Egyptian Journal of Aquatic Biology & Fisheries
Zoology Department, Faculty of Science,
Ain Shams University, Cairo, Egypt.
ISSN 1110 – 6131
Vol. 29(3): 765 – 790 (2025)
www.ejabf.journals.ekb.eg

Mangrove and Coastal Ecotourism Management: A Success Factors and Sustainable Management Analysis

Irwan Effendi[1], Harry Ernando[2]*, Azizah Mahary[3], Izzatulmila Effendi[4], Binzar Marpaung[5], Dessy Yoswaty[6], Susi Marni[7]

[1]Marine Sciences Department, University of Riau, Pekanbaru 28293, Indonesia
[2]Marine Sciences Department, University of Riau, Pekanbaru 28293, Indonesia
[3]Aquaculture Department, University of Asahan, Kisaran 21224, Indonesia
[4]Department of Psychology, University of Diponegoro, Semarang 50275, Indonesia
[5]Marine Sciences Department, University of Riau, Pekanbaru 28293, Indonesia
[6]Marine Sciences Department, University of Riau, Pekanbaru 28293, Indonesia
[7]Department of Management, Nagoya Indonesia University, Batam 29431 Indonesia
*Corresponding Author: universitasriau19@gmail.com

ARTICLE INFO

Article History:
Received: April 18, 2025
Accepted: May 10, 2025
Online: May 16, 2025

Keywords:
Mangrove conservation, Ecotourism demand, Local community Involvement, Ecotourism attractiveness, Public awareness, Ecotourism access

ABSTRACT

Mangrove degradation in Indonesia is a pressing environmental issue driven by various anthropogenic activities and economic factors. Mangrove conservation and ecotourism are closely linked, as ecotourism provides a sustainable financial incentive for the preservation and restoration of mangrove ecosystems. This research aimed to identify the success factors for sustainable management of mangroves and coastal ecotourism in the community by taking sample locations at Batubara Mangrove Park (BBMP), Batubara Regency, Indonesia. The data collection was conducted in the field to determine conditions, facilities, infrastructure, and stakeholders' perceptions. Interviews were conducted with tourists (50), tourism business owners (10), tourism employees (20), tourism management organizations (3), community leaders (5) and government officials (5). BBMP began operating in 2003 and has remained stable and is even developing. The main facilities to attract visitors include photo spots, some gazebos/cafés, an air balloon, a flying fox, a Japanese pavilion, a main bridge, tracking mangrove bridges, and a birdwatching facility. Supporting infrastructure includes a parking area, toilet, worship place, information boards, and rubbish bin. The success factors are good site management, adequate community demand for ecotourism, representative ecotourism attractions, condition of mangrove forests, sufficient facilities, good access to tourist locations, integration of Malay culture ecotourism, and the fostering of public awareness of the area. The first two key factors (good business location management and sufficient demand for community ecotourism) are likely to be the main considerations for the successful management of mangrove and coastal ecotourism areas.

INTRODUCTION

Southeast Asia's mangroves cover approximately 10,250km², representing 7% of global mangrove area **(Macintosh *et al.*, 2023)**. Ongoing pressures from human activities and climate change continue to challenge the sustainability of mangrove ecosystems in

Southeast Asia. Balancing development and conservation remains a critical issue for the region's mangrove health. The status of mangroves in Southeast Asia is characterized by both significant ecological importance and alarming rates of degradation. While mangroves provide essential services such as biodiversity support and climate resilience, they face threats from urban development, agriculture, and climate change. Notably, the region has experienced a substantial loss of mangrove cover, with some areas reporting declines of up to 44% since the 1970s **(Baltezar *et al.*, 2023)**.

Deforestation driven by aquaculture, agriculture, and urbanization poses significant risks. Climate change exacerbates these threats through increased cyclonic activity and salinity intrusion **(Macintosh *et al.*, 2023)**. Ecotourism has emerged as a viable strategy for mangrove conservation, providing economic incentives for local communities. Community-based initiatives and international partnerships are being developed to enhance mangrove restoration efforts **(Blanton *et al.*, 2024)**.

Indonesia has lost approximately 1.6 million hectares of mangrove from 1980 to 2005, with 2015 data indicating 3.5 million hectares remaining, of which 48% were in good condition **(Winarso *et al.*, 2020)**. The status of mangroves in Indonesia reflects a complex interplay of health, threats, and management practices. While some regions exhibit moderate to good health, others face significant degradation due to human activities and environmental pressures. The status of mangroves in Sumatera also reflects a complex interplay of ecological significance and human impact. Various studies indicate that while some areas maintain healthy mangrove ecosystems, others face significant degradation due to land use changes and human activities. In Payung Island, Musi Estuary, mangrove coverage decreased from 497.65 ha in 2009 to 488.49 ha in 2019, with dominant species including *Avicennia*, *Sonneratia*, and *Rhizophora* **(Ulqodry *et al.*, 2019)**. Taman Pulau Kecil hosts 17 mangrove species, with a density of 3,120 individuals/ha in Tapian Nauli Bay, indicating a relatively healthy ecosystem **(Muhtadi *et al.*, 2020)**. Sembilang National Park's mangrove management is rated "less sustainable," with a multidimensional sustainability index of 49.81, highlighting the need for improved local community engagement and conflict resolution **(Boer, 2015)**. In Langkat, mangrove areas decreased by 52.97 ha from 2010 to 2022, primarily due to conversion for oil palm plantations and fish farming **(Ginting *et al.*, 2023)**.

The mangrove ecosystem plays several crucial functions in coastal areas and marine environments. The functions of mangrove ecosystems are diverse and essential for maintaining the health and resilience of coastal environments worldwide. Mangroves act as natural barriers against waves, storms, and coastal erosion. Their dense root systems stabilize shorelines and reduce the impact of waves and currents, protecting coastal communities and infrastructure **(Arifanti *et al.*, 2022; Trialfhianty *et al.*, 2022)**. Mangroves serve as critical nursery habitats for many marine and terrestrial species, including fish, crustaceans, mollusks, and birds. The complex root systems provide shelter and breeding grounds for young organisms, supporting biodiversity and

contributing to healthy fisheries. Mangrove forests are highly efficient at sequestering and storing atmospheric carbon dioxide. The organic matter in mangrove soils accumulates over time, locking away carbon and helping mitigate climate change by reducing greenhouse gas levels **(Barbier, 2019; Wang & Gu, 2021)**. Mangroves filter nutrients, sediments, and pollutants from coastal waters, improving water quality and clarity. They trap sediment and organic matter, preventing them from reaching coral reefs and seagrass beds, vital marine ecosystems. The intricate root systems of mangroves trap sediments and avoid soil erosion, stabilizing coastal soils and preventing land loss. This helps maintain land elevation and prevents coastal areas from subsiding. Mangrove ecosystems support local fisheries and provide livelihoods for coastal communities through fishing, aquaculture, and ecotourism activities. By reducing the impact of storms and tsunamis, mangroves safeguard communities, infrastructure, and economic activities along coastlines **(Liu *et al*., 2022; Anu *et al*., 2024)**.

