

Ecotourism development with SWOT analysis as an effort to conserve mangrove ecosystems in Kotabaru Regency, South Kalimantan Province, Indonesia

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Abstract. The extent of Indonesia's mangrove forests has decreased in recent decades, generally influenced by anthropogenic factors including in Kotabaru Regency of South Kalimantan Province, Indonesia. It is necessary to prepare alternative livelihoods and sustainable use of mangrove areas as an effort to reduce pressure on mangrove forests, through cultivation in mangrove areas (silvofishery) and ecotourism. One of the methods used to map the potential of ecotourism is by using a descriptive analysis approach and SWOT analysis (Strength, Weakness, Opportunity, and Threats). The potential suitability of mangrove ecotourism can be assessed by: 1) identified the SWOT factors according to local characteristics then calculating weights and scores of these parameters; 2) field survey to acquire the thickness of mangrove vegetation from coast to land, mangrove density, mangrove species, tidal water levels in mangrove areas, aquatic and terrestrial biota objects that interact in mangroves, accessibility, and connectivity with other tourism area. The strategies for mangrove conservation at provincial level which have been formulated using SWOT approach, then derived into action plan at regional level by identifying a potential site for this purpose. Based on Mangrove Tourism Suitability Index, this site gains a total score of 2.81, (very appropriate category). Recommended mangrove ecotourism activities can be integrated with shrimp/milkfish/crab in silvofishery area which will be managed by local communities, as well as mangrove breeding and mangrove planting activities for mangroves species that naturally grow in the area. **Keywords:** *ecotourism, Kotabaru regency, mangrove conservation, SWOT analysis.*

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1 Introduction

Indonesia has the largest mangrove forest in the world [1], with more than 3 million hectares of mangrove forest are scattered along its coastline. South Kalimantan is a province in Indonesia with more than 1,300 km of coastline which holding more than 84,000 ha of mangrove forest, or nearly 2.5% national mangrove extent (Table 1) [2].

Table 1. Proportion of existing mangrove extent on various land use type in South Kalimantan Province

Canopy condition	Type of land use			Total (Ha)
	Conserved Forest (Ha)	Production Forest (Ha)	Other land use type (Ha)	
Sparse	793	172	2,512	3477
Moderate	9,696	2,327	14,226	26,249
Dense	35,297	704	18,806	54,806
Total (Ha)	45,786	3,203	35,544	84,532

(source: Ministry of Environment and Forestry Republic of Indonesia, 2021).

Global mangrove forests are being threatened mostly by anthropogenic pressures such as land conversion into aquaculture and agriculture, ports, housing/warehousing, oil palm plantation, etc. [3][4], thus causing mangrove loss about 1.58% annually [5]. This is probably due to mangrove forest often considered as idle and neglected land which provide no benefit to local inhabitants. Moreover, it is a natural habitat for dangerous reptiles such as crocodiles and snakes. Likewise, the South Kalimantan Province is currently become one of buffer area for Indonesia's new capital known as Nusantara city (stipulated under Indonesian Regulation no. 3 Year 2022), which currently under construction. This strategic geographical location will certainly induce urbanization, the development of new economic centres, hence leading to the need for greater land conversion soon, especially next to watershed and coastal areas in this province. The massive mangrove deforestation in Indonesia is recorded from 1980s to 1990s, where most of these forests are converted into aquaculture ponds [6][7]. But in a decade after (in 2000s), the productivity of aquaculture began to decline, thus many of shrimp ponds were abandoned. At the same period, the awareness on the importance of mangrove forest were rising, leading to mangrove planting across the nation including in the abandoned ponds [8][9][10][11].

To prevent further land use change in coastal area (particularly in mangrove forest), the government of Indonesia has established regulations, such as Presidential decree No. 73 year 2012 concerning Mangrove Ecosystem Management Strategy; while South Kalimantan Province established a regulation regarding marine spatial planning, as well as land use planning in coastal and small islands (as stipulated under Provincial Regulation no. 13 Year 2018). Moreover, it is necessary to prepare alternative livelihoods and sustainable use of mangrove areas as an effort to reduce pressure on mangrove forests [12], such as through aquaculture in mangrove areas (silvofishery) and ecotourism.

