Jurnal Natur Indonesia
21(1), April 2023: 75-80

p-ISSN 1410-9379
e-ISSN 2503-0345

Feasibility Assessment of Mangrove in Two Villages on Bengkalis Island for Ecotourism

Analisis Kelayakan Mangrove di Dua Desa di Pulau Bengkalis untuk Ekowisata

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ABSTRACT

Mangroves are a unique ecosystem that has an important role both bio-physically and socio-economically. Unfortunately, this ecosystem has suffered damage due to various forms of unwise use. Alternatively, the use of mangroves for ecotourism is often seen as more environmentally friendly and sustainable. On the other hand, some factors limit the success of mangrove ecotourism management. One of the most important factors is the feasibility of the mangrove itself as a capital for ecotourism. This study aims to evaluate the characteristics of mangroves in two villages on Bengkalis Island as ecotourism resources and to analyze their suitability as an ecotourism attraction. Data were collected through direct observation and interviews in Kuala Alam and Pematang Duku Village in Bengkalis District, Bengkalis Regency, Riau Province. The feasibility is analyzed using the Tourism Suitability Index (TSI) based on parameters that have been set by the TSI. The mangroves in Kuala Alam have an average cover thickness of 337 m, with a density of 300 trees/ha, which are composed of nine tree species. Mangroves in Pematang Duku have an average cover thickness of 948 m, with a density of 500 trees/ha, consisting of 14 tree species. The mangrove fauna found in the two villages is generally the same, as with the tidal pattern. The mangroves in Kuala Alam Village achieve a score of 1.75 which means they do not have tourism suitability (TSI<2) while mangroves in Pematang Duku achieve a score of 2.38 which meet the criteria to develop mangrove ecotourism (TSI>2).

Keywords: Mangrove Ecosystem, Tourism Suitability Index, Ecotourism Feasibility

ABSTRAK

Mangrove merupakan suatu bentuk ekosistem unik yang memiliki peranan sangat penting baik secara biofisik maupun sosial ekonomi. Sangat disesalkan ekosistem ini banyak mengalami kerusakan akibat berbagai bentuk pemanfaatan yang tidak bijaksana. Berkenaan dengan hal ini, pemanfaatan mangrove untuk ekowisata sering dipandang lebih ramah lingkungan dan berkelanjutan. Meskipun demikian, banyak faktor dapat membatasi keberhasilan pengelolaan ekowisata mangrove. Salah satu faktor terpenting adalah kelayakan mangrove itu sendiri sebagai modal penyelenggaraan ekowisata. Penelitian ini bertujuan untuk mengevaluasi karakteristik mangrove yang ada di dua desa yang terdapat di Pulau Bengkalis sebagai sumberdaya ekowisata dan menganalisis tingkat kesesuaiannya untuk dimanfaatkan sebagai obyek ekowisata. Data telah dikumpulkan melalui observasi secara langsung dan wawancara di Desa Kuala Alam dan Desa Pematang Duku yang ada di Kecamatan Bengkalis, Kabupaten Bengkalis, Provinsi Riau. Tingkat kelayakan wisata mangrove dihitung sebagai Indeks Kesesuaian Wisata (IKW) berdasarkan ketebalan tutupan, kerapatan pohon, jumlah jenis pohon, kekayaan fauna mangrove, serta pola pasang-surut air laut. Mangrove di Desa Kuala Alam memiliki ketebalan tutupan rata-rata 337 m, dengan kerapatan 300 pohon/ha, yang tersusun oleh sembilan jenis pohon. Mangrove di Desa pematang Duku memiliki ketebalan tutupan rata-rata 948 m, dengan kerapatan 500 pohon/ha, yang terdiri dari 14 jenis pohon. Fauna mangrove yang ditemukan di kedua desa secara umum sama, demikian pula pola pasang-surut lautnya. Dengan karakteristik seperti ini, mangrove di Desa Kuala Alam memperoleh nilai 1,75 yang artinya tidak memiliki kesesuaian wisata (IKW<2) sedangkan mangrove di Pematang Duku memperoleh nilai 2,38 yang artinya memiliki kesesuaian wisata (IKW>2) sehingga layak dikembangkan sebagai objek ekowisata.

