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Analysis of Marine Ecotourism Suitability Based on Physical Environmental Conditions and Water Quality Index at Arta Sungai Limau Beach, Padang Pariaman Regency

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ABSTRACT

Marine ecotourism is a type of tourism that involves activities related to marine activities carried out under or above the sea surface. Marine ecotourism generally covers three areas: the sea surface, under the sea, and on the coast. Marine ecotourism activities, especially beach tourism, are highly dependent on the condition of the oceanographic parameters of the region for the safety and comfort of tourists. This research was conducted in Arta Beach, Padang Pariaman Regency, West Sumatra Province, to determine the suitability of marine ecotourism at Arta Beach based on the parameters of physical environmental conditions. This study used a survey method: observation and data collection at the research location. Data analysis is used for the Tourism Suitability Index (IKW) method for physical environmental parameters and the STORET method for water quality parameters. The results of this study indicate that the tourism suitability index based on the physical condition of the environment carried out at Arta Beach at station 1 received a value of 2.49, including the suitable category, at station 2 received a value of 2.5, including the suitable category and station 3 received a value of 2.49 including the suitable category. The overall average value of IKW on Arta Beach is 2.49, included in the suitable category. This value means this beach can be used for beach ecotourism. Water quality parameters are analyzed using the storey method. The data obtained from the pH, DO salinity, and temperature parameters meet the quality requirements (good condition) and are suitable for marine tourism activities.

Keywords: Arta Beach, Marine Ecotourism, Marine Ecotourism Suitability

1. INTRODUCTION

Ecotourism is a form of tourist travel to natural areas carried out by conserving the environment and preserving residents' lives and welfare, enjoying nature's beauty, and making efforts to maintain it (Fandeli & Nurdin, 2005). Marine ecotourism activities are generally based on the uniqueness of nature, natural characteristics, local cultural arts, community characteristics, and unique attractions in each region (Yoswaty & Samiaji 2013).

According to Yulianda (2019), there are several parameters used to assess the level of suitability of beach recreation category tourism, such as water depth parameters, water brightness, beach type, bottom material, beach width, current speed, beach slope, dangerous biota, and freshwater availability.

In addition to oceanographic parameters, water quality indices also determine the suitability of marine tourism in coastal and marine areas in the coastal region. The water quality index is determined to assess the level of water quality in a body of water. The most widely used water quality index method in Indonesia is the STORET method, which is listed in the Decree of the Minister of Environment No. 115 of 2003 on Guidelines for Determining Water Quality Status.

2. RESEARCH METHOD

Time and Place

This research was conducted from January to March 2024 at Arta Beach, Sungai Limau District, Padang Pariaman Regency, West Sumatra Province. Data analysis was conducted at the Physical Oceanography Laboratory of the Department of Marine Science, Faculty of Fisheries and Marine Sciences, Universitas Riau.

Method

The survey method is used in this research, where observations and data collection

are carried out at the research location.

Figure 1. Map of location and research stations

Procedures

Determining Research Locations

The determination of the research station is represented by three stations starting from the end of Arta Beach to the edge of the river mouth. Data for water quality index parameters are DO, pH, temperature, and salinity. Data measurements of environmental physical condition parameters such as brightness, beach topography, current speed, and beach slope were measured in the intertidal area. In contrast, the beach depth was measured in the intertidal area up to 25 m offshore. Data measurements of water quality index parameters such as DO, pH, temperature, and salinity were measured in the intertidal area.

Physical Environmental Conditions

The physical environmental conditions measured are 1) Beach topography, including beach width, bottom material, beach type, and beach land cover; 2) Water brightness data obtained then processed by the formula:

$$K = \frac{d1 + d2}{2}$$

Description:

K = Water brightness
d1 = Secchi disk depth when not visible
d2 = Depth of Secchi disk when it starts to appear again

Calculation of current speed using the formula:

$$V = \frac{S}{t}$$

Description:

V = current speed (m/s)
S = distance traveled (m)
t = time (s)

The beach slope will be obtained using the formula:

$$\alpha = \arctan Y / X$$

Description:

α = The angle formed (°)
Y = Distance between the perpendicular line formed horizontally with the surface of the sand below
X = Depth (m)

Data collection technique for water quality parameters

Data collection of water quality index parameters (STORET method) data to be taken on the parameters of the water quality index are DO, temperature, salinity, and pH. Following what is regulated in the Decree of the Minister of Environment Number 51 of 2004 concerning Seawater Quality Standards.

Sediment Sampling Technique

Sediment sampling was conducted at low tide in the intertidal area of the beach using a pipeline. Sediment samples were put into plastic and taken to the laboratory for analysis. Sediment samples taken at as much as 500 g of wet weight are then taken at 100 g to analyze the sediment type.

Data Analysis

The analysis technique used is the Tourism Suitability Index Data (IKW) analysis, which uses oceanographic parameter data and water quality index parameter data to be processed using the analysis of tourism suitability index data for processing current speed, brightness, and beach topography processed using Excel applications. Furthermore, after the water quality index parameter data is obtained, then all the data is processed with the Water Quality Status Determination Data regulated in the Decree of the Minister of Environment No. 115 of 2003 using the STORET method, after being processed using the STORET method, the water quality index parameter data.