The silvofishery term is a combination from the latin word of 'silvo' (meaning 'the forest') and English word of 'fishery'; which can be interpreted as integrating brackish water aquaculture with the preservation of surrounding mangrove forest [13][14]. This system is similar with freshwater aquaculture at rice field which have been commonly practiced for decades, particularly in Southeast Asia. There are two basic silvofishery models, i.e.: (i) preserve mangrove vegetations inside ponds with a proportion of 60-80% of mangrove; and

(ii) the mangroves vegetations are outside ponds with balanced mangrove to water ratio. These basic models can be modified and customized according to coastal conditions [15]. There are many success stories of silvofishery in Indonesia [16][17], as a tool for conserving mangrove forest including the notable mangrove restoration and conservation in Delta Mahakam in East Kalimantan Province [18].

Another alternative to sustainable use of mangrove forest is through ecotourism. The scientific discussion regarding the concept of sustainable tourism itself was started around the 1960s and continues to grow since the term of Ecotourism was introduced by Ceballos-Lascurain in 1987 [19], until adopted worldwide including in Indonesia [20][21].

Many success stories in other places have encouraged the Provincial Government to conduct a feasibility study on integrated ecotourism with silvofishery development as part of efforts to preserve the mangrove ecosystem, especially in Kotabaru Regency, South Kalimantan Province, Indonesia.

2 Material and methods

This study is conducted on five coastal regencies in South Kalimantan Province with focused on the Kotabaru Regency as the largest region in this province. Process for data collection is done through several methods, including:

- Collection of secondary data, mainly the South Kalimantan Province's RZWP3K document, downloading satellite imageries for further analysis (NDVI) to obtain land use and mangrove distribution, as well as coastline condition in South Kalimantan Province.
- Aerial photography using drone also conducted in selected sites to acquire more detailed condition of mangrove and land use change evidence in coastal area.
- Hemisphere photography on field to verify the result of remote sensing analysis regarding density of mangrove canopy.
- Field survey to obtain mangrove and associated fauna species diversity, as well as to observe the condition of existing infrastructures facilities for carrying capacity and suitability analysis of the potential sites.
- Focus Group Discussion involving local key stakeholders and experts, to perform SWOT analysis and ecotourism suitability analysis [22].

The development of mangrove ecotourism development strategies in South Kalimantan Province (particularly in Kotabaru region) is conducted using a SWOT approach. Internal (Strengths and Opportunities) and external factors (Weaknesses and Threats) faced in planning the development of ecotourism activities, are identified by key stakeholders and experts. Each of these factors then weighted and scored based on stakeholders' perspective, to determine which strategy should be taken out of four alternatives, i.e.: (i) Aggressive strategy (optimizing strength to take advantage of opportunities); (ii) Diversification strategy (Diminishing threat by maximizing strength); (iii) Turn-around strategy (Diminishing weakness by maximizing opportunities); and (iv) Defensive strategy (identify possible efforts to combat weaknesses and threats).

Based on this preferred strategy, stakeholders then asked again to identify environmental parameters that support the suitability of existing ecotourism site and or other potential sites that will be developed as new ecotourism destination (if the aggressive strategy is preferred). These parameters then observed on field to facilitate the scoring process using Ecotourism Suitability Index (ESI) as follows:

$$ESI = \sum_{i=1}^n (W_i \times S_i) \quad (1)$$

where:

- ESI = Ecotourism Suitability Index;
- W = weight of the i^{th} parameter.
- S = score of the i^{th} parameter.

The final score will indicate the suitability of each proposed site, which categorized into the following class:

- Very Suitable : $ESI \geq 2.5$;
- Suitable : $2.0 \leq ESI < 2.5$;
- Less Suitable : $1.0 \leq ESI < 2.0$;
- Unsuitable : $ESI < 1$.

