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A POTENTIAL LOCATIONS OF MARINE TOURISM IN PASUMPAHAN ISLAND, PADANG CITY - INDONESIA

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ABSTRACT: The purpose of this study was to determine the condition of the underwater substrate and the location that has the potential to be developed as marine tourism (snorkelling) in Pasumpahan Island, Padang city. The research method used scoring assessment the suitability parameters of marine tourism with weighting the score. The location in this research was Pasumpahan Island waters based on waters brightness, beach type, lifeform, and underwater substrate. Based on the results of the study it can be concluded that 1) the basic substrate of Pasumpahan Island waters is a living coral area of 63,900 m² with a percentage of 25.81%, dead coral covering 75,600 m² with a percentage of 30.54%, and sand covering 108,000 m² with a percentage of 43.63 %; and 2) Pasumpahan Island has a suitability category for snorkelling tours as follows, quite suitable category (S2) with an area of 64,859 m², very suitable category (S1) with an area of 117,276 m².

Keywords: Potential, Substrate, Marine tourism, Smalls island, Pasumpahan – Padang

1. INTRODUCTION

Padang city has an 84 km coastline with 72,000 ha of water, and 19 small islands scattered around its territorial waters [1] [2]. Of course, the city of Padang has considerable marine tourism potential considering the vast waters and the many small islands. This will improve the economy in Padang City, according to [3-5] the tourism potential of the archipelago in Indonesia can reach thousands of trillions of rupiah. Therefore the development of marine tourism on the coast, especially small islands are able to become the future of tourism in Indonesia [6-8].

Pasumpahan Island is included in the administrative area of Bungus Teluk Kabung sub-district, located in the southern part of Padang City. Pasumpahan Island is one of the islands in the city of Padang which is quite close to the city centre, very easy to reach, either by land or sea. By land transportation, the location to Pasumpahan Island can be reached by passing Sungai Pisang village, followed by a fishing boat to cross (only a few minutes crossing). By sea, it can be reached via the Bungus Ocean Fisheries Port/PPS, and also through the coast in the Pasar Laban Bungus area [6] [7] [8].

Economically, with affordable access, it will be very popular and will be visited by many tourists, supported by island information that has spread widely. In addition to increasing regional income, it will also improve the economy of coastal communities near the island. This island began to become one of the island's tourist destinations in Padang city. After the end of Sikuai Island as a mainstay of island tourism in Padang city, the island began to be glimpsed by many tourists, both the local city of Padang, outside the region, as well as foreign tourists.

Increased tourism activities provide economic benefits but also have a negative impact on coral reef ecosystems [7]. Tourism activities such as snorkelling contribute to changes in the condition of coral reef ecosystems [8] [9]. Some tourist behaviours have the potential to damage coral reefs such as kicking corals, holding corals, walking on corals, due to snorkelling at inappropriate depths [10]. According to [11] the impact caused by each tourist behaviour on coral reefs is very small, but cumulatively these behaviours can put pressure on coral reefs and affect the percentage of coral cover.

Since there is no mapping of marine tourism potential zones especially snorkelling tourism as a marine tourism activity on Pasumpahan Island, it is necessary to conduct an analysis of the tourism potential area. Supported by the availability of information/survey data that has been conducted and by using the development of remote sensing technology and *Geography Information System* (GIS), it will be easier to obtain information in a short time that may be used for the purposes of developing the region. The purpose of this study was to determine the potential of marine tourism sites on Pasumpahan Island, Padang City.

2. RESEARCH METHODS

The type of beach chosen in this research is the type of gently sloping beach, the beach is not

directly adjacent to the high seas so that the waves are relatively calm, and the depth chosen is the depth in accordance with the parameters of the suitability of snorkelling tourism [11] [12]. From the above considerations, 4 observation station points emerged, with the coordinates of the station points is as follows:

Table 1 Observation Station Coordinates

Station	Latitude	Longitude
1	$01^0$07'4.02"	$100^0$22'17.6"
2	$01^0$07'8.85"	$100^0$22'14.8"
3	$01^0$07'10.8"	$100^0$21'59.6"
4	$01^0$07'6.86"	$100^0$21'55.6"

Source: field survey, 2018.

