



## Evaluation of the suitability of marine tourism in the Mandeh Archipelago, West Sumatra

Iswandi Umar

Department of Geography, Faculty of Social Science, Padang State University, Padang, 25131, Indonesia

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### Corresponding Author:

Iswandi Umar

Geography Department, Faculty of Social Science, Padang State University,

Tel. 081363315275

Email:

[iswandi\\_u@yahoo.com](mailto:iswandi_u@yahoo.com)

**Abstract.** *Indonesia has a great potential to develop marine tourism because it has many islands and beautiful coastal areas. Mandeh is one of the potential places to invent marine tourism due to its beautiful coastal lands and islands. This study aims to evaluate land suitability and to determine constraints for marine tourism development in the Mandeh archipelago. The evaluation of land suitability is done using the Geographical Information System (GIS) method with ten indicators, namely: depth, beach type, beach width, beach material, ocean current velocity, the slope of the beach, beach brightness, land use, hazardous biota, and availability of freshwater. Furthermore, to determine the constraints using the Interpretative Structural Modeling (ISM) Method, the ISM Method involves stakeholders from tourism experts, community leaders, tourism businesses, and local governments. The results of research on the evaluation of the land suitability of marine tourism in the Mandeh area are mostly or about 35% very suitable (S1) for developing marine tourism. Besides, the unsuitable area (N) is only 20% of the total area. Based on the analysis, there are two obstacles to developing marine tourism in the Mandeh archipelago. They are the low investment capital and the lack of professional personnel in developing marine tourism.*

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## INTRODUCTION

Marine tourism has a lot of contribution to the national economy by providing jobs and other economic activities (multiplier effect). It also becomes foreign exchange income for the country (Dahuri, 2001). In addition, marine tourism can be a driving force for the national economy due to the vast seas and islands and a very strategic position between two continents and oceans (Riski *et al.*, 2016; Ramenusa, 2016). Marine tourism is a form of tourism activity that prioritizes the attractiveness of nature in coastal and marine areas (Yani, 2018).

Indonesia has a great and promising prospect for industry and tourism, considering that Indonesia has abundant natural resources (Soekadijo, 2001). The tourism sector contributed substantially to the national Gross Domestic Product (GDP). Tourism utilizes a GDP of around 4.1% directly and 9% indirectly. This sector was also able to withstand the pressures of the global crisis. In Visit Indonesia 2019 program, the tourism sector managed to attract 6.5 million foreign tourists. It is equivalent to USD 7.5 million (Palupi *et al.*, 2019).

The Mandeh Archipelago is one of the marine tourism areas in the Pesisir Selatan Regency. Pesisir Selatan Regency has been designated as a potential area in the tourism sector since 2002. Defined as a marine tourism area, the number of tourists who visit Pesisir Selatan has increased. The number of domestic tourists increased up to 80%, and foreign tourists up to 5% (DISPARPORA Pesisir Selatan Regency, 2020). In addition, the Mandeh Archipelago has been included in the National Tourism Development Master Plan (RIPPNAS) since 2015 (Mukhtar *et al.*, 2017).

Mandeh is referred to as The Paradise in The South with about 18 000 hectares area. This place is administratively located in the District of Koto IX Tarusan. The beauty of this area is not proportional to the number of visits and development of tourist attractions. In addition, the characteristic of the area limits the use of space. Based on the above background, the purpose of this research is to determine the evaluation of the islands and determine the structure of maritime tourism constraints in Mandeh, West Sumatra Province.

## RESEARCH METHODS

### Research Time and Location

This research was conducted from December 2020 to March 2021. The location was at the Mandeh archipelago in Pesisir Selatan, West Sumatra. The location is 100°15'-100°30' E and 1°05'-1°20' S. This area is administratively in Jorong Carocok, Koto IX Tarusan District, Pesisir Selatan Regency, West Sumatra Province. The research area covered 5 (five) Nagari. Nagari is an administrative area equivalent to the prevailing village in West Sumatra Province. The distribution of Nagari in the research area can be seen in Figure 1.

