0.59. A species with the highest frequency value has a wide distribution compared to others [22].

The Dumai city forest tourism had a dominance value of 7.68 m^2/ha, with Macaranga triloba having the most significant value (0.90 m^2/ha). The presence of dominance is a sign that the area is favorable for the growth of this vegetation. Dumai forest tourism had a Shannon-Wienner diversity index (H') of 2.50, which indicates moderate diversity [20]. One of the crucial ecological elements in the long-term maintenance of Dumai forest tourism is the structure of the local vegetation community. Many species with the same abundance must create a high diversity index.

Animals in Dumai forest tourism. In the Dumai forest tourism, nine mammal species, four reptile species, and eight bird species were discovered. With a share of 72-78%, the avian family—which includes carnivorous, insectivorous, granivorous, and omnivorous birds—dominates the region. Mammals (16-25%) had the second-highest abundance, followed by reptiles (1-8%) (Figure 6).

Table 3. List of the dipterocarpaceae family members found in Dumai forest tourism

Species	Local Indonesian Name	Transect					Total
		I	II	III	IV	V	
Dryobalanops oblongifolia	Kapur petanang	0	5	0	0	0	5
Dryobalanops sp	Kayu kapur	3	15	0	0	0	18
Hopea mengarawan	Merawan	0	0	0	0	4	4
Parashorea aptera	Meranti batu	0	1	0	0	0	1
Shorea acuminata	Meranti hitam	2	0	0	0	0	2
Shorea hopeifolia	Meranti kuning	0	0	0	2	0	2
Shorea parvifolia	Meranti sarang punai	0	2	9	0	7	18
Shorea sp.	Meranti	0	5	4	2	12	23
Shorea teysmanniana	Meranti daun halus	4	0	0	0	0	4
Shorea uliginosa	Meranti daun lebar	10	4	7	12	5	38

Table 4. Vegetation structure in Dumai forest tourism

No	Transect	Total Species	Parameter			
			K (ind/ha)	F	D (m^2/ha)	H'
1	I	20	650.00	8.06	5.80	2.35
2	II	21	609.38	9.21	8.77	2.56
3	III	20	375.00	5.38	6.91	2.53
4	IV	18	293.75	4.75	6.85	2.56
5	V	20	650.00	11.00	11.59	2.52
Average		**19.80**	**515.63**	**7.95**	**7.68**	**2.50**