Kata Kunci: Ekosistem Mangrove, Indeks Kesesuaian Ekowisata, Kelayakan Ekowisata

Received: 18 March 2023
Accepted : 11 April 2023

INTRODUCTION

Mangroves are unique vegetation found in coastal environments with brackish water conditions. Mangrove ecosystems provide various benefits, both ecological and social, and economic benefits. In this ecosystem live various biotas, in the form of flora and fauna. Flora that forms mangrove vegetation helps protect the land from coastal erosion or abrasion (Syah, 2020) and resists the intrusion of seawater into the land (Kustanti, 2011). Although mangrove ecosystems provide various benefits to the surrounding environment, these ecosystems have the threat of damage caused by natural factors and especially by human activities. The existence of various interests in the utilization of coastal resources, both in the form of mangrove wood and coastal land has encouraged the degradation of the coastal environment, especially mangrove ecosystems. This proves that the exploitative use of mangrove resources has had a very real negative impact, so an environmentally friendly and sustainable use of these resources is needed, such as ecotourism activities. Ecotourism is a special interest tourism trip to nature that prioritizes the value of environmental conservation and the welfare of local communities (Friess, 2017).

Mangrove ecotourism activities are one form of ecotourism in the coastal environment by utilizing the mangrove ecosystem as an object of attraction. The success and success of this ecotourism activity mainly rely on the quality of the mangrove ecosystem itself. The good quality of the mangrove ecosystem can attract tourists to visit and enjoy this ecosystem so that mangroves are maintained and the community's economy can increase without damaging the mangrove ecosystem. Some parameters that become the benchmark of the quality of this ecosystem include mangrove thickness, mangrove density, mangrove species diversity, and diversity of fauna species associated with this ecosystem. Therefore, this study aims to: (1) evaluate the characteristics of mangroves in these two villages as an ecotourism resource, and (2) analyze the level of suitability of mangroves in each village as an ecotourism destination.

MATERIALS AND METHOD

Time and Place

This research was conducted in May-July 2022 in Kuala Alam Village and Pematang Duku Village, Bengkalis District, Bengkalis Regency (the research locations can be seen in Figure 1 and Figure 2).

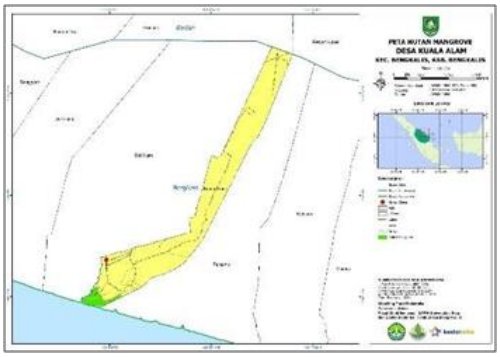

Figure 1. Location of Kuala Alam Village in Bengkalis Sub-district on Bengkalis Island

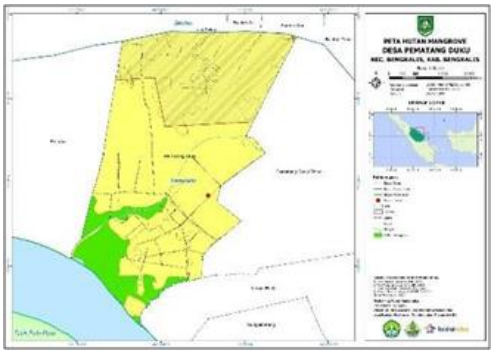

Figure 2. Location of Pematang Duku Village in Bengkalis Sub-district on Bengkalis Island

Research Methods

The method used in data collection in this research is by conducting *systematic* observation for structured observations based on existing conditions in the field and conducting document studies to strengthen the data obtained in the field. This research uses a mixed qualitative and quantitative approach because in this research the data obtained through field observations will be analyzed with the tourism suitability index (IKW) according to Yulianda (2019).