3. RESULT AND DISCUSSION

Beach Topography

Based on the research conducted at Arta Beach, the observed beach topographic parameters include beach width, beach type,

beach land cover, and water bottom material (Table 1 and Table 2).

Table 1 Topography of Arta Beach

Station	Beach width (m)	Beach type	Plant species found
1	23	Sandy beach	Pine trees, grasses, coconut trees
2	37	Sandy beach	Pine tree, Coconut tree, Ketapang
3	35	Sandy beach	Pine trees, grasses, coconut trees

Table 2 Sediment type analysis results

	Sediment Fraction (%)			
Station	Gravel	Silty	Sand	Sediment type
1	63,00	31,23	5,77	Sand gravel
2	68,45	28,75	2,80	Sand gravel
3	25,81	71,05	3,14	Gravelly sand

Based on the overall width, Arta Beach is very suitable for beach tourism activities Hutabarat et al. (2015). The width of the beach is related to the land area utilized by visitors or tourists to carry out various beach recreation activities. Based on observations made in the field, the beach width at station 1 has a value of 23 m, station 2 has a value of 37 m, and station 3 has a value of 35 m. Stations 1, 2, and 3 are categorized as very suitable. Based on field observations, the beach type of Arta Beach at stations 1, 2, and 3 is a sandy beach. According to Yulius (2018), a sandy beach is a beach dominated by a stretch or land of sand, either in black, grey, or black sand. Arta Beach has a white sand color, following the opinion of Yulianda (2019) that for beach tourism activities, it is better if a beach is a white sand beach, compared to a rocky or coral beach, because it can interfere with the comfort of tourists in tourism activities, especially bathing and swimming activities.

Based on laboratory observations at the three stations, it was found that Arta Beach station 1 was sandy gravel, station 2 was sandy gravel, and station 3 was gravelly sand. Munandar et al. (2014) state that gravel sediments are presental areas. This condition does not support the development of marine ecotourism, especially for swimming or bathing. Based on field observations of Arta Beach, land cover in the Arta Beach area varies at stations 1 and 3, with a beach land cover of pine trees, grasses, and coconut trees at stations 1 and 3 dominated by pine trees. Station 2 has a beach land cover of pine and coconut trees, and pine trees and ketapang dominate.

Depth of Beach

In-depth data was obtained at each station based on the research conducted at Arta Beach.

Table 3. Water depth values

Station	Measurement time	Depth (m)
1	08.00 WIB	1.5
	13.00 WIB	2.0
	17.00 WIB	2.8
2	08.00 WIB	1.2
	13.00 WIB	2.3
	17.00 WIB	2.7
3	08.00 WIB	1.2
	13.00 WIB	2.2
	17.00 WIB	2.8

Based on the results of depth measurements at Arta Beach, at station 1, the average depth is 2.1 m, while at station 2, the average depth is 2.06 m, and at station 3, the depth is at an average of 2 m. According to Yulianda (2019), the depth of water suitable for use in swimming and playing activities ideally ranges from 0 - 3 m, so it is found that the depth at Arta Beach is in the appropriate category.

Water Brightness

The results of measuring water brightness at Arta Beach obtained data at each station. The average brightness at Arta Beach at station 1 is 2.86, at station 2 is 2.7, and at station 3 is 2.5. The low value of the brightness of Arta Beach, especially at stations 1 and 2, is caused by the magnitude of the waves directly observed in the field. The low value of water brightness at station 3 is due to the position of station 3 in the estuary. This value indicates that the brightness of Arta Beach waters is unsuitable for

developing marine ecotourism (Romadhan, 2013).

Table 4. Water brightness values

Station	Measurement time	Water brightness (m)
1	08.00 WIB	3.5
	13.00 WIB	2.5
	17.00 WIB	2.6
2	08.00 WIB	2.4
	13.00 WIB	3.0
	17.00 WIB	2.7
3	08.00 WIB	2.2
	13.00 WIB	2.5
	17.00 WIB	2.8

A high brightness value is very good for marine tourism because tourists prefer clean coastal areas.

Current Speed

The results of measuring water brightness at Arta Beach obtained data at each station.

Table 5. Current Speed values

Station	Measurement time	Current speed (m/s)
1	08.00 WIB	0.16
	13.00 WIB	0.17
	17.00 WIB	0.25
2	08.00 WIB	0.19
	13.00 WIB	0.18
	17.00 WIB	0.22
3	08.00 WIB	0.19
	13.00 WIB	0.19
	17.00 WIB	0.20

Current speed is categorized into three categories: weak currents 0.01 - 0.19 m/s, medium current category 0.20 - 0.39 m/s, and fast current category > 0.40 m/s (Putra et al., 2013). The current speed at Arta Beach is included in the category of moderate current speed, which is not recommended for swimming activities. The average current velocity value at Arta Beach at station 1 is 0.20 m/s. At station 2, the average is 0.20 m/s; at station 3, the average is 0.20 m/s. This indicates that the current velocity of Arta Beach is categorized as moderate current. The current speed is in the category of not suitable for swimming activities. Current speed is closely related to the comfort of tourists who visit the attraction (Yulianda, 2019).