Description: K: Density; F: Frequency; D: Dominance; H': Diversity

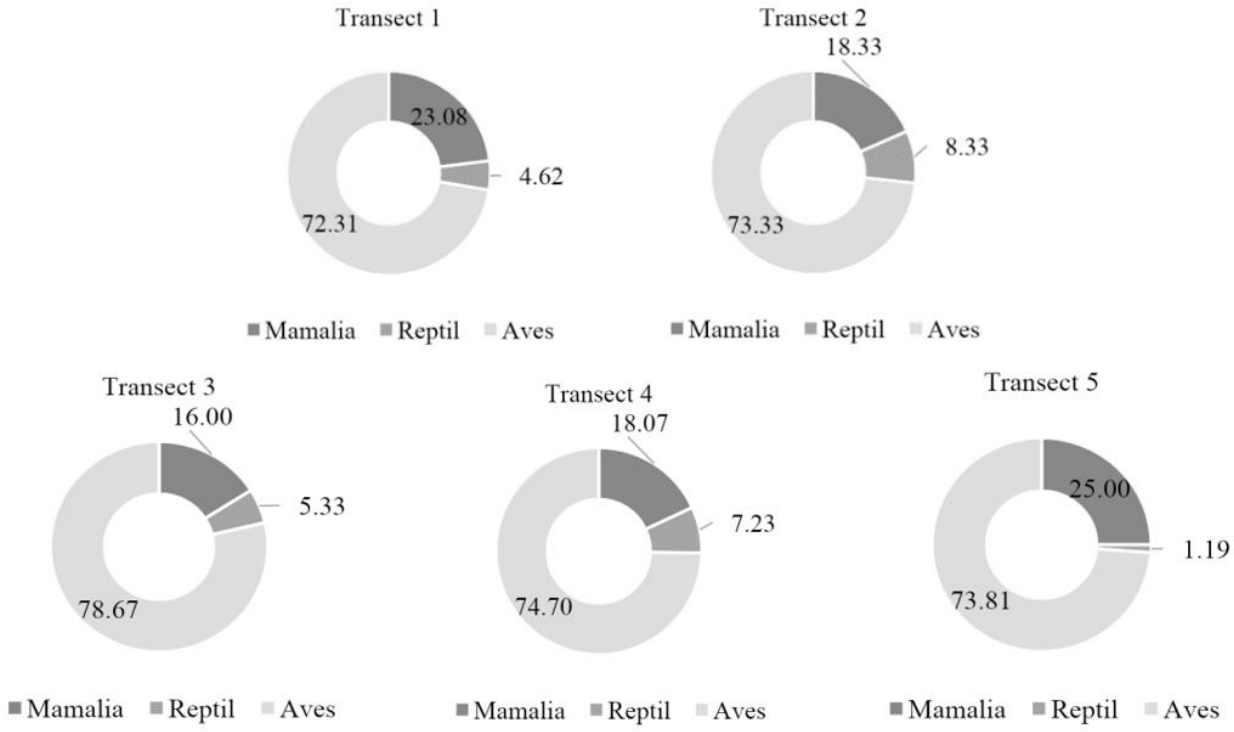

Figure 6. The abundance of animals in Dumai forest tourism

This study discovered that the overall animal species diversity index (H') ranged from 2.492 to 2.277 (Figure 7), indicating a moderate level of diversity. Transect 1 has the highest species diversity index and vegetation density level (650.00 ind/ha). Wu et al. [23] suggested that the diversity of animals, particularly birds, is directly related to the phonological properties of vegetation.

The Evenness Index (E) value can be used to measure each species' dominance within the community. The Evenness Index value obtained ranges from 1.004 – 1.620 (Figure 8), where Transect 1 has the maximum value. It illustrates that no animal species are predominating on Transect 1. Furthermore, the dominance index in Dumai forest tourism ranges from 0.098 – 0.119, indicating no dominance by one species (Figure 9).

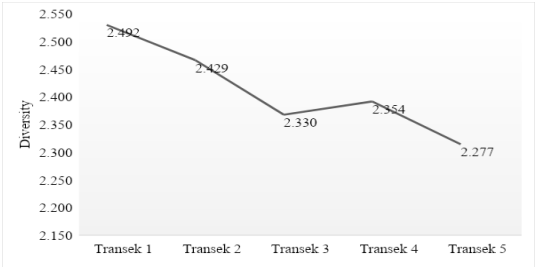

Figure 7. Animal diversity index in the Dumai tourism forest

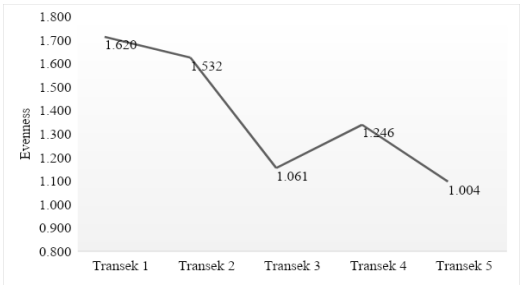

Figure 8. Animal evenness index in the Dumai tourism forest

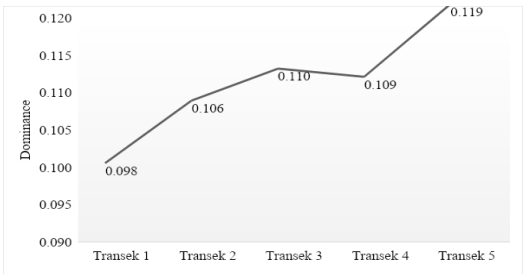

Figure 9. Animal dominance index in Dumai tourism forest

Planting various tree species can improve the diversity of animal species because the vegetation could provide food, shelter, nesting sites, and hiding places for animals. However, managing an environment must be done while preserving its natural features.

3.1.2 Economic condition of communities around Dumai forest tourism

Ecotourism affects local economic conditions in a variety of ways, including by promoting infrastructure investment [24], encouraging the growth of economic sectors [25], boosting employment opportunities and income [26], disseminating technical knowledge, promoting research and development, and building up human capital [27]. The multiplier effect research also reveals the impact of Dumai forest tourism on local economic conditions (Table 5**)**. The direct effect is the revenue from tourism visits. This income may come from purchases, entrance tickets, parking, and other sources.