Data Analysis

Data analysis of this study used the Tourism Suitability Index (IKW) according to Yulianda (2019), by considering the number of suitability parameters (n), parameter weights (Bi), and parameter scores (Si). The parameters observed in IKW are mangrove thickness, mangrove tree density, mangrove species, tides, and biota objects. The formula for calculating IKW is as follows:

$$IKW = \sum_{i=1}^{n} (Bi \; x \; Si)$$

RESULT AND DISCUSSION

Characteristics and conditions of mangrove ecosystems

The results of the research that has been carried out show that there are significant differences in characteristics and conditions between mangroves in Kuala Alam and Pematang Duku Village (Table 1). This difference can be seen from the area of mangroves, the average thickness of mangroves, tree density, and tree species found. Kuala Alam Village only has 13.9 ha of mangroves, while Pematang Duku Village has 275.6 ha of mangroves. This is partly due to the difference in the length of the coastline and the difference in the thickness of mangroves owned by each village. Mangroves in Kuala Alam Village have a thickness of 337.4m while Pematang Duku Village has an average thickness of 948.8m. According to local sources, mangroves in Kuala Alam Village have experienced damage due to tree felling and land use change to open shrimp ponds. Logging of mangrove trees is usually used for wood to support building foundations (trocok), and this case has occurred in several instances in Tanjung Pasir Village, Tanah Merah District, Indragiri Hilir Regency (Agustina *et al.*, 2021). The same disturbance in the form of opening shrimp ponds is currently also starting to threaten the mangroves of Pematang Duku Village.

Table 1. Comparison of mangrove characteristics and conditions in Kuala Alam Village and Pematang Duku Village

No.	Parameters	Kuala Alam	Pematang Duku
1	Mangrove category	Riverine mangrove, fringe mangrove	Riverine mangrove, fringe mangrove
2	Mangrove area (ha)	13,9	275,6
3	Average thickness mangrove (m)	337,4	948,8
4	Mean mangrove density		
	a. Trees/100 m^2	3	5
	b. Trees/ha	300	500
5	Main mangrove tree species	Api-api jambu (*Avicennia marina*), api-api putih (*A.Alba*), mangrove (*Rhizophora apiculata),* baru (*Hibiscus tiliaceus),* bebetak (*Hippomane mancinella),* bebuto (*Cerbera ordolam*) kedabu (*Sonneratia ovata),* perepat (*S. alba),* teruntum merah (*Lumnitzera littorea*)	Api-api jambu (*A.marina*), api-api putih (*A.alba),* mangrove (*R.apiculata),* bebetak (*H.mancinella),* bebuto (*C.ordolam*), belukap (*R.mucronata),* berembang (*S.caseolaris*), cepenai (*Antidesma orthogyne*), cingam (*Scyphiphora hydrophyllacea*), dungun (*Heritiera littoralis),* kedabu (*S.ovata),* putat (*Barringtonia* sp.), perepat (*S. alba*), tumu (*Bruguiera gymnorrhiza*)
6	Object biota		
	Mollusks	Snails	Snails, lokan, ground fruit
	Crustaceans	Senepak, kedendang, mangrove crab	Sinepak, kedendang, mangrove crab
	Fish	Tembakul	Tembakul
	Reptiles	Mangrove snake, monitor lizard	Mangrove snake, monitor lizard
	Mammals	Monkey	Monkey, otter
	Aves	Raja udang, eagle, bondol eagle	Raja udang, sea eagle, bondol eagle
7	Tides		
	Pattern	Semidiurnal	Semidiurnal
	Tidal range (m) towards the land	1.500-2.500	1.000-3.000
8	The existence of the river	1	4
9	Disruption and damage	Fishing activities, small-scale tree logging, land use change for shrimp pond opening	Fishing activities, small-scale tree logging, land use change for shrimp ponds, and oil palm plantations

Another difference is the authenticity of the mangrove vegetation. About half of the mangroves in Kuala Alam Village are not natural vegetation but have been replanted. According to information obtained, due to unsuccessful shrimp farming efforts, abandoned shrimp ponds were planted in 2012. As a result, the mangroves in the village consist of two "zones", the "front zone" and the "back zone". Vegetation in the front zone is a natural mangrove dominated by several tree species such as perepat (*S.alba*) and api-api (*A.alba*), while vegetation in the back zone is a planted mangrove consisting of only one species, mangrove (*R. apiculata*). The trees in the front zone are dominated by mature trees with an average trunk diameter (dbh) of 17.9 cm, while vegetation in the back zone has a trunk diameter of <10 cm. Mangroves in Pematang Duku Village are entirely natural vegetation. The average tree density in this vegetation reached approximately 500 trees/ha, with an average stem diameter of 16.1 cm. This data shows that the mangroves of Kuala Alam and Pematang Duku Village both have sparse mangrove criteria with a density of <1,000 trees/ha based on the Decree of the Minister

of Environment No. 201 of 2004 related to standard criteria and guidelines for determining mangrove damage.