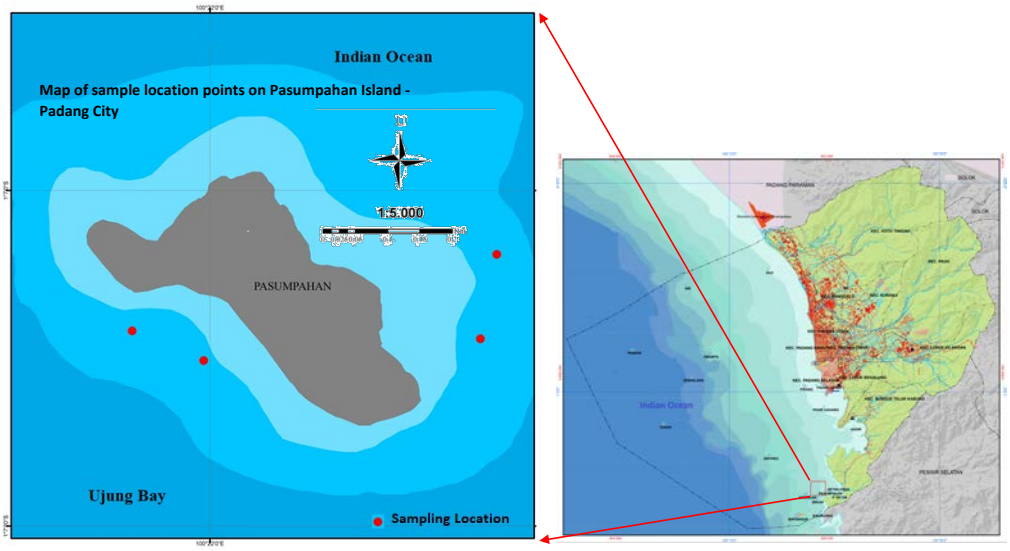

Fig.1 Map of Research Location Map

This analysis is carried out to determine the suitability of use as well as the potential of marine tourism for snorkelling activities in Pasumpahan Island in accordance with their designation.

Analysis of the suitability and potential of the area is done by the suspension method in which each parameter is given a value or score in accordance with the criteria [11].

Table 2 Physical appropriateness assessment system of marine tourism in the type of snorkelling tourism

Parameter	weight	S1	score	S2	score	S3	score	N	score
1. waters brightness (%)	5	100	3	80-<100	2	20-<80	1	<20	0
2. coral cover	5	>75	3	>50-75	2	25-50	1	<25	0
3. life form	3	>12	3	>7-12	2	4-7	1	<4	0
4. reef fish	3	>50	3	30-50	2	10-<30	1	<10	0
5. Current speed (cm/sec)	1	0-15	3	>15-30	2	>30-50	1	>50	0
6. coral reef depth (m)	1	1-3	3	>3-6	2	>6-10	1	>30	0
7. Flat stretch of coral	1	>500	3	>100-500	2	20-100	1	<20	0

Source: [11][12].

The formula used for the suitability of snorkelling tours is shown in the following formula [11-13]:

$ITS = \sum (N_i/N_{max}) \times 100\%$

Where :

ITS = index of tourism suitability
N_i = parameter value-I (weight X score)
N_{max} = Maximum value of a travel category

Based on the calculation of class intervals as above formulated, the physical suitability classification of marine tourism (snorkelling) is divided into four categories, i.e:

S1 = very suitably (75-100%)
S2 = quite suitable (50-<75%)
S3 = conditionally suitable (25- <50%)
N = incompatible (<25%).

The raw data in the form of tabulations obtained from the input data is then processed using the ARC GIS 10.3 software to be interpolated [14][15]. This interpolation activity uses data from sampling points from the results of data collection recorded, then the data of that point is converted into spatial data or data that has space.