Table 5. The value of the multiplier effect in the Dumai forest tourism

Criteria	Value	Description
Keynesian Local Income Multiplier	0.02	The economic impact on tourism activities is insignificant as the Keynesian Local Income Multiplayer value was <1
Ratio Income Multiplier Type I	0.84	The economic impact on tourism activities is insignificant as the Ratio Income Multiplayer Type I and II values were less than or equal to 1
Ratio Income Multiplier Type II	1.14	

Two multiplier values are used to quantify the economic impact of ecotourism activities: (1) Keynesian Local Income Multiplier, which shows how much tourist spending affects the income of local communities, and (2) Ratio Income Multiplier, which illustrates how tourist spending directly impact on the overall local economy. Multiplier values quantify immediate, delayed, and induced effects.

The Keynesian Local Income Multiplier in Dumai forest tourism is 0.02, which means an increase in visitor spending of Rp. 10,000 (0.67 USD) will result in Rp. 200.00 (0.013 USD) increase in locals' revenue. The value of the Type I Income Multiplier Ratio in Dumai forest tourism is 0.84, meaning an increase of Rp. 10,000 (0.67 USD) in the business unit's income equals an increase of Rp. 8,400 (0.65 USD) in the community's overall income. Furthermore, the value of the Type II Income Multiplier Ratio is 1.14, indicating that for every Rp 10,000.00 (0.67 USD) tourists spend, the community will gain a total income of Rp 11,400.00 (0.76 USD). According to research by Chidakel et al. [28], the multiplier impact of visitor spending on tourism can boost regional business and economic growth in Thailand.

3.1.3 Social Perceptions of the function of Dumai forest tourism

There are numerous ethnic groups represented among the residents of Dumai city. People from inside and outside the city visit the Dumai Tourism Forest for pleasure, sports, and education about nature. Visitors typically have different opinions about Dumai forest tourism regarding its ecological, social, aesthetic, and economic roles, as presented in Table 6.

With an average of 1.94, public perception of the four primary roles of Dumai forest tourism fell into the severe category. This figure depicts that the Dumai forest tourism has not served the neighborhood as well as it could have. As the average value for the ecological function is the lowest, offering community members educational resources on the forest's primary role in the ecosystem is imperative.

3.1.4 Dumai forest tourism management

The central government, provincial governments, city governments, associated agencies and institutions, educational institutions, research institutions, and non-governmental organizations are generally the institutional components in the sustainable management of Dumai forest tourism. The active

role of these organizations will generate investments that can entice commercial institutions and investors to get involved in realizing the sustainable management of Dumai forest tourism. Based on interviews with experts, the factors that influence the active role of these institutions are (1) budget management; (2) plan document management; (3) human resources; (4) organization management; (5) facilities and infrastructure; and (6) monitoring and evaluation system.

Table 6. Public perception of Dumai forest tourism

No	Forest Tourism Function	Total Score	Total Respon-dents	Mean	Category
1.	Ecological function				
	a. Vegetation Cover	87.84	50	1.76	Severe
	b. Diversity of Vegetation and Animals	90.275	50	1.81	Severe
	c. City Identity	91.133	50	1.82	Severe
2.	Social Function	104.975	50	2.10	Poor
3.	Aesthetic Function	101.913	50	2.04	Poor
4.	Economic Function	106.3	50	2.13	Poor
	Mean			**1.94**	**Severe**

3.2 Dumai forest tourism sustainability

The ecological dimension, which consists of vegetation diversity, animal diversity, and tree density, describes how the environment supports sustainability. The MDS study produced a sustainability index value of 41.52, classifying it as less sustainable (Figure 10a). This number reflects the ecologically poor state of Dumai forest tourism. According to Ikhsani [29], in research conducted in the same area, land fires and forest encroachment in 2016 have decreased the forest density. High accessibility to the forest may encourage or even cause communities to engage in deforestation.

The economic aspect discusses the nature of the local economy and how it affects the viability of Dumai forest tourism. The economic dimension has seven attributes: (1) economic access for the community; (2) multiplier effect; (3) employment and business opportunities; (4) community income; (5) non-tax state revenue; (6) tourism products; and (7) non-timber forest resources. The value of the sustainability index for the economic dimension was 20.60 or less sustainable (Figure 10b).

