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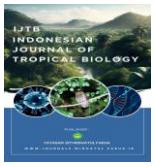

Original Research Paper

Development of Ecotourism Based on Ecosystem Services in the Tanjung Batu Mangrove Ecosystem, Central Sekotong, Indonesia

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Abstract

Mangrove ecosystems provide essential ecological and socio-economic services that support coastal sustainability, yet their potential has not been fully optimized in ecotourism development. This study aims to identify the roles of mangrove ecosystem services, review effective ecotourism models, and formulate development recommendations for the Tanjung Batu Mangrove Area. A Systematic Literature Review (SLR) following the PRISMA 2020 protocol was conducted, and 52 eligible articles were analyzed using thematic synthesis supported by bibliometric mapping. The findings show that regulating and cultural ecosystem services are the most influential in shaping mangrove ecotourism, particularly through shoreline protection, habitat support, and educational value. Community-based ecotourism (CBE), educational tourism, and conservation-oriented approaches emerge as the most effective models across tropical coastal regions. Successful implementation is determined by ecological integrity, community participation, and supportive governance. For Tanjung Batu, integrating these components offers a strategic framework for enhancing tourism potential while strengthening conservation outcomes. This study recommends applying a hybrid community-based and education-focused ecotourism model supported by governance collaboration to ensure long-term ecological resilience and sustainable coastal development.

Keywords: Coastal management; Community empowerment; Ecosystem services; Mangrove ecotourism; SLR.

INTRODUCTION

Mangroves are coastal ecosystems composed of salt-tolerant plant communities inhabiting intertidal zones and functioning as critical components of tropical coastal environments. Ecologically, mangroves stabilize shorelines, reduce erosion, provide nursery habitats for marine organisms, and store substantial amounts of carbon (Bimrah et al., 2022; Nagelkerken et al., 2019; Zhang et al., 2019). They also contribute to climate regulation and coastal protection by enhancing ecosystem resilience against environmental disturbances (Dabalà et al., 2023; Choudhary et al., 2024). Beyond ecological roles, mangroves support social and economic aspects of coastal communities through the provision of natural resources and environmental services (Akram et al., 2023).

In line with growing concerns for sustainable coastal management, mangrove ecosystems have increasingly been promoted as ecotourism destinations that integrate conservation, environmental education, and community empowerment. Mangrove-based ecotourism allows the ecological value of mangroves to be utilized without degrading their structure or function, as tourism activities are typically conducted in controlled and interpretive formats (Prihadi et al., 2024; Tjahjono et al., 2022). Previous studies emphasize that ecotourism development can enhance local economies while simultaneously fostering environmental stewardship, particularly when ecosystem services are integrated into tourism design (Phelan et al., 2020; Dewi & Nugroho, 2020). The success of mangrove ecotourism is closely associated with ecological quality, community engagement, institutional capacity, and governance support (Swangjang & Kornpiphat, 2021; Ekasari et al., 2024).

Despite its rich biodiversity and ecosystem service potential, the development of ecotourism in the Tanjung Batu Mangrove Area of Central Sekotong remains suboptimal. Existing limitations include inadequate tourism infrastructure, the absence of ecosystem-service-based management models, and insufficient community involvement in conservation activities (Hizmi & Junaid, 2023; Markum et al., 2024). Ecological pressures such as logging, shoreline change, and declining water quality also threaten mangrove integrity (Anggraini et al., 2023). Comparable challenges have been reported in other mangrove regions across Indonesia and Southeast Asia, where degradation, limited local capacity, and weak institutional coordination hinder sustainable ecotourism outcomes (Rahman et al., 2021; Huynh et al., 2021; Wibowo et al., 2023). These conditions highlight the need for strategic development grounded in scientific evidence and tailored to local socio-ecological characteristics.

Previous studies have explored mangrove ecosystem services, ecotourism potential, and community-based management; however, integrative reviews that systematically combine these themes within the specific context of Tanjung Batu remain limited (Leal & Spalding, 2021; Kibria et al., 2022). To address this gap, the present study employs a

Systematic Literature Review (SLR) based on the PRISMA 2020 protocol (Page et al., 2021) to identify key mangrove ecosystem services relevant to ecotourism, examine ecotourism development models proven effective in prior studies, and formulate recommendations suited to the ecological and socio-economic conditions of Tanjung Batu. The novelty of this study lies in its development of a conceptual model integrating ecosystem services, community participation, and governance mechanisms as a foundation for sustainable ecotourism development. This research is crucial for strengthening scientific support and policy direction for ecotourism planning in Tanjung Batu and similar coastal regions.

