

A Review of The Suitability of Mangrove Agro-ecotourism Areas in Perupuk Village, Batubara Regency, North Sumatra Province

Uswatul Hasan(*)^{1,3}, Siti Mardiana², Syahbudin Hasibuan²

¹ Doctoral student of Agricultural Science, Medan Area University,

² Graduate, School of Agricultural Science, Medan Area University,
Jalan Sei Serayu No. 70A Medan, North Sumatra 20121, Indonesia

³ Faculty of Fisheries, Dharmawangsa University,
Jalan. KL. Yos Sudarso No.224, Medan, North Sumatra, 20115, Indonesia

*Corresponding author: uswatuhasan@dharmawangsa.ac.id

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Abstract

*This study aimed to measure the suitability of mangrove ecosystems in Perupuk village, Batubara district as an ecotourism area. Several ecological parameters were used to consider suitability, including mangrove type, thickness, and density. In addition, biota diversity and tidal height were also observed. Mangrove observations were carried out using the 10 x 10 metre quadratic transect method as many as 20 pieces were let on the shoreline area toward, land. The results showed that this area was only overgrown with *Avicennia marina* with a thickness of 203.7 meters, and a density of 2100 Ind/ha. There are 31 species of biota associated with mangrove ecosystems consisting of 3 bivalve species, 1 gastropod, 6 fish, 16 birds, 2 crustaceans, 2 arthropods, and 1 mammal. The ecotourism suitability index analysis results show that this area is very suitable for mangrove ecotourism sites with a suitability value of 73.75%.*

Keywords: *Agro-ecotourism; Mangrove ecosystem; Perupuk Village*



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INTRODUCTION

Ecotourism is a form of sustainable tourism that focuses on exploring nature while engaging in environmentally friendly activities (Đurić & Topalić Marković, 2023; Rana, 2023). It aims to protect ecosystems, educate visitors, and benefit local communities economically and socially (Kropinova et al., 2023). There are various types of ecotourism, including cultural and heritage tourism, spa (healing) tourism, and recreational tourism, which heavily rely on natural elements like water and forest areas for their development (Gök, 2022). Ecological tourism, a subset of ecotourism, aligns closely with sustainable development principles and emphasizes slow tourism in protected

natural areas (Çavuş & Zere, 2021). One of the ecotourism concepts developing in North Sumatra is mangrove ecotourism.

The mangrove tourism suitability index is a measure used to assess the suitability of mangrove areas for ecotourism activities. Several studies have analyzed the suitability of different mangrove areas using this index. The Peo Waume Forest Area in Wakatobi Regency, Southeast Sulawesi, was found to have a mangrove ecotourism suitability index of 2.15 (Alsita et al., 2023). In Kuala Alam Village, Bengkalis Regency, Riau Province, the mangroves were found to have a tourism suitability index below 2, indicating unsuitability for ecotourism (Jati et al., 2023). On the other hand, the mangroves in Pematang Duku Village, Bengkalis Regency, achieved a tourism suitability index above 2, making them suitable for mangrove ecotourism (Wantu et al., 2022). The Tambatan Hati Pelangi mangrove area in Tilamuta District, Boalemo Regency, Gorontalo Province, was also found to have a suitable tourism suitability index ranging from 2.02 to 2.27 (Ledheng et al., 2022). The Susuk Pool Mangrove Ecosystem, in an unspecified location, had a total of 15.5 ha and was categorized as very appropriate for ecotourism (Fabanjo & Abdullah, 2022). Meanwhile, studies on the suitability of mangrove ecotourism in North Sumatra are still very limited. Therefore, this research focuses on the suitability of mangrove tourism areas based on ecological conditions.

METHOD

This research was conducted from July to October 2023 in Perupuk village, Batubara Regency, North Sumatra Province (Figure 2). Various data were collected in this study, including mangrove thickness, mangrove density, biota diversity, and high tide. Mangrove identification was conducted by referring to the Handbook of Mangrove Recognition in Indonesia (Noor et al., 2006). Mangrove density measurements were carried out using the transect quadrat method, the transect quadrats were made of as many as 20 pieces with a size of 10 x 10 meters (Figure 1), laying transects starting from the coastal area towards the mainland (Hasan et al., 2024). Measurement of mangrove thickness is done by calculating the distance from the shoreline towards the land where mangroves can still be found.