The governance dimension explains the role of the parties in the management of the Dumai forest tourism, consisting of 10 attributes, namely (1) budget allocation, (2) accessibility, (3) regional information database, (4) management organization, (5) community participation, (6) law enforcement, (7) management plan, (8) infrastructure, (9) monitoring and evaluation system, and (10) human resources. This component had a sustainability index value of 39.98 and was included in the less sustainable category (Figure 10d). In general, all areas designated as forest regions in Indonesia have unsustainable governance, including Dumai forest tourism. Suwarno [30] suggested that this was brought on by the initial processes of gazettement of forest regions in Indonesia, which were carried out on a macro scale on a map without going through the process of inventory and boundary demarcation in the field.

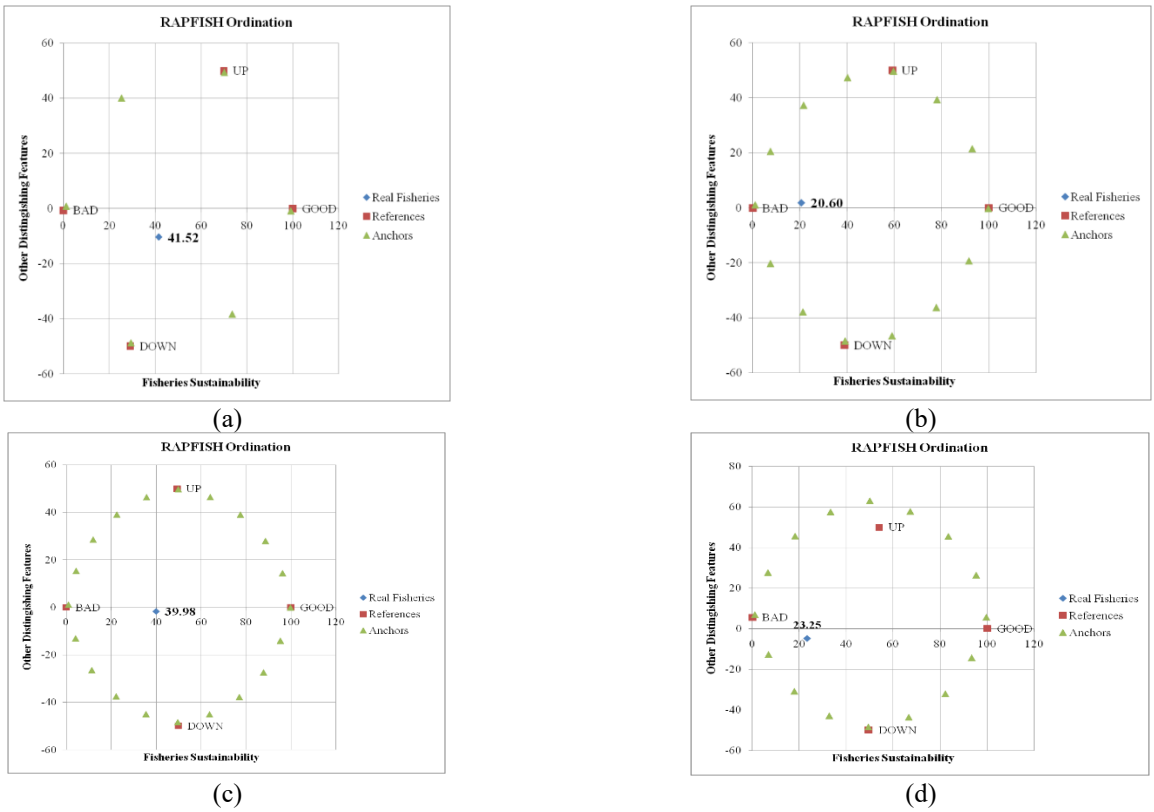

Figure 10. RAPFISH ordination of the sustainability index for (a) Ecology, (b) Economy, (c) Social, and (d) Governance in Dumai forest tourism

The social component describes how future societal influences on natural resources, particularly forests, will be affected by the management of Dumai forest tourism. There are eight characteristics in the social dimension: (1) Access to woods by the local community; (2) Dependence on forests; (3) Public communication; (4) Conflict; (5) Participation of the community; (6) Community empowerment; (7) Community perception; and (8) Education level. The value of the sustainability index for the social dimension was in the less sustainable category at 23.25 (Figure 10c). This demonstrates that the community has not fully benefited from Dumai forest tourism.

Azwar and Mulyadi [31] found that factors influencing sustainable forest management include institutional and personnel competence, social institution involvement, accessibility to management provisions, and the legal status of customary forests. Laclau et al. [32] also emphasized the importance of budget, human resources, and institutional capability in forest management.

