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Integrating Mangrove Conservation and Community-Based Ecotourism for Coastal Sustainability: Strategic Insights from Pohuwato Regency

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Abstract *Mangrove ecosystems provide critical ecological services, support coastal livelihoods, and contribute significantly to climate change mitigation through their blue carbon storage capacity. Despite their importance, many mangrove areas in Indonesia continue to face increasing pressures from land-use conversion, resource exploitation, environmental degradation, and climate-related threats. Community-based ecotourism has emerged as a promising strategy for balancing ecosystem conservation and local economic development; however, effective management requires a comprehensive understanding of internal capacities and external challenges affecting mangrove sustainability. This study aims to evaluate the strategic potential of mangrove ecosystem conservation and management in Pohuwato Regency, Indonesia, to support sustainable community-based ecotourism development. Data were collected through field observations, questionnaires, and stakeholder assessments and analyzed using SWOT (Strengths, Weaknesses, Opportunities, and Threats) supported by IFAS and EFAS matrices. The results revealed an IFAS score of 2.45 and an EFAS score of 2.53, producing strategic coordinates of X = 1.05 and Y = 0.61. These values position the study area within Quadrant I of the SWOT matrix, indicating a strong capacity to pursue an aggressive development strategy by leveraging existing strengths and opportunities. High ecotourism potential, mangrove biodiversity, institutional collaboration opportunities, and conservation funding availability emerged as the most influential factors supporting future development. The study highlights that strengthening community participation, enhancing ecotourism infrastructure, and promoting collaborative governance are essential for achieving long-term coastal sustainability. These findings contribute to the growing discourse on integrating mangrove conservation and ecotourism as a pathway toward resilient coastal development and sustainable blue economy initiatives in tropical regions.*

Keywords: *Mangrove Conservation; Community-Based Ecotourism; Coastal Sustainability; Blue Economy; SWOT Analysis*

1. INTRODUCTION

Mangrove ecosystems are among the most valuable coastal ecosystems due to their significant ecological, economic, and social functions. Ecologically, mangroves serve as natural barriers that protect coastal areas from erosion, storm surges, tidal waves, and sea-level rise, while simultaneously functioning as critical habitats, nursery grounds, spawning areas, and feeding sites for numerous marine species. Mangrove forests also contribute substantially to biodiversity conservation and ecological stability in tropical coastal regions (Alongi, 2020; Worthington et al., 2020). Furthermore, mangrove ecosystems have gained increasing global attention because of their exceptional capacity to sequester and store carbon, making them one of the most important blue carbon ecosystems for climate change mitigation and adaptation strategies (Alongi, 2020; Melo et al., 2020; Sharma et al., 2023). Economically, mangroves support fisheries productivity, provide non-timber forest products, strengthen coastal protection services, and create opportunities for sustainable tourism and livelihood diversification among coastal communities. Indonesia possesses approximately 3.36 million hectares of mangrove forests, representing around 21% of global mangrove coverage, thereby placing the country at the center of global mangrove conservation initiatives (Murdiyarso et al., 2022).

Despite their strategic importance, mangrove ecosystems continue to experience severe degradation caused by land-use conversion, overexploitation of natural resources, environmental pollution, coastal infrastructure expansion, and climate-related disturbances. The conversion of mangrove areas into aquaculture ponds, settlements, and agricultural land has significantly reduced mangrove coverage and ecosystem functionality in many coastal regions (Melo et al., 2023; Richards & Friess, 2020). These pressures not only threaten biodiversity and ecological resilience but also undermine the socio-economic sustainability of coastal communities that depend heavily on mangrove ecosystem services. Across Southeast Asia, mangrove deforestation remains a major environmental challenge due to rapid coastal development, weak governance systems, and competing land-use interests (Richards & Friess, 2020).

Additionally, climate change impacts, including sea-level rise, increased storm intensity, and coastal erosion, have further heightened the vulnerability of mangrove ecosystems worldwide (IUCN, 2021; Sharma et al., 2023). Consequently, sustainable management approaches that simultaneously address ecological conservation and socio-economic development have become increasingly important within contemporary coastal management frameworks.