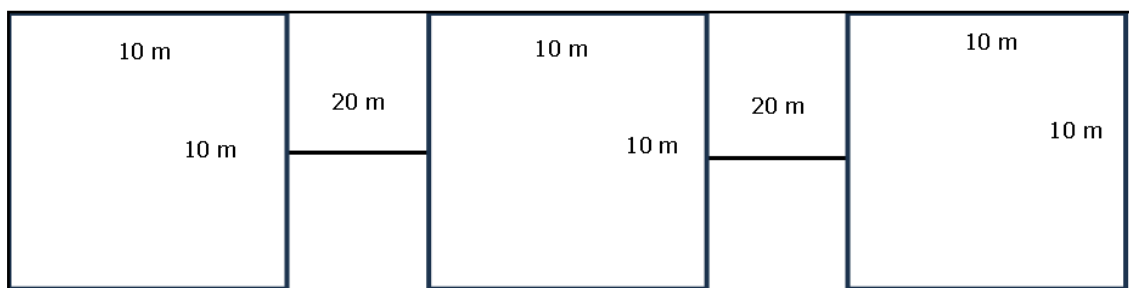


Figure 1. Illustration of Quadratic Transect Method

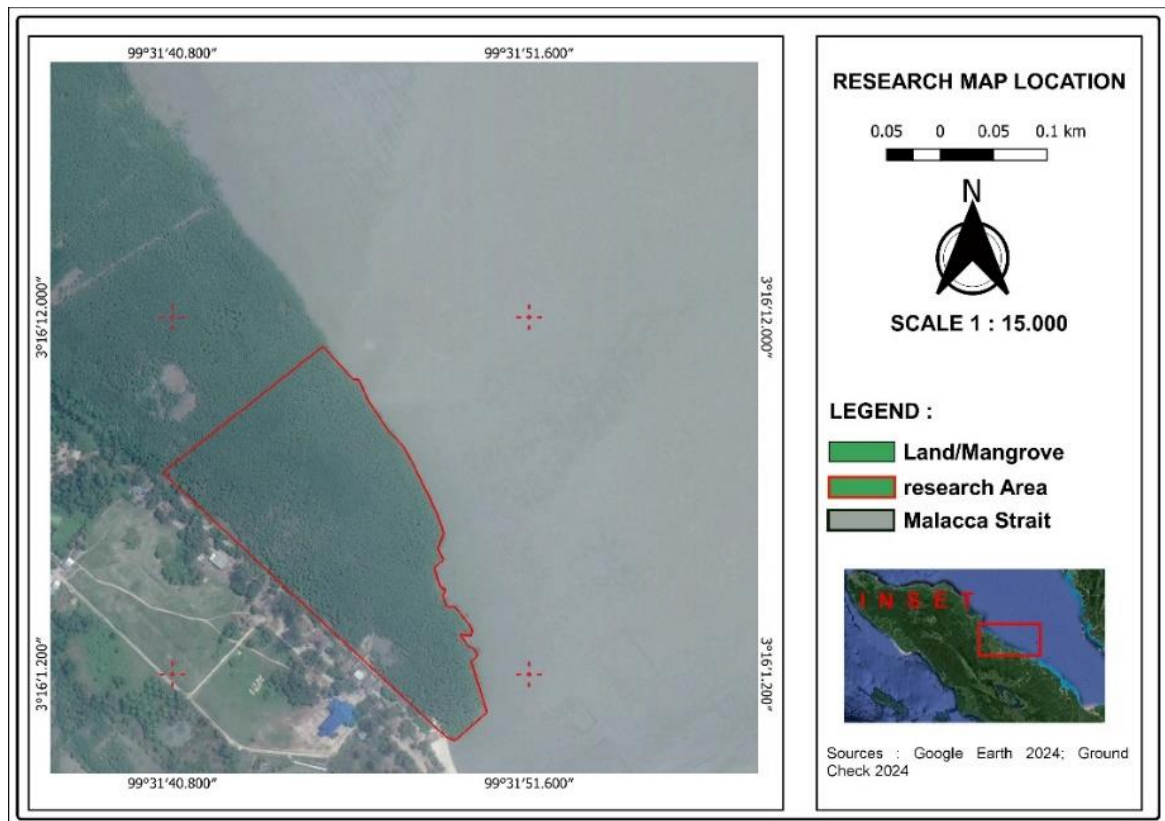


Figure 2. Map of Research Location

Data Analysis

Mangrove density was calculated using the formula by (English et al., 1994):

$$D_i = \frac{N_i}{A} \dots\dots\dots (1)$$

Where :

- D_i* = density of the *i*-th species
- N_i* = total number of individuals of the *i*-th species
- A* = total sampling area