RESEARCH METHODS

This study employed a Systematic Literature Review (SLR) approach to synthesize scientific evidence related to the development of ecosystem-services-based mangrove ecotourism. The SLR followed the PRISMA 2020 protocol, which includes the stages of identification, screening, eligibility, and final inclusion (Murad, 2020).

Research Design

A systematic review design was selected to obtain a comprehensive, structured, and replicable understanding of the current state of knowledge on mangrove ecosystem services, ecotourism development, and community based coastal management (Moussa, 2024). The review was conducted between January and March 2025 following established SLR standards.

Population and research sample

The literature search was conducted through three major academic databases Scopus, ScienceDirect, and Google Scholar because these platforms are widely recognized for prviding comprehensive, multidisciplinary, and high-quality scientific publications relevant to environmental science, coastal ecosystem management, and ecotourism research. Scopus and ScienceDirect host peer-reviewed journals with rigorous editorial standards, making them suitable for ensuring the reliability and validity of evidence synthesized in a Systematic Literature Review following PRISMA guidelines (Page et al., 2021). Google Scholar was included to broaden coverage and capture additional gray or emerging literature that may not be indexed in traditional databases but is essential for understanding diverse perspectives within mangrove ecosystem studies (Phelan et al., 2020). Previous research on mangrove ecosystems and coastal management has also relied on these databases due to their extensive indexing of studies related to ecosystem services, blue carbon, biodiversity, and sustainable ecotourism (Dabalà et al., 2023; Dong et al., 2022). Therefore, selecting these three major databases ensures both comprehensiveness and methodological rigor in capturing relevant literature. The search strategy incorporated Boolean operators with the following keywords:

a) “mangrove ecotourism”
b) “ecosystem services”
c) “community-based ecotourism”
d) “mangrove conservation”
e) “coastal management”.

An example of the query string used is: (“mangrove” AND “ecotourism”) AND (“ecosystem services” OR “community participation” OR “conservation”)

Inclusion and Exclusion Criteria

The inclusion and exclusion criteria were established to ensure that the selected articles were methodologically relevant, scientifically rigorous, and aligned with the objectives of this Systematic Literature Review. Setting clear criteria is a key requirement in PRISMA-based reviews to maintain transparency, reduce selection bias, and ensure that only high-quality evidence is synthesized (Page et al., 2021). The focus on peer-reviewed journal articles published between 2015 and 2024 was chosen to capture the most recent advancements in mangrove ecosystem services, ecotourism, and community-based management, fields that have seen rapid conceptual and empirical development in the last decade (Dabalà et al., 2023; Taillardat et al., 2023).

Limiting the review to empirical and conceptual studies directly related to mangrove ecosystems ensures that the synthesized findings are ecologically and contextually relevant, as mangrove research often relies on updated ecological data, socio-economic assessments, and governance analyses (Bimrah et al., 2022; Phelan et al., 2020). The exclusion of books, theses, and non-peer-reviewed sources was necessary to maintain methodological rigor, as non-academic sources may lack standardized review processes and could compromise the reliability of the SLR synthesis (Rahman et al., 2021; Huynh et al., 2021).

Additionally, articles without full-text availability were excluded to ensure accurate evaluation of research design, results, and methodological quality following JBI-based appraisal practices. Studies unrelated to ecotourism, ecosystem services, or mangrove management were also excluded to maintain a clear thematic focus aligned with the research aims. Overall, these criteria collectively strengthen the validity, relevance, and reproducibility of the review process. The selection of articles was guided by the following criteria:

1. Articles published in peer-reviewed journals.
2. Publications between 2015–2024.
3. Studies focusing on mangrove ecosystems, ecotourism, ecosystem services, or community participation.
4. Articles written in English.
5. Empirical or conceptual research relevant to coastal and mangrove-based tourism.

Exclusion Criteria

1. Non-scholarly publications (books, theses, reports).
2. Articles without full-text availability.
3. Studies unrelated to ecotourism or ecosystem services.
4. Publications with insufficient methodological explanation.

