



## Exploring the Sustainable Status of Community-Based Ecotourism in East Java, Indonesia: A Comprehensive Assessment

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### ABSTRACT

The purpose of this research was to comprehensively assess the sustainable status of community-based ecotourism. The research employed a comprehensive assessment methodology to explore the sustainable status of community-based ecotourism in East Java, Indonesia. This methodology used multidimensional scaling (MDS). The findings of the research revealed the current sustainable status of community-based ecotourism in East Java, Indonesia. It highlighted strengths and areas for improvement across different dimensions, shedding light on the overall sustainability performance of the ecotourism initiatives in the region. This research contributed to the field by offering a comprehensive assessment of the sustainable status of community-based ecotourism. It provided insights into the unique challenges and opportunities faced by ecotourism initiatives in the region, thereby adding originality to the existing body of knowledge on sustainable tourism development.

### INTRODUCTION

Natural resources play an important and strategic role in the sustainability of a nation's development and livelihood. For Indonesia, natural resources are one of the pillars of the economy, contributing to state revenues and employment absorption, as well as providing spillover effects to other sectors including the tourism sector. However, unfortunately, environmental crises have continued to be a phenomenon that is never devoid of intense intellectual struggles and escalating intensities. A grand design that places the economy as the paradigm of development poses a threat to environmental sustainability. In fact, the world's ecosystems have experienced a decrease in both area and habitat quality that has rapidly increased over the last 50 years (**Food & Agriculture Organization, 2021**). Unsustainable and exploitative natural resource management patterns also have the potential to cause significant economic losses in addition to environmental damage. Therefore, natural resource management aims to optimize the overall functions and benefits of ecosystems, which are crucial to life (**Tiarantika & Efani, 2021**).

Thus, if ecosystem functions can be properly optimized in their management, the ecosystems would hopefully be sustainable, and thus surrounding communities can enjoy the benefits of those ecosystems. In general, the implementers or users of environmental services who are obliged to preserve environmental sustainability in ecosystem resource management are institutions and communities that do not contradict state regulations (**Riniwati *et al.*, 2019**).

The tourism sector is one of the sectors demanded to appreciate the local resource potentials. This sector is also one of the major contributors of foreign exchange to the Indonesian state. Since 2008, the Indonesian Government has been promoting tourism in Indonesia through the Visit Indonesia program by introducing the diversity and uniqueness of Indonesia's natural environment and culture, which have been internationally recognized. Indonesian tourism has become the fastest growing, ranking 9th in the world, third in Asia, and number one in the Southeast Asian region, with its achievements in the tourism sector being noted as "The Top 20 Fastest Growing Travel Destinations" (**Kementerian Pariwisata Dan Ekonomi Kreatif Republik Indonesia, 2022**). Therefore, tourism is seen as contributing to the welfare of the world's population. However, tourism development is often cited as one of the main causes of environmental and even social damage. According to a report (**World Tourism Organization, 2022**), tourism infrastructure development without considering environmental sustainability leads to land use changes. Uncontrolled development of tourism facilities, such as resorts, hotels, and restaurants, can damage environmental sustainability. Protected flora must be cleared to realize an adequate infrastructure. Fauna feels disturbed by the crowd of tourists leads to an aggressive behavior toward humans. The influx of foreign cultures conflicting with local customs causes shifts in social order in addition to changes in local cultural values (**Kinseng, 2021**).

To support better ecotourism management, sustainable ecotourism management is needed. The concept of sustainable ecotourism development itself includes several dimensions, viz. environmental sustainability, economic sustainability, social sustainability, and institutional sustainability (**Bhuiyan *et al.*, 2015; Sitepu *et al.*, 2021**). If each component is seen as important to support the overall process of sustainable development, then sustainable ecotourism development policies must be able to maintain the priority level of each sustainability component. In practice, in the issue of ecotourism area management, there are dimensions that have an influence on successful management but are often ignored. In other research studies, such as those of **Lola *et al.* (2017)**, **Ariyani and Fauzi (2019)**, **Sadikin *et al.* (2019)** and **Nematpour *et al.* (2021)**, was stated that achieving sustainable ecotourism management requires several other supporting dimensions, including infrastructure, technology, and regulation. All of these components are necessary as prerequisites for fulfilling sustainable ecotourism development as mandated in the **World's Summit on Sustainable Development (2012)**. If these principles of sustainable and holistic development are not met, ecotourism development will lead to environmental degradation and the unfulfillment of social and economic welfare.

Another issue is the theoretical disharmony between "Business Tourism Theory" (**Gronross, 1984; R. Wang *et al.*, 2011; Crnogaj *et al.*, 2014**) and "Destination Tourism Theory" (**Brundtland United Nations, 1987; Mitchell *et al.*, 1997; Ross & Wall, 1999; Grzanic & Saftic, 2010; Tabataba, 2019**), reflecting differences in focus and core values

in their approaches to the tourism industry. Ecotourism destination theory prioritizes nature sustainability and environmental conservation, emphasizing environmentally friendly approaches, local community participation, and environmental education for visitors. In contrast, business tourism theory tends to focus on economic growth, job creation, and financial profit. A focus on economic profit in business tourism theory can lead to more intensive and possibly unsustainable resource management if not properly regulated. Furthermore, tourist experiences in both theories can also show significant differences, where ecotourism destination theory emphasizes understanding and appreciation of the environment, while business tourism theory tends to pursue consumer needs without emphasizing environmental education. Therefore, efforts to achieve a suitable balance between economic growth and environmental sustainability will continue to be a challenge to reduce this disharmony in the practice of the tourism industry.

In addition to considering sustainability dimensions, sustainable ecotourism management also needs to consider its management patterns, involving not only local governments and cultural and tourism institutions but also requiring community participation. According to **Pornprasit and Rurkkhum (2019)**, to grow community participation, at least three conditions must be met: the opportunity in development, the ability to utilize these opportunities, and the willingness/motivation to participate. From this community participation relationship, community-based ecotourism (CBE) is known.