The ecotourism suitability index was calculated using the formula (Yulianda, 2007):

$$IKW = \sum \left[\frac{N_i}{N_{Max}} \right] \times 100\% \dots\dots\dots (2)$$

Where :

- IKW* = Tourism Suitability Index
- N_i* = The value of the *i*-th parameter (Weight x Score)
- N_{max}* = Maximum score (4)

The value of the tourism suitability index obtained is then adjusted to the following categories:

- S1 = Very Suitable, with IKW > 75-100%
- S2 = Suitable, with IKW > 50-75%
- S3 = Conditionally Suitable, with a value of > 25-50%
- N = Not Suitable, with a score > 25%

Assessment of the level of suitability of mangroves is done by using a matrix of the suitability of the area for the coastal tourism mangrove tourism category. Assessment is done based on weighting and the value indicated by the magnitude of the score, which is then done by combining several variables of the difference in value between classes to determine the classification of the suitability of mangrove areas in Pulau Banyak Village, Langkat Regency.

Table 1. Suitability matrix of mangrove tourism

Parameter	Bobot	Category	Skor
Mangrove thickness (m)	0.380	>500	4
		>200-500	3
		50-200	2
		<50	1
Mangrove density (100m ²)	0.250	>15-20	4
		>10-15; >20	3
		10-15	2
		<5	1
Mangrove species	0.150	>5	4
		3-5	3
		2-1	2
		0	1
Low tides (m)	0.120	0-1	4
		>1-2	3
		>2-5	2
		>5	1
Biota objects	0.100	Fish, shrimp, crabs, mollusks, reptiles, birds and typical/endemic/rare animals	4
		Fish, shrimp, crabs, mollusks	3
		Fish, mollusks	2
		One of the aquatic biota	1

RESULTS AND DISCUSSION

Mangrove Thickness

The results of measuring the thickness of mangroves in the Perupuk village area of Batubara Regency showed that the thickness of mangroves was around 203.7 meters is in category >200-500 with score 3. These results are not much different from those found by Tuwongkesong et al 2018 in the mangrove area of Tongkina village, Bunaken, Manado City with a thickness of 138.65 meters. [Tambunan et al. \(2023\)](#) reported that the thickness of mangroves in Budo village, North Minahasa Regency 143.3 meters.

Mangrove Species Density

Based on the results of observations, there are only *Avicenia marina* species in the research location with a density of 2100 ind/Ha (21 ind/100 m²) is in category >10-15;>20 with score 3. *A. marina*, a 14-meter tall plant, is distributed in various regions such as Australia, Indonesia, India, Madagascar, Saudi Arabia, and parts of Africa, with limited presence in North America ([Sadeer & Mahomoodally, 2022](#)). The plant's

tolerance to oil pollution was studied, showing its ability to degrade polycyclic aromatic hydrocarbons (PAHs) from rhizosphere soil, making it a potential candidate for phytoremediation in coastal marine environments (Nadhifah & Nurweda Putra, 2022).

Low Tides

Tidal data was obtained from the Hydro-Oceanographic Centre (PUSHIDROSAL) of the Indonesian Navy. The highest tide occurred in September 2023 with 2.05 metres and the lowest tide was 0.35m. Meanwhile, the average tidal height during the study was 1.66 m (Table 2).

Table 2. Average tidal range in Perupuk village, during research conduct

Month	Hight Tides (HT)	Low Tides (LT)	HT-LT
July	2.00	0.37	1.63
Augustus	2.03	0.38	1.65
September	2.05	0.35	1.70
October	2.03	0.39	1.64
Average			1.66

Muhidin et al., (2020) revealed that tidal events in every region of the earth's surface are not uniform, possibly due to variations in the attractive forces of the moon and sun and the condition of the underwater form in each region. Tides are a physical factor that affects mangrove ecosystems. Estimation of high and low tides is essential to effectively track activities. Masud et al., (2020) showed that during high tides, access to mangrove ecosystems is difficult for tourists, although the conditions are beneficial for activities such as photography. In contrast, during low tide, tracking activities become easier.

Biota Object

Various biota were observed in the mangrove location of Perupuk village, consisting of bivalves, gastropods, fish, birds, crabs, and mammals. (Table 3). According to Nugroho et al., (2019), the flora and fauna in mangrove forests are a combination of two groups, namely: (1) Land-dwelling fauna groups (aboveground and aerial); (2) Aquatic biota consisting of two types, namely: species that live in water, such as fish and shrimp, and species that live on hard (roots and trunks of mangrove trees) and soft (mud) substrates, especially crabs, crustaceans, and many other species. The existence of associated biota objects in the mangrove ecosystem can be enjoyed directly and provides its own satisfaction for tourists and becomes an added value in the mangrove ecosystem area (Sadik et al., 2017).