Data Extraction and Analysis

Selected articles were reviewed using a thematic synthesis approach (Crepault et al., 2023). Each article was coded based on four analytical themes derived from the research objectives:

1. types of mangrove ecosystem services,
2. ecotourism models and development strategies,
3. roles and participation of local communities, and

4. enabling and inhibiting factors in mangrove ecotourism.

Bibliometric patterns were also examined using VOSviewer to map keyword co-occurrence, research clusters, and dominant topics in the field.

PRISMA Flow Process

The PRISMA 2020 flow diagram was used to illustrate the article selection process. The initial search produced 1,236 records, which were reduced to 312 articles after removing duplicates (Guo et al., 2023). After screening titles and abstracts, 94 articles remained for full-text assessment. Finally, 52 articles met all criteria and were included in the final synthesis.

Quality Assessment

A methodological quality appraisal was performed using a simplified checklist based on the Joanna Briggs Institute (JBI) guidelines, focusing on clarity of objectives, methodological rigor, relevance, and validity of findings. Only studies rated as medium to high quality were included (Munn et al., 2021).

RESULTS AND DISCUSSION

Overview of Selected StudiesA total of 52 peer reviewed articles were included in this systematic review after the PRISMA screening process. The publication trend shows a steady increase in research related to mangrove ecosystem services, conservation, and ecotourism in the last decade, particularly after 2018. This upward trend aligns with global scientific attention toward climate mitigation through blue carbon ecosystems (Dong et al., 2022; Taillardat et al., 2023) and the growing recognition of mangroves as nature based solutions for coastal resilience (Friess et al., 2020). Most studies were conducted in regions with high mangrove diversity, especially Southeast Asia such as Indonesia, Malaysia, Thailand, and Vietnam which are known to host some of the world's most extensive mangrove forests (Giri & Long, 2016; Thomas et al., 2017). This geographic concentration reflects both ecological richness and increasing national interest in sustainable coastal development. Table 1 presents an overview of the selected studies included in this review, highlighting publication year, study location, research focus, and key findings related to mangrove ecosystem services and ecotourism development.

Table 1. Overview of Selected Studies on Mangrove-Based Ecotourism

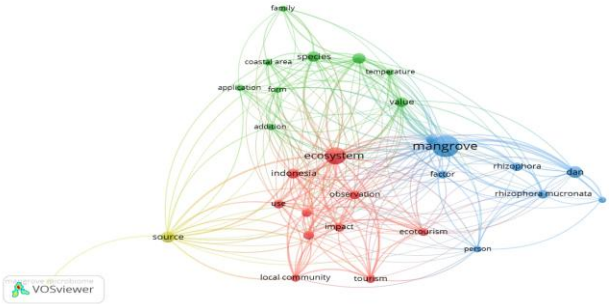
Author(s)	Year	Study Location	Research Focus	Key Findings
Basyuni *et al*.	2022	Indonesia	Mangrove carbon storage	Mangroves have high carbon sequestration potential supporting climate mitigation
Dewi & Nugroho	2020	Indonesia	Mangrove ecotourism framework	Integration of conservation, education, and community participation is essential
Huynh *et al*.	2021	Vietnam	Community empowerment	Ecotourism increases income and environmental awareness
Kibria *et al*.	2022	Bangladesh	Community resilience	Mangrove ecotourism strengthens social–ecological resilience
Rahman *et al*.	2021	Bangladesh	Community-based ecotourism	Community ownership improves sustainability outcomes
Blanton *et al*.	2024	Southeast Asia	Regional ecotourism trends	Strong link between conservation success and ecotourism governance

The reviewed studies demonstrate a multidisciplinary research landscape. Ecological studies predominantly focus on mangrove structure, species diversity, and ecological functions such as habitat provision, sediment stabilization, and carbon storage (Basyuni et al., 2022; Nagelkerken et al., 2019; Zhang et al., 2019). Meanwhile, socio-economic and tourism studies address community involvement, livelihood diversification, and the potential of community-based ecotourism models to promote sustainable development (Rahman et al., 2021; Nugraha et al., 2021; Huynh et al., 2021). Policy- and governance-oriented studies emphasize institutional arrangements, conservation regulations, and the role of multi-stakeholder collaboration in managing mangrove areas (Noor et al., 2020; Halim et al., 2023; Wibowo et al., 2023). This diversity of approaches highlights that mangrove ecotourism research is inherently integrative, requiring the convergence of ecological science, social systems, and environmental governance.