The development of a mangrove ecotourism program is an effort to use mangrove land in a sustainable manner, simultaneously with preservation of mangrove forest. Therefore, number of visitations for each specific activity inside ecotourism site, should be limited to mitigate disturbance or pressure to the environment. This estimation is conducted using carrying capacity analysis according to the condition of the site [22], as follows:

$$CC = E \times \frac{L_u}{L_s} \times \frac{T_t}{T_{pv}} \quad (2)$$

where:

- CC : Carrying capacity of tourism area (people/day);
- E : Ecological potential of visitors per unit area (people);
- Lu : Length or area that can be utilized (meters or m^2);
- Ls : Area unit for a specific category (meters or m^2);
- Td : Time provided by the area for tourism activities in one day (hours/day);
- Tv : Time spent by visitors for each activity (hours/day).

3 Results and discussion

3.1. Field observation on mangrove loss in South Kalimantan Province

Preliminary field observation shows that river and coastal erosion as well as land use changes are identified as the drivers of mangrove loss in South Kalimantan Province (Figure 1). Realizing the existing condition of environmental degradation along the coastal area, the South Kalimantan provincial government analyse various options to reduce the degradation rate, including this study to inventory the potential for ecotourism development in mangrove forest areas.



River erosion



Coastal erosion



Land conversion into aquaculture ponds



Figure 1. Evidence of mangrove loss in South Kalimantan Province due to different natural causes and anthropogenic pressures (land use change).

3.2. Analyzing the potential for ecotourism development using the SWOT approach

Key local stakeholders are involved to identify the strength, weakness, opportunity, and threat factors regarding the potential of ecotourism development as an effort to conserve mangrove ecosystem in South Kalimantan Province, then determine their respective weight and score as follows:

Table 2. Identification of SWOT factors and scoring result

No	Internal Factors (IFAS)	Weight	Rating	Total
	Strength (S)			
S1	Availability of existing regulation, such as Presidential decree No. 73 year 2012 concerning Mangrove Ecosystem Management Strategy.	0.12	4	0.48
S2	High diversity of mangrove species	0.12	4	0.48
S3	Vast area and high density of mangrove forest	0.09	3	0.28
S4	High interest from local investor to be involved in ecotourism development	0.09	3	0.28
S5	Several mangrove forests are close to the city centre	0.09	3	0.28
S6	Massive mangrove planting campaign by government agency, private sector, universities, and NGO	0.06	2	0.12
S7	Several sites are relatively pristine, can be developed as new ecotourism sites	0.12	4	0.48
S8	Strong support from local farmer or fisherman groups	0.06	2	0.12
S9	Natural habitat for endemic fauna such as bekantan/Proboscis monkey (<i>Nasalis larvatus</i>) and Crab-eating macaque (<i>Macaca fascicularis</i>)	0.12	4	0.48
S10	Good awareness and support to the blue carbon campaign.	0.12	4	0.48
	Total score (S)			3.48
	Weakness (W)			
W1	Local governments are not derived specific regulation concerning mangrove ecosystem management yet.	-0.11	1	-0.11
W2	No institutional arrangement for sustainable use of mangrove areas in place.	-0.11	1	-0.11
W3	Poor infrastructure and facilities in existing tourism sites.	-0.08	2	-0.17
W4	Some of mangrove forests are difficult to be accessed.	-0.08	2	-0.17
W5	Zonation for ecotourism remains unclear.	-0.08	2	-0.17
W6	Lack of campaign for mangrove forests as ecotourism site.	-0.08	2	-0.17
W7	Continuous land use change from mangrove forest into brackish water ponds, agricultural area, mine, ports, and housing.	-0.11	1	-0.11
W8	Poor law enforcement due to limited officer.	-0.11	1	-0.11

