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Analysis of the Suitability of Pasumpahan Island Marine Tourism Based on the Tourism Suitability Index

Analisis Kesesuaian Wisata Bahari Pulau Pasumpahan Berdasarkan Indeks Kesesuaian Wisata (IKW)

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Abstract

Pasumpahan Island is one of the national and international tourist destinations located in Padang City, West Sumatra Province. This island is included in the Regional Marine Protected Area (KKLD) which has a very good coral reef ecosystem, so its management must be following applicable laws and regulations. This research was conducted in March 2022 on Pasumpahan Island, Bungus District, Padang City, West Sumatra Province. The method used is a field survey with data collection using a purposive sampling method. The measured index of water quality was processed using the Storet method. Pasumpahan Island's physical environment is relatively good with a wide expanse of white sand. The suitability of marine tourism in this island area based on the tourism suitability index (IKW) is 85.71% which is included in the S1 category (very suitable). The water quality of the Pasumpahan Island tourist area based on the water quality index (IKP) is in the very good category. Based on the IKW and IKP, the tourist area of Pasumpahan Island is very feasible to be developed as a national marine tourism area.

Keywords: IKP, IKW, Environmental conditions, Pasumpahan Island, Tourism

Abstrak

Pulau Pasumpahan merupakan salah satu destinasi wisata nasional dan internasional yang terletak di Kota Padang, Provinsi Sumatera Barat. Pulau ini termasuk dalam Kawasan Konservasi Laut Daerah (KKLD) yang memiliki ekosistem terumbu karang yang sangat baik, sehingga pengelolaannya harus sesuai dengan peraturan perundang-undangan yang berlaku. Penelitian ini dilakukan pada bulan Maret 2022 di Pulau Pasumpahan, Kecamatan Bungus, Kota Padang, Provinsi Sumatera Barat. Metode yang digunakan adalah survei lapangan dengan pengambilan data menggunakan metode purposive sampling. Pengukuran indeks kualitas air dilakukan dengan metode Storet. Lingkungan fisik Pulau Pasumpahan relatif baik dengan hamparan pasir putih yang luas. Kesesuaian wisata bahari di kawasan pulau ini berdasarkan indeks penyesuaian wisata (IKW) sebesar 85,71% yang termasuk dalam kategori S1 (sangat sesuai). Kualitas perairan kawasan wisata Pulau Pasumpahan berdasarkan indeks kualitas air (IKP) berada pada kategori sangat baik. Berdasarkan IKW dan IKP, kawasan wisata Pulau Pasumpahan sangat layak dikembangkan sebagai kawasan wisata bahari nasional.

Kata Kunci : IKP, IKW, Kondisi lingkungan, Pulau Pasumpahan, Wisata

1. Introduction

Tourism activity is an activity that is carried out in a relatively short period from the original place to the location of a tourist object with reasons to have fun, take advantage of free time and fulfill curiosity (Suwantoro, 2016). Tourist objects are everything that is targeted in tourism such as forests, rivers, lakes, and beaches. Indonesia's tourism sector has a large role in economic development; this is supported by government data which shows an increase from time to time. The rapid development in the marine tourism sector must be balanced with the packaging of a tourist location to answer the challenges of an increasing flow of visitors. Coastal and marine areas can be developed into tourist areas in the form of beautiful beach views and environmental beauty, the development of a beach as a tourist location is an environmental service from the allocation of resources which tends to provide benefits to one's inner satisfaction because it has certain aesthetic values, besides that it indirectly has an impact on the community around tourist sites because there are many activities carried out by tourists which will make a big contribution in increasing people's income. Changes in the oceanographic conditions of a body of water can occur due to the continuous movement of water masses due to natural factors as well as human activities carried out in the waters.

According to Masduqi (2014), as a result of human activity various types of waste and pollutant materials will be found in the sea, This of course can lead to environmental degradation in coastal areas and the surrounding ecosystem, so the excessive entry of organic and inorganic substances into the waters will cause a decrease in the quality of oceanography around these waters. The water quality index is an estimation system in the form of an index obtained by combining water quality parameters on a certain scale which is then used as a single-digit scale with a certain calculation method. The application of this standard becomes a reference in evaluating water conditions so that it can be decided whether the water can be used or not. The most widely used water quality index methods in Indonesia are the Storet and Pollution Index (PI) methods, which are listed in the Decree of the Minister of Environment No. 115 of 2003 concerning Guidelines for Determining Water Quality Status. Based on the description above, the authors are interested in conducting research on the suitability analysis of marine tourism based on the study of parameters of physical environmental conditions and water quality index on the Coast of Pasumpahan Island.