Recent studies have highlighted the importance of ecosystem-based management and participatory governance in enhancing the long-term sustainability of mangrove ecosystems. Community participation, collaborative governance, and local stewardship have been identified as critical factors influencing the effectiveness of conservation initiatives because they strengthen environmental awareness, social responsibility, and local ownership of natural resources (Murdiyarso et al., 2022; Iskandar & Mussadun, 2024; Sitiningrum, 2025). Within this context, mangrove-based ecotourism has emerged as a promising strategy capable of integrating conservation objectives with local economic development. Ecotourism not only generates alternative income opportunities for coastal communities but also promotes environmental education, ecosystem appreciation, and conservation awareness among visitors and local stakeholders. Therefore, mangrove ecotourism has increasingly been recognized as a practical manifestation of sustainable development and blue economy principles in coastal regions (IUCN, 2021; Pham et al., 2020; Sutrisna & Suyasa, 2022).

The successful implementation of mangrove ecotourism, however, depends on more than the existence of ecological resources alone. Effective ecotourism development requires adequate infrastructure, institutional capacity, stakeholder collaboration, supportive policies, and long-term financing mechanisms. Collaborative governance involving governments, local communities, academics, non-governmental organizations, and private sectors has been widely recognized as a prerequisite for achieving sustainable mangrove management while minimizing environmental degradation associated with tourism activities (Melo et al., 2019; Mardianton et al., 2024). Recent research has further emphasized that the integration of community empowerment, local knowledge, adaptive governance, and conservation financing can significantly improve the sustainability of ecotourism-based conservation initiatives (Ahmad et al., 2025; Alfiandri et al., 2024).

Although numerous studies have examined mangrove conservation and ecotourism development in Indonesia, most have primarily focused on ecological assessments, tourism potential evaluations, or community participation separately. Limited attention has been given to identifying the strategic interaction between internal management capacities and external development opportunities that influence the long-term sustainability of mangrove ecotourism. Furthermore, empirical studies that integrate conservation priorities, governance challenges, and ecotourism development strategies within the context of coastal sustainability remain relatively scarce, particularly in emerging coastal destinations in eastern Indonesia. This gap limits the ability of policymakers and local stakeholders to formulate adaptive management strategies capable of balancing conservation objectives with socio-economic development needs.

Pohuwato Regency, located in Gorontalo Province, possesses extensive mangrove ecosystems that provide important ecological services, support fisheries productivity, and offer considerable opportunities for ecotourism development. Nevertheless, the region continues to face several management challenges, including illegal logging, mangrove encroachment, environmental pollution, weak institutional coordination, and limited tourism infrastructure. These challenges indicate the need for integrated management strategies that can simultaneously strengthen conservation efforts and improve community welfare. Given its ecological significance and development potential, Pohuwato represents an important case for examining how strategic management approaches can support sustainable mangrove ecotourism development.

The novelty of this study lies in its integrated evaluation of mangrove ecosystem conservation and ecotourism development through the combined assessment of internal capacities and external strategic environments using IFAS, EFAS, and SWOT frameworks. Unlike previous studies that primarily focus on ecological conditions or tourism potential, this research emphasizes the strategic interaction between conservation assets, governance capacity, development opportunities, and external threats in supporting community-based ecotourism. By positioning mangrove ecotourism within the broader framework of

coastal sustainability and blue economy development, this study provides strategic insights for strengthening adaptive and sustainable mangrove management in tropical coastal regions.

Therefore, this study aims to analyze the strategic factors influencing mangrove ecosystem conservation and management in Pohuwato Regency and to formulate sustainable community-based ecotourism development strategies based on SWOT, IFAS, and EFAS analyses. The findings are expected to contribute to the growing discourse on coastal sustainability, mangrove conservation, and ecotourism governance while providing practical recommendations for policymakers and local stakeholders in managing coastal ecosystems more sustainably.

2. RESEARCH METHOD

2.1 Research Design

This study employed a quantitative descriptive approach to evaluate the strategic potential of mangrove ecosystem conservation and management in supporting community-based ecotourism development in Pohuwato Regency, Gorontalo Province, Indonesia. The study adopted SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis as a strategic assessment framework to identify internal and external factors influencing the sustainability of mangrove ecosystem management. The SWOT approach was selected because it enables a systematic evaluation of ecological, socio-economic, institutional, and environmental factors that affect conservation and ecotourism development. Internal factors were assessed using the Internal Factor Analysis Summary (IFAS) matrix, while external factors were evaluated through the External Factor Analysis Summary (EFAS) matrix. The integration of these analytical tools facilitated the identification of strategic priorities and management directions for sustainable mangrove ecotourism development.