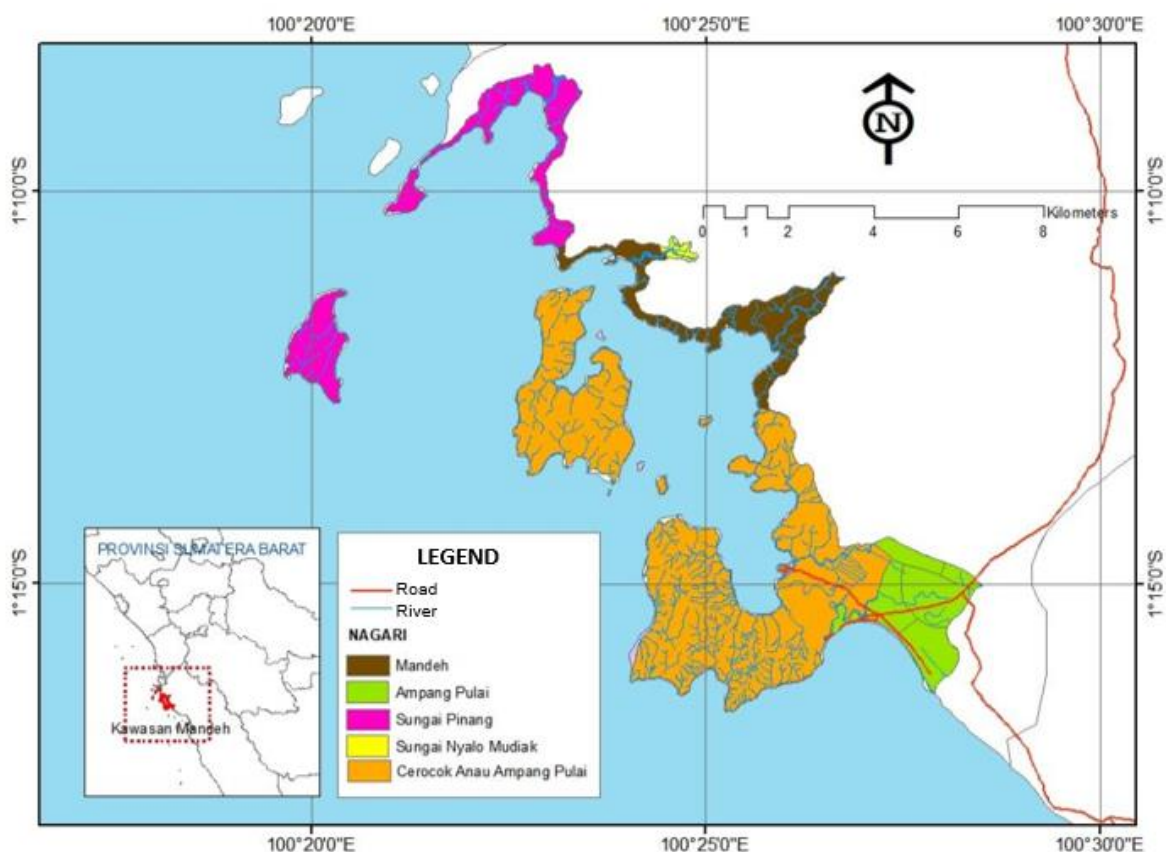


Figure 1 Research location

The Mandeh archipelago is a bay area with a topography of mostly (57.5%) steep slopes. The area has several islands Cubadak Island, Pagang Island, Sirojong Island, Satan Island, Marak Island, Pasumpahan Island, Pamutusan Island, Suwarnadwipa, Sikulo Bay. The name comes from the word maandeh, which

means to lean. The Mandeh area is a place for ships from the south of the coastal area to rest for shelter from sea waves. This area only started to be developed around 2010 (DISPARPORA Pesisir Selatan Regency, 2020).

**Data Analysis**

The research population is the Mandeh Archipelago. An overlay of five land units was carried out to determine the sample in this study, namely landform, slope, soil type, geology, and land use. The results of the overlay figure out 11 land units (SPL). It is presented in detail on the land unit map (Figure 2). There are ten indicators used in the research on evaluating the suitability of marine tourism land in the Mandeh Archipelago. The indicators are water depth, beach type, beach width, basic material, ocean current velocity, beach slope, beach brightness, land use, hazardous biota, and freshwater availability.