The characteristics of mangrove vegetation in Kuala Village, especially in the front zone, are quite disturbed by fishermen's activities, such as clearing trees to create a passing path for boats. In addition, each mature tree in this zone also requires space around the tree for the growth of breathable roots, making it impossible for the trees to grow at too close a distance (Supardjo *et al.,* 2008). Mangroves in Pematang Duku Village, which were natural vegetation until the time of the research, were relatively undisturbed by fishermen's activities. As in Kuala Alam Village, the mangrove frontage in this village was also dominated by only two tree species, namely perepat (*S.alba*) and api-api (*A.alba)*. In Kuala Alam Village, only nine mangrove species were found, while 14 mangrove species were found in Pematang Duku Village. However, as is common in other coastal areas in Indonesia, only two tree species were found, namely perepat (*S.alba*) and api-api (*A.alba*) (Noor *et al.*, 2006). However, mangroves (*R.apiculata* and *R. mucronata*) are also found in the zone behind the mangroves in Pematang Duku Village.

Mangroves are also a habitat for various types of fauna because the presence of this vegetation creates shelter, foraging, and breeding grounds for various types of animals (Noor *et al.,* 2006). Fauna that can be found in Kuala Alam and Pematang Duku Village generally have many similarities. The types of fauna commonly found in both villages consist of mollusks, crustaceans, Pisces, reptiles, aves, and mammals. Generally, mollusks can be found in both villages, including snails, lokans, and crabs. The types of crustaceans that can be found in both places consist of several types of shrimps, crabs (including members of the Grabsidae, Portunidae, and Ocypodidae families), and rama-rama (Thalassinidae family). The fish that are most easily found are mudskipper (Gobiidae family), while the most commonly seen reptile is the monitor lizard (*Varanus salvator*). Some interesting bird species are raja udang (Halcyonidae family), eagles (*Heliaeetus leucogaster*), and *Heliastur indus*. According to information obtained from fishermen in both villages, at least two species of mammals, namely pigs (*Sus scrofa*) and monkeys (*Macaca fascicularis)*, can also be found in the mangrove vegetation, although they are rarely seen.

The characteristics and conditions of mangroves in the two villages as described above greatly affect their attractiveness as ecotourism objects. In general, mangroves as natural vegetation have a stronger appeal as an ecotourism object than mangroves that are planted vegetation (Setyabudi & Permana, 2020), especially if the mangrove vegetation planted consists of only one type and is planted regularly and densely like plantation crops. Considering this, mangroves in Kuala Alam Village have a lower attractiveness as an ecotourism object compared to mangroves in Pematang Duku Village. This is because, in addition to having a very small area and not so thick, half of it is vegetation that is planted tightly, regularly, and only consists of one type of tree.

Tourism Suitability Index

The suitability of mangrove ecotourism can be assessed based on many parameters, namely mangrove thickness, mangrove tree density, mangrove tree species richness, tidal characteristics, and biota or fauna associated with this ecosystem (Yulianda, 2019). Based on these parameters, an evaluation of the suitability of mangrove ecotourism in Kuala Alam and Pematang Duku Village has been conducted. The results of this evaluation have been summarized in Table 2.