W9	Zonation for mangrove and bekantan conservation area remains unclear.	-0.11	1	-0.11
W10	Poor waste management in mangrove area.	-0.11	1	-0.11
	Total score (W)			-1.33
	Accumulation (S) + (W)			2.15
No	External Factors (EFAS)	Weight	Rating	Total
	Opportunity (O)			
O1	Availability of existing regulation, such as Presidential decree No. 73 year 2012 concerning Mangrove Ecosystem Management Strategy.	0.20	4	0.80
O2	Tourism sector continuous to grow and attract public interest.	0.20	3	0.60
O3	Improving transportation sector, facilitating access for domestic and foreign tourist.	0.10	3	0.30
O4	Availability of educated, skilled and productive age workforce	0.10	3	0.30
O5	Utilization local wisdom and traditional art, to produce specialty handicraft and culinary	0.10	3	0.30
O6	South Kalimantan Province become a buffer zone for the new Capital city /Ibu Kota Negara (IKN) of Indonesia	0.10	3	0.30
O7	Good commitment of local government in managing mangrove ecosystem.	0.20	4	0.80
	Total score (O)			3.40
	Threat (T)			
T1	Local government remains unfocused in monitoring the critical mangrove forest (inadequate mangrove restoration/rehabilitation program)	-0.14	2	-0.27
T2	Logging/land clearing in mangrove forest	-0.14	2	-0.27
T3	High tide and coastal abrasion.	-0.09	2	-0.18
T4	Rate of suspended sediment	-0.14	1	-0.14
T5	Land use change from mangrove forest into aquaculture ponds, agricultural fields, mine, ports, and housing	-0.18	1	-0.18
T6	Pollution in mangrove ecosystem caused by marine litter, industrial/mining waste, ship waste, domestics waste, etc	-0.18	1	-0.18
T7	Poor littering habit	-0.14	1	-0.14
	Total score (T)			-1.36
	Accumulation (O) + (T)			2.04

Total score of Internal Factors (IFAS) and External Factors (EFAS) then plotted into 4-quadrant diagram of SWOT analysis, as follows:

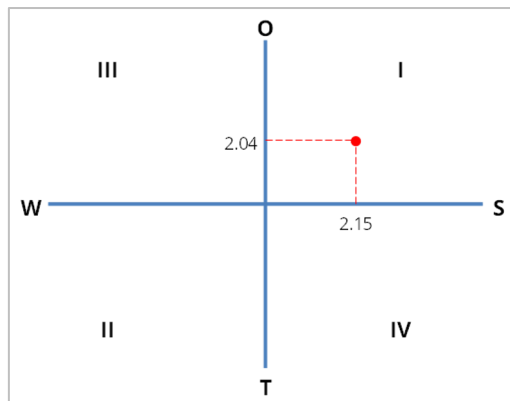


Figure 2. 4-quadrant diagram result of SWOT analysis.

Figure 2 above indicates that preferred strategy to develop sustainable management of mangrove is in quadrant I (2.15, 2.04) which is 'aggressive' and focused on growth-oriented strategy. Hence, S-O based strategy for mangrove forest management can be formulated as follows:

- a. Developing mangrove conservation and rehabilitation as a tourism program.
Mangrove forests have various physical, ecological, economic, and socio-cultural functions. Its physical functions include stabilizing coastal areas, protecting coastlines, and maintaining sediment stability. The ecological function is as nutrient provider, spawning ground, nursery ground and feeding ground for associated fauna. The economic function of the mangrove ecosystem is providing livelihood for surrounding community; while the social and cultural function of mangrove forests is providing areas for social and cultural activities, conservation, and education. Considering these important functions of mangroves, conservation and rehabilitation activities should be promoted simultaneously with the development of ecotourism program. This can be achieved with a well-designed plan which considers the carrying capacity of environment.
- b. Strengthen enforcement of laws and regulations to preserve mangrove forest.
It is the Government's task to establish a clear boundary among each land use zone (which has been declared in Provincial Regulation no. 13 Year 2018 or known as Provincial RZWP3K). This regulation should be disseminated to communities and business actors. The capacity of law enforcers must be improved, so the government can monitor the implementation of regulation and be able to perform law enforcement properly, thus massive logging and land conversion can be prevented.
- c. Increasing community participation and related stakeholders' engagement in ecotourism sector.
One of the ecotourism development purposes is to increase community participation, thus ecotourism can provide alternative livelihood and economic benefit for local community. Community engagement can be established through training and assistance by government to upgrade the skill set of local communities (e.g.: foreign language, specialties art and culinary, hospitality, etc.).
- d. Integrating silvofishery with ecotourism.
Historical data has revealed that the east coast of Kalimantan was once converted into aquaculture land on a massive scale. To prevent repeating history and to gain support from fishermen in the region, Government should allocate sufficient area for silvofishery activity within ecotourism site. This shrimp or milkfish or mangrove crab cultivation activities in silvofishery area will be run by local communities, while mangrove breeding and planting activities using mangroves species that naturally grow in the area (such as *Avicennia sp.*, *Sonneratia sp.* and *Rhizophora sp.*), will be organized by site manager or local government agencies. Therefore, local communities gain economic benefit while various activities can be done without destroying the mangrove ecosystem. i.e.: scientific research, education, tourism, sport, and aquaculture.