2.2 Study Area

The research was conducted in the coastal mangrove ecosystem of Pohuwato Regency, Gorontalo Province, Indonesia (Figure 1). Pohuwato Regency possesses extensive mangrove forests that provide essential ecological functions, including coastal protection, fisheries support, biodiversity conservation, and carbon sequestration. In addition to their ecological importance, mangrove ecosystems in the region offer considerable opportunities for ecotourism development due to their landscape attractiveness and biological diversity.

Despite these potentials, the study area faces several environmental and management challenges, including illegal logging, mangrove land conversion, environmental pollution, inadequate tourism infrastructure, and limited institutional coordination. These conditions highlight the need for integrated management strategies that can simultaneously support ecosystem conservation and local economic development through sustainable ecotourism initiatives (Kusmana, 2021).

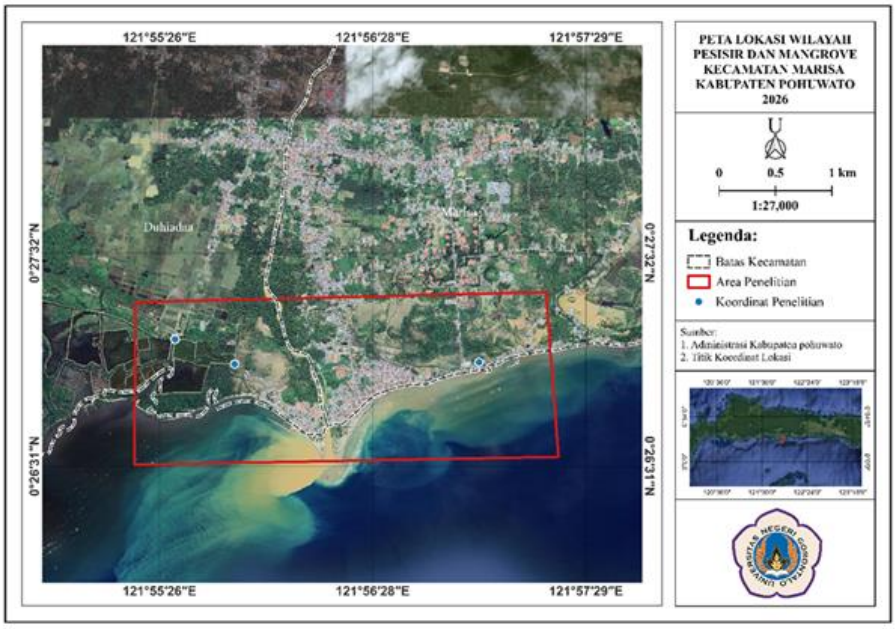

Figure 1. Location of the Study Area

2.3 Data Collection

Data collection was conducted through field observations, questionnaires, and stakeholder interviews. Field observations were undertaken to identify the condition of mangrove ecosystems, assess ecotourism attractions, document supporting facilities, and evaluate environmental issues affecting the study area. Observational data provided direct information regarding ecosystem characteristics and tourism development potential.

Questionnaires were distributed to respondents involved in mangrove-related activities to obtain assessments of internal and external factors influencing conservation and ecotourism development. The questionnaire focused on identifying strategic factors associated with ecosystem conditions, community participation, infrastructure availability, institutional support, funding opportunities, and environmental challenges.

To complement the quantitative data, semi-structured interviews were conducted with key stakeholders, including local government representatives, community leaders, tourism actors, and conservation practitioners. These interviews were intended to obtain deeper insights into management practices, conservation efforts, development constraints, and future opportunities for mangrove ecotourism. The combination of observations, questionnaires, and interviews enabled data triangulation and enhanced the reliability of the research findings.

2.4 Identification of Strategic Factors

The identification of SWOT factors was conducted through a synthesis of field observations, stakeholder perceptions, interview results, and relevant literature. Internal factors consisted of strengths and weaknesses associated with ecological resources, tourism potential, infrastructure conditions, institutional capacity, and community participation. External factors included opportunities and threats related to government policies, conservation funding, market demand, environmental pressures, and climate-related risks.

All identified factors were subsequently classified into the IFAS and EFAS matrices and evaluated according to their relative importance for mangrove conservation and ecotourism development. This process enabled the systematic assessment of strategic conditions affecting the sustainability of mangrove ecosystem management in Pohuwato Regency.