Bibliometric analysis using VOSviewer strengthens this observation by revealing three major research clusters:

1) ecosystem services and blue carbon processes (Leal & Spalding, 2021; Dong *et al*., 2022),
2) ecotourism development and sustainability frameworks (Dewi & Nugroho, 2020; Kibria *et al*., 2022), and
3) conservation and coastal governance (Noor *et al*., 2020; Rudianto *et al*., 2023).

The interconnectedness of these clusters suggests that contemporary mangrove research increasingly integrates ecological value with socio-economic benefits and institutional mechanisms. This reinforces the need for holistic ecotourism strategies in areas such as Mangrove Tanjung Batu, where ecological functions, community livelihoods, and governance capacity must be aligned. The bibliometric visualization of these thematic relationships is presented in Figure 1 as supporting evidence.



Feagure 1. Mangrove Ecosystem Services and Their Role in Ecotourism

The synthesis of 52 reviewed studies reveals that mangrove ecosystems provide a diverse array of ecosystem services that form the ecological basis for mangrove ecotourism. These ecosystem services are commonly categorized into provisioning, regulating, supporting, and cultural functions. Although provisioning services such as fisheries resources, timber, and honey remain essential for local livelihoods, the literature highlights that they play a relatively minor role in ecotourism development compared to regulating and cultural services. Regulating services, particularly shoreline stabilization, erosion control, habitat protection, and carbon sequestration, are widely recognized for their importance in enhancing the resilience of coastal areas to climate-related hazards (Dong et al., 2022; Friess et al., 2020). These regulatory functions not only safeguard coastal communities but also enhance the natural appeal of mangrove ecotourism destinations by showcasing the protective functions of nature.

Supporting ecosystem services also play a crucial role in shaping ecotourism potential. Mangroves serve as critical nursery grounds for juvenile fish, crustaceans, and other marine organisms (Nagelkerken et al., 2019), maintaining the ecological vitality of coastal waters. This ecological productivity enhances opportunities for wildlife observation, including birdwatching and aquatic fauna exploration activities that are often central to ecotourism programs. Additionally, supporting services maintain soil formation and nutrient cycling, ensuring the long-term sustainability of the mangrove ecosystem (Zhang et al., 2019). The integrity of these supporting services determines the quality of tourism activities, as ecotourism relies heavily on nature-based attractions and intact natural settings.

Cultural ecosystem services emerge as the most directly relevant category for tourism development. Mangroves provide spaces for recreation, education, photography, cultural activities, and environmental learning. Many reviewed studies highlight that mangrove ecotourism gains added value when cultural and interpretative elements are emphasized through guided tours, local storytelling, and environmental education programs (Dewi & Nugroho, 2020; Kibria et al., 2022). For example, interpretive boardwalks, canoe tours, and hands-on conservation activities such as mangrove planting can significantly enhance visitor engagement while fostering pro-environmental behavior. These findings indicate that cultural services should be integrated into tourism design to strengthen visitor experiences and differentiate mangrove destinations from other coastal attractions. The literature also shows that ecosystem services play a critical role in encouraging community involvement in ecotourism activities. In many coastal regions, local communities rely on mangrove ecosystem services for their livelihoods, and ecotourism provides an alternative economic opportunity that can reduce reliance on extractive activities. Several studies demonstrate that ecotourism initiatives grounded in ecosystem services tend to strengthen conservation attitudes, as communities recognize that maintaining ecosystem health directly supports tourism benefits (Rahman et al., 2021; Huynh et al., 2021). Integrating ecosystem services into tourism therefore helps create a positive feedback loop where conservation supports tourism, and tourism provides incentives for conservation.

In the context of Mangrove Tanjung Batu, these findings carry significant implications. The area's ecological richness, including diverse mangrove species and high carbon sequestration potential, provides a strong foundation for ecotourism development. The regulating services, such as wave attenuation and sediment stabilization, can be highlighted as part of interpretive educational tours, aligning with global narratives on climate resilience and blue carbon (Leal & Spalding, 2021; Dong et al., 2022). Meanwhile, cultural services particularly aesthetic scenery and community-based environmental education offer opportunities to design tourism packages focused on nature trails, photography, birdwatching, and mangrove restoration activities. Ensuring the sustainability of these ecosystem services through continuous conservation, habitat protection, and community engagement will be crucial for positioning Tanjung Batu as a resilient and competitive ecotourism destination.