Despite the ecological importance, ongoing threats from land conversion and inadequate management practices pose risks to their sustainability. Addressing these challenges is crucial for preserving these vital ecosystems. It requires a multifaceted approach that balances ecological health with socio-economic needs. Mangrove conservation and ecotourism are closely linked, as ecotourism provides a sustainable financial incentive for the preservation and restoration of mangrove ecosystems. These ecosystems offer critical environmental services, such as biodiversity conservation and climate change resilience, while also supporting local livelihoods. Ecotourism activities have been particularly successful in Southeast Asia countries, where they contribute to economic development and community well-being. The integration of ecotourism with mangrove conservation efforts has shown promising results in various regions, although challenges remain in ensuring sustainable management and equitable benefit distribution **(Effendi *et al*., 2022a; Blanton *et al*., 2024)**.

Mangrove ecotourism refers to tourism activities that focus on experiencing and learning about mangrove ecosystems while promoting their conservation and sustainable use. Mangrove ecotourism is crucial in raising awareness, supporting conservation efforts, and providing sustainable economic opportunities for communities while preserving these vital coastal ecosystems. Visitors are often guided by trained naturalists or local experts who provide educational insights into mangroves' ecology, biodiversity, and cultural significance. Ecotourism activities are designed to minimize disturbance to mangrove habitats and wildlife. This includes designated trails, boardwalks, and guidelines for responsible behavior. Revenue generated from ecotourism can fund conservation initiatives, habitat restoration projects, and community-based mangrove protection efforts **(Das & Chatterjee, 2020; Cahyaningsih *et al*., 2022)**.

Ecotourism fosters a deeper connection between visitors and nature, inspiring conservation stewardship and responsible travel practices. Mangrove ecotourism can provide economic opportunities for local communities through guided tours, handicraft

sales, and hospitality services (e.g., homestays). Visitors may engage in cultural exchanges, participate in traditional activities, or purchase locally-made crafts, supporting community livelihoods. Ecotourism activities can facilitate partnerships with researchers and conservation organizations to monitor mangrove health, biodiversity, and ecosystem services. Tour operators and guides may contribute to data collection efforts, such as recording wildlife sightings or monitoring environmental parameters **(Tjahjono *et al.*, 2022)**. Mangrove ecotourism management is a multifaceted approach that integrates environmental conservation, community involvement, and sustainable economic development. Effective management strategies are essential for balancing ecological integrity with tourism growth, as evidenced by various studies highlighting the importance of stakeholder participation and policy integration. Involving local communities in planning and managing ecotourism initiatives is crucial. For instance, the Aceh Jaya mangrove area emphasizes community participation in all ecotourism activities, which enhances local livelihoods and fosters environmental stewardship **(Elfandayani *et al.*, 2021)**. The management need to strengthen local tourism awareness groups to improve governance and resilience against climate-related risks **(Markum *et al.*, 2024)**. Successful mangrove ecotourism relies on effective environmental policies. Research indicates that integrating municipal legislation and ecosystem management plans can enhance sustainability, although challenges like low community participation and resource limitations persist **(Nasution *et al.*, 2025)**.

Collaborative strategies that engage various stakeholders, including government and private sectors, can raise awareness and improve management practices **(Irmayanti, 2024)**. Despite the potential of mangrove ecotourism, many areas face stagnation due to sectoral management approaches. **Suci *et al.* (2022)** highlighted the need for a multidimensional strategy that addresses ecological, economic, and socio- cultural factors to enhance sustainability of mangrove ecotourism business. It is also important to recognize that external factors, such as climate change and economic pressures, can significantly impact the effectiveness of mangrove ecotourism management. Balancing these challenges with sustainable practices remains a critical area for future research and action.

Coastal areas face challenges such as coastal erosion, pollution, and climate change impacts that threaten both their livelihoods and cultural heritage. Balancing economic development with environmental conservation is crucial for sustainable development in the areas. Ecotourism initiatives and sustainable fishing practices can provide alternative livelihoods while preserving natural resources **(Abdullah & Isa, 2020; Effendi *et al.*, 2021)**. This research aimed to identify the success factors for sustainable management of mangroves and coastal ecotourism by taking sample locations at Batubara Mangrove Park (BBMP), Batubara Regency, Indonesia.

MATERIALS AND METHODS

1. Duration and study site

This research was carried out from January to March 2023 by taking sample locations of the Batubara Mangrove Park (BBMP) ecotourism location, Limapuluh District, Batubara Regency, Indonesia (Fig. 1).

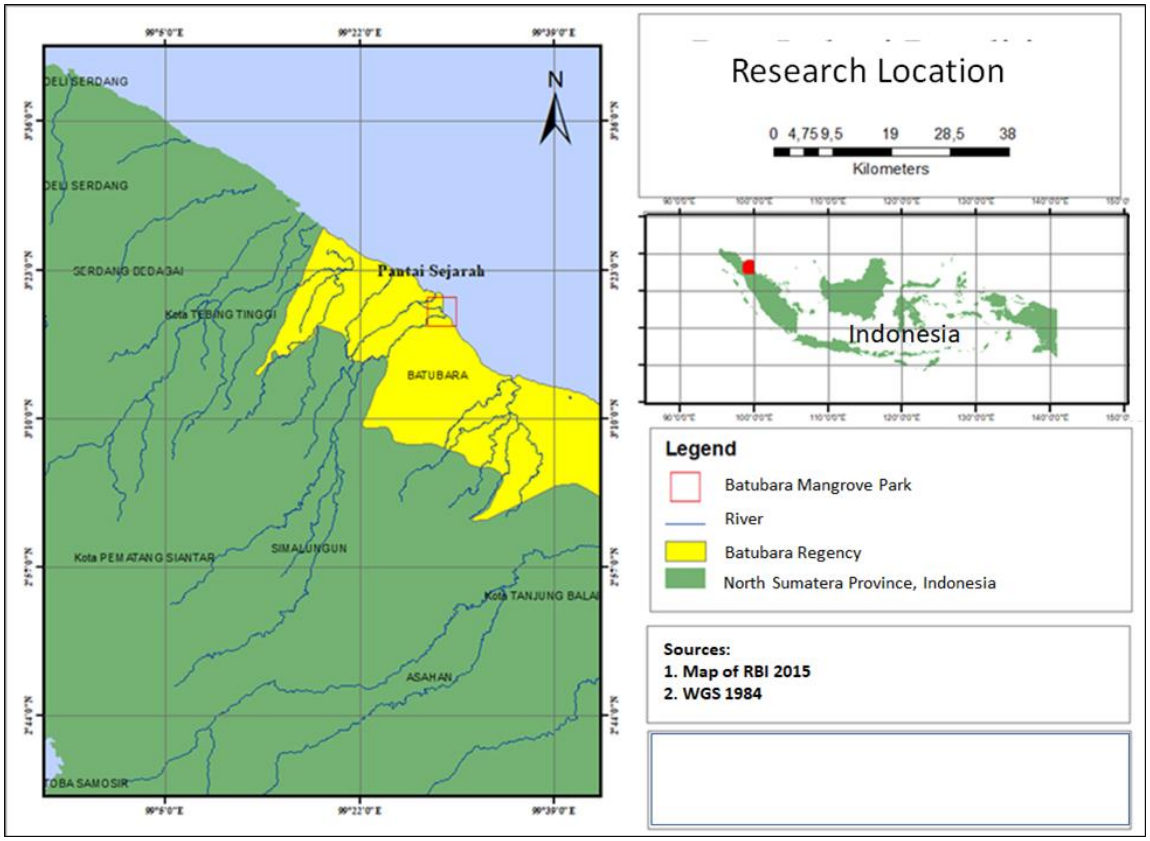

Fig. 1. Research location, Lima Puluh District, Batubara Regency, Indonesia

2. Data collection

Observations and data collection were carried out in the field to determine the condition of BBMP facilities and infrastructure and stakeholders' perceptions of this ecotourism. Interviews were conducted with tourists (50 persons), tourism business owners (10 persons), tourism employees (20 persons), tourism management organizations (3 persons), community leaders (5 persons) and government officials (5 persons). Secondary data were collected from reports from ecotourism management organizations and government sources. In the initial research stage, a field survey was carried out to see the condition of the research location and the ecotourism area. The research station was divided into three sampling points (stations) for measuring several mangrove vegetation and coastal water quality parameters. A list of questions was prepared in the questionnaire according to the group and number of respondents interviewed.