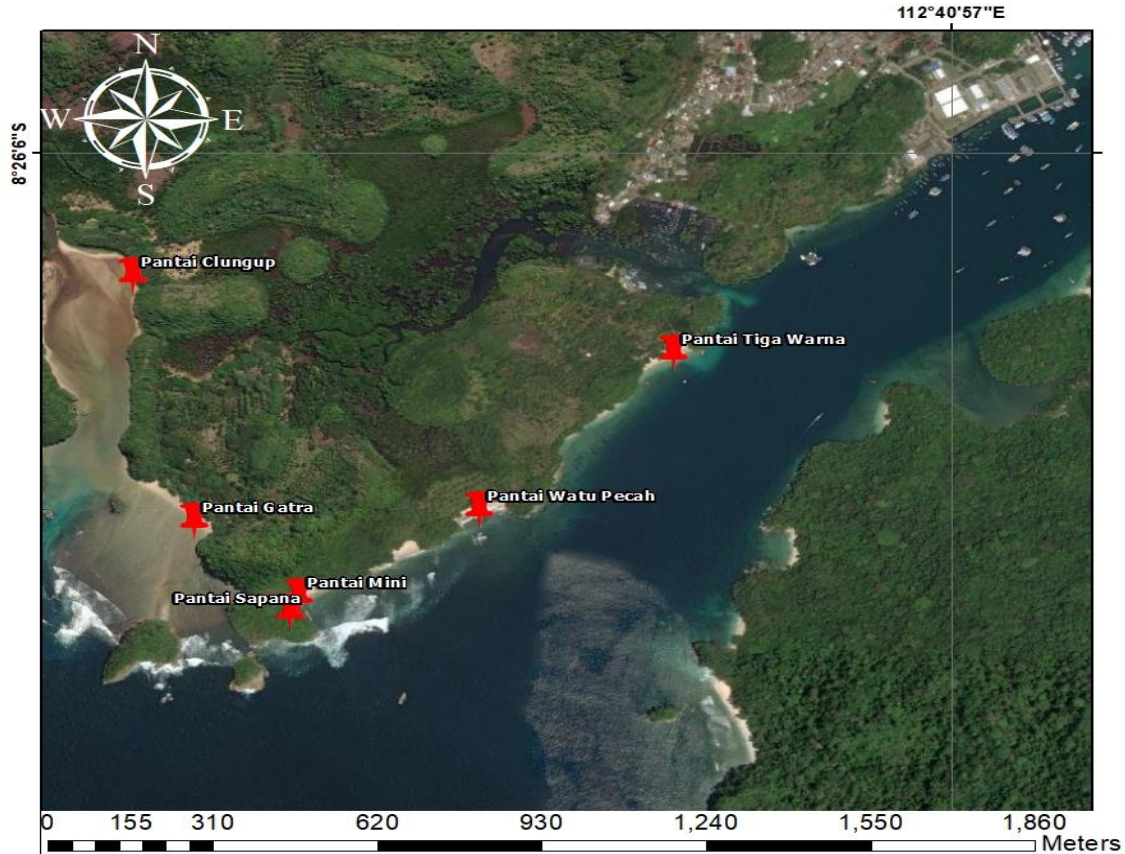
Community-based ecotourism has become an important approach in sustainable tourism development in Indonesia, especially in East Java. For example, ecotourism destinations in East Java, Indonesia, offer unique tourist experiences while considering environmental sustainability and the welfare of local communities. However, despite the importance of the contribution of community-based ecotourism to environmental preservation and local economic development, comprehensive studies on the sustainability status of community-based ecotourism in East Java, Indonesia, are still limited. Research on the sustainability status of community-based ecotourism in East Java, Indonesia, is highly urgent for several reasons (**Admasu, 2020**).

First, community-based ecotourism has great potential to provide significant economic and social benefits to local communities while preserving natural and cultural heritage. However, to achieve its full potential, an in-depth understanding of the sustainability status of existing community-based ecotourism practices is required (**Defeo et al., 2016; Jupiter et al., 2017**). Second, with increasing tourist interest in responsible and sustainable tourism experiences, this research will provide valuable insights for destination managers and local governments in designing policies and practices that support community-based ecotourism (**Sturiale et al., 2020**). Third, this research has a broader relevance in the global context as community-based ecotourism in East Java, Indonesia, and would serve as a model for sustainable ecotourism practices in other countries with similar cultural and natural diversity (**Bakhsh et al., 2023**). As a result, an in-depth and comprehensive research on the sustainability status of community-based ecotourism in East Java, Indonesia, would make a significant contribution to the development of sustainable tourism, environmental preservation, and the welfare of local communities in the region.

## MATERIALS AND METHODS

### 1. Research location

This research was conducted at 6 observation points of community-based ecotourism (CBE) implementation (Fig. 1): Clungup Beach, Gatra Beach, Watu Pecah Beach, Sapana Beach, Mini Beach, and Tiga Warna Beach located in East Java Province, Indonesia (CMC Tiga Warna area).



**Fig. 1.** Research location

### 2. Research design

The research design titled "Exploring the Sustainable Status of Community-Based Ecotourism at East Java Indonesia: A Comprehensive Assessment" employed a multidimensional approach covering eight research dimensions: environmental, social, economic, institutional, infrastructure, conservation, technology, and regulatory aspects (Fig. 2). This comprehensive assessment aimed to provide a holistic understanding of the sustainability status of community-based ecotourism in East Java, Indonesia.

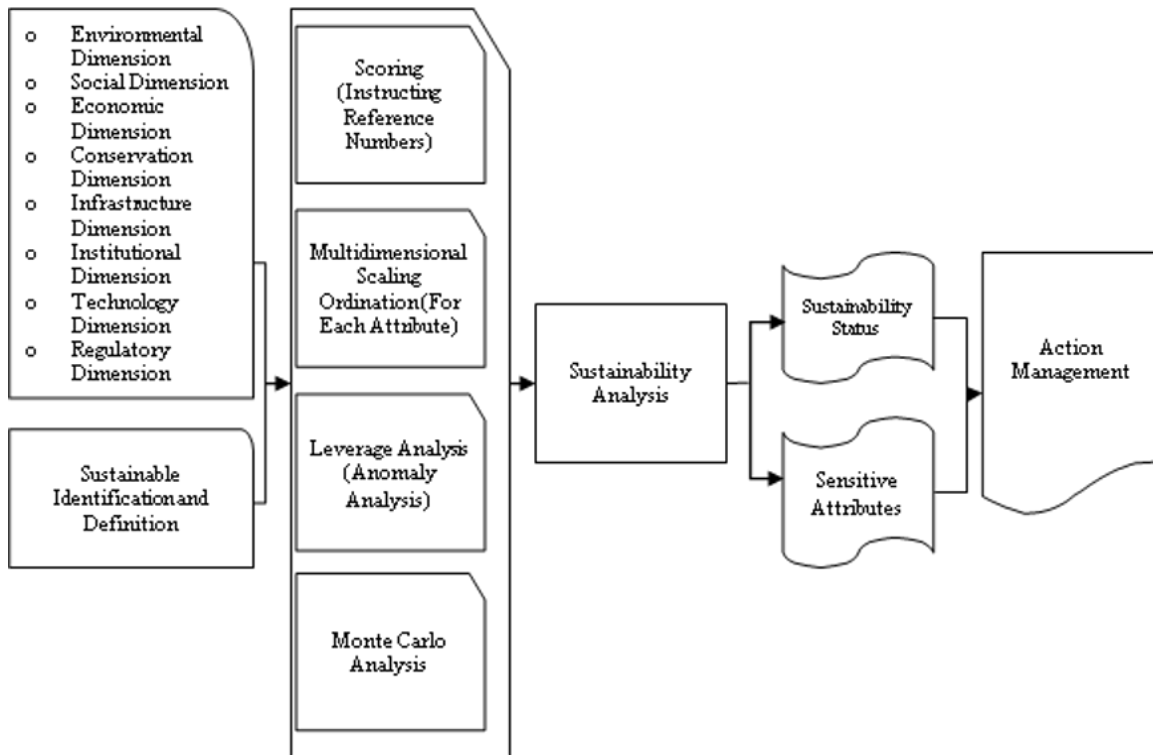


Fig. 2. Research design

### 3. Research dimensions and attributes

Data in the sustainability analysis of community-based ecotourism management were sourced from environmental, social, economic, infrastructure, institutional, conservation, technology, and regulatory dimensions. The following were the operational definitions of each attribute (Table 1):