2.5 Data Analysis Techniques

The SWOT analysis was conducted using the IFAS and EFAS matrices to determine the strategic position of mangrove ecosystem management in Pohuwato Regency. Each factor was assigned a weight based on its relative importance, with the total weight in each matrix standardized to 1.00. Ratings were then assigned using a four-point scale, where a value of 4 represented a highly influential factor and a value of 1 represented a factor with minimal influence on management performance.

The score of each factor was obtained by multiplying its assigned weight by its corresponding rating. The weighted scores were then summed to obtain the total IFAS and EFAS values. The strategic position of the study area was determined using the difference between strengths and weaknesses (X-axis) and the difference between opportunities and threats (Y-axis), calculated as follows:

$$X = S - W$$
$$Y = O - T$$

where:

S = total strength score,
W = total weakness score,
O = total opportunity score,
T = total threat score.

The resulting coordinates were plotted on a SWOT Cartesian diagram to determine the strategic position of the study area. The identified quadrant was subsequently used to formulate strategic management recommendations through the development of Strength–Opportunity (SO), Weakness–Opportunity (WO), Strength–Threat (ST), and Weakness–Threat (WT) strategies. These strategies served as the basis for designing sustainable and community-based mangrove ecotourism development initiatives in Pohuwato Regency (Rangkuti, 2021).

3. RESULT AND DISCUSSION

3.1. Internal Strategic Conditions of Mangrove Ecotourism Development (IFAS Matrix)

The IFAS analysis revealed that the Pohuwato mangrove ecosystem possesses a relatively strong internal capacity for supporting sustainable ecotourism development, as reflected by a total score of 2.45. The difference between strengths and weaknesses generated a positive strategic value (X = 1.05), indicating that internal strengths substantially outweigh existing weaknesses. This finding suggests that the ecological and socio-economic assets available within the study area provide a solid foundation for long-term conservation and ecotourism initiatives.

Among the identified strengths, the highest contribution originated from the high potential for nature-based and educational tourism (score = 0.72), followed by mangrove species diversity (score = 0.45). These findings indicate that the ecological characteristics of the mangrove ecosystem are not only important from a conservation perspective but also constitute a valuable resource for developing educational and experiential tourism products. Mangrove biodiversity has been widely recognized as a critical component of successful ecotourism destinations because diverse ecosystems provide opportunities for environmental interpretation, wildlife observation, and ecosystem-based learning experiences (Alongi, 2020; Worthington et al., 2020). The presence of rich biodiversity therefore enhances both ecological value and tourism attractiveness within the study area.

Table 1. IFAS Matrix of the Pohuwato Mangrove Ecosystem

Internal Factors	Mean Weight	Rating	Score
STRENGTHS			
S1: High mangrove species diversity	2.95	0.15	3	0.45
S2: Strong local community support for conservation	2.10	0.11	2	0.22
S3: Adequate accessibility of the area	2.38	0.12	3	0.36
S4: High potential for nature-based and educational tourism	3.62	0.18	4	0.72
WEAKNESSES			
W1: Limited ecotourism infrastructure	2.52	0.13	2	0.26
W2: Lack of trained tourism management personnel	2.33	0.12	2	0.24
W3: Low awareness of ecology-based tourism	2.05	0.10	1	0.10
W4: Absence of local ecotourism management regulations	2.00	0.10	1	0.10
TOTAL	19.95	1.00		2.45

Community support for conservation also emerged as an important internal strength. The growing awareness of local communities regarding mangrove conservation reflects the increasing acceptance of ecosystem-based development approaches. Previous studies have demonstrated that community participation is a fundamental prerequisite for sustainable ecotourism because local stakeholders often function as ecosystem stewards and key actors in conservation initiatives (Murdiyarso et al., 2022; Iskandar & Mussadun, 2024). Consequently, strengthening community engagement can improve both conservation outcomes and tourism sustainability.

Despite these strengths, several weaknesses remain significant barriers to ecotourism development. Limited tourism infrastructure and the lack of trained tourism management personnel obtained the highest weakness scores, indicating that institutional and operational capacities remain inadequate. Similar challenges have been reported in many emerging ecotourism destinations where tourism development progresses more slowly than conservation initiatives due to insufficient infrastructure investment and limited human resource capacity (Pham et al., 2020). Without adequate facilities, visitor experiences may be compromised, reducing the competitiveness of the destination and limiting its contribution to local economic development.