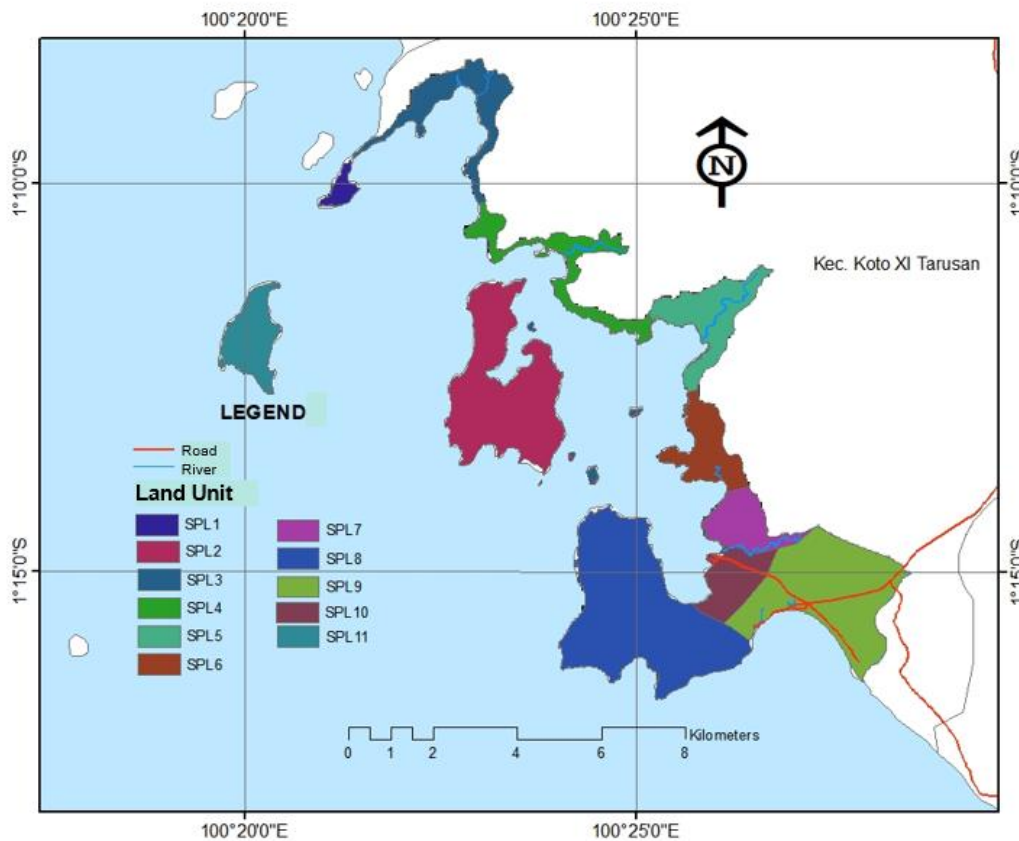


Figure 2 Land unit mapping

Table 1 Indicators of land suitability for marine tourism

No	Indicator/weight	Sub Indicator	Value	Score
1.	Water Depth (meters)/5	0-3	4	20
		3-6	3	15
		6-10	2	10
		>10	1	5
2.	Beach Type/8	White sand	4	32
		Rocky white sand	3	24
		Black sand, rocky and steep	2	16
		Mud, rocky and steep	1	8

No	Indicator/weight	Sub Indicator	Value	Score
3.	Beach Width (meters)/3	>15	4	12
		10-15	3	9
		3-10	2	6
		<3	1	3
4.	Basic Materials/9	Sand	4	36
		Sandy coral	3	27
		Muddy sand	2	18
		Mud	1	9
5.	Ocean Current Velocity (m/s)/10	0-0.17	4	40
		0.17-0.34	3	30
		0.34-0.51	2	20
		>0.51	1	10
6.	Beach Slope /5	Flat (0-8 %)	4	20
		Ramps (8-17%)	3	15
		Slightly steep (17-27%)	2	10
		Steep (>27%)	1	5
7.	Beach Brightness (meter)/7	>10	4	28
		5-10	3	21
		3-5	2	14
		<2	1	7
8.	Land use/4	Moor of coconut and fir trees	4	16
		Shrubs	3	12
		High Shrubs	2	8
		Mangroves and settlements	1	4
9.	Hazardous Biota /7	Nothing	4	28
		Sea urchins	3	21
		Stingray	2	14
		Sharks and whales	1	7
10.	Freshwater Availability (distance/km)/3	< 0.5	4	12
		0.5-1	3	9
		1-2	2	6
		>2	1	3