3.3. Suitability analysis on potential ecotourism sites, particularly in Kotabaru Regency.

The South Kalimantan Province is comprised of 5 coastal regencies where Kotabaru is the largest, with an area of 9,351 km² or more than a quarter of this province. For the case of Kotabaru Regency, there are three ecotourism sites that have been operational, such as

Lanal's mangrove ecotourism (in Pulau Laut Utara), Langadai mangrove ecotourism (in Kelumpang Hilir), and Tanjung Samalantakan Mangrove ecotourism (in Pamukan Selatan). Yet, their supporting facilities require improvements.

Since the SWOT analysis resulting an aggressive strategy, local government planned to develop another mangrove ecotourism site in Tanjung Pemancingan. This proposed site has a very good road infrastructure with easy access to the city centre of Kotabaru, airport, seaport, and other tourist destinations in Kotabaru. The first step to assess the suitability of this proposed site, is by organizing a series of focus group discussion involving key local stakeholders and experts to identify relevant parameters that will be observed in the field, also determine class and weight for each parameter. The result is summarized in Table 3.

After the ecotourism suitability parameters for South Kalimantan Province has been established, a series of field observations and analysis are conducted to assess current condition of proposed ecotourism site (Tanjung Pemancingan), with the following results:

- Mangrove thickness. In the northern side (the cape), mangrove thickness is relatively thin (about 60 m) due to existing infrastructure of shipping port. While in the south, mangrove thickness is increasing until more than 400 m;
- The result of NDVI analysis and field observation using Hemispherical photography reveal that mangrove thickness in Tanjung Pemancingan is very dense, where the distance between tree is less than 3 m, and canopy coverage percentage ranges around 70-80%;
- More than 7 species of mangroves are scattered along the coast of Tanjung Pemancingan. On the abandoned ponds in the east of Sekukup river mouth, various mangroves species can be found, such as: *Avicennia marina*, *A. officinalis*, *A. rumphiana*, *Bruguiera gymnorrhiza*, *Rhizophora apiculata* and *Xylocarpus granatum*. While along its east coast is dominated by *Sonneratia alba*;
- Tides. Typical tidal pattern of the waters in eastern Kalimantan (including in Kotabaru Regency) is a mixed tide prevailing semidiurnal with a Formzal value ranges between 0.66 and 0.93, which indicate two high tides and two low tides per day with different height and time interval. The dominant ocean current direction to the southward, due to influence of mass movements from the Pacific Ocean (Indonesian Through Flow), with a speed > 0.3 m/s. During the west monsoon, the pattern of ocean current usually moves to east-southeast direction. During the first transition season, ocean current in the northern Kotabaru moves to the southeast and south while the southern Kotabaru, the current move to the east and southwest due to influence of Java Sea currents. During the east monsoon and the second transition season, the dominant current moves towards the south and west, with a speed of > 0.2 m/s.
- High diversity of fauna can be found in this site, such as bekantan/proboscis monkey (*Nasalis larvatus*), crab-eating macaque (*Macaca fascicularis*), and various of fish, shrimp, molluscs, reptile, amphibia, and migrating seabirds;
- This site has a very good road infrastructure, close to city centre with easy access to airport, seaport.
- Close to other tourism sites which as good natural beach and several forests which known as natural habitat for bekantan/Proboscis monkey (*Nasalis larvatus*);
- Hospitality and strong support from local communities and private sectors.

Table 3. Summary of ecotourism suitability parameters for South Kalimantan Province.