3. RESULTS

Pasumpahan Island which is located in the Reserve of Coastal Conservation Areas and Small Islands as a Small Island Park in Padang City, based on Mayor's Decree No. 397 of 2014 where the area was divided into area I, Bindalang Island, Sibonta Island, Sibonta Kasiak and the surrounding sea area of 1,005.7 ha. Area II, Sikuai Island, Sironjong Island, Pasumpahan Island, Setan Island, Ular Island, Sirandah Island and the surrounding sea area of 1,269.26 ha [14].

Pasumpahan Island has a nearly uniform type of beach. For the east-south part of the beach type is generally in the form of white sand and white sand mixed with a little stretch of coral originating from coral fragments with a beach width ranging from ± 15 m to be exposed to seawater. In the south-west part has the type of beach that experiences a little abrasion, is more dominated by steep and steep coral rocks, and has a pretty big wave of waves.

Pasumpahan Island has almost the same beach slope, where the beach slope ranges from 10°-<40°, including the category of ramps, except for south to west experiencing a fairly large slope, which is >40°. This condition is due to the fact that the location is often used as a boat landing area by fishermen and because the waves hit the beach.

3.1 Underwater substrate

Based on the processing of Landsat Sentinel-2 2018, it was found that the Underwater substrate of Pasumpahan Island consisted of dead coral, live coral and sand (Tabel 3, Tabel 4, and Fig. 2).

Table 3 Results of the analysis of the underwater substrate in Pasumpahan Island

Life Form (St 1)		CM-1	
		Freq	%
Hard coral		**9**	**44,02**
Acropora branching	*ACB*	2	33,33
Branching coral	*CB*	3	4,63
Massive coral	*CM*	2	3,13
Submassive coral	*CS*	2	2,93
Death Coral		**5**	**16,23**
Dead coral	*DC*	0	0
Dead coral with algae	*DCA*	5	16,23
Abiotic		**17**	**39,72**
Rock	*RCK*	0	0
Ruble	*R*	9	17,66
Sand	*S*	8	22,06
Silt	*SI*	0	0
Life Form (St 3)		**CM-1**	
		Freq	**%**
Hard coral		**13**	**51,09**
Acropora branching	*ACB*	6	27,2
Acropora submassive	*ACS*	0	0
Acropora tabulate	*ACT*	0	0
Branching coral	*CB*	2	1,06
Coral encrusting	*CE*	0	0
Foliose coral	*CF*	0	0
Massive coral	*CM*	5	22,83
Submassive coral	*CS*	0	0
Heliopora	*CHL*	0	0
Tubipora	*CTU*	0	0
Death Coral		**6**	**21**
Dead coral	*DC*	2	5,6
Dead coral with algae	*DCA*	4	15,4
Abiotic		**6**	**19,83**
Rock	*RCK*	0	0
Ruble	*R*	4	12,63
Sand	*S*	2	7,2

Life Form (St 2)		CM-1	
		Freq	%
Hard coral		**21**	**68,96**
Acropora branching	*ACB*	10	29,93
Acropora submassive	*ACS*	1	0,4
Acropora tabulate	*ACT*	0	0
Branching coral	*CB*	1	0,8
Coral encrusting	*CE*	0	0
Foliose coral	*CF*	0	0
Massive coral	*CM*	8	36,23
Submassive coral	*CS*	1	1,6
Heliopora	*CHL*	0	0
Tubipora	*CTU*	0	0
Death Coral		**7**	**13,7**
Dead coral	*DC*	0	0
Dead coral with algae	*DCA*	7	13,7
Other biota		**2**	**0,96**
Soft coral	*SC*	0	0
Sponge	*SP*	2	0,96
Abiotic		**4**	**22,65**
Rock	*RCK*	0	0
Ruble	*R*	0	16,66
Sand	*S*	4	3,26
Silt	*SI*	1	2,73
Life Form (St 4)		**CM-1**	
		Freq	**%**
		18	**46,1**
Hard coral			
Acropora branching	*ACB*	1	4
Acropora submassive	*ACS*	0	0
Acropora tabulate	*ACT*	0	0
Branching coral	*CB*	4	20,4
Coral encrusting	*CE*	0	0
Submassive coral	*CS*	13	21,7
Heliopora	*CHL*	0	0
Tubipora	*CTU*	0	0
Death Coral		**8**	**20,3**
Dead coral	*DC*	0	0
Dead coral with algae	*DCA*	8	20,3
Abiotic	**14**	**33,6**	
Rock	*RCK*	0	0
Ruble	*R*	0	0
Sand	*S*	4	13,9
Silt	*SI*	10	19,7