Ecotourism Development Models Identified in the Literature

The systematic review identified several ecotourism development models that have been applied across mangrove regions worldwide. Among these, the most widely documented and consistently successful model is Community Based Ecotourism (CBE). This model emphasizes local participation, empowerment, and shared governance between communities and external stakeholders (Rahman *et al*., 2021; Nugraha *et al*., 2021). Studies from Southeast Asia, particularly Indonesia and Thailand, show that CBE not only enhances local income but also increases environmental stewardship, as communities recognize the economic value of maintaining healthy mangrove ecosystems (Huynh *et al*., 2021). The success of CBE relies on strong social capital, clear benefit-sharing mechanisms, and the community's capacity to manage tourism services such as guiding, canoe rentals, homestays, and handicraft production. To synthesize patterns of mangrove ecotourism implementation, Table 2 summarizes the main development models identified across the reviewed studies.

Table 2. Ecotourism Development Models Identified in the Literature

Ecotourism Model	Core Characteristics	Supporting References
Community-Based Ecotourism (CBE)	Local ownership, benefit-sharing, participatory management	Rahman *et al*. (2021); Huynh *et al*. (2021)
Educational Ecotourism	Environmental interpretation, outdoor learning, conservation awareness	Dewi & Nugroho (2020)
Conservation-Incentive Ecotourism	Restoration activities, volunteer tourism, ecosystem monitoring	Kibria *et al*. (2022); Rudianto *et al*. (2023)
ICZM-Based Ecotourism	Integrated coastal planning, zoning, multi-sector coordination	Noor *et al*. (2020); Halim *et al*. (2023)

Another model frequently discussed in the literature is educational ecotourism, which positions mangrove areas as outdoor learning sites. This model integrates environmental education with tourism by offering activities such as guided ecological tours, interpretation trails, species identification sessions, and conservation workshops (Dewi & Nugroho, 2020). Educational ecotourism is often implemented in collaboration with schools, universities, and research institutions, making it suitable for regions that aim to promote environmental literacy. Its emphasis on experiential learning helps visitors understand ecological processes, ecosystem services, and the importance of conservation—elements that significantly enhance the long-term sustainability of tourism initiatives. Several studies also note that educational ecotourism promotes behavioral change among tourists, reinforcing conservation messages through hands-on participation in restoration activities.

A third development model emerging from the reviewed studies is the conservation-incentive ecotourism model, which integrates tourism activities with active ecosystem restoration and monitoring. In this model, tourists are encouraged to take part in mangrove planting, beach clean-ups, biodiversity monitoring, and awareness campaigns (Kibria et al., 2022; Rudianto et al., 2023). The model is designed to create direct links between tourism revenues and conservation outcomes, ensuring that ecosystem protection remains a core objective. This approach can be particularly effective in degraded mangrove areas that require ongoing rehabilitation. It also appeals to tourists who seek meaningful and environmentally responsible travel experiences, thereby creating niche ecotourism markets such as volunteer tourism and conservation tourism.

The fourth model identified is the Integrated Coastal Zone Management (ICZM) based ecotourism model, which emphasizes the alignment of tourism planning with broader coastal management frameworks. This model incorporates multi-stakeholder collaboration, zoning plans, regulatory instruments, and ecosystem based management strategies (Noor et al., 2020; Halim et al., 2023). ICZM-based ecotourism ensures that tourism development does not conflict with fisheries, conservation areas, or community land use. It is particularly relevant for regions with high population density or complex resource-use dynamics, where tourism must be carefully balanced with other socio-economic activities. ICZM-based ecotourism also strengthens legal protection for mangrove areas, reducing risks of land conversion, unregulated development, and environmental degradation.