No	Parameter	Weight	Class	Score
1.	Mangrove forest thickness	0,19	> 500	3
			200 - 500	2
			50 - 200	1
			< 50	0
2.	Mangrove density	0,18	< 5	3
			5 - 10	2
			10 - 15	1
			15 - 20	0
3.	Mangrove species	0,16	> 5	3
			3 - 5	2
			2 - 1	1
			0	0
4.	Tidal	0,12	0 - 1	3
			1 - 2	2
			2 - 5	1
			>5	0
5.	Diversity of fauna species	0,12	fish, shrimp, crab, molluscs, reptiles, seabirds, proboscis monkey	3
			Fish, shrimp, crab, molluscs, reptiles, seabird, monkey	2
			fish, crab, molluscs, reptiles	1
			Only one water fauna existed	0
6.	Accessibility	0,12	Asphalted road to the site > 90%	3
			25% < Asphalted Road to the site < 75%	2
			40% < Asphalted Road to the site < 60%	1
			Asphalted Road to the site < 60%	0
7.	Connectivity with other tourism sites	0,11	Close to more three other tourism destinations	3
			Close to more two other tourism destinations	2
			Close to more another tourism destination	1
			Remote area	0

Results of field observation and satellite imagery analysis then converted into score according to their respective parameter and class, as follows:

Table 4. Scoring the mangrove ecotourism suitability index

No	Parameter	Data source	Weight	Category	Score	W x S
1.	Mangrove forest thickness (m)	Satellite imagery analysis	0.19	200 - 500	2	0.38
2.	Mangrove density (m)		0.18	< 5	3	0.54
3.	Mangrove species	Field observation	0.16	7	3	0.48
4.	Tides/oceanography characteristics		0.12	0 – 1	3	0.36
5.	Diversity of fauna species		0.12	>7	3	0.36
6.	Accessibility		0.12	Very good	3	0.36
7.	Connectivity with other tourism sites		0.11	3 other sites	3	0.33
Mangrove Ecotourism suitability index (ESI)						2.81

Table 4 reveals total score of ESI is 2.81, or in ‘very suitable’ category. Based on this result, the government can start designing the site plan for this selected location (Figure 3). In the southwest of Tanjung Pemancingan, mangrove ecotourism will be integrated with shrimp/milkfish/mangrove crab cultivation ponds (silvofishery), where visitors can learn the ecological functions of mangroves, economic benefits, environmental services, and processed products related to mangroves. Meanwhile, mangrove conservation (through

mangrove seeding and planting activities for the species of *Avicennia sp.*, *Soneratia sp.* and *Rhizophora sp.*, etc.) and preservation of protected birds and other fauna are located along the west coast of Tanjung Pemancingan. Figure 4 shows the 3D design of facilities that will be provided in Tanjung Pemancingan, including roads, parking areas, educational huts, public toilets, footbridges, watchtowers, mangrove cafes, floating gazebos on artificial lakes, parking areas and panoramic screen spots.



Figure 3. Site plan of mangrove ecotourism in Tanjung Pemancingan. The left side figure is the designated zone for ecotourism. While the white dashed box is zoomed in the right-side figure, indicating the area for tracking and silvofishery activity.



Figure 4. Design of facilities that will be provided in mangrove ecotourism of Tanjung Pemancingan.

Ecotourism is different with mass tourism. Hence, number of visits at a certain time should be limited according to area carrying capacity, to prevent over tourism and mitigate negative impact of tourism to the ecosystem [22]. Type of tourism activity became primary variable to estimate required space and time by a tourist to do such activity comfortably. In

this case, possible tourism activities that can be done in Tanjung Pemancingan among others: (i) tracking, (ii) bird or fauna watching.

Table 5. Carrying capacity estimation.

Type of tourism activity	Visitor (V)	Total area for respective activity (m ²)	Estimated required space per person (m ²)	Total operational time per day (hrs)	Estimated visiting time per person (hrs)	Estimated max. visit (visitor/day)
Tracking	1	500	5	8	2	80
Bird/fauna watching	1	200	25	8	4	32

4 Conclusion

Mangrove forest preservation in South Kalimantan Province can be implemented through ecotourism integrated with silvofishery, where local communities remain able to use mangrove ecosystem in sustainable manner. However, the practice of ecotourism should limit the number of visitors according to mangrove ecosystem carrying capacity, to prevent negative impact of ecotourism to the environment.

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