3.3 Dumai forest tourism multidimensional sustainability

The results of the MDS analysis showed that the sustainability index of Dumai city forest tourism for the ecological dimension was 41.52 (less sustainable), the economic dimension was 20.60 (less sustainable), the social dimension was 23.25 (less sustainable), and the management dimension was 39.98 (less sustainable). The multidimensional sustainability status of Dumai city forest tourism can be described by a kite diagram which can be seen in Figure 11.

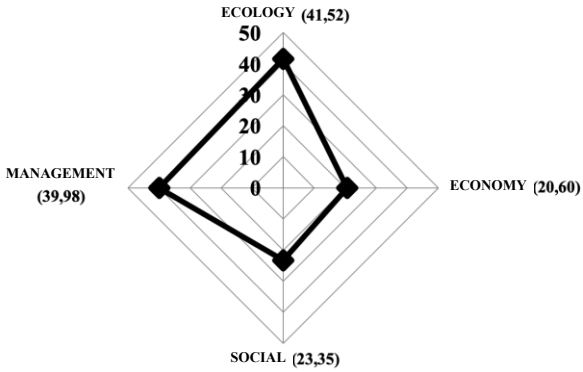

Figure 11. Sustainability status of Dumai forest tourism

3.4 Prospective analysis

The results of a prospective analysis of determinants of the sustainable management of the Dumai city forest tourism can be seen in Figure 12.

According to Bourgeois et al. [14], the selected determinant attributes were those in quadrant I and quadrant II. The attributes in quadrant I determining factors or driving factors contain factors with a strong influence but low dependence. Attributes in quadrant II are connecting factors that have a strong influence and dependence between factors. The results of the prospective analysis show that of the 16 sensitive attributes, there are five key factors (Figure 12), namely: (1) diversity of vegetation; (2) work and business opportunities; (3) public communication; (4) community participation; (5) area information database. These factors play a role in determining the sustainability index for managing Dumai forest tourism.

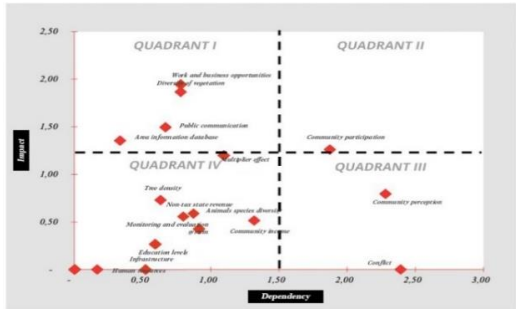

Figure 12. Influence and dependency between lever attributes based on sustainability analysis in Dumai city forest tourism

3.5 Sustainable Dumai forest tourism management strategy

Based on the description of these dominant factors, the remedial interventions carried out to realize the sustainable management of Dumai forest tourism are arranged in the form of 3 alternative scenarios. Scenarios describe future conditions from each dimension and each key sustainability factor. Strategic scenarios are formulated based on anticipation of conditions that may occur in the future, considering the dominant factors above. Changes in the condition of each dominant factor in the future have several possibilities, as described in Table 7 below.

Furthermore, a sustainable Dumai city forest tourism management strategy scenario is implemented operationally, as in Table 8.

The strategic scenario presented in this study is based on the sustainability index results, field data, and interview results in predicting conditions that may arise in the future by considering various elements. Three alternative options could be implemented to achieve the sustainable management of Dumai forest tourism, as listed in Table 9.

The scenarios were created after considering local characteristics, available resources, potential restrictions, and governmental directives for administering Dumai forest tourism. In the best case, all parameters reach sustainable values. The ecological, economic, social, and governance components have significantly increased compared to the present state. The social dimension is the one that has grown the most. As a result, implementing social dimension activities, such as community formation, regular activities, public communication infrastructure, and increased community involvement in preserving, developing, and addressing forest area issues, need to be given priority. All necessary parties were included in the formulation of the operationalization, which included a discussion of the variables that must be considered, the opportunities and challenges, and the implementation strategy for the successful management of Dumai forest tourism.