3. Identification of mangrove biota

Identification of mangrove species was carried out by observing and photographing some parts of the mangrove morphology, such as roots, stems, leaves, flowers, and fruit **(Kitamura *et al*., 1998; Noor *et al*., 2006)**. Fauna were identified through observation, interviews with local communities, and literature studies from several sources, including mammals, reptiles, birds, and coastal invertebrates **(Giesen *et al*., 2006)**.

4. Water quality

Water quality measurements were carried out at low and high tide at each research station. Measurements were carried out three times, including temperature, salinity, and pH, Data collection was conducted in the morning, between 8:00 a.m., which is when the tide is high. Water quality measurements were conducted on surface water, namely by setting three observation stations 1, 2 and 3. Station 1 is located at the northern end, station 2 in the middle and station 3 at the southern end of BBMP.

5. Data analysis

The data obtained in this research were compiled, tabulated, and statistically analyzed using principal component analysis (PCA), following modifications based on **Vajčnerová *et al.* (2012)**, **Li *et al.* (2018)** and **Wang (2020)**. The results were then discussed descriptively.

RESULTS

1. General condition of Batubara Mangrove Park

Initially, this ecotourism area was named as Historical Beach. However, since September 2020, this ecotourism area has changed its name to Batubara Mangrove Park (BBMP). The park is located on the coast of the Malacca Strait and directly opposite several areas of the Malaysian Peninsula. People from various places have long used this location as a family recreation location on certain days or holidays. Access to tourist locations uses land transportation, which only takes around 31 minutes from Batubara City. Land transportation roads have been made of concrete, making them easy to access. No public transportation is available to the location, so tourists have to use private transportation. However, visitors can stay at the house of one of the managers. Based on the results of observations and interviews in the field, the BBMP ecotourism area is busy with tourists on holidays—for example, Saturday and Sunday. The number of holiday visitors ranges from 500 to 1,500 people, while it is around 100 on weekdays. During major holidays, it reaches 5,000 visitors.

BBMP is 120km from Medan City and 18.3km from Batubara City. Ecotourism activities developed in this area have ecological and social criteria. Bird watching, animal observation, enjoying the beauty of mangrove vegetation via wooden bridges,

enjoying water sports such as canoeing, and taking photographs of the beauty and uniqueness of mangrove vegetation and animals as exciting objects.

Temperature of seawater ranged from 30-31ºC, salinity ranged from 32-34ppt, and pH was around 8 (Table 1). The mangrove species at the research location were *Avicennia marina, Bruguiera clindrica,* and *Rhizophora apiculata*. The average density value in the BBMP ecosystem was 2,033 individuals/ha. They are dominated by the *Avicennia marina,* which valued 1,856 individuals/ha (Table 2).

Table 1. Water quality of Batubara Mangrove Park (BBMP)

No.	Parameter	Station 1	Station 2	Station 4
1.	Temperature (º C)	30	31	30
2.	Salinity (ppt)	32	34	33
3.	pH	8	8	8

Table 2. Mangrove density at Batubara Mangrove Park

No.	Species	Total samples (tree)	D (individuals /ha)	RD (%)	IVI (%)
1.	*Avicennia marina*	167	1856	91.3	256
2.	*Bruguiera clindrica,*	12	133.3	6.6	33.3
3.	*Rhizophora apiculata*	4	44.4	2.2	10.7
	Total	183	2033	100	300

IVI = Important value index; RD = relative density; D = density

Based on the data in Table (2), the density of the mangrove ecosystem in the BBMP Area is in good condition with a very dense category. Based on Decree of the Ministry of Environment of the Republic of Indonesia No. 201, 2004, the condition of mangrove density is said to be very good and very dense if the density is more than 1500 individuals/ha (Table 3). The area in question contains approximately 456 hectares of mangrove forest.

Table 3. Quality standards for mangrove density in Indonesia

Class	Criteria	Forest cover	Density (individuals/ha)
Good	Very dense	≥ 75	≥ 1500
	Moderate	≥ 50 - < 75	≥ 1000 - < 1500
Damaged	Sparse	< 50	< 1000

Source: **DME (2004)**.

The birds found included the ivory gull (*Pagophila eburnean*), cinnamon-headed green pigeon (*Treron fulvicollis*), little egret (*Egretta garzetta*), and the great egret

(*Ardea alba*). Some reptiles were found: the mangrove snake (*Forfidana ceucobalia*), water snake (*Enhydris enhydris*), and Asian water monitor (*Varanus salvator*). Some marine animals were also observed, i.e. the red violin crabs (*Uca* spp), yellow violin crabs (*Uca* spp), blood cockles (*Anadara granosa*), prawns (*Penaeus* sp.), Indo-Pacific horseshoe crab (*Tachypleus gigas*), and the mud snails (*Cerithidea cingulate*).

2. Facilities and infrastructure

The ecotourism facilities and infrastructure at BBMP are relatively sufficient and well-maintained. Public facilities supporting ecotourism include parking areas, toilets, places of worship, photo spots, and rubbish bins. Meanwhile, the main existing ecotourism features are some gazebos/cafés, hot air balloons, a flying fox set, a Japan pavilion, a main bridge, some tracking mangrove bridges, and birdwatching facilities (Table 4).

Table 4. Availability of BBMP facilities, infrastructure and their conditions

No.	Facilities and infrastructure	Total	Mark
1.	Parking area	5.000 m^2	Poorly maintained but adequate
2.	Toilet	10 units	Well-maintained and adequate
3.	Worship place	1 unit 25 m^2	Well-maintained and adequate
4.	Photo spot	5 units	Well-maintained and adequate
5.	Information boards	1 unit	Well-maintained and adequate
6.	Rubbish bin	20 units	Well-maintained and adequate
7.	Gazebo/cafe	20 units	Well-maintained and adequate
8.	Air balloon	1 unit	Well-maintained and adequate
9.	Flying fox	1 unit	Well-maintained and adequate
10.	Japan pavilion	1 unit	Well-maintained and adequate
11.	Main bridge	1 unit	Well-maintained and adequate
12.	Tracking mangrove bridges	6 units	Well-maintained and adequate
13.	Birdwatching facility	1 unit	Well-maintained and adequate

3. BBMP ecotourism management

Community-based BBMP management under the auspices of the Cinta Mangrove Farmers Group (KTCM) has been practiced. All ecotourism facilities and infrastructure belong to KTCM. All members of this organization carry out ecotourism service activities at all levels. All business profits belong to management, but they set aside a portion for the organization's sustainability. Apart from that, KTCM always invites the

community, government, and several industries around the location to revitalize, maintain, care for, and feel like they own BBMP. These companies include PT Indonesia Asahan Aluminum (Inalum). Since 2002, KTCM has carried out nursery activities in 2002, planting mangroves in 2003 with a planting area of 200 Ha. Since then, many parties have provided seedling assistance to support the mangrove planting in the two villages.