Source: Yulianda (2007)

This study uses the following equation to determine the class interval of the marine tourism land suitability index. Based on the indicator table, the highest parameter value is 244, while the lowest parameter value is 61. There are four classes for the land suitability class. The use of Equation 1 is to obtain class intervals. With this equation, we obtained an interval of 45, and the class suitability of marine tourism land is presented in Table 2.

$$IKWB = \sum [c_{maks} - b_{min}]/k \tag{1}$$

Description:

- IKWB : Index of Marine Tourism Land Suitability
- $c_{maks}$  : The highest parameter value
- $b_{min}$  : The lowest parameter value
- k : Number of classes desired

Table 2 Interval class marine tourism land suitability

No	Index of Marine Tourism Land Suitability	Class Interval
1.	Very Suitable (S1)	197-244
2.	Suitable (S2)	152-196
3.	Marginally suitable (S3)	107-151
4.	Unsuitable (N)	61-106

The constraints in marine tourism objects in the Mandeh Archipelago development are determined by the Interpretative Structural Modeling (ISM) method. The ISM method was first introduced by Warfield (1974) and developed by Saxena *et al.* (1992). This method is very suitable for solving problems that have high complexity. The sampling method is purposive sampling. This method is beneficial in determining the constraints on marine tourism development based on expert opinion. The experts involved come from tourism experts, community leaders, tourism businesses, and local governments. Marimin (2005), Eriyatno and Larasati (2013), and Umar and Dewata (2017) describe several stages in the ISM method. Those stages are as follows: (1) breaking down elements into several sub-elements; (2) determining the contextual relationship between the sub-elements; (3) determining the Structural Self Interaction Matrix (SSIM); (4) making Reachability Matrix (RM); (5) performing transitivity; (6) determining the hierarchical structure vertically; and (7) determining the relationship matrix of Driver Power (DP) and Dependence (D). Creating an SSIM (Structural Self Interaction Matrix) is done by pairwise comparison with the VAXO symbol. The meaning of the symbols are:

- a. V if  $E_{ij} = 1$  and  $E_{ji} = 0$ ; V = the  $i^{th}$  sub-element has more role than the  $j^{th}$  sub-element and not vice versa
- b. A if  $E_{ij} = 0$  and  $E_{ji} = 1$ ; A = the  $j^{th}$  sub-element is more important than the  $i^{th}$  sub-element and not vice versa
- c. X if  $E_{ij} = 1$  and  $E_{ji} = 1$ ; X = both sub-elements have the same level of role and are interrelated, and
- d. O if  $E_{ij} = 0$  and  $E_{ji} = 0$ ; O = the two sub elements are not related to each other

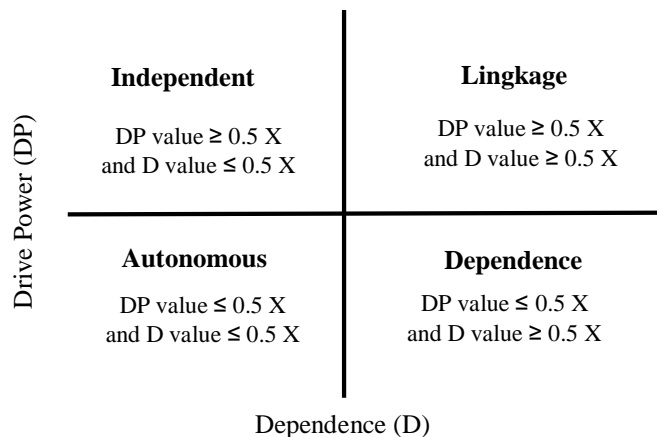


Figure 3 Driver power and dependence relationship matrix on ISM

Furthermore, the contextual relationships between the elements can be divided into four categories. The categories are Autonomous (first quadrant), Dependence (second quadrant), Linkage (third quadrant), and Independent (fourth quadrant). Marimin (2005) explains those elements. (1) the elements included in the autonomic quadrant mean that the element or sub-element is not related/ has very little relationship to the system; (2) the dependence quadrant is an element or sub-element that has a weak influence and the relationship to other variables is very high; (3) the linkage quadrant has the meaning that the element or sub-element has a strong influence, but also has a high linkage to other variables; and (4) the independent quadrant can be interpreted that the element or sub-element has a strong influence and the relationship to other variables is very little. For clarity, the contextual relationship between elements in the ISM method is presented in Figure 3.