2. Material and Method

2.1. Time and Place of Research

This research was carried out in March 2022 on Pasumpahan Island, Bungus District, Padang City, West Sumatra Province. Data analysis was carried out at the Physics Oceanography Laboratory, Department of Marine Science, Faculty of Fisheries and Marine, Universitas Riau.

2.2. Research methods

The method used in this study was a survey method, namely observation and data collection carried out at the research location. Data obtained from the research location were then brought to the Marine Physics Laboratory, Faculty of Fisheries and Marine, Universitas Riau to be processed with the data processing application used in this study. The flow of this research begins with input data obtained in the field using the sampling method (primary data) which is then processed using the IKW (Travel Conformity Index) method and the storet method.

2.3 Research Procedure

The procedure used in this study consisted of determining the research station, data collection techniques for oceanographic parameters and water quality index parameters, and comparison of the results of measurement of oceanographic parameters with tourism suitability index and water quality index parameters by determining the status of water quality according to Decree of the Ministry of Environment Number 115 of 2003, this data is also linked to the Tourism Suitability Index on Pasumpahan Island Beach.

2.3.1. Determination of Research Stations

Determination of research station points using simple random sampling. Simple random sampling is a method used to determine station points randomly with locations used that can represent the entire area. The following is the point of collection of data parameters for environmental physical conditions and index parameter data.

2.3.2. Data Collection

Retrieval of data on the physical parameters of the aquatic environment is measured by means in-situ. Measurements were made at each sampling point of each station. Measurement of parameters of the physical conditions of the environment in this study includes temperature, current velocity, and depth.

2.4. Data Processing

Processing of physical environmental condition parameter data, processing of water quality index parameter data that is measured in the field, and processing of Pasumpahan Island waters tourism conformity index data, consisting of parameters:

2.4.1. Processing of Brightness and Turbidity Data

The data that has been obtained while in the field will be processed in the Excel application which will then be presented in tabular form, which can later be seen at what stations and at what sampling points there are the highest and lowest values of the brightness and turbidity of the waters of Pasumpahan Island.

2.4.2. Coastal Topography Data Processing

The beach topography data obtained while in the field will then be processed using the formula for the suitability index value of marine tourism based on the measured coastal topography of Pasumpahan Island.

2.4.3. Flow Data Processing

Flow data obtained during field measurements, and then processed using the Excel application, will produce a flow data table.

2.4.4. Wave Data Processing

Wave height data that has been obtained while in the field, then processed using an application, then the wave height data will be presented in the form of an Excel application.

2.4.5. Water Quality

The pollution index value data is processed using the storet method, the rules of the Decree of the Minister of Environment No. 115 of 2003 which are defined as follows, Lij represents the concentration of water quality parameters listed in the Water Allocation Standard (j), and Ci represents the concentration of water quality parameters (i) obtained from the analysis of water samples at a sampling location from a river channel, then PIj is the Pollution Index for the designation (j) which is a function of Ci/Lij.

2.4.6. Processing of Tourism Suitability Index (IKW)

Data analysis uses a suitability matrix or Tourism Suitability Index (IKW) which is compiled based on the importance of each parameter to support activities in the area. The formula used for the suitability of beach tourism is (Yulianda, 2007).

$$IKW = \frac{Ni}{N\ Max} \times 100\%$$

Information:

IKW = Tourism suitability index (%)
Ni = Value of the i-parameter (weight x score)
N max = Maximum value of a tourism category (84)

Based on the suitability matrix, suitability classes are then prepared for beach recreation and swimming tourism activities. Suitability class is divided into 4 suitability classes include:

S1 = Very following the value of 83-100%
S2 = Corresponds to the value of 50 - <83 %
S3 = Following the conditional with a value of 17 ± <50 %
TS = does not match the value <17 %

The scale used to fill the column in determining the weight is as follows: 1) Giving weight 5: based on the thought that this parameter is very necessary or a key parameter. 2) Giving weight 3: based on the thought that this parameter is necessary and 3) Giving weight 1: based on the idea that this parameter in research is not needed / a parameter that is less important, which means that without this parameter tourism activities can still run.

Giving a score based on the quality of suitability parameters during the data collection process in the field. The criteria for each score are: 1) Giving a score of 3 good parameters conditions, 2) Giving a score of 2 parameter conditions have a fairly good quality, and 3) Giving a score of 1 parameter conditions have poor quality.