The interaction between dominant factors will be considered in determining future management strategies. Increasing the diversity of vegetation is a component that must be considered to improve the quality of the vegetation of Dumai forest tourism. Improving vegetation diversity can be done by increasing the number and types of vegetation in Dumai city forest tourism. Opportunities for work and business in the sustainability of forest tourism in Dumai city are important to improve the economic function of forest tourism by increasing the number and types of more diverse

businesses. In addition, the placement of business actors in strategic locations and the provision of adequate infrastructure can be carried out so that the economic function of Dumai city forest tourism can run well. Stakeholder support for the sustainability of Dumai city forest tourism is also an important matter that can affect the sustainability of the functions of forest tourism from an ecological, economic, social, and governance perspective.

Table 7. Description of each scenario of Dumai city forest tourism management strategy

Scenario	Description
I	Making improvements to the sustainable management of Dumai city forest tourism by minimally increasing the scoring of several key attributes
II	Making improvements to the sustainable management of Dumai city forest tourism by increasing the scoring of all key attributes optimally
III	Making improvements to the sustainable management of Dumai city forest tourism by maximizing the scoring of all key attributes

Table 8. Implementation of a sustainable Dumai city forest tourism management strategy

Dominant factors	Sustainable Dumai city forest tourism management
Vegetation diversity	Increasing the diversity of vegetation to optimize the function of the Dumai forest tourism as a tourist destination
Job and business opportunities	Increasing job and business opportunities around Dumai city forest tourism with strategic placements, providing infrastructure, and increasing various types of businesses
Public communication	Forming a community to hold routine activities and adequate infrastructure to create good public communication for the community and visitors around Dumai city forest tourism
Community participation/Involvement	Increasing community participation by forming a community to maintain, develop and discuss issues of Dumai city forest tourism management with the government, academics, and private institutions
Regional information database	Provision of a new and relevant area information database around the Dumai city forest tourism

Table 9. Strategies for improving each factor in each scenario of sustainable management of the Dumai forest tourism

No	Factor	Future condition			
		Present condition	Scenario I	Scenario II	Scenario III
1	Vegetation diversity	The vegetation diversity score was 2.50 (moderate)	Maintain current vegetation diversity value of 2.50 (moderate)	Increase the vegetation diversity score to 3.00 (moderate)	Increase the vegetation diversity score to 3.25 (high)
2	Employment and business opportunities	Employment and business opportunities rate at 7.6% (low)	Increase employment and business opportunities rates by 25%-49.9% (moderate) and more diverse types of businesses	Increase employment and business opportunities rates by 50%-75% (high) with strategic placements and more diverse types of businesses	Increase employment and business opportunities rates by >75% (very high) with strategic placement, provision of infrastructure, and more diverse types of businesses
3	Public communication	Low public communication value	Forming a community to improve public communication to maintain	Forming a community and holding regular activities to improve public communication to maintain and develop	Forming a community, holding regular activities, and providing infrastructure to improve public communication
4	Society participation	Community participation was limited and not optimal	Increase community participation by forming a community	Increase community participation by forming a community	Increase community participation by forming communities to maintain, develop, and discuss problems
5	Regional information database	No adequate regional information database	Provide regional information database	Provide a regularly updated database of regional information	Provide a relevant and regularly updated database of regional information

Description: Scoring for present condition=0; scenario I=1; scenario II=2; scenario III=3

4. CONCLUSIONS

In conclusion, the ecology of the Dumai city forest tourism, which was analyzed, consisted of the condition of the vegetation and animals. A vegetation diversity index of 2.50 indicates a moderate level of diversity. Meanwhile, the index of animal diversity ranged from 2.27-2.49, indicating moderate diversity. In term of economy, Dumai city forest tourism can be seen from the multiplier effect, where the results of the analysis show a Keynesian local income multiplier value of 0.02; the value of the type i income multiplier ratio is 0.84; and the value of the type ii income multiplier ratio is 1.14.

The public's perception of the main function of Dumai forest tourism, both ecological, social, aesthetic, and economic functions, is in a very bad category, which means that the function of the forest for the community is still not optimal, since the management of Dumai forest tourism has not been implemented optimally. The area information database was not yet available, community participation is still low, infrastructure is not optimal, and human resources are not optimal. The current level of sustainability of Dumai city

forest tourism management is included in the less sustainable status category. The sustainable scenario of Dumai city forest tourism management shows that all dimensions achieve sustainable value in the maximum scenario. The dimension that has experienced the highest increase is the social dimension, so it is necessary to pay attention to the implementation of activities on the social dimension, such as: forming a community, holding routine activities, providing public communication facilities and infrastructure, and increasing community participation to maintain, develop and discuss forest area issues. Further research needs to be done to increase the sustainability of Dumai city tourism forest management by looking at the sensitive attributes in this research as a driving factor for the sustainability of Dumai city tourism forest.