Source: Data analysis 2018**.**

Table 4 Underwater substrate of Pasumpahan Island

Substrate	Area m²	%
Dead coral	75.600	30,54
Sand	108.000	43,63
Coral Life	63.900	25,81
Total	**247.500**	**100**

Source: Data analysis 2018.

The underwater substrate can be determined using Landsat Sentinel-2 2018 using Lyzenga methods [15] to see the distribution of underwater substrate where the results obtained in the form of dead coral covering an area of 75,600 m², 108,000 m² sand, live coral 63,9000 m². Almost on every side of the island there are live coral, live coral cover is the most dominant in the northern part of the island this is caused in this section is the high seas so that frequent large waves occur, generally coral reefs are more developed in large undulating waters, in addition to carrying plankton as a food source also provides oxygen supply in seawater and prevents settling of colonies [16][17].

In the waters of Pasumpahan Island, sandy coral material is the underwater compiler. However, at depths of 0-2 m, underwater substrate is fine sand. At a depth of 2-10 m the underwater substrate in the form of a stretch of coral both live and dead coral that is almost found on each side of the spill island with a percentage of live coral 25.81% and the percentage of dead coral 30.54%.

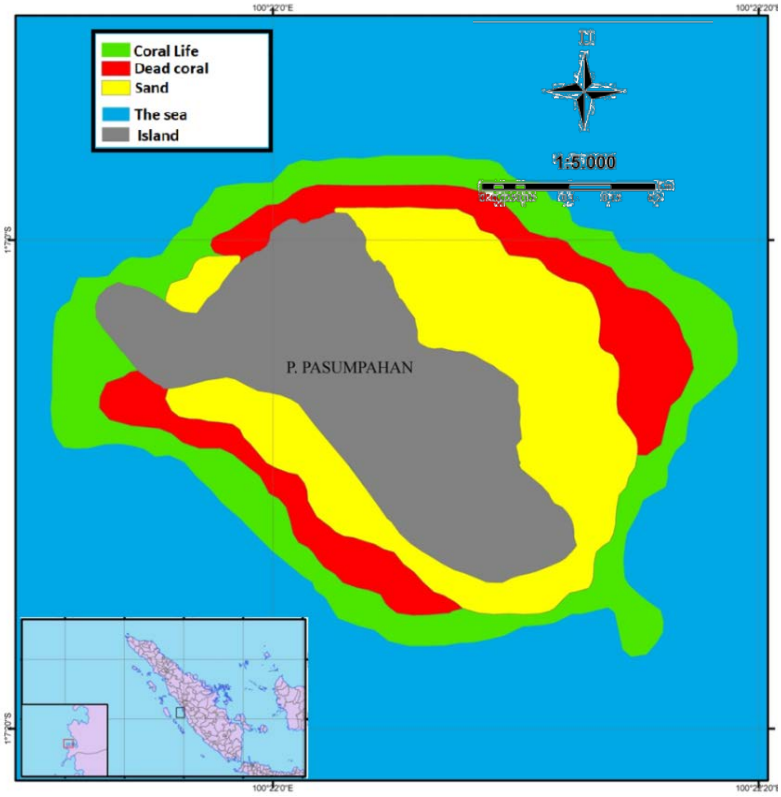

Fig. 2 Map of the underwater substrate of Pasumpahan Island

3.2 Suitability analysis of marine tourism locations in Pasumpahan Island

Based on the results of the field survey, the results of the suitability of the snorkelling tourism location are obtained as can be seen in Table 3. Meanwhile, the results of field observations were processed using the scoring method [11-13]. Where the description is based on the suitability parameters, i.e.