Table 1. Research dimensions and attributes

| Dimension        | Attributes  |
|------------------|---|
| Environment      | Environmental protection and management planning                                |
|                  | Utilization of natural resources according to environmental capacity            |
|                  | Pollution control and/or environmental damage                                   |
|                  | Environmental sustainability  |
|                  | Consistency of environmental quality  |
|                  | Tourism suitability   |
|                  | Natural beauty  |
|                  | Tourist attraction cleanliness  |
|                  | Carrying capacity   |
| Social           | Community participation   |
|                  | Respect for social-cultural and religious values of communities around the area |
|                  | Community empowerment   |
|                  | Local business opportunities  |
|                  | Opportunities to work in the tourism sector                                     |
|                  | Community welfare   |
| Social conflicts |   |

| <b>Dimension</b>                                    | <b>Attributes</b>   |
|---|---|
| <b>Economy</b>                                      | Community knowledge   |
|   | Harmony among stakeholders  |
|   | Driving regional economic development                             |
|   | Accelerating economic development                                 |
|   | Local revenue   |
|   | Sustainable ecotourism efforts                                    |
|   | Ecotourism industry growth  |
|   | Ecotourism industry benefits                                      |
|   | Conservation budget   |
| Facilities budget                                   |   |
| CSR (corporate social responsibility) by management |   |
| <b>Infrastructure</b>                               | Public facilities   |
|   | Health facilities   |
|   | Worship facilities  |
|   | Public transportation facilities to tourist locations             |
|   | Access roads to ecotourism locations                              |
|   | Travel routes   |
|   | Number of attractions   |
|   | Attraction appeal   |
|   | Land availability   |
| <b>Institutional</b>                                | NGO roles   |
|   | Institutional activity  |
|   | Growth of institutions/community groups                           |
|   | Task division   |
|   | Decision-making authority   |
|   | Education and Information   |
|   | Coordination among managers                                       |
|   | Coordination between managers and relevant agencies               |
|   | Governance system   |
| <b>Conservation</b>                                 | Preservation of natural capacity                                  |
|   | Balanced natural resource utilization                             |
|   | Preservation of ecological processes                              |
|   | Continuous rehabilitation efforts                                 |
|   | Preserving the integrity of areas according to natural landscapes |
|   | Avoiding extinction risks   |
|   | Considering the potential and capacity of areas                   |
|   | Ecosystem protection  |
|   | Biodiversity conservation   |
| <b>Technology</b>                                   | Level of marketing technology mastery                             |
|   | Ability to implement environmentally friendly technology          |
|   | Database technology development capability                        |
|   | Ease of ecotourism information                                    |
|   | Online ecotourism marketing                                       |
|   | Digital advertising   |
|   | Institutional databases   |
|   | Tourism databases   |
| Ecosystem databases                                 |   |
| <b>Regulation</b>                                   | Availability of legal instruments                                 |

| Dimension | Attributes   |
|-----------|--|
|           | Regional regulations for ecotourism management                       |
|           | Transparency in policies   |
|           | Availability of legal oversight                                      |
|           | Number of local security personnel                                   |
|           | Legal education on natural resource management                       |
|           | Policy harmonization   |
|           | Compliance in managing tourism documents                             |
|           | Implementation of management in accordance with management documents |

#### 4. Data analysis

The research utilized a survey-based methodology, targeting various stakeholders including destination managers, local communities, related stakeholders, and visitors. Purposive sampling was used to ensure cross-sector representation, and data collection primarily involved structured questionnaires administered through interviews and surveys. The collected quantitative data underwent analysis using multidimensional scaling (MDS) techniques to visualize the relationship between the eight research dimensions, enabling deeper exploration of their interactions and impacts on the sustainability of community-based ecotourism. Sustainability analysis employed multidimensional scaling (MDS) analysis, leverage analysis, Monte Carlo analysis, determination of stress values, and coefficient of determination (R<sup>2</sup>) values. The selection of multidimensional scaling (MDS) in this Rapfish analysis was made since the results obtained have proven to be more stable than other multivariate analysis methods, such as factor analysis and multi-attribute utility theory (MAUT) (Pitcher & Preikshot, 2001).

**Table 2.** Sustainability status index

| Sustainability index | Status   | Explanation              |
|----------------------|----------|--------------------------|
| 0 - 25               | Poor     | Not Sustainable          |
| 26 - 50              | Fair     | Less Sustainable         |
| 51 - 75              | Adequate | Sufficiently Sustainable |
| 76 - 100             | Good     | Highly Sustainable       |

Source: (Pitcher & Preikshot, 2001).