Considering that infrastructure is relatively sufficient, in 2023, BBMP is encouraged to enter the realm of digitalization. Information is conveyed to the public via the site coalmangrovepark.com. Currently, more than 40 people work as BBMP tourism managers. Then there is also the MSME group with 20 members, Batik with 20 people, Tunjang Bakau with 15, and Silvo Fishery with 20. Not to mention including workers paid daily if holidays and visits increase. At least 120 people earned benefits and income from this BBMP.

4. Attractions at BBMP

4.1 Culinary and gazebo/café

The gazebo provides national dishes and typical Malay food on the coast. While enjoying the green mangrove forests as well as the beauty of the sea coast and a variety of migratory birds, these gazebos provide facilities for family dining at BBMP tourist locations. There are 6 gazebos (Figs. 2, 3) that prepare a variety of local Batubara Regency MSME dishes and various seafood dishes caught from the sea.

4.2 Hot air balloons

The presence of a hot air balloon (Fig. 4) in the BBMP area is a special part. The balloon is intended further to increase the attraction and interest of visiting tourists. The breezy beach and green mangrove forests are a perfect combination, making a hot air balloon an aesthetic and comfortable place to relax with your partner and family.

4.3 Flying fox

BBMP also has a game ride for tourists who like adrenaline challenges, namely the flying fox. It is a favorite ride, especially for children of all ages. The flying fox is the answer for children who like the challenge of speed and height in a game (Fig. 5).

Fig. 2. Rows of gazebos. Providing typical Indonesian and Malay food

Fig. 3. Rows of gazebos on the main bridge of BBMP

Fig. 4. Hot air balloons decorate the BBMP

4.4 Floating mosque

In addition to tourist spots, BBMP also provides a comfortable place of worship for the Muslim community, namely a floating mosque (Fig. 6). This mosque is one of the icons in this tourist area. This mosque, with an area of 64m^2, was built jutting into the beach. It makes this mosque look like it floats when the tide comes in.

Fig. 5. Flying fox in BBMP

Fig. 6. Floating mosque in BBMP

4.5 Japan pavilion

During World War II, Japanese army troops landed on this beach. Until now, the history of the landing has been remembered by naming the location Historical Beach. To remember this event, BBMP, with the help of PT. Inalum built a Javan pavilion (Fig. 7). Visitors only need to buy local MSME (micro, small, and medium enterprises) products as an entrance ticket to enter this pavilion. In this place, visitors can immerse themselves in history while supporting local MSMEs. There is a unique MSME product, Jeruju dipped flower tea, which is made from a species of mangrove and Asian pigeonwings flower (*Clitoria ternatea*), which is useful for maintaining stamina and body health.

4.6 Mangrove tracking

Exploring the mangrove forest, which is still very shady, can calm you down and get closer to nature (Fig. 8). This tourist attraction, built in 2023, adds to its attraction for tourists and environmental lovers. Visitors can directly touch mangrove trees from various species of mangrove communities. The main bridge, built solidly in 2020, is the main attraction of the BBMP ecotourism area. Visitors can walk from the beach for 200m toward the sea while enjoying the beauty of the preserved mangrove forest.

Fig. 7. Japan Pavilion in BBMP

Fig. 8. Mangrove tracking BBMP

4.7 Birdwatching ecotourism

Birdwatching ecotourism is one of the activities carried out at BBMP (Fig. 9). It is held to coincide with the celebration of World Migratory Bird Day (WMBD), which is celebrated in October and May every year. However, visitors can still enjoy the presence of resident and migratory water birds from October to May the following year. Several species of resident and migratory shorebirds are found in this place. Some of them are rare and protected birds. Examples include red knot (*Calidris canutus*) and the Far Eastern curlew (*Numenius madagascariensis*).

Fig. 9. Birdwatching ecotourism

4.7 Success factors for sustainable management

From the results of interviews with BBMP visitors, it can be seen that the main factors for visitors to come (willingness to pay or WTP) include: road access to the location, mangrove forests attractions, environmental conservation programs, community-based governance, natural marine attractions, artificial attractions, and ecotourism attractions. More detailed data is presented in Table (5).

Table 5. Principal component factors key to BBMP's success according to visitors

No.	Principal Component Factors	Total score	Average score	STDEV	PCAR
1	Road access to the location	392	7.84	0.681	1
2	Mangrove forests attractions	389	7.78	0.465	2
3	Environmental conservation programs	387	7.74	0.803	3
4	Community-based governance	380	7.60	0.495	4
5	Natural marine attractions	374	7.48	0.886	5
6	Artificial attractions	352	7.04	0.198	6
7	Ecotourism attractions	317	6.34	1.171	7
8	Sense of comfort	317	6.34	1.222	8
9	Sense of security	293	5.86	1.050	9
10	Quality of ecotourism attractions	292	5.84	0.738	10
11	Food and drink suitability	253	5.06	0.998	11
12	Supporting facilities	189	3.78	0.465	12
13	Presence of tourism products	183	3.66	0.479	13
14	Cultural attractions	155	3.10	0.303	14
15	Intensive promotion by various parties	155	3.10	0.303	15
16	Availability of public transportation	133	2.66	0.557	16

STDEV= standard deviation; PCAR = principal component analysis rank.

The results of interviews with tourism business owners, tourism employees, tourism management organizations, community leaders and government officials include sufficient community demand for ecotourism, mangrove forests attractions, environmental conservation programs, natural marine attractions, community-based governance, artificial attractions, and road access to the location. More detailed data from this interview is presented in Tables (6-10).

Table 6. Principal component factors to BBMP's success according to tourism business owners

No.	Principal Component Factors	Total score	Average score	STDEV	PCAR
1	Sufficient community demand for ecotourism	84	8.400	0.516	1
2	Mangrove forests attractions	80	8.000	0.471	2
3	Environmental conservation programs	79	7.900	0.316	3
4	Natural marine attractions	78	7.800	0.789	4
5	Community-based governance	73	7.300	0.675	5
6	Artificial attractions	71	7.100	0.738	6
7	Road access to the location	70	7.000	0.667	7

8	Food and drink suitability	63	6.300	0.675	8
9	Sense of comfort	63	6.300	1.160	9
10	Quality of ecotourism attractions	58	5.800	0.632	10
11	Sense of security	58	5.800	0.422	11
12	Ecotourism attractions	45	4.500	1.080	12
13	Intensive promotion by various parties	39	3.900	0.876	13
14	Supporting facilities	37	3.700	0.675	14
15	Availability of public transportation	32	3.200	1.135	15
16	Presence of tourism products	31	3.100	0.738	16
17	Cultural attractions	31	3.100	0.316	17

STDEV= standard deviation; PCAR = principal component analysis rank.

Table 7. Principal component factors key to BBMP's success according to tourism employees

No.	Principal Component Factors	Total score	Average score	STDEV	PCAR
1.	Mangrove forests attractions	169	8.450	0.510	1
2.	Natural marine attractions	155	7.750	0.786	2
3.	Artificial attractions	153	7.650	0.587	3
4.	Environmental conservation programs	152	7.600	0.503	4
5.	Sufficient community demand for ecotourism	151	7.550	0.510	5
6.	Community-based governance	150	7.500	0.889	6
7.	Road access to the location	141	7.050	0.224	7
8.	Intensive promotion by various parties	127	6.350	1.226	8
9.	Ecotourism attractions	122	6.100	0.641	9.
10.	Food and drink suitability	121	6.050	0.224	10
11.	Supporting facilities	117	5.850	0.745	11
12.	Availability of public transportation	98	4.900	0.912	12
13.	Presence of tourism products	81	4.050	0.826	13
14.	Sense of security	75	3.750	0.444	14
15.	Quality of ecotourism attractions	73	3.650	0.489	15
16.	Sense of comfort	62	3.100	0.308	16
17.	Cultural attractions	53	2.650	0.587	17

STDEV= standard deviation; PCAR = principal component analysis rank.