Based on these findings, it is evident that no single model can be universally applied across all mangrove ecotourism destinations. Instead, successful ecotourism development requires a hybrid approach tailored to local ecological conditions, governance structures, and socio economic characteristics. For Mangrove Tanjung Batu, a combined model incorporating CBE, educational tourism, and conservation-incentive strategies appears most suitable. The area's ecological richness, community interest, and potential governance support provide a strong basis for integrating multiple models into a coherent ecotourism framework. This aligns with contemporary sustainability principles, where tourism must simultaneously enhance community welfare, conserve ecosystems, and promote long-term environmental resilience.

Enabling and Inhibiting Factors

The reviewed studies reveal a set of enabling factors that significantly support the successful development of mangrove-based ecotourism. One of the most prominent enabling factors is the presence of strong community engagement, which ensures shared responsibility for tourism operations and conservation activities (Rahman *et al*., 2021; Huynh *et al*., 2021). Communities that demonstrate collective motivation and social cohesion tend to manage ecotourism more effectively and maintain ecological integrity through local regulations, volunteer groups, and participatory restoration initiatives. Moreover, ecological quality including high mangrove species diversity, healthy tidal systems, and stable sediment environments is consistently identified as a prerequisite for attracting visitors and offering diverse tourism experiences (Nagelkerken *et al*., 2019; Zhang *et al*., 2019). High ecological value increases visitor satisfaction and helps differentiate mangrove destinations within competitive coastal tourism markets. The enabling and inhibiting factors influencing mangrove ecotourism development are summarized in Table 3**,** based on recurring findings across the reviewed literature.

Table 3. Enabling and Inhibiting Factors of Mangrove-Based Ecotourism

Category	Factors	Key References
Enabling Factors	Healthy mangrove ecosystems	Friess *et al*. (2020); Zhang *et al*. (2019)
	Strong community participation	Rahman *et al*. (2021); Nugraha *et al*. (2021)
	Institutional and policy support	Noor *et al*. (2020); Wibowo *et al*. (2023)
	Adequate tourism infrastructure	Dewi & Nugroho (2020)
Inhibiting Factors	Environmental degradation	Taillardat *et al*. (2023)
	Limited community capacity	Nugraha *et al*. (2021)
	Unequal benefit-sharing	Rahman *et al*. (2021)
	Weak governance enforcement	Rudianto *et al*. (2023)

Another key enabling factor is institutional and policy support, particularly from local governments and conservation agencies. Studies show that policy instruments such as zoning regulations, conservation area designation, and Integrated Coastal Zone Management (ICZM) frameworks enhance planning efficiency and reduce land-use conflicts (Noor *et al*., 2020; Halim *et al*., 2023). Collaborations between communities, government agencies, NGOs, and academic institutions strengthen ecotourism governance through co-management arrangements and joint monitoring programs. In addition, accessibility and infrastructure, such as boardwalks, viewing towers, signage, and boat facilities, are essential for

improving tourist mobility and safety. Well-designed ecotourism infrastructure also enhances environmental education by providing interpretive elements that highlight ecosystem services and conservation values (Dewi & Nugroho, 2020). Despite these enabling factors, several inhibiting factors present challenges to ecotourism sustainability.

One major constraint identified in multiple studies is environmental degradation, often caused by pollution, overharvesting, land conversion, and climate-driven hazards such as coastal erosion (Friess *et al*., 2020; Taillardat *et al*., 2023). Degraded mangrove ecosystems reduce tourism appeal, impair ecosystem services, and increase the costs of restoration. Another inhibiting factor is limited local capacity, including gaps in tourism management skills, marketing knowledge, language proficiency, and digital literacy (Nugraha *et al*., 2021; Wibowo *et al*., 2023). Without capacity-building initiatives, communities may struggle to compete with other destinations or manage tourism operations effectively.

Social and governance-related inhibiting factors also influence ecotourism outcomes. Unequal benefit-sharing can lead to internal conflicts and distrust among stakeholders, undermining collective action and long-term participation (Rahman *et al*., 2021). In some cases, external commercial operators dominate tourism activities, reducing community control and weakening local incentives for conservation. Additionally, weak enforcement of conservation regulations allows environmentally harmful activities such as illegal timber extraction or land encroachment to persist, thereby compromising the ecological foundation of ecotourism (Noor *et al*., 2020; Rudianto *et al*., 2023). These governance gaps highlight the need for clear institutional arrangements, transparent financial systems, and strengthened regulatory enforcement to support sustainable tourism management.