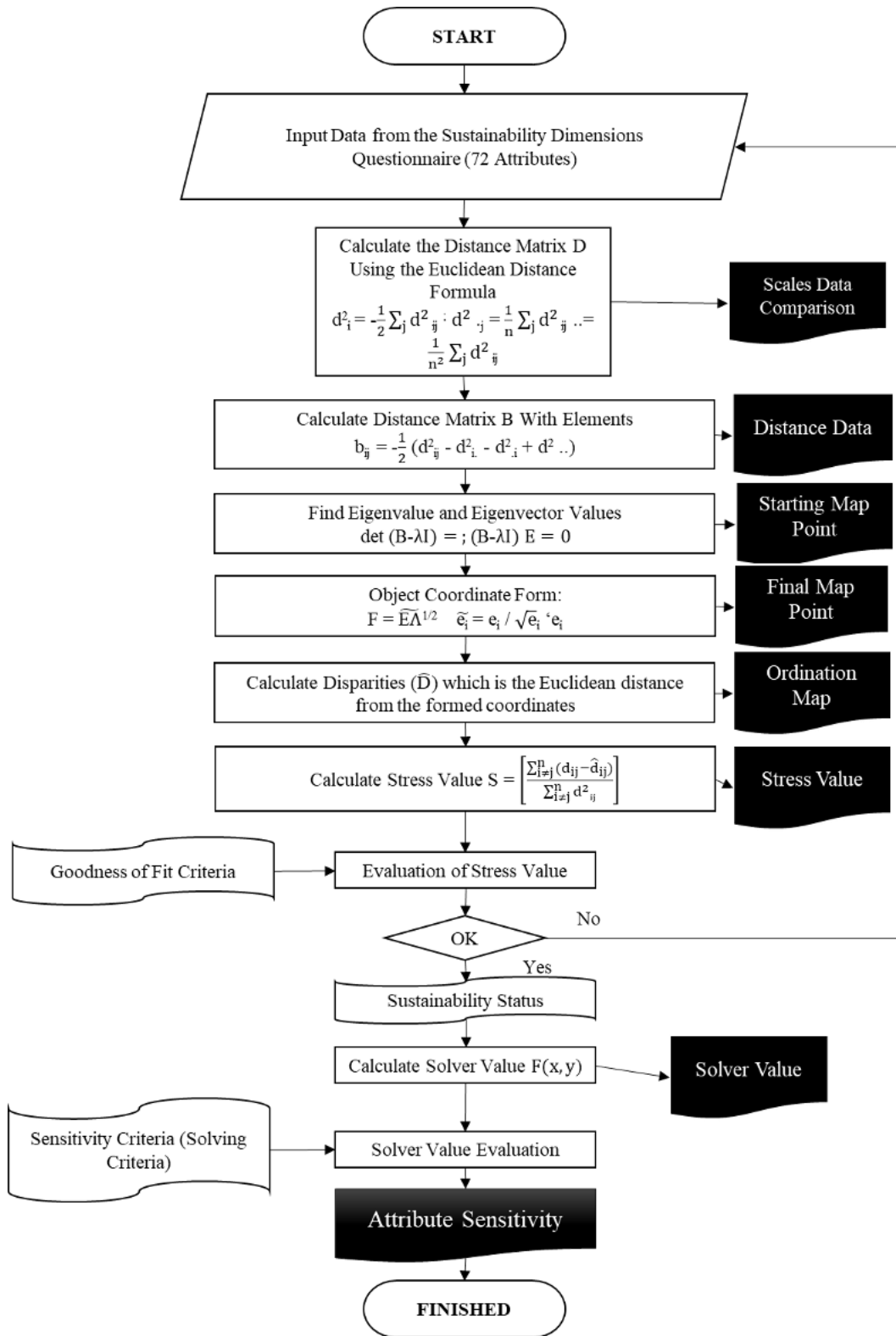


Fig. 3. Data analysis framework

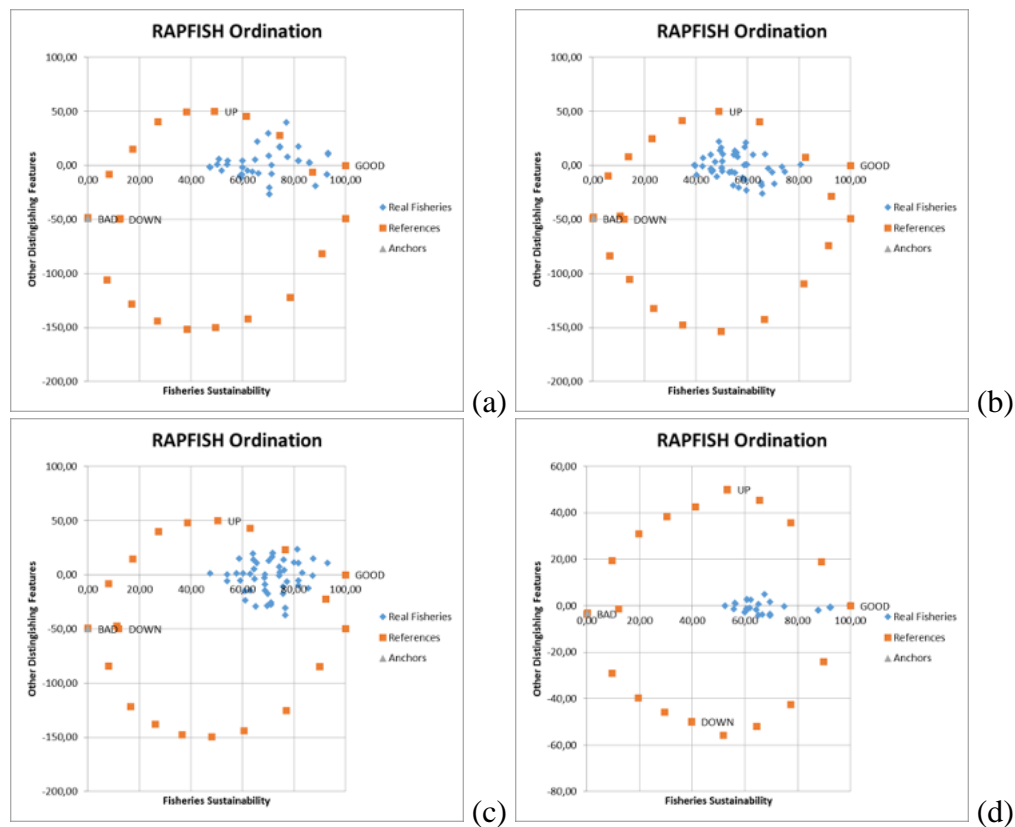


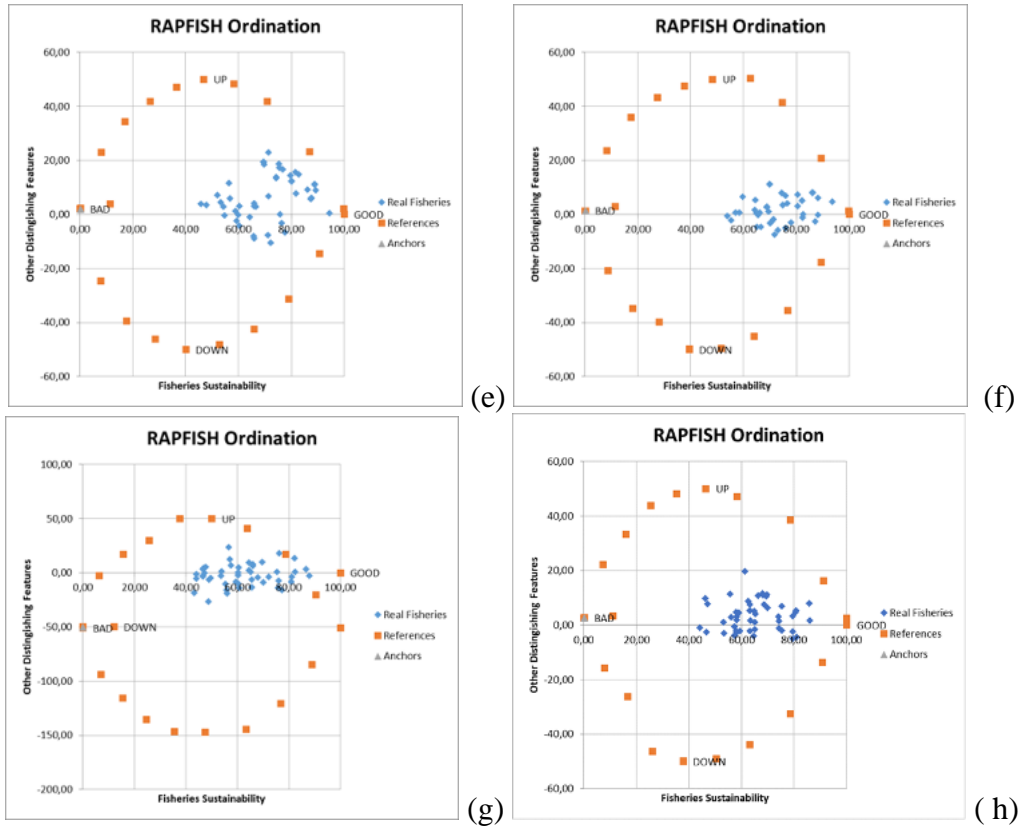
## RESULTS AND DISCUSSION

The sustainability of ecotourism management becomes a crucial aspect in facing global challenges related to environmental conservation and biodiversity. With increasing awareness of the importance of preserving nature, many ecotourism destinations strive to maintain a balance between tourism, nature conservation, and the well-being of local communities. In this discussion, exploring various factors determining the sustainability status of ecotourism management included conservation efforts, community participation, environmental education, economic impacts, visitor management, and sustainable practices. Analysis of these factors would provide insights into the extent to which an ecotourism destination contributes to nature conservation, empowers local communities, and creates meaningful sustainable tourism experiences.

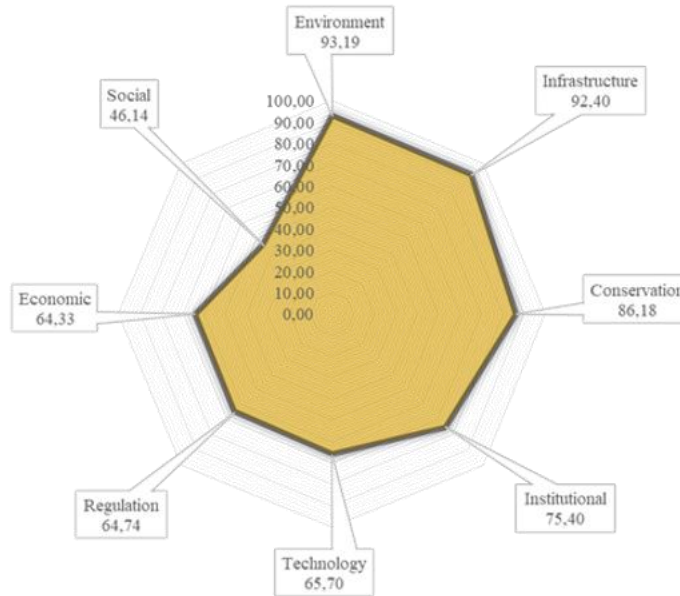
### 1. Sustainability status

The sustainability status of community-based ecotourism management in East Java was assessed based on eight dimensions forming sustainable management. The sustainability status of each dimension can be seen in the following kite diagram ( Fig. 5):



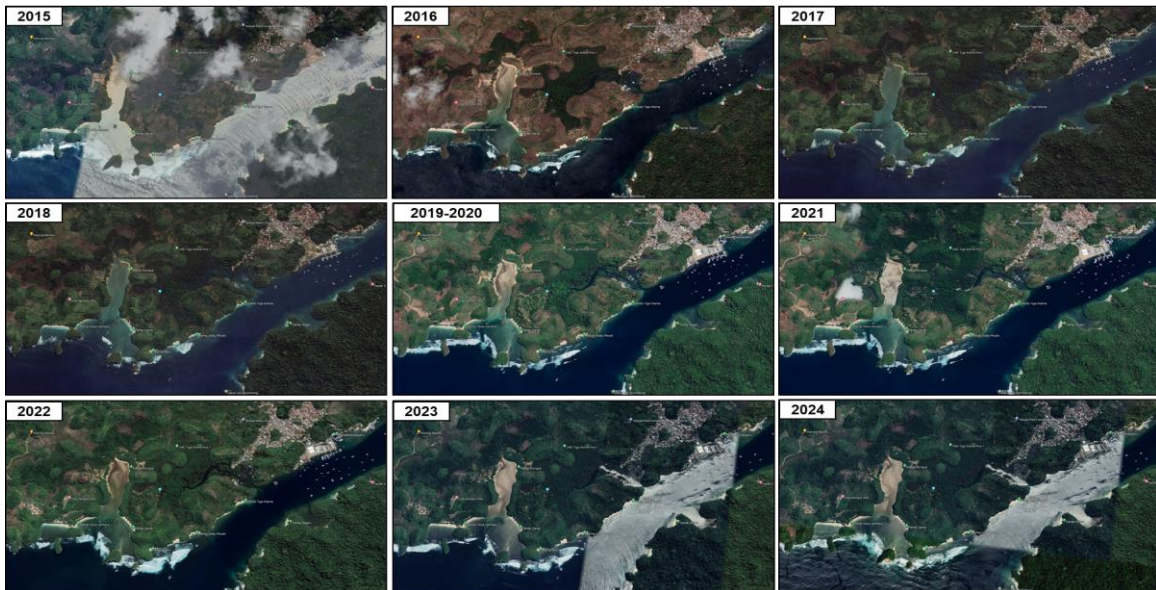


**Fig. 4.** Ordination sustainable status: a) environment; b) social; c) economic; d) infrastructure; e) institutional, f) conservation; g) technology, and h) regulation



**Fig. 5.