Table 8. Principal component factors to BBMP's success according to tourism organizations

No.	Principal Component Factors	Total score	Average score	STDEV	PCAR
1	Environmental conservation programs	25	8.333	0.577	1
2	Sufficient community demand for ecotourism	23	7.667	0.577	2
3	Mangrove forests attractions	22	7.333	0.577	3
4	Community-based governance	22	7.333	1.155	4
5	Natural marine attractions	22	7.333	0.577	5
6	Artificial attractions	22	7.333	0.577	6
7	Road access to the location	22	7.333	0.577	7
8	Food and drink suitability	20	6.667	1.155	8
9	Sense of comfort	19	6.333	0.577	9.
10	Quality of ecotourism attractions	18	6.000	0.000	10
11	Sense of security	17	5.667	1.155	11
12	Ecotourism attractions	14	4.667	1.155	12
13	Intensive promotion by various parties	13	4.333	0.577	13
14	Supporting facilities	12	4.000	1.000	14
15	Availability of public transportation	11	3.667	0.577	15
16	Presence of tourism products	10	3.333	0.577	16
17	Cultural attractions	8	2.667	0.577	17

STDEV= standard deviation; PCAR = principal component analysis rank.

Table 9. Principal component factors to BBMP's success according to surrounding community leaders

No.	Principal Component Factors	Total score	Average score	STDEV	PCAR
1	Mangrove forests attractions	42	8.40	0.548	1
2	Environmental conservation programs	39	7.80	0.837	2
3	Natural marine attractions	39	7.80	0.447	3
4	Community-based governance	38	7.60	0.548	4
5	Artificial attractions	38	7.60	0.894	5
6	Sufficient community demand for ecotourism	38	7.60	0.548	6
7	Road access to the location	35	7.00	0.000	7
8	Food and drink suitability	31	6.20	1.304	8
9	Sense of comfort	30	6.00	0.707	9.
10	Quality of ecotourism attractions	30	6.00	0.000	10

11	Sense of security	29	5.80	0.837	11
12	Ecotourism attractions	25	5.00	1.000	12
13	Intensive promotion by various parties	19	3.80	0.447	13
14	Supporting facilities	21	4.20	0.837	14
15	Availability of public transportation	18	3.60	0.548	15
16	Presence of tourism products	16	3.20	0.447	16
17	Cultural attractions	13	2.60	0.548	17

STDEV= standard deviation; PCAR = principal component analysis rank.

Table 10. Principal component factors key to BBMP's success according to government staffs

No.	Principal Component Factors	Total score	Average score	STDEV	PCAR
1	Mangrove forests attractions	42	8.40	0.548	1
2	Ecotourism attractions	39	7.80	0.447	2
3	Environmental conservation programs	38	7.60	0.548	3
4	Natural marine attractions	38	7.60	0.548	4
5	Sufficient community demand for ecotourism	37	7.40	0.548	5
6	Quality of ecotourism attractions	37	7.40	0.894	6
7	Food and drink suitability	36	7.20	0.447	7
8	Intensive promotion by various parties	32	6.40	1.140	8
9	Artificial attractions	29	5.80	0.837	9.
10	Sense of security	29	5.80	0.447	10
11	Supporting facilities	28	5.60	1.140	11
12	Availability of public transportation	25	5.00	0.707	12
13	Presence of tourism products	20	4.00	0.707	13
14	Cultural attractions	20	4.00	1.000	14
15	Community-based governance	19	3.80	0.837	15
16	Sense of comfort	16	3.20	0.447	16
17	Road access to the location	13	2.60	0.548	17

STDEV= standard deviation; PCAR = principal component.

DISCUSSION

From the results of interviews with respondents, it shows that there are several main factors for the success of BBMP management. The results of the PCA analysis show this. PCA is used to analyze various factors such as resource conditions, environmental conditions, and regional conditions to assess the potential of ecotourism sites. For instance, in the Yellow River Basin, PCA helped in constructing a

comprehensive evaluation model to understand the current situation and potential of tourism resources **(Wang, 2020)**. In sea areas, PCA, combined with GIS technology, evaluates the suitability for tourism by extracting principal components from numerous influencing factors. This method provides a comprehensive score that aids in selecting suitable areas for tourism and recreation, ensuring rational development of marine projects **(Li *et al*., 2018)**. PCA is also utilized to evaluate the quality of tourist destinations by analyzing factors such as attractions, services, marketing management, and sustainability. This helps in identifying key dimensions that contribute to visitor satisfaction and sustainable development **(Vajčnerová *et al*., 2012)**. Below the author discusses several key factors that are the key to the success of sustainable management of BBMP.

1. Community-based governance

BBMP can be said to be successfully managed among the Malay community. This success is closely related to the governance system implemented. The managers under KCMP have implemented a holistic and integrated approach, with a focus on environmental sustainability, involvement and empowerment of local communities, education, and quality tourism experiences. By applying the principles and best practices in ecotourism governance, destinations can achieve long-term benefits for the environment, society, and economy. Good ecotourism governance is very important to ensure that ecotourism activities provide maximum benefits for the environment, local communities, and the economy, and minimize negative impacts **(Sarinastiti & Wicaksono, 2021; Mushkudiani *et al*., 2023; Fatkhurrahman *et al*., 2024)**. The principles of ecotourism governance include a) maintaining and protecting ecosystems and biodiversityl b) Ensure wise and sustainable use of natural resources; c) involving local communities in planning, management, and decision-making; d) ensure that the economic benefits of ecotourism are received by local communities, and e) respect and preserve local culture and traditions (**Effendi *et al*., 2018; Hermon *et al*., 2020; Effendi *et al*., 2022b)**.

Furthermore, **Brenner and Job (2006)**, **Sadikin *et al*. (2017)** and **Effendi *et al*. 2022a)** added that several keys to successful management of an ecotourism area include; 1) Involvement of all stakeholders, including government, local communities, non-governmental organizations, and the private sector, in the planning and decision- making process; 2) Building strong partnerships between various parties to support ecotourism sustainability; 3) Promoting ecotourism by emphasizing sustainability aspects and its benefits for the environment and local communities; 4) Avoid over- promotion which can cause overtourism and negative impacts on the environment and local culture; 5) Local communities manage tourist destinations with a focus on environmental and cultural

preservation, and 6) Tourists are invited to participate in activities that support sustainability, such as tree planting and preserving local culture.

2. Sufficient tourism demand

The success of managing the BBMP ecotourism area cannot be separated from the demand for adequate tourist attractions. This demand is more visible from local tourists. Several large cities with large populations are not too far from this ecotourism location. For example, Kisaran, Limapuluh, Lubuk Pakam, Sei Rampah, and Medan. Table (11) shows the position of several nearby large cities, the population, and the travel distance from each city.