In the context of Mangrove Tanjung Batu, both enabling and inhibiting factors are highly relevant. The area benefits from strong ecological potential, community interest, and strategic location within the Sekotong tourism corridor. However, challenges such as limited infrastructure, fluctuating community capacity, and potential ecological disturbances may hinder tourism development. Strengthening local governance, enhancing community training programs, and implementing restoration and monitoring initiatives will be critical steps toward optimizing enabling conditions while mitigating inhibiting factors. By addressing these challenges proactively, Mangrove Tanjung Batu can develop into a resilient and well-managed ecotourism destination that aligns ecological sustainability with community welfare.

Proposed Conceptual Model for Mangrove-Based Ecotourism

Based on the synthesis of the reviewed literature, a conceptual model for mangrove-based ecotourism is proposed to integrate ecological integrity, community participation, governance mechanisms, and tourism development strategies. The model positions ecosystem services as the ecological foundation, emphasizing that healthy mangrove ecosystems through their regulating, supporting, and cultural functions are essential prerequisites for any sustainable tourism initiative (Dong *et al*., 2022; Nagelkerken *et al*., 2019). Based on the synthesis of findings presented in Tables 1–3, a conceptual model is proposed to integrate ecological, social, governance, and tourism dimensions. Table 4 summarizes the main components of the proposed conceptual model and their functional roles.

Table 4. Components of the Proposed Conceptual Model for Mangrove-Based Ecotourism

Model Component	Role in Ecotourism System	Supporting Literature
Mangrove Ecosystem Services	Ecological foundation and tourism attraction	Dong *et al*. (2022); Leal & Spalding (2021)
Community Participation	Social backbone and stewardship	Huynh *et al*. (2021); Rahman *et al*. (2021)
Multi-Stakeholder Governance	Policy support and coordination	Noor *et al*. (2020); Halim *et al*. (2023)
Tourism Product Development	Visitor experience and economic benefits	Dewi & Nugroho (2020); Kibria *et al*. (2022)
Feedback Mechanisms	Adaptive and sustainable system	Phelan *et al*. (2020)

These ecosystem services directly influence the attractiveness of the destination, the diversity of tourism activities offered, and the perceived value among visitors. Without ecological integrity, tourism appeal declines, and the socioeconomic benefits become unsustainable. The second component of the model emphasizes community participation as the social backbone of ecotourism. As shown in earlier sections, active involvement of local residents in planning, management, and benefit-sharing significantly increases the likelihood of long-term sustainability (Rahman *et al*., 2021; Huynh *et al*., 2021). The model highlights that communities play dual roles as both beneficiaries and stewards of ecotourism activities. Through skill development, capacity building, and inclusion in governance structures, communities gain economic opportunities while simultaneously contributing to conservation through monitoring, restoration, and environmental education initiatives. This mutually reinforcing relationship becomes the core driver of resilient ecotourism systems. The third pillar of the model is multi-stakeholder governance, which ensures coordination and alignment across different interests and institutions. Local governments, conservation agencies, NGOs, and academic stakeholders provide regulatory frameworks, technical knowledge, and resource support for ecotourism development (Noor *et al*., 2020; Halim *et al*., 2023). The model adopts principles of Integrated Coastal Zone Management (ICZM) to promote zoning, collaborative decision-making, and conflict resolution mechanisms. Strong governance reduces land-use conflicts, enhances conservation compliance, and strengthens long-term policy support all of which are critical for maintaining the ecological and social components of the system.

The fourth component highlights tourism product development and experience design, which translate ecological and social capital into marketable tourism offerings. Based on the reviewed studies, the most effective products include educational ecotourism, community-based tours, conservation oriented activities, and interpretive

experiences (Dewi & Nugroho, 2020; Kibria *et al*., 2022). These products must be designed around the unique ecosystem services of mangroves, ensuring that tourism activities reinforce conservation goals rather than degrade ecological conditions. Infrastructure such as boardwalks, viewing platforms, interpretation centers, and canoe routes plays a supporting role in delivering high quality experiences while minimizing ecological disturbance.