** Kite diagram of community-based ecotourism management

The index and status of community-based ecotourism management in East Java indicate the percentage of the current sustainability status of ecotourism. The results show that community-based ecotourism management in East Java has a highly sustainable environmental dimension with a score of 93.19, indicating a strong commitment to preserving the natural environment and ecosystems in the area. The infrastructure in the location also received a high score of 92.40, indicating that the facilities provided have been well designed and managed to minimize negative impacts on the surrounding environment. However, the social dimension in this management received a relatively low score of 46.14, indicating that there is still room for improvement in terms of engaging local communities and adopting a more inclusive approach to their interests and needs. Additionally, the economic and technology dimensions, although scoring moderately sustainable (64.33 and 65.70, respectively), can also be improved to ensure that this ecotourism provides fair and sustainable economic benefits to local communities and utilizes technology in an environmentally friendly manner. For the institutional and conservation dimensions, each received highly sustainable scores of 75.40 and 86.18, indicating a strong framework and high commitment to preserving natural resources and biodiversity at the location. Lastly, the regulatory dimension received a moderately sustainable score of 64.74, indicating efforts to establish policies and regulations that support sustainable ecotourism management. Overall, community-based ecotourism management in East Java demonstrates a strong commitment to environmental preservation and conservation, but there is still room for improvement in the social, economic, and technological aspects to achieve overall better sustainability.