The demand for ecotourism has increased significantly in recent decades. This phenomenon is driven by various factors including changes in tourist attitudes and preferences, increased environmental awareness, and the role of technology in promoting ecotourism destinations. Demand for ecotourism continues to grow along with increasing environmental awareness and changes in tourist preferences. Several countries have developed policies and regulations that support ecotourism as part of their sustainable development strategies. The government provides economic incentives for entrepreneurs and local communities to develop ecotourism businesses. However, challenges such as over-tourism and management capacity must be addressed to ensure long-term sustainability **(Carvache-Franco *et al.*, 2021; Pham *et al.*, 2021)**.

Table 11. Position, distance, and population of several large cities in North Sumatra Province to BBMP

No.	City	Population (persons)	Distance (Km)	Travel time
1.	Kisaran	791,174	45	48 minutes
2.	Limapuluh	443,816	21	15 minutes
3.	Lubuk Pakam	1,991,108	96	1 h and 35 minutes
4.	Rantau Prapat	505,875	174	4 h and 30 minutes
5.	Kota Pinang	325,451	228	5 h and 41 minutes
6.	Aek Kanopan	396,555	110	3 h and 3 minutes
7.	Sei Rampah	669,746	68	1 h and 18 minutes
8.	Medan	2,527,050	124	2 h and 7 minutes
9.	Tanjungbalai	179,589	76	2 h and 15 minutes
10.	Tebing Tinggi	177,029	46	1 h 15 minutes

3. Representative tourism attractions

Attractions have a very important meaning for the sustainability of an ecotourism location. Natural attractions such as national parks, rainforests, coral reefs, and volcanoes are the main attractions that bring tourists to visit. Cultural attractions such as traditional villages, traditional ceremonies, and handicrafts provide special experiences for tourists. The success of ecotourism depends on the development of attractive attractions and good management **(Yuwono *et al*., 2021)**. At BBMP, natural beauty is combined with man-made attractions. For example, hot air balloons are combined with sea views and expanses of mangrove forests. Likewise, with the flying fox attraction, bird watching, and others. Malay cultural attractions are not specifically shown at BBMP but are only shown in the form of food and drink menus, friendly service, and modesty of dress.

4. Condition of mangrove forests

BBMP has a mangrove forest area that is quite large (436 Ha) and has a suitable cruising area for tourists to carry out nature exploration (tracking) activities. The number of mangrove species is not very diverse (*A. marina, B. clindrica, R. apiculata*), but is quite dense (2,033.00 ind/ha). Referring to the Decree of the Minister of Environment of the Republic of Indonesia No. 201 of 2004 concerning standard criteria and guidelines for determining mangrove damage, it can be seen that the density of the mangroves is in good condition with a very dense category **(DME, 2004)**. The lushness, density, and diversity of these mangroves are also considered to be a special attraction for this mangrove ecotourism area.

5. Supporting facilities

Ecotourism-supporting facilities play an important role in supporting sustainable ecotourism. Toilets, parking areas, hand washing places, places of worship, and availability of trash cans are examples of these supporting facilities. The availability of security personnel who can control visitors, maintain a family atmosphere among visitors, and maintain vehicle safety is also part of the supporting facilities. Creating a clean and safe atmosphere at all tourist locations is crucial. A safe, comfortable, and beautiful atmosphere will provide a positive experience for tourists and allow them to come back to visit. For an ecotourism area to become an area of interest to visitors, it is necessary to improve these facilities. Well-designed and sustainably managed ecotourism support facilities play a key role in creating positive tourism experiences for the environment **(Effendi *et al*., 2022a; Firdaus *et al*., 2023)**. According to the author's observations, to date, the existence, quantity quality, and functionality of these supporting facilities at BBMP are available and well managed. Toilets, parking areas, hand washing places, places of worship, and rubbish bins are available and distributed according to visitors' needs. This ecotourism area does not have special security personnel. However,

it seems that all managers are jointly responsible for this so that a manly atmosphere is created. This is certainly an important point for the development and sustainability of this coastal ecotourism area.

6. Access to ecotourism location

Ecotourism accessibility is the most important thing in attracting visitor interest. Very difficult access will affect the number of tourist visits. So far, land road access to the BBMP location is quite supportive. Access not only facilitates tourist arrivals, but also ensures that ecotourism activities are carried out sustainably, provide economic benefits for local communities, and minimize negative impacts on the environment. With the right approach, good access can support sustainable ecotourism and provide deep and meaningful experiences for tourists. Good access increases tourist comfort and safety, which in turn improves the overall quality of the ecotourism experience **(Mafruhah *et al.*, 2019; Candranegara *et al.*, 2022)**.

7. Community awareness of conservation

The nuances of conservation education are clearly visible as soon as you enter the BBMP area. Tagging mangrove trees with local, English, and Latin names is intended as a vehicle for education and environmental conservation. Posting names and photos of birds and aquatic animals around the BBMP area is also part of this effort. Placing rubbish bins in the right places, displaying notice boards "keep clean", throw rubbish in the right place", "save water" and so on are BBMP's real efforts to educate the spirit of nature conservation. Environmental education for tourists and local communities through ecotourism can increase awareness and conservation action. Training and education provided by ecotourism organizations increase the capacity of local communities to manage and develop their tourism businesses independently.

Determining a mangrove area as a conservation area means trusting the community in managing conservation programs and placing the community as the main actors. Cooperation in developing BBMP mangrove ecotourism is a decisive step in developing ecotourism potential. The existence of cooperation from the business world can help managers in building ecotourism facilities. Activities like this can be implemented in the form of a corporate social responsibility (CSR) program. Non- governmental organizations (NGOs) play a dominant role in mentoring and counseling about the importance of community participation in mangrove ecotourism development **(Tlali & Musi, 2021)**.

Community and government participation in managing mangrove ecotourism is clearly very influential. Starting from preparing activity plans, preparing budget plans, determining locations, procuring seeds, planting, maintaining, and monitoring are important in tourism management. At all these stages, community participation cannot be separated and must be integrated with each other. Community participation in planning is

very necessary to help determine the direction of ecotourism development so that it does not clash with the values and traditions of the local community **(Huang *et al*., 2023)**.

CONCLUSION

The mangrove and coastal ecotourism has been managed well and can continue to develop. The key factors for successful management includes good location management, sufficient community demand for ecotourism, representative quantity and quality of ecotourism attractions, well-maintained condition of mangrove forests, and adequate facilities and infrastructure. Apart from that, there are also factors such as access to good tourist locations, involvement of local communities in the management and integration of Malay culture, and fostering public awareness of the meaning of sustainable conservation. The first two key factors (good business management and sufficient demand) are likely to be the main considerations for the successful management of mangrove and coastal ecotourism areas.

ACKNOWLEDGMENTS

We would like to thank to the Institute for Research and Community Service, University of Riau, funded this research. The same words were conveyed to Marine Sciences and Aquaculture Department, University of Riau, Pekanbaru, Aquaculture Department, University of Asahan, Kisaran, Department of Psychology, University of Diponegoro, Semarang, and Department of Management, Nagoya Indonesia University, Batam, Indonesia for their support to this study.

REFERENCES

Abdullah, R.P.S.R. and Isa, S.S. (2020). Gastronomy Tourism Growth in Malaysia: A Case Study of Malay Restaurants Performance in Klang Valley. Journal of Tourism and Hospitality Education, 10, 8–21. https://doi.org/10.3126/jthe.v10i0.28731.