The absence of specific regulations governing mangrove ecotourism management further illustrates institutional limitations within the study area. Regulatory frameworks play a critical role in balancing conservation objectives and tourism utilization because they establish management responsibilities, environmental standards, and stakeholder rights. The lack of such regulations may increase the risk of unmanaged tourism expansion and ecosystem degradation in the future.

3.2. External Opportunities and Threats Affecting Mangrove Sustainability (EFAS Matrix)

The EFAS analysis produced a total score of 2.53, with a positive opportunity–threat differential (Y = 0.61), indicating that external opportunities currently exceed environmental and management threats. This result suggests that the broader policy and development environment remains favorable for the implementation of mangrove conservation and ecotourism programs in Pohuwato Regency.

The most influential opportunity identified in this study was the potential collaboration with research institutions (score = 0.52), followed by the availability of national and international conservation funding programs (score = 0.48). These findings reflect increasing global attention toward mangrove conservation as part of climate change mitigation, biodiversity protection, and blue economy initiatives. International funding mechanisms increasingly prioritize coastal ecosystem restoration and community-based conservation, creating significant opportunities for local governments and communities to access financial and technical support (Murdiyarso et al., 2022; Sharma et al., 2023).

Table 2. EFAS Matrix of the Pohuwato Mangrove Ecosystem

External Factors	Mean	Weight	Rating	Score
OPPORTUNITIES				
O1: Supportive local government policies	2.52	0.09	3	0.27
O2: Increasing tourist interest in ecotourism	2.71	0.10	3	0.30
O3: Potential collaboration with research institutions	3.43	0.13	4	0.52
O4: Availability of national/international conservation funding programs	3.33	0.12	4	0.48
THREATS				
T1: Conversion of mangrove land into aquaculture ponds	4.14	0.15	2	0.30
T2: Domestic and industrial waste pollution	3.48	0.13	2	0.26
T3: Climate change and sea-level rise	4.43	0.16	1	0.16
T4: Illegal exploitation of mangrove resources	3.19	0.12	2	0.24
TOTAL	27.23	1.00		2.53

The growing demand for ecotourism also represents a promising opportunity. Contemporary tourism trends demonstrate increasing visitor preferences toward nature-based tourism experiences that emphasize environmental sustainability and educational value. This trend has accelerated following the global shift toward responsible tourism practices, creating new opportunities for coastal destinations that possess high ecological quality and conservation value (Pham et al., 2020). Consequently, the Pohuwato mangrove ecosystem is well positioned to benefit from expanding ecotourism markets if appropriate management strategies are implemented.

Nevertheless, several threats continue to challenge long-term sustainability. Climate change and sea-level rise received the highest mean value among respondents, indicating substantial concern regarding future environmental risks. Mangrove ecosystems are particularly vulnerable to changing coastal dynamics, including increased storm intensity, shoreline retreat, and saltwater intrusion (IUCN, 2021; Sharma et al., 2023). These threats may significantly reduce ecosystem resilience if adaptive management measures are not implemented.

The conversion of mangrove land into aquaculture ponds was identified as another critical threat. Land conversion remains one of the primary drivers of mangrove loss throughout Southeast Asia and continues to undermine ecosystem services and biodiversity conservation efforts (Richards & Friess, 2020). Therefore, effective spatial planning and stronger conservation regulations are required to minimize future habitat degradation.).

3.3. Strategic Position of Mangrove Ecotourism Development

The integration of IFAS and EFAS results generated strategic coordinates of X = 1.05 and Y = 0.61, positioning the Pohuwato mangrove ecosystem within Quadrant I of the SWOT matrix. This quadrant

represents an aggressive growth strategy, indicating that the study area possesses sufficient internal strengths to capitalize on available external opportunities. Such a position reflects favorable conditions for expanding conservation-based tourism initiatives while simultaneously strengthening ecosystem protection.

The strategic position suggests that development efforts should focus on maximizing ecological assets and institutional opportunities rather than prioritizing defensive management approaches. Similar findings have been reported in ecotourism studies where areas characterized by strong ecological resources and supportive external environments tend to achieve greater success in implementing sustainable tourism strategies (Rangkuti, 2021). In this context, the Pohuwato mangrove ecosystem possesses the necessary foundation to integrate conservation objectives with economic development through carefully planned ecotourism initiatives.