Finally, the model conceptualizes feedback loops connecting ecological, social, governance, and tourism components. Healthy ecosystems enhance tourism appeal; successful tourism increases community welfare; empowered communities actively protect the ecosystem; and strong governance reinforces conservation through regulations and strategic planning. These feedback mechanisms highlight ecotourism not as a linear process but as an adaptive system that evolves through continuous monitoring, restoration, and stakeholder engagement. For Mangrove Tanjung Batu, applying this conceptual model would provide a structured framework for integrating ecological conservation, community empowerment, and responsible tourism development into a cohesive and mutually reinforcing system.

The conceptual model illustrates how sustainable mangrove-based ecotourism emerges from the dynamic interaction between ecological, social, institutional, and tourism-related components. At the core of the model are mangrove ecosystem services, which serve as the ecological foundation upon which all other elements depend. These services ranging from shoreline protection and carbon sequestration to biodiversity support and cultural values shape the attractiveness of mangrove environments and provide the natural capital required for ecotourism activities. Without healthy and functioning ecosystems, the potential for meaningful tourism experiences and long-term economic benefits is significantly diminished.

Building upon this ecological foundation, the model highlights community participation as the social backbone of ecotourism development. Local communities act simultaneously as custodians of mangrove resources and beneficiaries of tourism-related opportunities. Their involvement in planning, management, and monitoring not only ensures more inclusive decision-making but also reinforces stewardship behaviors that contribute to ecosystem protection. Through capacity-building, collaborative governance, and equitable benefit-sharing, community participation strengthens the social sustainability of ecotourism and promotes a sense of collective ownership over conservation outcomes.

The model also emphasizes multi-stakeholder governance as a critical institutional pillar that aligns community interests with broader regulatory and management frameworks. Local governments, conservation agencies, NGOs, and academic institutions provide policy guidance, technical support, and coordination mechanisms that facilitate effective ecotourism implementation. Governance instruments such as zoning regulations, conservation agreements, and Integrated Coastal Zone Management (ICZM) approaches help mitigate land-use conflicts, improve compliance, and enhance institutional stability. This governance support is essential to ensure that ecotourism development remains ecologically responsible and socially equitable.

The third operational pillar consists of tourism product development, which transforms ecological assets and community capacities into experiential offerings for visitors. Activities such as guided boardwalk tours, birdwatching, interpretive education, canoe routes, and conservation-based experiences enable visitors to engage directly with mangrove ecosystems. High-quality infrastructure, interpretive signage, and environmental storytelling enhance the educational and experiential dimensions of ecotourism, fostering deeper environmental awareness and encouraging pro-conservation behavior among tourists. This component acts as the bridge connecting natural capital with economic and educational benefits.

The interaction among these three pillars ecosystem services, community participation, and multi-stakeholder governance drives two primary outcomes: conservation outcomes and enhanced visitor experiences. Conservation outcomes include improved habitat restoration, stronger environmental protection, and more effective monitoring. Enhanced visitor experiences reflect increased satisfaction, learning, and behavioral change toward environmental responsibility. These outcomes, in turn, reinforce the health of mangrove ecosystems and the capacity of communities and institutions to support ecotourism activities, forming a continuous feedback loop.

Ultimately, the model conceptualizes sustainable mangrove-based ecotourism as an adaptive socio-ecological system that evolves through ongoing learning, collaboration, and environmental management. When ecological integrity is preserved, community welfare is enhanced, and governance mechanisms are well coordinated, mangrove ecotourism can function as a resilient strategy that supports both conservation and sustainable development. This holistic model provides a practical framework for guiding ecotourism initiatives in Mangrove Tanjung Batu and other coastal regions with similar ecological and social characteristics.

CONCLUSION

This systematic review demonstrates that sustainable mangrove-based ecotourism is rooted in the interplay between ecological integrity, community participation, effective governance, and well designed tourism products. Mangrove ecosystem services particularly coastal protection, biodiversity support, and carbon sequestration provide the essential ecological foundation that shapes tourism attractiveness and long term viability. Community involvement strengthens stewardship, supports livelihood diversification, and enhances local ownership of conservation initiatives.

The review also highlights the importance of multi-stakeholder governance, which ensures regulatory support, coordination, and equitable benefit sharing. The conceptual model developed in this study illustrates how these ecological, social, and institutional components interact through reinforcing feedback loops to form a resilient socio ecological system. For Mangrove Tanjung Batu, this integrated approach offers a practical pathway for developing ecotourism that is environmentally responsible and socially inclusive.

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