Anu, K.; Parveen, H.; Sneha, V.K.; Busheera, P.; Muhammed, J. and Augustine, A. (2024). Mangroves in environmental engineering: Harnessing the multifunctional potential of nature's coastal architects for sustainable ecosystem management. Results in Engineering, 21, 2024, 101765. https://doi.org/10.1016/j.rineng.2024.101765.

Arifanti, V.B.; Sidik, F.; Mulyanto, B.; Susilowati, A.; Wahyuni, T.; Subarno, S. and Novita, N. (2022, May 1). Challenges and Strategies for Sustainable Mangrove Management in Indonesia: A Review. Forests, 13 (695): 1-18. https://doi.org/10.3390/f13050695.

Baltezar, P.; Murillo-Sandoval, P. J.; Cavanaugh, K. C.; Doughty, C. L.; Lagomasino, D.; Tieng, T.; Simard, M. and Fatoyinbo, T. (2023). A regional map of mangrove extent for Myanmar, Thailand, and Cambodia shows losses of 44% by 1996. Frontiers in Marine Science, 10. https://doi.org/10.3389/fmars.2023.1127720.

Barbier, E.B. (2019). Valuing coastal habitat-fishery linkages under regulated open access. Water (Switzerland), 11(4): 1-10. https://doi.org/10.3390/w11040847.

Blanton, A.; Ewane, E. B.; McTavish, F.; Watt, M. S.; Rogers, K.; Daneil, R.; Vizcaino, I. S.; Gómez, Á.; Arachchige, P. S. P.; King, S.; Galgamuwa, G. A. P.; Peñaranda, M. L. P.; Al-Musawi, L.; Montenegro, J. F.; Broadbent, E. N.; Almeyda Zambrano, A. M.; Hudak, A. T.; Swangjang, K.; Valasquez-Camacho, L. F. and Mohan, M. (2024). Ecotourism and mangrove conservation in Southeast Asia: Current trends and perspectives. Journal of Environmental Management, 365, 121529. https://doi.org/10.1016/j.jenvman.2024.121529.

Brenner, L. and Job, H. (2006). Actor-oriented management of protected areas and ecotourism in Mexico. Journal of Latin American Geography, 5(2): 7–27.

Cahyaningsih, A.P.; Deanova, A.K.; Pristiawati, C.M.; Ulumuddin, Y. I.; Kusumawati, L. and Setyawan, A.D. (2022). Review: Causes and impacts of anthropogenic activities on mangrove deforestation and degradation in Indonesia. International Journal of Bonorowo Wetlands, 12(1): 12-22. https://smujo.id/bw/article/view/9215/5560.

Candranegara, I.M.W.; Mirta, I.W.; Putra Sedana, I.D.G. and Wirata, G. (2022). Hexahelix Concept in The Development of Ecotourism Area in The Kelating Traditional Village Ecotourism Area, Kerambitan District, Tabanan Regency. IAPA International Conference and International Indonesia Conference on Interdisciplinary Studies (IICIS), 144, 1-14. https://doi.org/10.30589/proceedings.2022.688.

Carvache-Franco, M.; Carvache-Franco, W.; Víquez-Paniagua, A.G.; Carvache-Franco, O. and Pérez-Orozco, A. (2021). The role of motivations in the segmentation of ecotourism destinations: A study from Costa Rica. Sustainability (Switzerland), 13(17): 1-18. https://doi.org/10.3390/su13179818.

Das, M. and Chatterjee, B. (2020). Community empowerment and conservation through ecotourism: A case of Bhitarkanika Wildlife Sanctuary, Odisha, India. Tourism Review International, 24(4): 215–231. https://doi.org/10.3727/154427220x15990732245655.

DME (Decree of the Minister of Environment) No. 201 of 2004 concerning standard criteria and guidelines for determining mangrove damage. 2004. Ministry of the Environment of the Republic of Indonesia. Jakarta.

Effendi, I.; Yoswaty, D.; Harahap, I. M. S.; Jupendri, J. and Andrizal, A. (2022). Mangrove Conservation, Ecotourism, and Development Strategy in Bandar Bakau

Dumai, Indonesia. Journal of Environmental Management and Tourism, 13(5), 1443. https://doi.org/10.14505/jemt.v13.5(61).19.

Effendi, I.; Elizal, Rizal, Y.; Wiyati, R. and Maryanti, S. (2018). Preliminary study on ecotourism potency of tropical forest and coastal area on PT Diamond Raya Timber concession area, Riau Province. IOP Conference Series: Earth and Environmental Science (Vol. 216). Institute of Physics Publishing. https://doi.org/10.1088/1755-1315/216/1/012046.

Effendi, I.; Nursyirwani, N.; Panjaitan, W.P.; Yoswaty, D.; Ghalib, M.; Razman, M.R. and Andrizal, A. (2021). Potency and development strategy of sungai bersejarah mangrove ecotourism, siak regency. Journal of Environmental Management and Tourism, 12(8): 2272–2282. https://doi.org/10.14505/jemt.v12.8(56).25.

Effendi, I.; Yoswaty, D.; Harahap, I.; Jupendri, J. and Andrizal, A. (2022a). Mangrove Conservation, Ecotourism, and Development Strategy in Bandar Bakau Dumai, Indonesia. Journal of Environmental Management and Tourism, 13(5): 1443–1452. https://doi.org/10.14505/jemt.v13.5(61).19

Effendi, I.; Yoswaty, D.; Harahap, I.; Jupendri, J.; Adriani, Y.; Effendi, I. and Andrizal, A. (2022b). Mangrove and Malay ethnocultural approaches for conservation in Dumai Municipality, Indonesia. International Journal of Conservation Science, 13(4): 1173–1186.

Elfandayani, S.; Rahmi, M.M.; Lubis, F.; Zurba, N. and Suriani, M. (2021). Pengelolaan ekowisata mangrove di kawasan wisata mangrove Desa Gampong Baro Kecamatan Setia Bakti Kabupaten Aceh Jaya. 5(2): 105-117. https://doi.org/10.35308/jaas.v5i2.5062.

Fatkhurahman, F.; Effendi, I.; Effendi, Iz.; Hadiyati, H.; Akbar, M. R.; Dawami, D. and Jamaan, A. (2024). Prospects and analysis of coastal ecotourism in Malay community. AACL Bioflux 17(1): 360-373.

Firdaus E.; Haryono, D.; Indra, M. and Effendi, I. (2023). Legal aspects and development of Bandar Bakau Dumai, Indonesia as a mangrove conservation and ecotourism area. AACL Bioflux 16(3):1448-1458.

Giesen, W.; Wulffraat, S.; Zieren, M. and Scholten, L. (2006). Mangrove Guidebook for Southeast Asia. FAO and Wetlands International. Dharmasarn Co., Ltd. 781 p. https://www.fao.org/3/ag132e/ag132e.pdf.

Ginting, S. D. and Rauf, A. (2023). The analysis of land use change of mangrove ecosystem in Langkat, North Sumatera, Indonesia. Journal of Environmental and Development Studies. https://doi.org/10.32734/jeds.v4i2.12559.

Hermon, D.; Ikhwan, Putra, A. and Oktorie, O. (2020). Spatial analysis of tsunami vulnerability zones as a basic concept of coastal disaster mitigation in development planning of Pariaman city. Journal of Advanced Research in Dynamical and

Control Systems, 12(7):681–690. https://doi.org/10.5373/JARDCS/V12SP7/20202158

Huang, C.C.; Li, S.P.; Chan, Y.K.; Hsieh, M.Y. and Lai, J.C.M. (2023). Empirical Research on the Sustainable Development of Ecotourism with Environmental Education Concepts. Sustainability (Switzerland), 15(13): 1-15/ https://doi.org/10.3390/su151310307.