3.4. Strategic Implications for Sustainable Mangrove Ecotourism

The SWOT matrix identified the Strength–Opportunity (SO) strategy as the most appropriate management approach. The priority strategy emphasizes the development of mangrove ecotourism based on biodiversity assets and educational tourism potential while leveraging conservation funding and institutional partnerships. This approach aligns with contemporary coastal sustainability frameworks that advocate integrating ecosystem conservation, local economic development, and stakeholder collaboration within a single management model (Melo et al., 2019; Ahmad et al., 2025). Based on the strategic position analysis, a SWOT strategy matrix was developed to formulate alternative management strategies, as presented in Table 3.

Table 3. SWOT Strategy Matrix for Pohuwato Mangrove Ecotourism Management

	STRENGTHS (S)	**WEAKNESSES (W)**
OPPORTUNITIES (O)	**SO Strategy:** Develop mangrove ecotourism based on high natural tourism potential (S4) by utilizing conservation funding programs (O4) and collaboration with research institutions (O3).	**WO Strategy:** Improve the capacity of tourism management personnel (W2) through training programs supported by local government agencies (O1) and research institutions (O3).
THREATS (T)	**ST Strategy:** Utilize mangrove biodiversity (S1) and educational tourism potential (S4) to address climate change (T3) and land conversion threats (T1) through community-based conservation programs.	**WT Strategy:** Strengthen local regulations (W4) to mitigate illegal exploitation (T4) and environmental pollution (T2) through multi-stakeholder collaboration.

The implementation of this strategy may include the development of environmentally friendly tourism infrastructure, mangrove boardwalks, biodiversity interpretation centers, educational tourism programs, and community-based conservation activities. Such initiatives can increase visitor engagement while simultaneously enhancing environmental awareness and generating alternative livelihood opportunities for local communities. Previous studies have demonstrated that ecotourism can contribute significantly to conservation outcomes when local communities actively participate in planning and management processes (Alfiandri et al., 2024; Mardianton et al., 2024).

From a governance perspective, strengthening institutional coordination and establishing clear regulatory frameworks should become a priority. Effective governance is essential for preventing resource conflicts, ensuring environmental compliance, and maintaining long-term ecosystem integrity. Furthermore, collaboration among local governments, academic institutions, conservation organizations, and community groups can facilitate knowledge exchange, capacity building, and access to conservation financing. These mechanisms are increasingly recognized as key components of adaptive coastal governance and sustainable blue economy development.

The findings indicate that the Pohuwato mangrove ecosystem possesses substantial ecological assets and favorable strategic conditions for sustainable ecotourism development. However, long-term success will depend on the ability of stakeholders to address institutional weaknesses, strengthen local capacity, and implement adaptive management strategies capable of responding to environmental and climate-related challenges. The integration of conservation, community participation, and ecotourism development therefore represents a promising pathway toward achieving coastal sustainability and resilient blue economy growth in Pohuwato Regency.

4. CONCLUSION

Mangrove ecosystem conservation and management in Pohuwato Regency demonstrate favorable conditions for supporting sustainable community-based ecotourism development. The strategic position identified within Quadrant I of the SWOT matrix indicates that the region possesses dominant internal strengths and significant external opportunities that can be leveraged to enhance both conservation outcomes and socio-economic benefits. High mangrove biodiversity, strong educational tourism potential, and community support emerge as key assets that strengthen the capacity of the area to develop as a sustainable ecotourism destination.

The availability of research collaboration opportunities, conservation funding programs, and increasing demand for nature-based tourism further reinforces the prospects for long-term development. Nevertheless, several challenges remain, particularly limited ecotourism infrastructure, inadequate management capacity, mangrove land conversion, and the increasing impacts of climate change. Addressing these challenges requires integrated management approaches that combine ecological conservation, institutional strengthening, stakeholder participation, and adaptive governance mechanisms.

The integration of mangrove conservation and community-based ecotourism offers a viable pathway for achieving coastal sustainability while simultaneously supporting local economic development and ecosystem resilience. Effective collaboration among government agencies, local communities, research institutions, and conservation organizations is essential to ensure that tourism development contributes to long-term environmental protection rather than ecosystem degradation. Within the broader context of sustainable coastal management, mangrove ecotourism should be positioned not only as a tourism activity but also as a strategic instrument for biodiversity conservation, climate change adaptation, and sustainable blue economy development.Further research is recommended to integrate multi-criteria decision-making approaches, stakeholder governance analysis, and ecosystem service valuation to strengthen strategic planning and support more comprehensive mangrove management frameworks in tropical coastal regions.

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