**Fig. 6.** Comparison of satellite images of vegetation changes

## 2. Attribute sensitivity

In the context of ecotourism, understanding attribute sensitivity is key to assessing the effectiveness of various management strategies. This involved identifying the most impactful elements and understanding how their interactions can affect the balance between nature conservation, the well-being of local communities, and the sustainability

of the system. By uncovering attribute sensitivity holistically, managers can design and adjust policies more carefully, minimizing the risk of negative impacts, and maximizing positive benefits for all stakeholders. In this discussion, we explored various dimensions of attribute sensitivity in the management of ecotourism, highlighting challenges, opportunities, and strategic steps that could be taken to maintain sustainability and harmonious balance in the ecotourism destination. The following is an exposition of the sensitive attributes in this study:

**Table 3.** Sensitive attributes of community-based ecotourism management

| No. | Dimension      | Attribute sensitivity  |
|-----|----------------|--|
| 1   | Environment    | <ul style="list-style-type: none"> <li>• Pollution control and/or environmental damage control (4.80)</li> <li>• Carrying capacity (4.74)</li> <li>• Natural beauty (2.98)</li> <li>• Cleanliness of tourist attractions (2.94)</li> </ul>             |
| 2   | Social         | <ul style="list-style-type: none"> <li>• Employment opportunities in the tourism sector (4.30)</li> <li>• Social conflicts (3.93)</li> <li>• Community welfare (3.46)</li> <li>• Community participation (3.02)</li> </ul>                             |
| 3   | Economic       | <ul style="list-style-type: none"> <li>• Local original income (5.17)</li> <li>• Facility budget (5.09)</li> <li>• Conservation budget (3.21)</li> <li>• Acceleration of economic development (3.08)</li> </ul>  |
| 4   | Infrastructure | <ul style="list-style-type: none"> <li>• Road access (6.68)</li> <li>• Attraction appeal (2.00)</li> <li>• Number of attractions (1.96)</li> <li>• Travel routes (1.84)</li> <li>• Worship facilities (1.84)</li> </ul>                                |
| 5   | Institutional  | <ul style="list-style-type: none"> <li>• Governance system (5.64)</li> <li>• Coordination between managers and relevant agencies (5.28)</li> <li>• Coordination among managers (3.42)</li> <li>• Education and information (3.18)</li> </ul>           |
| 6   | Conservation   | <ul style="list-style-type: none"> <li>• Avoiding extinction hazards (5.58)</li> <li>• Ecosystem protection (3.85)</li> <li>• Balanced natural resource utilization (3.06)</li> <li>• Biodiversity preservation (2.86)</li> </ul>                      |
| 7   | Technology     | <ul style="list-style-type: none"> <li>• Ecotourism information accessibility (5.15)</li> <li>• Mastery level of marketing technology (3.95)</li> <li>• Institutional database (3.46)</li> <li>• Ecosystem database (2.81)</li> </ul>                  |
| 8   | Regulation     | <ul style="list-style-type: none"> <li>• Policy harmonization (8.40)</li> <li>• Transparency in policies (3.88)</li> <li>• Availability of legal oversight (3.15)</li> <li>• Compliance in implementing tourism management documents (2.92)</li> </ul> |

In the environmental dimension, four attributes were identified showing a high sensitivity to community-based ecotourism management. First, pollution control and/or

environmental damage with a value of 4.80 indicate that efforts to maintain environmental sustainability need to be the main focus (Klarin, 2018). Second, carrying capacity with a value of 4.74 illustrates the importance of understanding and managing the maximum capacity of ecotourism to prevent excessive environmental impacts (Bakhsh *et al.*, 2023). Natural beauty, as an attribute with a value of 2.98, indicates that preserving and enhancing natural beauty is crucial in attracting and retaining visitor interest (Le *et al.*, 2019). Finally, tourism site cleanliness with a value of 2.94 emphasizes the need to maintain cleanliness at tourist destinations, which is essential in creating a positive and sustainable tourism experience (Zhang *et al.*, 2019). The high sensitivity to these attributes underscores the need for holistic ecotourism management steps that consider potential environmental impacts. By focusing on pollution control, maximum manageable capacity, preserving natural beauty, and maintaining cleanliness, managers can ensure that community-based ecotourism in East Java remains an attractive tourist destination without sacrificing environmental sustainability and biodiversity, which are its main attractions.

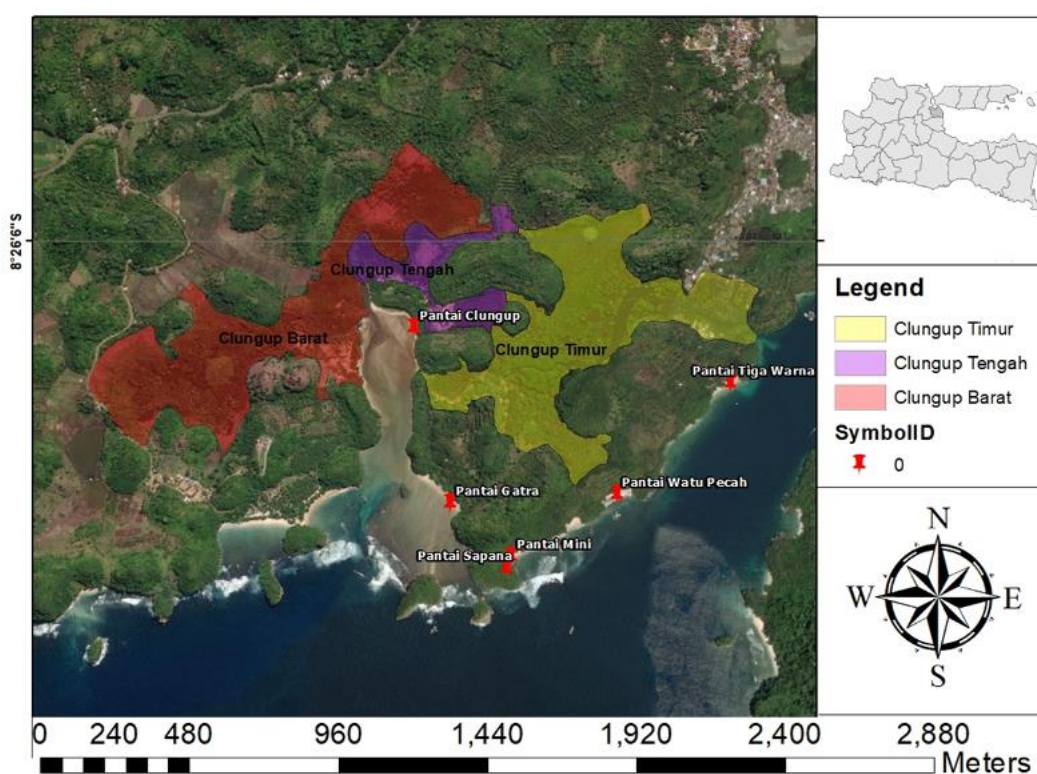


Fig. 7. Coastal forest rehabilitation area

In the social dimension, four attributes showed high sensitivity to community-based ecotourism management in East Java. Initially, opportunities for employment in the tourism sector with a value of 4.30 indicate that ecotourism management needs to consider and enhance job opportunities for the local community (Kim & Xie, 2019). Next, social conflicts with a value of 3.93 indicate the importance of managing and mitigating potential conflicts that may arise among various stakeholders involved in ecotourism area management (Baynham-herd *et al.*, 2018). In addition, community