3.2.1 Waters brightness

On Pasumpahan Island, brightness on all sides can reach ≤ 15 m, this is due to the clear and bluish waters. This shows that Pasumpahan Island has pretty good brightness, but if the Sungai Pisang village area experiences heavy rain, some of the waters of Pasumpahan Island will experience quite a high turbidity with a brightness level of 0-2 m caused by the influence overflow of river water on mainland of Sungai Pisang village.

3.2.2 Coral reefs and Life form

Coral reefs that live on Pasumpahan Island can be found evenly distributed at all research stations, where the condition of coral reefs is dominated by living corals with a total percentage of 52.52%. According to the Decree of the Minister of Environment No. 4/2001 concerning the quality standards of coral reef damage [18-20], it can be categorized as "good".

Department of Fisheries and Marine-Padang City (2012) recorded the growth of live coral on Pasumpahan Island by 40.00%, when compared with the results of research conducted an increase of 12.52%. However, at the time of the research, it was also found that there was a large amount of plastic waste involving coral reefs, if left unchecked it would affect the growth of the coral.

3.2.3 Current speed

The current speed at the surface in water is strongly influenced by wind, waves, tides and river flow. The current velocity at the surface of the waters during a study in June 2018 was between 15.3-16.6 cm/sec. Department of Fisheries and Marine-Padang City (2012) noted that the speed currents on the surface vary between 5-15 cm/sec,

where the direction of the current is dominant towards the west and northwest.

3.2.4 Reef fish

From the results of data collection on Pasumpahan Island reef fishes were conducted in 4 stations as many as 65 species (species) of reef fish which were divided into 31 reef fish families. The types of *chaetodontidae, balistidae, Blennidae, Labridae, Pomacentridae* and *Lutjanidae* are the types most often encountered during data collection around Pasumpahan Island.

3.2.5 Coral reef depth

The coral reef depth of Pasumpahan Island is quite varied both on the north, east and west sides. On the north side, the depth tends to be flat, which ranges from 0-12 m. On the east side, the condition of the depth of coral reefs is also classified as flat with depths ranging from 0-12 m. The west side has a greater slope than the north side and the east side. The west side has a depth of between 0-15 m.

Based on the suitability index table of snorkelling tours on the island of the spill obtained the category i.e: 1) the category is very suitable (S1) From the scoring results, we get a very appropriate category at station 2 and station 3 where the tourism suitability index at this station is 78.94% for station 2 and 71.92% for station 3 with an area of 117,276 m²; 2) Quite an appropriate category (S2) at stations 1 and 4, the tourism suitability index was obtained according to the same value, which was 54.38% with an area of 64,859 m². The conditions are quite suitable for snorkelling tours at stations 1 and 4 influenced by the percentage of coral community cover that is moderate and the width of the reef that is unable to support snorkelling tourism activities properly. But the most influential is the percentage of coral reef community cover because it is one of the parameters with the highest weight. The unhealthy coral reef community at stations 1 and 4, resulted in a suitability index of snorkelling tourism at the station no more than 50%.

Table 5 Suitability index of marine tourism (snorkelling)

Parameter	weight	S1	score	S2	score	S3	score	N	score
1. waters brightness (%)	5	3	15	3	15	3	15	3	15
2. coral cover	5	1	5	2	15	2	15	1	5
3. life form	3	1	3	1	3	1	3	1	3
4. reef fish	3	1	3	2	6	1	3	1	3
5. Current speed (cm/sec)	1	2	2	2	2	2	2	2	2
6. coral reef depth (m)	1	2	2	2	2	2	2	2	2
7. Flat stretch of coral	1	1	1	1	1	1	1	1	1
Total		11	31	13	45	12	41	11	31
ITS (%)		54,38		78,94		71,92		54,38	
Category		S2		S1		S1		S2	