**RESULTS AND DISCUSSION**

Land suitability is the suitability of particular land or location for a particular purpose through an assessment with certain indicators to create a more directed use of land (Yulianda, 2020). Sitorus (1985) and Harjowigeno (1998) explain that the purpose of land suitability is to optimize the potential of the land and create sustainability. The results of the analysis of land suitability for marine tourism in the Mandeh Archipelago show that there are about 35% of the areas in the very suitable category (S1), about 30% belong to the suitable category (S2), 15% are in a marginally suitable category (S3), and about 20% of the areas are unsuitable for tourism. Aziz *et al.* (2012) explained that in the development of marine tourism objects, the fewer the limiting factors, the higher the Land Suitability Index. Based on FGD with relevant stakeholders, there are several obstacles faced in developing marine tourism in Mandeh. These constraints can be presented as sub-element constraints. The ISM method is used to determine the priority scale of the constraint elements.

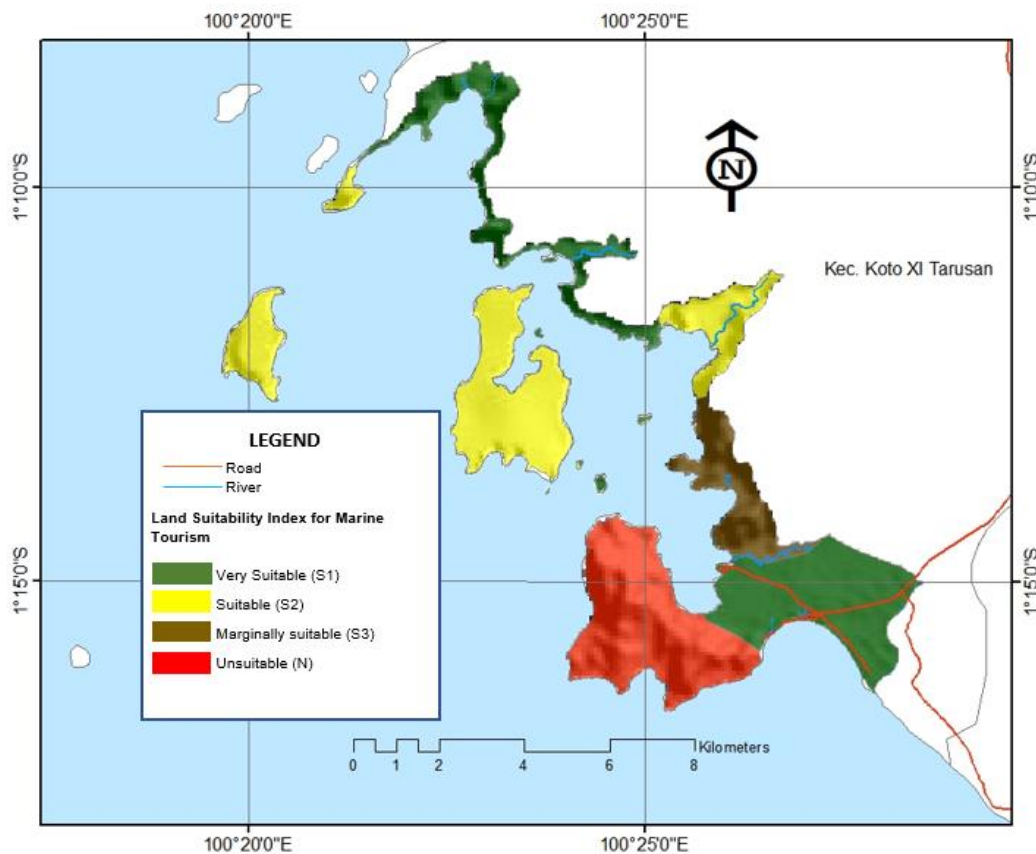


Figure 4 Map of land suitability index for marine tourism in the Mandeh Archipelago