2.5. Data analysis

The analysis technique used is the analysis of tourism suitability index data (IKW), which will use oceanographic parameter data and water quality index parameter data to be processed using tourism suitability index data analysis, for wave data processing, brightness, turbidity, and beach topography are processed using

the Excel application. Furthermore, after the water quality index parameter data is obtained, then all the data is processed with Pollution Index (IP) value data following the Decree of the Minister of Environment No. 115 of 2003 using the storet method, after being processed using the storet method, index parameter data water quality. The data obtained is also processed and presented in tabular form and discussed descriptively referring to the relevant literature.

3. Result and Discussion

3.1. General Condition of Research Area

Pasumpahan Island is an island located in the city of Padang, precisely in the Bungus Teluk Kabung sub-district, located at 01°07'04" south latitude and 100°22'03" east longitude. This island is flat island and partly hilly, bordered by the Indian Ocean and the mouth of the Sungai Pisang, this type of beach has white sand, calm waters, and grows coastal vegetation in the form of coconut trees making it suitable to be used as marine tourism object. Based on the Mayor of Padang's decree with decree No. 224/2011 this island was designated as a regional marine conservation area (KKLD) in Padang City. The status of this island is a regional marine conservation island, so marine tourism activities cannot be carried out haphazardly so a study of the suitability of marine tourism is needed to manage marine tourism on Pasumpahan Island.

3.2. Parameter Measurement Results of Physical Conditions of the Environment

3.2.1. Brightness

Brightness in water is influenced by several factors, such as suspended solids, turbidity, weather conditions, and the time of data collection (Effendi, 2003). The brightness value is also influenced by the ability of sunlight to penetrate the bottom which is affected by turbidity (Widiatmaka, 2013). High brightness values and low turbidity on the coast of Pasumpahan Island are very good values for marine tourism activities because tourists tend to prefer coastal areas that have clear water.

Table 1. The brightness of the waters

Station	Measurement time	Rated brightness(m)
1	08.00 AM	1.65
	01.00 PM	2.50
	05.00 PM	2.60
2	08.00 AM	2,15
	01.00 PM	2.70
	05.00 PM	3,20
3	08.00 AM	2,10
	01.00 PM	2.40
	05.00 PM	2.85

3.2.2 Beach Width

The width of the beach is related to the extent of beach land that can be used for various beach tourism activities. The type of beach on Pasumpahan Island is a beach with open land and a basic water substrate in the form of white sand with a little coral, with land cover in the form of coconut tree vegetation. Pasumpahan Island also has several small hills which make it a hilly and not flat island. This is following the type of sand and the color of the sand at a beach tourism location that determines its aesthetic value on the beach, both black and white sand beaches. Sandy beaches do not have a fixed substrate whose function is so that organisms can attach, because the substrate particles are continuously moved by waves (Saraswati et al., 2017).

The measured depth is low because the station is only 30 m away from the lowest tide on the coast. This 30 m distance is taken into consideration by marine tourism activities, especially swimming and snorkeling. because considering that there are no special distance restrictions for someone to do swimming activities, this is following the statement (Suparno, 2013). The maximum depth value in coastal ecotourism is between 3 and 6 m, so the depth value on Pasumpahan Beach is included in the appropriate category.

Table 2. Beach Width

Station	Beach width (m)
1	7, towards the sea
2	9, towards the sea
3	4, towards the sea

3.2.3 Flow Speed

According to Suparno (2013), the current speed scale is divided into 4 parts, namely; 0-0.25 m/s in the slow category, 0.25 – 0.5 m/s in the medium category, 0.5-1 m/s in the fast category and 1m/s in the very fast category. The current speed on Pasumpahan Island Beach is included in the slow current category which is safe

for swimming and recreational tourism activities because the results of the research show that the speed is vulnerable between values of 0 – 0.25 m/s.

Table 3. Current Speed

Station	Measurement time	Depth(m)
1	08.00 AM	1.5
	01.00 PM	1,7
	05.00 PM	1,9
2	08.00 AM	1.5
	01.00 PM	1,7
	05.00 PM	1,9
3	08.00 AM	1,6
	01.00 PM	1,7
	05.00 PM	2

3.2.4. Wave Height

According to Thurman & Trujillo (2013), wave height is classified into 5 classes, namely: Very high: >2 meters, High: 1.5–2 m, Medium: 1-1.5 m, Low: 0.5 – 1 m, Very low: <0.5 meters. Based on measurements of wave height at each research station, the wave height on the Pasumpahan Island coast can be categorized into a low class, because the average wave height at each station does not reach above 1 meter. The longer and stronger the wind blows, the bigger the waves are formed. Where the wind speed on Pasumpahan Island is also relatively low.