Source: Data analysis 2018**.**

Table 6 Results of suitability (snorkelling) parameters observation

Parameter	Station 1	Station 2	Station 3	Station 4
1. waters brightness (%)	100	100	100	100
2. coral cover	44,02	68,96	51,09	46,01
3. life form	4	5	4	5
4. reef fish	13	18	17	13
5. Current speed (cm/sec)	15,3	15,3	16,6	16,4
6. coral reef depth (m)	7	6	7	5
7. Flat stretch of coral	70	70	100	100

Source: Data analysis 2018**.**

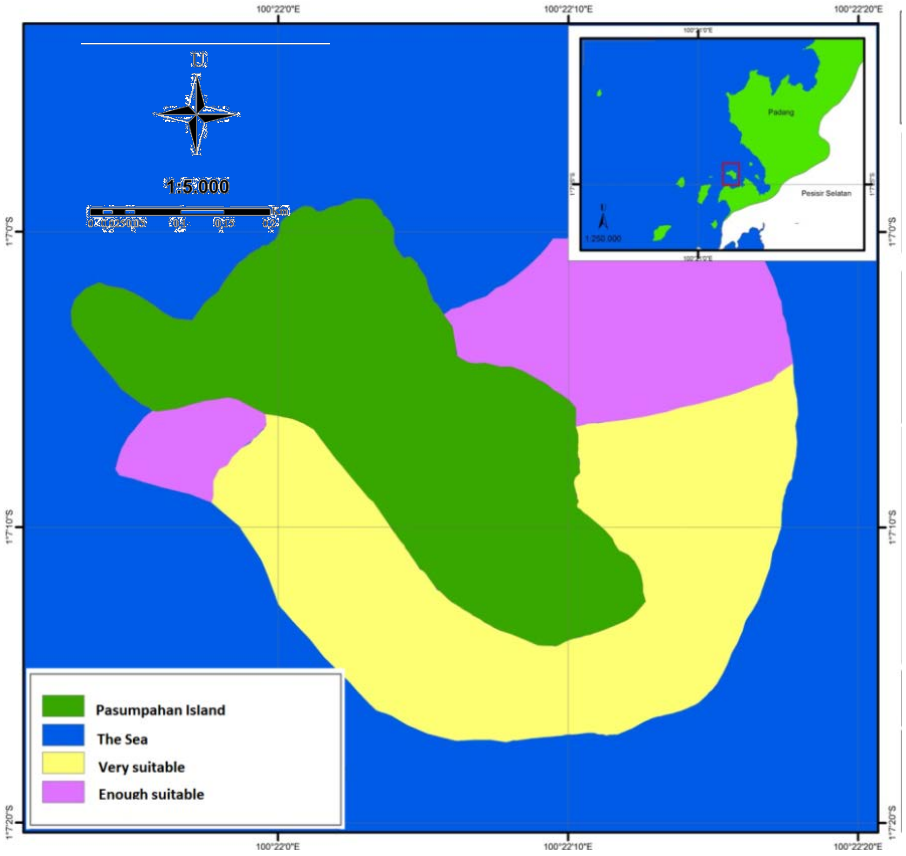

Fig. 3 Map of Suitability index of marine tourism (snorkelling)

4. CONCLUSION

The underwater substrate data of Pasumpahan Island i.e dead coral covering an area of 75,600 m², sand 108,000 m2, live coral 63,900 m². Based on the results of the suitability analysis of snorkelling tourism locations in the waters of Pasumpahan Island using the scoring method, Generating: Observation stations 2 and 3 are included in the category of very suitable with the tourism suitability index value of 78.94% for station 2 and 71.92% for station 3. At station and 4, the tourist suitability index is obtained according to the same value of 54.38 %. Of the results, planning, control, and supervision of the condition of the substrate waters of Pasumpahan Island are needed so that the beauty of the island's natural location is maintained and for managers to pay attention to the appropriate area for snorkelling activities.

5. ACKNOWLEDGEMENTS

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