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REFERENCES

[1] Siswantoro, H. (2012). Kajian daya dukung lingkungan wisata alam Taman Wisata Alam Goojogan Sewu Kabupaten Karanganyar. Thesis Universitas Diponegoro, Semarang. http://eprints.undip.ac.id/36497/1/tesis_hariadi_siswantoro_mil32_undip.pdf.

[2] Stronza, A.L., Hunt, C.A., Fitzgerald, L.A. (2019). Ecotourism for conservation? Annual Review of Environment and Resources, 44: 229-253. https://doi.org/10.1146/annurev-environ-101718-033046

[3] Jurkus, E., Povilanskas, R., Taminskas, J. (2022). Current trends and issues in research on biodiversity conservation and tourism sustainability. Sustainability, 14(6): 3342. https://doi.org/10.3390/su14063342

[4] Latupapua, Y. (2007). Studi Potensi Kawasan dan Pengembangan ekowisata di Tual Kabupaten Maluku Tenggara, Ambon. Universitas Pattimura. http://etd.repository.ugm.ac.id/penelitian/detail/34012.

[5] Das, M., Chatterjee, B. (2015). Ecotourism: A panacea or a predicament? Tourism Management Perspectives, 14: 3-16. https://doi.org/10.1016/j.tmp.2015.01.002

[6] Zhu, J., Sun, J. (2022). Ecotourism design and plant protection based on sensor network. Frontiers in Plant Science, 13: 993838. https://doi.org/10.3389/fpls.2022.993838

[7] Salazar-Sepúlveda, G., Vega-Muñoz, A., Contreras-Barraza, N., Zada, M., Adsuar, J.C. (2022). Indigenous forestry tourism dimensions: A systematic review. Forests, 13(2): 298. https://doi.org/10.3390/f13020298

[8] Hadi, S.P. (2017). Pariwisata berkelanjutan (sustainable tourism). Paparan Narasumber Seminar Sosialisasi Sadar Wisata. Edukasi Wisata bagi Masyarakat di Semarang. Proceeding seminar sosialisasi.

[9] Sorge, S., Mann, C., Schleyer, C., Loft, L., Spacek, M., Hernández-Morcillo, M., Kluvankova, T. (2022). Understanding dynamics of forest ecosystem services governance: A socio-ecological-technical-analytical framework. Ecosystem Services, 55: 101427. https://doi.org/10.1016/j.ecoser.2022.101427

[10] Gusliana, H.B. (2019). The authority of the local government in forest management and its implication toward local autonomy in Riau Province. Jambe Law Journal, 1(2): 251-267. https://doi.org/10.22437/jlj.1.2.251-267

[11] Ministry of National Development Planning of the Republic of Indonesia. (2019). BAPPENAS, Indonesia. https://en.wikipedia.org/wiki/Ministry_of_National_Development_Planning_(Indonesia).

[12] Garrod, B., Wilson J., Bruce, D. (2001). Planning for marine ecotourism in the EU Atlantic Area: Good practice guidance: A summary. University of the West of England, Bristol. https://uwe-repository.worktribe.com/output/1089277/planning-for-marine-ecotourism-in-the-eu-atlantic-area-good-practice-guidance-a-summary.

[13] Kavanagh, P., Pitcher, T.J. (2001). Rapid appraisal of fisheries (RAPFISH) project. Fisheries Centre Research University of British Columbia, Canada. https://www.fao.org/3/X4175E/X4175E00.pdf.

[14] Bourgeois, R., Liswanti, N., Mukasa, C., Zamora, A., Herawati, T., Monterroso, I., Larson, A. (2017). Guide for co-elaboration of scenarios for reform and security of forest tenure. CIFOR, Bogor. https://doi.org/10.17528/cifor/006749

[15] Hardjomidjojo, H. (2004). Metode analisis prospektif. Departemen Teknologi Industri Pertanian, Fakultas Teknologi Pertanian, Institut Pertanian Bogor, Bogor. http://ejournal-balitbang.kkp.go.id/index.php/jkse/article/download/232/235.