Tourism Suitability Index

Based on the results of the analysis of ecotourism suitability, it is known that the value of the tourism suitability index is 73.75% with a very suitable category (Table 4). This result is different from the results obtained by other researchers in various regions in Indonesia, such as Pratiwi & Muhsoni, (2021) which gets a suitability value of 51-57%

with a conditionally suitable category in the sampang mangrove ecosystem, Madura. Next [Tuwongkesong et al., \(2018\)](#) which gets the IKW value of mangrove ecosystems on the coast of Tongkaina Village, Bunaken District, Manado City, which is 51.2%, with a conditionally suitable category. The difference in suitability index values can be caused by various factors, including high tides, biota diversity and mangrove species density.

Table 3. Biota object in the mangrove area of Perupuk village, Batubara Regency

Group	Species	Common Name
Bivalva	<i>Geloina erosa</i>	Mud Shells
	<i>Geloina expansa</i>	Mud Shells
	<i>Glauconome virens</i>	Razor Clam
Gastropoda	<i>Telescopium telescopium</i>	Mangrove snails
	<i>Mugil sp</i>	Flathead grey mullet
Pisces	<i>Lates calcaliver</i>	Barramundi
	<i>Megalops cyprinoides</i>	Indo-Pacific Tarpon
	<i>Eleutheronema tetradactylum</i>	Fourfinger threadfin
	<i>Chanos chanos</i>	Milkfish
Aves	<i>Plotosus canius</i>	Gray eel-catfish
	<i>Numenius arquata</i>	Common Curlew
	<i>Numenius phaeopus</i>	Common Whimbrel
	<i>Sterna hirundo</i>	Common Tern
	<i>Calidris alba</i>	Sanderling
	<i>Limosa limosa</i>	Black-Tailed Godwit
	<i>Pluvialis fulva</i>	Pacific Golden Plover
	<i>Xenus cinereus</i>	Terek Sandpiper
	<i>Ixobrychus sinensis</i>	Yellow Bittern
	<i>Limnodromus semipalmatus</i>	Asian dowitcher
	<i>Charadrius mongolus</i>	Lesser Sand Plover
	<i>Arenaria interpres</i>	Ruddy Turnstone
	<i>Tringa guttifer</i>	Nordmann's greenshank
	<i>Calidris falcinellus</i>	Broad-billed Sandpiper
	<i>Sterna albifrons</i>	Little tern
	<i>Gleochelidon nilotica</i>	Gull-Billed Tern
Crustacean	<i>Penaeus monodon</i>	Tiger Prawn
	<i>Penaeus merguensis</i>	White Prawn
	<i>Metapenaeus ensis</i>	Brown Shrimp
Arthropoda	<i>Scylla serrata</i>	Mud Crab
	<i>Scylla tranqueberica</i>	Mud Crab
Mamalia	<i>Macaca fascicularis</i>	Crab-Eating Monkey

Table 5. Tourism Suitability Index

Parameter	Bobot (B)	Category	Score (S)	Results	B x S	Ni/Nmax
Mangrove thickness (m)	0.38	> 500	4	203.7	1.14	0.29
		>200-500	3			
		50-200	2			
		<50	1			
Mangrove Density (Ind/Ha)	0.25	>15-20	4	21	0.75	0.19
		>10-15; >20	3			
		10 s/d 15	2			
		<5	1			
Mangrove Species	0.15	>5	4	1	0.3	0.08
		3 s/d 5	3			
		2 s/d 1	2			
		0	1			
Low Tides	0.12	0 sd 1	4	1.66	0.36	0.09
		>1-2	3			
		>2-5	2			
		>5	1			
Biota objects	0.1	Fish, shrimp, crabs, mollusks, reptiles, birds and typical/endemic/rare animals	4	Fish, shrimp, crabs, mollusks, reptiles, birds, and typical/endemic/rare animals	0.4	0.1
		Fish, shrimp, crabs, mollusks	3			
		Fish, mollusks	2			
		One of the aquatic biota	1			
Σ					2.95	0.74
Tourism Suitability Index Category					73.75 Very Suitable	

CONCLUSION

The mangrove ecosystem of Perupuk Village, Batubara Regency is very suitable as a mangrove ecotourism destination because this area has abundant biota species and other supporting factors are in balance.

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