Table 4. Wave Height

Research station	Measurement time	Gel height(m)
1	08.00 WIB	0.55
	13.00 WIB	0.63
	17.00 WIB	0.75
2	08.00 WIB	0.52
	13.00 WIB	0.66
	17.00 WIB	0.78
3	08.00 WIB	0.54
	13.00 WIB	0.58
	17.00 WIB	0.73

3.3. Tourism suitability index Parameters of Physical Conditions of the Environment

The suitability index for Pasumpahan Island beach tourism based on the parameters of the physical condition of the environment is 72, for the brightness and turbidity parameters a score of 3 is obtained and multiplied by the weight value, which gets a result of 9, which is the maximum weight in the category of important parameters. The wave parameter gets a score of 2 and is multiplied by the weight value. Those who get a result of 10, this result does not get the maximum value, this is caused by the wave parameter which is too slow, and is not suitable for use as a means of water sports that require wave height to do it, such as surfing. According to Suparno (2013), waves with a height above 1.5 meters are waves that are considered ideal for this activity.

Table 6. Travel Suitability Index

No	Parameter	Weight	Score	Results
1	Brightness and turbidity	3	3	9
2	Wave Height	5	2	10
3	Current speed	3	2	6
4	Depth (coastal topography)	5	3	15
5	Beach type (coastal topography)	5	3	15
6	Beach width (beach topography)	5	1	5
7	Bottom water substrate (coastal topography)	3	3	9
8	Land cover (coastal topography)	1	3	3
	Amount			72

The current velocity parameter gets a score of 2 and is multiplied by the weight value and gets a result of 6, this result does not get the maximum value because the current speed on Pasumpahan Island is relatively slow and tends to be calm so tourism activities for water rides and water sports are not optimally carried out, but this supports swimming and recreational activities for tourists, according to Widiatmaka (2013) which states that the current speed is suitable for tourism activities, namely with a vulnerable value of 0 - 0.17 m/s which is classified as a weak current so suitable for swimming. Relatively calm currents will give the impression of comfort to visitors who carry out tourism activities on the beach (Wisha, 2016).

The water depth parameter gets a score of 3 and multiplied by the weight value, gets a result of 15, this result gets the maximum result because the measured depth value is good for diving activities, both scuba diving and snorkeling, this is also supported by the presence of coral reefs so that it adds aesthetic value for the depth parameter. This is also supported by Widiatmaka (2013) which states that the value limit according to depth for beach tourism is with a depth value of 1-2 m so that swimming activities are safe to do on Pasumpahan Island Beach.

The beach type parameter gets a score of 3 and is multiplied by the weight, getting a result of 15, this result gets the maximum value because the Pasumpahan Island beach type is a white sandy beach covered with coconut tree vegetation which adds beauty so that visitors are comfortable traveling on Pasumpahan Island beach. The beach width parameter gets a score of 1 and is multiplied by the weight to get a result of 5, this result is the lowest value of all oceanographic parameters measured, this is due to the close distance between the highest tides and the beach area, so visitors can only do water tourism such as swimming, diving, and other water sports.

The bottom substrate parameters get a score of 3 and multiplied by the weight value get a result of 9, this result gets the maximum value because the bottom substrate of the waters from Pasumpahan Island beach is white sand, the bottom substrate of white sandy waters is more in demand by tourists compared to other substrates because it adds value to the beauty of coastal waters. this is in line with the opinion of Tambunan (2013) which states that sandy beaches are more suitable for the use of all tourism activities.

The land cover parameter gets a score of 3 and is multiplied by the weight to get a result of 3, this result gets the maximum value because the land cover of the Pasumpahan Island beach is coconut trees that add to the beauty when traveling on the Pasumpahan Island beach. The results of the calculation of the parameters of the physical conditions of the environment are entered into the IKW formula (tourism suitability index) to see the category of tourist suitability for the parameters of the physical conditions of the environment. The value of the tourism suitability index was obtained at 85.71%, this is included in the S1 category (very suitable).