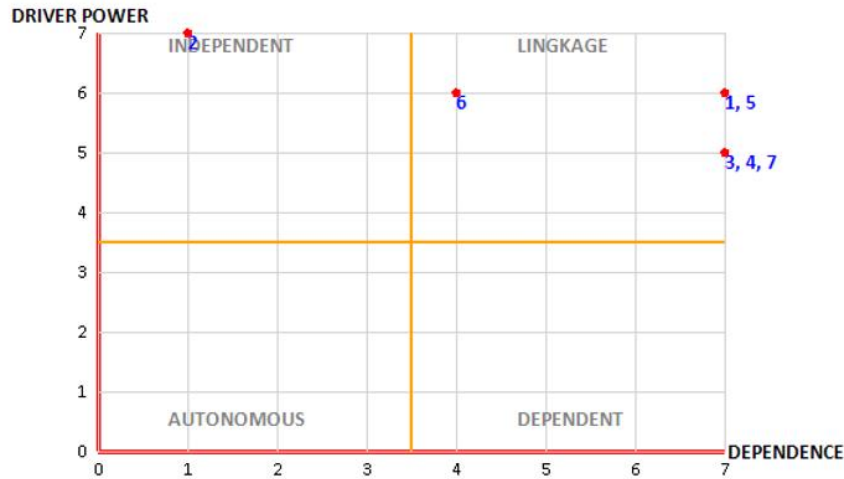
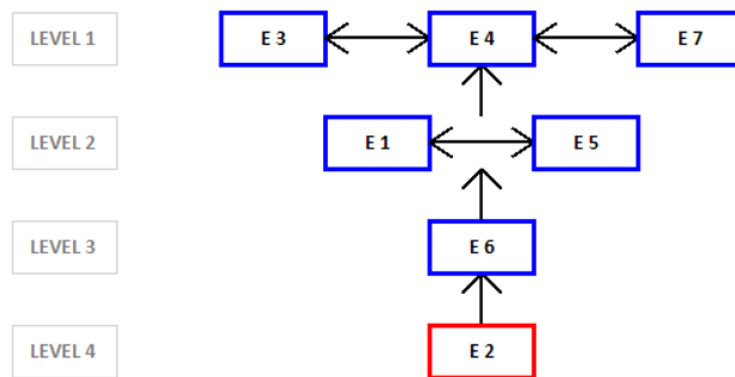


Figure 5 Graph of the relationship between drive power (DP) and dependence on the constraints of developing marine tourism objects in Mandeh Archipelago

Figure 5 shows the relationship between drive power (DP) and dependence (D) constraints on the development of marine tourism objects in the Mandeh Archipelago. From the picture, we can see that there is one element in quadrant IV or independent. It is the E2 element (lack of investment capital and professional staff in developing marine tourism). According to Marimin (2005), Umar and Dewata (2017, 2020), the elements contained in the independent quadrant mean that the driving force is high, and its dependence on other elements is lower. So the main problem in developing marine tourism in the Mandeh area is the lack of capital and professional staff in tourism development. The constraints on developing marine tourism are illustrated in the hierarchical structure in Figure 6.



Description:

- E1. The lack of cleanliness on the beach because of the large amount of waste carried by the sea current
- E2. Lack of investment capital and professional personnel in marine tourism development
- E3. Security and cultural conflicts of local communities
- E4. There is still a lack of supporting infrastructure and diving tourism
- E5. Inadequate transportation and accessibility systems
- E6. The low quality of service for tourism organizers
- E7. Lack of public awareness about the economic impact of tourism

Figure 6 The hierarchical structure of constraints on the development of marine tourism objects in the Mandeh Archipelago



According to Umar (2018), in the development of marine tourism in Indonesia, invested capital and professional problems are the main problems. Many owners of capital (investors) are worried that it will not make a big profit. In addition, according to Djou (2013), the weakness in the development of marine tourism in Indonesia is that it is not supported by professional staff. Therefore, the tourist objects became an uninteresting place to visit for a long time. Amalyah *et al.* (2016) and Umar (2018) add that the impact of a shortage of professionals causes a lack of service quality for tourists.

## CONCLUSION

The Mandeh archipelago, in general, based on land suitability, is very suitable to be developed as a marine tourism object. The analysis of the suitability of marine tourism in Mandeh Archipelago shows that about 35% of the area is in a very suitable category (S1), about 30% is in a suitable category (S2), 15% is in a marginally suitable category (S3), and about 20% is unsuitable for tourism (N). The limiting factor in the evaluation of land suitability is dominated by slope indicators and water clarity. The prior obstacle in developing marine tourism is the lack of invested capital and professionals in the tourism business.

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