welfare with a value of 3.46 highlights the urgency of ensuring that ecotourism benefits reach and enhance the overall welfare of the local community (**Khanra *et al.*, 2021**). Lastly, community participation with a value of 3.02 emphasizes the importance of actively involving the community in decision-making and ecotourism program implementation (**Defeo *et al.*, 2016**; **Jupiter *et al.*, 2017**). The high sensitivity to these attributes indicates that social sustainability in community-based ecotourism management in East Java not only includes economic aspects but also needs to consider social aspects involving community empowerment, conflict prevention, and welfare improvement. By balancing job opportunities, conflict mitigation, welfare enhancement, and community participation, ecotourism managers can ensure that the positive impacts generated can be felt by the entire local community, creating a harmonious and sustainable relationship in this tourist destination.

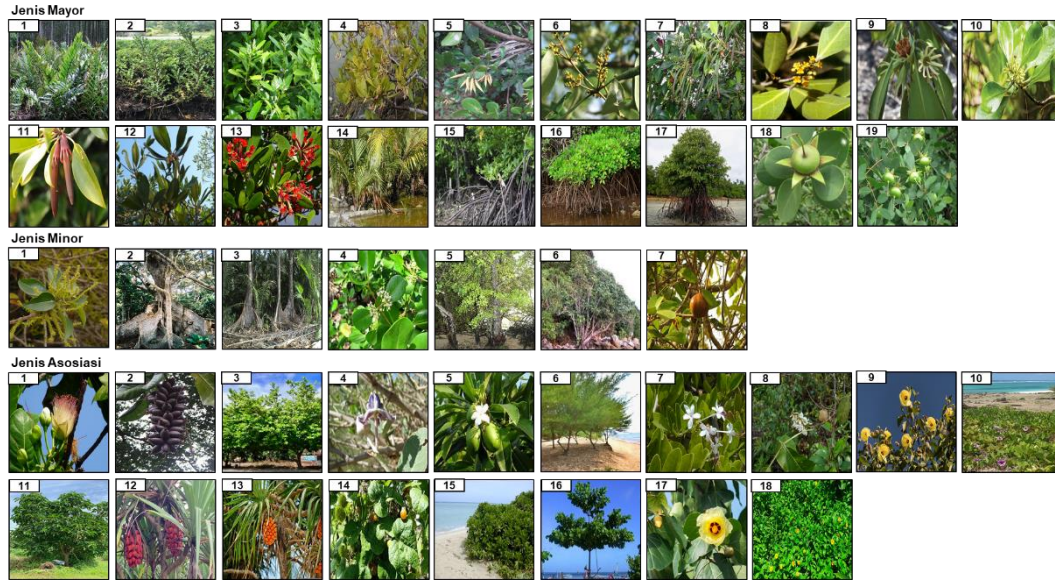
In the economic dimension, four attributes showed a high level of sensitivity to community-based ecotourism management in East Java. Firstly, local revenue (PAD) with a value of 5.17 indicates that ecotourism has a significant impact in supporting the local economy (**Kim & Xie, 2019**). Secondly, facility budgeting with a value of 5.09 illustrates the importance of adequate funding allocation to maintain and improve facilities that support ecotourism sustainability (**Admasu, 2020**). The third attribute, conservation budgeting, with a value of 3.21 indicates that ecotourism management contributes to financing conservation and environmental preservation programs (**Mudzenzi *et al.*, 2021**). Lastly, economic development acceleration with a value of 3.08 highlights the role of ecotourism as an economic growth driver that can improve the standard of living for the local community (**Zingi *et al.*, 2022**).

The high sensitivity to these economic attributes emphasizes that ecotourism sustainability is not only measured in terms of environmental conservation and biodiversity but also in its contribution to the local economy. Wise management needs to ensure that the economic benefits generated from ecotourism can be enjoyed by the entire local community through a sustainable and responsible resource allocation approach. By continually considering income, budget allocation, and conservation support, ecotourism managers can ensure that positive economic impacts can continue to grow and sustain in the long term. The infrastructure dimension in community-based ecotourism management in East Java highlights five attributes that show various levels of sensitivity. Road access, as the attribute with the highest value of 6.68, emphasizes the importance of good and adequate accessibility to support the smooth flow of tourists to ecotourism destinations (**Cassia *et al.*, 2021**). This attribute is a crucial element in providing a positive experience for visitors and ensuring that ecotourism is easily accessible to both the local community and tourists. The attractiveness of attractions, number of attractions, travel routes, and worship facilities, with the values of 2.00, 1.96, 1.84, and 1.84, respectively, reflect other variables in infrastructure that have significant impacts on the attractiveness and comfort of destinations (**Gautama *et al.*, 2020**). Strong attraction can enhance tourist attraction, while a good number of attractions and travel routes can enrich visitor experiences (**Leiper, 1979**; **Corton *et al.*, 2021**). Worship facilities are important since they reflect efforts to address the cultural and religious needs of the local community, creating an inclusive environment for visitors with diverse backgrounds (**Adinugraha *et al.*, 2021**). The varying sensitivities to infrastructure attributes underscore the need to focus on providing comprehensive facilities and services to support ecotourism sustainability. By

considering accessibility needs, attractions, and cultural requirements, ecotourism managers can improve the quality and attractiveness of destinations and provide a positive experience for all involved parties.

The institutional dimension in community-based ecotourism management in East Java highlighted four attributes that show a high level of sensitivity to overall management. Governance system, the attribute with the highest value of 5.64, indicates that the effectiveness of governance systems and management is key to maintaining ecotourism sustainability (Wang *et al.*, 2021). Good coordination between managers and relevant departments, with a value of 5.28, reflects the importance of collaboration and synchronization among parties involved in destination management (Wondirad *et al.*, 2020). Coordination among managers, with a value of 3.42, highlights the need to strengthen collaboration among ecotourism managers, including private sectors, government, and local communities (Tseng *et al.*, 2019). Education and information, although with a lower value of 3.18, indicate the importance of increasing outreach and information efforts to local communities, tourists, and stakeholders to raise awareness of the importance of environmental conservation and sustainable ecotourism management (Mugizi *et al.*, 2017). The high sensitivity to these institutional attributes underscores that a robust institutional framework and effective cooperation are crucial in maintaining ecotourism sustainability. Through focusing on transparent management, efficient coordination, and continuous education efforts, ecotourism managers can ensure that policies and practices implemented adhere to sustainable principles, and destinations remain sustainable and beneficial for all parties involved.