Beach Slope

The results of measuring the slope of the beach at Arta Beach obtained the following data:

Table 6. Coastal slope values

Station	Coastal slope (°)
1	4,7
2	4,5
3	2,7

The slope of the Arta Beach beach at station 1 has a value of 4.7°, station 2 has a value of 4.5°, and station 3 has a value of 2.7°. However, from the value of the slope of the beach, each station is categorized as a sloping beach and suitable as a tourist spot. According to Yulianda (2019), the slope of the beach that is suitable for tourism is the slope of the beach with an elevation angle of <10°.

Distance to Freshwater Source

Based on the research conducted at Arta Beach, the following data was obtained for distance to freshwater sources.

Table 7. Value of distance to freshwater sources

Station	Distance to Freshwater Source (m)
1	600
2	500
3	200

Based on research that has been conducted at Arta Beach, data on the distance of fresh water sources with station 1 is 600 m, at station 2 is 500 m, and station 3 is 200 m; the presence of freshwater found on Arta Beach can be found in the stalls of traders. The source of fresh water at Arta Beach comes from the river at Station 3. Therefore, the closer the distance between the beach and the availability of fresh water, the better the area will be for ecotourism. Following the statement of Yulianda (2019), the availability of fresh water is sufficient and not too far from the water source, namely <1km. The distance between fresh water and Arta Beach is in the appropriate category.

Tourism Suitability Index of Environmental Condition Parameters

Based on the research conducted at Arta Beach, the tourism suitability index data can be seen in Table 8.

Table 8. Tourism suitability index

No	Parameters	Weight	Description St1	score	Total	St 2	score	Total	St 3	score	Total
1	Beach type	0,200	Sandy beach	3	0,6	Sandy beach	3	0,6	Sandy beach	3	0,6
2	Beach width	0,200	23	3	0,6	37	3	0,6	35	3	0,6
3	Water bottom material	0,170	Sand gravel	2	0,34	Sand gravel	2	0,34	Gravelly sand	2	0,34
4	Depth of beach	0,125	2,1	3	0,375	2,06	3	0,375	2	3	0,375
5	Water Brightness	0,125	2,86	1	0,125	2,7	1	0,125	2,5	1	0,125
6	Current Speed	0,080	0,20	2	0,16	0,20	2	0,16	0,20	2	0,16
7	Beach Slope (°)	0,080	4,7	3	0,24	4.5	3	0,24	2,7	3	0,24
8	Coastal land cover	0,010	Shrubs, low scrub savanna	2	0,02	Coconut open land	3	0,03	Shrubs, low scrub savanna	2	0,02
9	Dangerous biota	0,005	None	3	0,015	None	3	0,015	None	3	0,015
10	Distance to fresh water source	0,005	600	3	0,015	500	3	0,015	200	3	0,015
Beach recreation tourism suitability index value (Ni)					2,49			2,5			2,49
Maximum value of IKW for beach recreation activities (N max)							2,5				
Average IKW of Arta Beach for beach tourism activities							2,49 (Suitably)				

From the calculation of IKW based on the measured parameters, the physical condition of the environment for the category of beach tourism recreation can be concluded that the Tourism Suitability Index at Arta Beach is categorized as suitable.

Measurement Results of Water Quality Parameters

Determination of water quality status by comparing the values obtained in the field with predetermined quality standards. Based on the decision of the Minister of Environment Number 51 of 2004 concerning seawater quality

standards for marine ecotourism, water quality measurement parameters (DO, salinity, pH, and temperature) are in the appropriate category.

Table 9. Water quality

No	Parameters	Units	Quality standard	value	Score	Class	category	Description
1.	Temperature	Celcius	Natural	Maks: 31^0	0	A	Excellent	As per quality standards
				Min: 28^0	0			
				Average : 29^0	0			
2.	Salinitas	$^0/_{00}$	Natural	Maks: $25^0/_{00}$	0	A	Excellent	As per quality standards
				Min: $25^0/_{00}$	0			
				Average : $25^0/_{00}$	0			
3.	pH	-	7	Maks: 7	0	A	Excellent	As per quality standards
				Min: 7	0			
				Average : 7	0			
4.	DO	mg/l	>5	Maks: 7,7	0	A	Excellent	As per quality standards
				Min: 6,5	7			
				Average : 7	0			

4. CONCLUSION

Arta Beach has great potential and opportunities to be developed as a beach ecotourism area. The tourism suitability index based on the physical condition of the environment carried out at Arta Beach at Station 1 received a value of 2.49, including the Suitable category; Station 2 received a value of 2.5, including the Suitable category; and Station 3 received a value of 2.49 including the Suitable category. The overall average value of IKW on Arta Beach is 2.49, which is included in the Suitable category. This value means this beach can be used for beach ecotourism. Water quality parameters are analyzed using the storet method. The data was obtained from pH, DO, salinity, and temperature parameters.

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