Table 2. Results of the tourism suitability index (IKW)

No.	Parameter	Kuala Alam				Pematang Duku			
		Characteristics	Score	Quality	Ni*	Characteristics	Score	Quality	Ni*
1	Mangrove thickness(m)	200-500	2	0,380	0,760	>500	3	0,380	1,140
2	Mangrove density(trees/ 100 m^2)	<5	0	0,250	0	5-10	1	0,250	0,250
3	Mangrove type	9	3	0,150	0,450	14	3	0,150	0,450
4	Object biota	Fish, shrimps, crabs, mollusks, reptiles, birds	3	0,100	0,300	Fish, shrimps, crabs, mollusks, reptiles, birds	3	0,100	0,300
5	Tide (m)	1-2	2	0,120	0,240	1-2	2	0,120	0,240
	Total				1,75				2,38
	tourism suitability index				1,75				2,38
	Suitability Level				Not suitable				Suitable

In the criteria used by Yulianda (2019), good mangrove conditions have an average thickness of more than 500m. This refers to Law No. 27 of 2007 concerning the management of coastal areas and small islands, which states that for mangroves to function as coastal protection, they must have a thickness of at least 500m.

Therefore, in evaluating the suitability of ecotourism, mangrove thickness has a large weight, which is 0.380, so mangroves with a thickness of more than 500 m get the highest score of 3. In this case, mangroves in Kuala Alam Village only have a thickness of 337.4 m so they only get a score of 2 with a value of 0.760. Mangroves in Pematang Duku Village with a mangrove thickness of 948.8 m thus obtaining a score of 3 with a value of 1.140. The effectiveness of mangroves as coastal protection and their beauty are also greatly influenced by the density of the trees that compose them. In the evaluation of ecotourism suitability, tree density is given a quality of 0.250. Mangroves that are considered "suitable" must have a density of more than 15-20 trees/100 m^2 with a score of 3. Referring to this criterion, the mangroves found in Kuala Alam Village which only have a density of 3 trees/100 m^2 obtained a score of 0 with a value of 0. The low density of trees in Kuala Alam Village is due to the logging activities of mangrove trees, especially those in the leading zone of the mangrove ecosystem. According to Agustini *et al.* (2016), one of the factors causing the low-density value is the large value of adult mangrove cover with a diameter between 10.19-63.69 cm, this condition is considered not ideal for mangrove growth in tight conditions. Mangroves in Pematang Duku Village which have a density of 5 trees/100 m^2 obtained a score of 1 with a value of 0.250.

In evaluating the suitability of mangrove ecotourism, tree species richness is given a weight of 0.150 and the highest score is 3 if it is composed of more than five tree species. In the mangroves in Kuala Alam Village and Pematang Duku Village, there are nine and 14 tree species, respectively, so they each get a score of 0.450. In addition to flora diversity, which includes various types of mangrove-forming trees, other biota diversity in the form of fauna can also affect the attractiveness of mangrove ecotourism. This aspect quality is 0.100 and the highest score is given if there are at least six fauna groups in the mangrove ecosystem. In this case, mangroves in Kuala Alam Village and Pematang Duku Village both have at least six fauna groups, so they get a score of 0.300.

In this evaluation, tidal patterns were also taken into account. This parameter, which has a quality of 0.120, relates to the pattern of water inundation beneath the mangrove during both high and low tides the highest score is given if the seawater level at high tide only ranges from 0-1 m. This relates to the security, safety, and comfort of visitors to ecotourism objects when they are in the middle of mangroves. In this case, because the height of seawater at high tide in these two places ranges from 1-2 m, they both get a score of 2 with a value of 0.240. From the evaluation described above, it can be seen that the tourism suitability index (IKW) of mangroves in Kuala Alam and Pematang Duku Village is 1.75 and 2.38 respectively (Table 2). Because it does not reach the lowest suitability limit (IKW = 2), the mangroves in Kuala Alam Village are considered not suitable to be developed as a mangrove ecotourism destination, while mangroves in Pematang Duku Village are suitable to be developed as a mangrove ecotourism destination.

CONCLUSION

Based on the research that has been done, the characteristics and conditions of mangroves in Pematang Duku Village have advantages over Kuala Alam Village, this is assessed from the area of mangroves, the average thickness of mangroves, and the average density of mangrove trees. Analysis of IKW shows that mangroves in Pematang Duku Village are suitable to be developed as mangrove ecotourism with a value of 2.38, while mangroves in Kuala Alam Village are not suitable to be developed as mangrove ecotourism because they get a value of 1.75.

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