[16] Kanisius, P. (2016). Mengenal Pohon Dipterocarp dan Manfaatnya. Kompasiana. https://yayasanpalung.com/2016/09/29/masyarakat-kayong-lestarikan-lingkungan-dengan-membuat-tikar-pandan/.

[17] Septria, D., Manurung, T.F., Tavita, G.E. (2018). Keanekaragaman jenis pohon famili dipterocarpaceae di hutan adat bukit benuah Kecamatan sungai ambawang kabupaten kubu raya. Jurnal Hutan Lestari, 6(1): 114-122. http://doi.org/10.26418/jhl.v6i1.23999

[18] Sari, N. (2014). Kondisi tempat tumbuh pohon keruing (Dipterocarpus spp) di kawasan ekowisata Tangkahan, Taman Nasional Gunung Leuser, Sumatera Utara. Jurnal Penelitian Ekosistem Dipterokarpa, 8(2): 65-72. https://doi.org/10.20886/jped.2014.8.2.65-72

[19] Indriyanto. (2006). Ekologi Hutan. Indriyanto, Jakarta, Bumi Aksara.

[20] Odum, E.P. (1996). Dasar-dasar Ekologi; Edisi Ketiga. Gadjah Mada University Press, Yogyakarta.

[21] Amirta, R., Angi, E.M., Ramadhan, R., Kusuma, I.W., Wiati, C.B., Haqiqi, M.T. (2017). Potensi Pemanfaatan Macaranga. Mulawarman University Press, Samarinda.

[22] Noor, Y.R., Khazali, Suryadiputra. (1999). Panduan Pengenalan Mangrove di Indonesia. PHKA/WI-IP. Bogor.

[23] Wu, J., Li, H., Wan, H., Wang, Y., Sun, C., Zhou, H. (2021). Analyzing the relationship between animal diversity and the remote sensing vegetation parameters: the case of Xinjiang, China. Sustainability, 13(17): 9897. https://doi.org/10.3390/su13179897

[24] Anup, K.C. (2016). Ecotourism and its role in sustainable development of nepal. In L. Butowski (Ed.), Tourism. IntechOpen. https://doi.org/10.5772/62308

[25] Iasha, A., Yacob, M.R., Kabir, I., Radam, A. (2015). Estimating economic value for potential ecotourism resources in Puncak Lawang park, Agam district, west Sumatera, Indonesia. Procedia Environmental Sciences, 30: 326-331. https://doi.org/https://doi.org/10.1016/j.proenv.2015.10.058

[26] Lee, C.C., Chang, C.P. (2008). Tourism development and economic growth: A closer look at panels. Tourism Management, 29: 180-192. https://doi.org/https://doi.org/10.1016/j.tourman.2007.02.013

[27] Quezada-Sarmiento, P.A., del Cisne Macas-Romero, J., Roman, C., Martin, J.C. (2018). A body of knowledge representation model of ecotourism products in southeastern Ecuador. Heliyon, 4(12): e01063. https://doi.org/https://doi.org/10.1016/j.heliyon.2018.e01063

[28] Chidakel, A., Child, B., Muyengwa, S. (2021). Evaluating the economics of park-tourism from the ground-up: Leakage, multiplier effects, and the enabling environment at South Luangwa National Park, Zambia. Ecological Economics, 182: 106960. https://doi.org/10.1016/j.ecolecon.2021.106960

[29] Ikhsani, H. (2021). Analisis vegetasi di Taman Wisata Alam (TWA) Sungai Dumai, Riau. Wahana Forestra: Jurnal Kehutanan, 16(1): 25-36. https://doi.org/10.31849/forestra.v16i1.5720

[30] Suwarno, E. (2017). Identifikasi hambatan pengukuhan kawasan hutan Di Provinsi Riau. Jurnal Analisis Kebijakan Kehutanan, 14(1): 17-30. https://doi.org/10.20886/jakk.2017.14.1.17-30

[31] Azwar, B., Mulyadi, A. (2020). Index and management sustainability condition of Kenegerian Rumbio customary forest, Riau Province-Indonesia. International Journal of Environmental Science, 5: 241-202. https://www.iaras.org/iaras/filedownloads/ijes/2020/008-0027(2020).pdf.

[32] Laclau, P., Meza, A., Lima, J.G.S.D., Linser, S. (2019). Criteria and indicators for sustainable forest management: Lessons learned in the southern cone. International Forestry Review, 21(3): 315-323. https://doi.org/10.1505/146554819827293196