3.4. Water Quality

Determining quality status is done by comparing data on water quality with quality standards that have been set according to its designation. For temperature parameters (Yuningsih, 2011) stated that the variability of temperature and salinity indirectly also resulted in variations in the measured pH and alkalinity values. So temperature can be interpreted as one of the variables that affect other variables in the waters. Effendi (2003) states that 23-32°C is the natural temperature of tropical waters in Indonesia so Pasumpahan Island Beach is in the category of suitable for marine tourism. Because this is in line with the optimal temperature statement for coastal areas, which is 23-35°C.

Table 7. Water quality

No	Parameter	unit	Quality standards	Mark	score	Class	Category	Information
1.	Temperature	^{o}C	Experience	Max: 31	0	A	Very well	According to Quality Standards
				Min: 28	0			
				Average: 29.6	0			
2.	Salinity	‰	Experience	Max: 31	0	A	Very well	According to Quality Standards
				Min: 31	0			
				Average: 31	0			
3.	pH	-	7	Max: 7	0	A	Very well	According to Quality Standards
				Min: 7	0			
				Average: 7	0			
4.	DO	mg/l	>5	Max: 7.4	0	A	Very well	According to Quality Standards
				Min: 5.2	0			
				Average: 6.4	0			
5.	Smell	-	Odorless	No smell	0	A	Very well	According to Quality Standards
				No smell	0			
				No smell	0			
6.	Rubbish	-	Nothing	Nothing	0	A	Very well	According to Quality Standards
				Nothing	0			
				Nothing	0			

Salinity is the concentration of all salt solutions obtained in seawater, if the higher the salinity level in water the osmotic pressure will also be large (Widiatmaka, 2013). The pH value of water is one of the chemical parameters which is quite important in monitoring the stability of water. The pH value in the ocean will not drop because seawater contains natural buffers that function to maintain pH levels such as bicarbonate, carbonate, calcium, borate, and hydroxide. The ability of seawater to maintain a decrease in pH due to the addition of acids is called alkalinity, buffering capacity, and carbonate hardness (Sutirto et al., 2014). The description of the high and low levels of pH or alkalinity in waters is measured by the pH content. pH value = 7 indicates neutral water,

Based on the Decree of the Minister of State for the Environment No. 51 of 2004 The pH quality standard for marine tourism is 7 - 8.5. it can be said that Pasumpahan Island Beach has a pH that is following the quality standards that have been established as marine tourism for recreational activities and swimming by Decree of the State Minister for the Environment No. 51 of 2004 because the value is not more than 8.5 (Anonimus, 2004). The degree of acidity greatly influences the toxicity of polluting materials and the solubility of some gases and determines the form of substances in water. The pH value on Pasumpahan Island Beach which complies with quality standards creates a sense of comfort for visitors because there are many activities carried out such as swimming and other water tourism.

DO is used as an indication of the degree of dirtiness of the waste in the waters. The higher the water pollutant, the less dissolved oxygen levels in these waters so that oxygen levels can be used as a parameter to determine water quality (Saraswati et al., 2017). DO in water starts from the process of photosynthesis in Theoyana et al. (2015) statement, namely diffusion from air and turbulence. The higher the content of organic matter in water, the DO needed by bacteria for the decomposition process also increases, which in turn reduces the DO content in the waters due to competition because the odor is related to visitor comfort in marine tourism areas and also The aroma or smell found in the waters is one of the physical parameters of the quality of coastal waters (Thurman & Trujillo, 2004).

Garbage is the main pollution factor in a tourist location because it is related to the aesthetic aspects of a trash tourism location around the coast of Pasumpahan Island so that according to the quality standards that have been set, waste is also one of the aspects related to the comfort of visitors at marine tourism sites.

4. Conclusion

The tourism suitability index based on the parameters of the physical condition of the environment taken on the coast of Pasumpahan Island gets a value of 85.71% which is included in the S1 category (very suitable). The parameters of the water quality index, it is analyzed using the storet method, and for the results of data processing the water quality index using the storet method is 0 according to the quality standards of marine tourism waters regulated in Appendix VII Government Regulation Number 22 of 2021, the results of processing the storet method are included in category $0 \leq PIj \leq 1.0$ = meets quality standards (good condition) and is feasible for marine tourism activities with activities that include swimming, snorkeling and water tourism.

5. Suggestion

This study only describes the suitability level of marine tourism based on parameters of physical environmental conditions and the water suitability index. It is suggested that further research be carried out on social and economic aspects, as well as the management of facilities and infrastructure in the coastal area of Pasumpahan Island.

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