Irmayanti, D. (2024). Collaborative Strategies for Managing Mangrove Ecotourism: Raising Awareness and Stakeholder Participation in Sustainable Tourism. Lontar : Jurnal Ilmu Komunikasi, 12(2): 322-333. https://doi.org/10.30656/lontar.v12.i2.8744.

Kitamura, S.; Anwar, C.; Chaniago, A. and Baba, S. (1998). Hand Book of Mangrove in Indonesia – Bali and Lombok. JICA ISME. 118 p.

Li, B.; Wang, Q.; Liu, Z.; Huang, X. and Wang, B. (2018). An Examination of the Suitability of Sea Area for Tourism and Recreation Based on Principal Component Analysis. 1087(3), 032026. https://doi.org/10.1088/1742-6596/1087/3/032026.

Liu, X.; Liu, H.; Chen, L. and Wang, X. (2022). Ecological interception effect of mangroves on microplastics. Journal of Hazardous Materials, 423, Part B, 2022, 127231. https://doi.org/10.1016/j.jhazmat.2021.127231.

Macintosh, D.; Suarez, E.; Aung, T.; Friess, D. A.; Lee, C.; Hossain, M. and Nightingale, M. (2023). IUCN Red List of Ecosystems, Mangroves of the Andaman. https://doi.org/10.32942/x2930f.

Mafruhah, I.; Mulyani, N. S.; Istiqomah, N. and Ismoyowati, D. (2019). Development of Ecotourism based on Community Empowerment (a Case Study of Kebumen Regency). Jurnal Ekonomi Pembangunan: Kajian Masalah Ekonomi Dan Pembangunan, 19(2): 196-206. https://doi.org/10.23917/jep.v19i2.6996.

Markum, M.; Ichsan, A.C.; Lesmono Aji, I.M. and Ashari, A.M. (2024). Enhancing the Capacity of Tourism Awareness Groups in Climate Change Adaptation and Mitigation at the Tanjung Batu Mangrove Ecotourism, Sekotong Tengah Village, West Lombok Regency. Unram Journal of Community Service, 5(3): 163–169. https://doi.org/10.29303/ujcs.v5i3.704.

Muhtadi, A.; Harahap, Z. A.; Pulungan, A.; Nurmatias, N.; Lubis, P.; Siregar, Z.; Ompusunggu, R. Y. and Aulia, F. (2020). Status and mangrove distribution in Taman Pulau Kecil conservation area, Central Tapanuli District, North Sumatra Province. DEPIK. Jurnal Ilmu-Ilmu Perairan, Pesisir dan Perikanan, 9(2): 200–209. https://doi.org/10.13170/DEPIK.9.2.15065.

Mushkudiani, Z.; Chkhirodze, D. and Tevdoradze, S. (2023). Challenges of sustainable ecotourism and its impact on economy (Georgian case). Access Journal - Access to Science, Business, Innovation in the Digital Economy, 4(3): 400–408. https://doi.org/10.46656/access.2023.4.3(5).

Nasution, M. S.; Hussin, H.; Rusli, Z.; Mayarni, M.; Mashur, D.; Zulkarnaini, Z. and Ananda, F. (2025). Integration of Environmental Policies in Sustainable

Management of Mangrove Ecotourism. E3S Web of Conferences, 611, 04003. https://doi.org/10.1051/e3sconf/202561104003.

Noor R.Y.; Khazali, M. and Suryadiputra, I.N.N. (2006). Mangroves Identification Guidelines in Indonesia. Wedlands International- Indonesia Programme. Bogor, 220 p.

Pham, H.S.T. and Khanh, C.N.T. (2021). Ecotourism intention: the roles of environmental concern, time perspective and destination image. Tourism Review, 76(5): 1141–1153. https://doi.org/10.1108/TR-09-2019-0363

Sadikin, P.N.; Pramudya, B.; Mulatsih, S. and Arifin, H.S. (2017). Enhancing Socio-Economic Institution Strategic Planning of Ecotourism, Mount Rinjani National Park. International Journal of Sciences: Basic and Applied Research (IJSBAR), 31(1): 142156.

Sarinastiti, E.N. and Wicaksono, M.S. (2021). Coastal ecotourism management for sustainable development in Panggul, Trenggalek Regency, East Java, Indonesia. Journal of Sustainability Science and Management, 16(6): 256–273. https://doi.org/10.46754/jssm.2021.08.022.

Suci, M. D.; Hamidy, R. and Putra, R. (2022). Analisis keberlanjutan ekowisata mangrove mengkapan siak. Jurnal Ilmu Lingkungan, 16(1): 25-41. https://doi.org/10.31258/jil.16.1.p.25-41.

Tjahjono, A.; Intyas, A.C. and Fattah, M. (2022). Mangrove management strategy for sustainable business based on Indonesian ecological products. Geojournal of Tourism and Geosites, 43(3): 1045–1055. https://doi.org/10.30892/gtg.43325-919

Tlali, L.T. and Musi, M.L. (2021). Gender Equality and Empowerment through Corporate Social Responsibility in Ecotourism at Malealea, Lesotho: A Qualitative Study. Athens Journal of Tourism, 8(4): 247–268. https://doi.org/10.30958/ajt.8-4-3.

Trialfhianty, T.I.; Muharram, F.W.; Suadi, Quinn, C. H. and Beger, M. (2022). Spatial multi-criteria analysis to capture socio-economic factors in mangrove conservation. Marine Policy, 141, 2022, 105094. https://doi.org/10.1016/j.marpol.2022.105094.

Ulqodry, T. Z.; Agussalim, A.; Widiastuti, I.; Aryawati, R. and Aprianto, A. E. (2019). The preliminary assessment of mangrove status at Payung Island in Musi Estuary, Indonesia. https://seminar.bio.unsoed.ac.id/index.php/ICoMIRE/ICoMIRE-2019/paper/view/498.

Vajčnerová, I.; Šácha, J. and Ryglová, K. (2012). Using the principal component analysis for evaluating the quality of a tourist destination. Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis, 60(2), 449–458. https://doi.org/10.11118/ACTAUN201260020449.

Wang, Y.S. and Gu, J.D. (2021). Ecological responses, adaptation and mechanisms of mangrove wetland ecosystem to global climate change and anthropogenic activities. International Biodeterioration and Biodegradation, 162, 2021, 105248. https://doi.org/10.1016/j.ibiod.2021.105248.

Wang, Z. (2020). Eco-tourism benefit evaluation of Yellow River based on principal component analysis. Journal of Intelligent and Fuzzy Systems, 39(6), 8907–8915. https://doi.org/10.3233/JIFS-189288.

Winarso, G.; Kamal, M.; Rosid, M. S.; Asriningrum, W. and Supriatna, J. (2020). Kajian Pustaka Asesmen Status Kondisi Ekosistem Mangrove. 1(2), 48–56. https://doi.org/10.24233/SRIBIOS.1.2.2020.200.

Yuwono, E.; Maulany, R.I. and Barkey, R.A. (2021). Site suitability evaluation for ecotourism development: a case study in Bulue Village, Soppeng District, Indonesia. Journal of Sustainability Science and Management, 16(1): 129–140. https://doi.org/10.46754/jssm.2021.01.012.