The conservation dimension in community-based ecotourism management in East Java highlighted four attributes that reflect high sensitivity to environmental conservation and biodiversity preservation efforts. The first attribute, avoiding endangerment, with a value of 5.58, emphasizes the importance of protecting species and ecosystems that may be endangered due to human activities or other factors (AK *et al.*, 2023). Efforts to prevent endangerment are key to maintaining ecosystem sustainability and ecotourism overall. Ecosystem protection, as the second attribute with a value of 3.85, indicates the need to ensure that ecotourism sustainability is supported by extensive ecosystem conservation efforts (Mudzengi *et al.*, 2021; Cerveny, 2022). This includes habitat preservation, sustainable natural resource utilization, and controlling negative impacts on characteristic destination ecosystems. Balanced natural utilization, as the third attribute with a value of 3.06, underscores the importance of maintaining a balance between natural resource utilization for ecotourism needs and environmental preservation (Sturiale *et al.*, 2020).



**Fig. 8.** Mangrove diversity in CBE (CMC Tiga Warna)

Lastly, biodiversity conservation, with a value of 2.86, indicates that ecotourism management should pay attention to and preserve species and ecosystem diversity that supports natural balance (Samal & Dash, 2023). The high sensitivity to these conservation attributes indicates that ecotourism managers need to take concrete steps to protect and preserve biodiversity and ensure that ecotourism activities do not have negative impacts on ecosystems. Via focusing on species preservation, ecosystem protection, balanced natural utilization, and biodiversity conservation, this destination can continue to be a sustainable tourism destination that supports natural balance.

The technology dimension in community-based ecotourism management in East Java featured four attributes that significantly influence the operational continuity and sustainability of this destination. The attribute of ecotourism information accessibility, with the highest value of 5.15, indicates that the ease of access and dissemination of ecotourism-related information is key to maintaining visitor engagement. Advanced information systems can provide visitors and stakeholders an easy access to relevant information, enhancing their understanding of ecotourism values and sustainable practices (Cassia *et al.*, 2021). The level of mastery of marketing technology, with a value of 3.95, illustrates the importance of implementing modern marketing technology to enhance destination visibility and attractiveness. Utilizing digital platforms, social media, and online marketing tools can help reach a broader audience, promote ecotourism attractions, and increase visitor participation (Mandić & Praničević, 2019). Institutional database, as the third attribute with a value of 3.46, highlights the crucial role of structured databases in managing institutional information and coordinating stakeholders involved in ecotourism management (Osman *et al.*, 2018; Tajer & Demir, 2022). The final attribute, ecosystem database, with a value of 2.81, indicates the need to collect and analyze ecosystem-related data to support evidence-based and sustainable decision-making. These data include information, such as mangrove types, water quality, land quality, and other data related to the ecosystem in ecotourism areas (Addison *et al.*, 2018).



The high sensitivity to these technology attributes emphasizes that the implementation of technological innovations is key to improving operational efficiency, strengthening marketing, and supporting sustainable decision-making in ecotourism management. By leveraging technology wisely, ecotourism managers can ensure that this destination remains sustainable, attracts tourists, and has a positive impact on the environment and local communities. The regulatory dimension in community-based ecotourism management in East Java reflected four attributes that indicate a high sensitivity to the legal framework and policies governing this destination. Policy harmonization, as the attribute with the highest value of 8.40, reflects the importance of coordination and alignment between various policies affecting ecotourism (**Wang et al., 2021**). This alignment is necessary so that policies support the sustainable goals of ecotourism, creating a consistent environment and supporting an effective management. Transparency in policy, with a value of 3.88, emphasizes the need for an openness in the policy-making process.

This transparency creates clarity for all involved parties, including local communities, managers, and other stakeholders, enabling them to effectively engage in decision-making processes (**Beaudoin et al., 2022**). The availability of legal oversight, as the third attribute with a value of 3.15, indicates the importance of having legal oversight institutions that can ensure the implementation of policies and practices in accordance with applicable laws in ecotourism management (**Sudini & Wiryani, 2022**). This oversight creates accountability and ensures that ecotourism management operates within the boundaries set by the law. Compliance in implementing tourism management documents, with a value of 2.92, highlights the importance of compliance with regulations and tourism management guidelines that have been established. This compliance forms the basis for maintaining the integrity of ecotourism and preventing violations that could harm the environment and destination sustainability (**Mandic et al., 2018**). The high sensitivity to these regulatory attributes indicates that the legal framework and regulations play a crucial role in ecotourism management. By emphasizing harmonization, transparency, oversight, and compliance, this destination can ensure that regulations support sustainable visions, maintain environmental integrity, and create a fair and transparent environment for all stakeholders.

## CONCLUSION

The study on community-based ecotourism in East Java reveals that the environmental dimension exhibits excellent sustainability due to robust policies and practices in nature conservation and ecosystem balance. However, attributes such as pollution control, carrying capacity, natural beauty, and site cleanliness are highly sensitive and require holistic management to mitigate potential impacts. In contrast, the social dimension shows less favorable sustainability, with major issues in community participation and benefit distribution. To improve social sustainability, re-evaluation of community empowerment programs, active participation in decision-making, and respect for local culture are essential. The economic dimension shows relatively good sustainability but needs further enhancement through sustainable business practices and innovative strategies to boost and diversify local community income. Infrastructure sustainability is excellent, reflecting strong development and maintenance of facilities that support efficient and sustainable ecotourism operations. The institutional dimension

is also excellent, though improvements in management effectiveness are needed, requiring a robust institutional framework and effective cooperation. Conservation efforts demonstrate excellent sustainability with effective policies in maintaining natural sustainability and biodiversity. The technology dimension shows relatively good sustainability, with room for improvement in efficiency and positive impacts. The regulatory dimension is relatively good, and continuous updates and improvements to the regulatory framework are crucial for achieving higher sustainability levels. Recommendations from these findings emphasize focusing on improving social and economic sustainability while continuing to enhance management practices in environmental, infrastructural, institutional, conservation, and technological dimensions. This approach aims to achieve better overall sustainability, providing responsible and educational tourism experiences, preserving natural beauty, and supporting the welfare of local communities and ecosystems.

The implications of this research are crucial for improving the sustainability of community-based ecotourism management. Although the environmental dimension demonstrates good sustainability, sensitivity to specific attributes emphasizes the need for a more holistic management approach to minimize negative environmental impacts. On the other hand, the social dimension's less favorable sustainability underscores the need for improvement in local community participation and benefits through the evaluation of empowerment programs and increased understanding of local culture. Furthermore, improving economic sustainability can be achieved through the adoption of sustainable business practices and income source diversification. Improvements in infrastructure, institutions, conservation, and technology are also necessary to enhance overall ecotourism management effectiveness. Finally, the importance of regulatory improvements underscores the need for updated and improved regulations to create a controlled and sustainable environment for community-based ecotourism. This will ensure that ecotourism can provide sustained positive benefits to the environment, local communities, and visitors.

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