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Strategy of maritime tourism management Areas (case study in Gorontalo Province)

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ABSTRACT

This research was conducted in July-October 2023. The research location is in the Barrier Reef (barrier reef) in the waters of Botutonuo Village, Kabila Bone, Bone Bolango Regency, Gorontalo Province. The consideration of choosing this location is because there is a barrier reef and there is als coral transplantation which is loca d directly opposite the Botutonuo Beach Tourism, so it is important to conduct a study on the development of marine tourism potential which can later be developed to improve the welfare of the local community and its surroundings, the location. Method and Research Design Coral reefs require optimal environmental conditions, namely at warm temperatures around above 20o C to be able to grow and reproduce well. Coral reefs also choose to live in clear and unpolluted water environments. Based on the results and discussions, the conclusions are as follows: The biophysical waters of Botutonuo Village are in good condition as indicated by the high diversity index value; The level of land suitability for snorkeling and diving tourism at stations II and III is in the appropriate category, while station III fo each of these tours is in the unsuitable category; The carrying capacity for snorke ng tourism at station I is 53 people/day and station II people/day, while the carrying capacity for diving activities at each station is 14 people/day;

Keywords: Land suitability, marine ecotourism, land carrying capacity

INTRODUCTION

Based on the definition of tourism and ecotou sm (Wood. 2002) states that tourism has a wide scope and activities. Tourism includes 5 (five) types of activities, namely marine tourism (beach and sun tourism), rural tourism (rural and agrotourism), nature tourism (natural tourism), cultural tourism (cultural tourism), or business travel. The position of ecotourism is indeed rather unique, standing on three legs at once, namely rural tourism, nature tourism and cultural tourism.

The implementation of tourism for destination sustainability has six principles, namely: 1) to the maximum extent possible eliminating the negative impacts of the presence of 34 tourists on the environment of tourist destinations, 2) conducting tourism with the aim of increasing understanding and awareness of nature, 3) maximizing local community participation, 4) tourists contributing to conservation efforts, 5) providing economic benefits to local communities, and 6) opening opportunities for local communities and tourism workers to utilize the beauty of natural resources (Fennel and Eagles, 1990 in Depbudpar 2007). Thus, to achieve a sustainable destination, the involvement of all related parties is needed, all physical components (ecosystems), socio-cultural, and economic in an integrated manner, so that

tourism can play a sustainable role by increasing the competitiveness of Tourist Destination Objects (ODTW).

Moscardo and Kim (1990) said that sustainable tourism must pay attention to: 1) Increasing the welfare of local communities, 2) ensuring intergenerational and intergenerational beauty, 3) protecting biological diversity and maintaining existing ecological systems, and 4) ensuring cultural integrity.

The ecological carrying capacity is based on the understanding that the environment has a maximum capacity to support growth in accordance with its maximum utilization capacity. The definition given by Kenchington and Hudson (1984) states that carrying capacity is the ultimate constraint faced by biota by environmental limitations such as the availability of food, space or spawning grounds, disease, predator cycles, temperature, sunlight, and salinity. Dahuri (2002) states that the carrying capacity of an area ultimately determines the scarcity of vital natural resources and ecosystem services needed by humans and living organisms that inhabit the area. The environmental carrying capacity system is reduced if damage occurs caused by humans. The ecological carrying capacity is based on the understanding that the environment has a maximum capacity to support growth in accordance with its maximum utilization capacity. The definition given by Kenchington and Hudson (1984) states that carrying capacity is the ultimate constraint faced by biota by environmental limitations such as the availability of food, space or spawning grounds, disease, predator cycles, temperature, sunlight, and salinity. Dahuri (2002) states that the carrying capacity of an area ultimately determines the scarcity of vital natural resources and ecosystem services needed by humans and living organisms that inhabit the area. The environmental carrying capacity system is reduced if damage occurs caused by humans.

RESEARCH METHODOLOGY

This research was conducted in July-October 2023. The research location is in the Barrier Reef (barrier reef) in the waters of Botutonuo Village, Kacataman Kabila Bone, Bone Bolango Regency, Gorontalo Province. The consideration of choosing this location is because there is a barrier reef and there is also coral transplantation which is located directly opposite the Botutonuo Beach Tourism, so it is important to conduct a study on the development of marine tourism potential which can later be developed to improve the welfare of the local community and its surroundings, the location.Methodand Research Design

Methodmarine tourism development strategy in the barrier reef of Botutonuo Village, Bone Bolango Regency using survey, observation and interview methods. The observation method was carried out to obtain data on the characteristics of the coral reef ecosystem in the barrier reef which includes presentation analysis.coral cover, coral fish density, coral fish species diversity index, coral fish species evenness index,dominance index, tourism water quality parameters, marine tourism suitability, and formulationmarine tourism development plan in the barrier reef area of Botutonuo Village.

1. Data collection technique

Data collection was carried out through primary data collection and secondary data. Primary data was obtained through interviews and direct observations in the barrier reef area (*barrier reef*Bioecological data includes coral reefs, reef fish and benthos, coral lifeforms and water quality. Secondary data were collected from various sources, both government documents and research results relevant to this study. The data collection techniques are described as follows:

Determination of Research Stations

The determination of the location of this study was carried out using purposive sampling by conducting an initial survey. The survey was conducted to determine the right location to collect data with the intention of making it easier for researchers to plan dives and to save more time in collecting data so that the data obtained later can be more representative (Sugiyono, 2010 in et al., 2017). The determination of the stations in this study was 3 stations (Figure 3.1) with the following details:

1. Station 1 is a natural coral reef area of the Barrier Reef (natural station) with coordinates 00°26'54.89" N and 123°07'16.28" E.
2. Station 2 is a natural coral reef area of the Barrier Reef with coordinates 00°26'42.27" N and 123°07'22.47" E.
3. Station 3 is a natural coral reef area of the Barrier Reef with coordinates 00°48'07" N and 123°07'17',95" E.

Data Collection Procedure

Data collection procedures in the development of marine tourism in the barrier reef area of Botutonuo Village include data on coral reefs, reef fish, and water quality parameters.

(a).Coral Cover

Coral reef ecosystem cover data were collected using the LIT (Line Intercept Transect) method referring to UNEP (1993), which uses a 50 m line transect at a depth of 3 m and 10 m. A depth of 3 meters represents coral cover for snorkeling tourism suitability and a depth of 10 meters represents coral cover for diving tourism suitability. The technical implementation of data collection in the field is where a diver places a 50 m long meter parallel to the coastline, where the position of the coast is located to the left of the diver. Recording of coral cover is carried out right on the meter line with centimeter accuracy, for observations of bottom-filling biota based on growth forms (life forms) with certain codes (English et al. 1997).

(b). Reef fish

The collection of coral fish data in this study used the visual census method or visual census technique (VCT) on the same transect as the coral reef. The visual census method refers to English et.al., (1997). In detail, the coral fish data collection procedure is as follows:

1. Laying a 50 meter long line transect parallel to the coastline.
2. Wait for 10 to 15 minutes to let the disturbed fish return to their original place.
3. Then return to the start of the transect by passing through another area and not passing around the transect line and remaining in the water.
4. Recording coral fish data by diving following the *line transect* which has been installed around the reef parallel to the coastline, with an estimated width of 2.5 meters on the right and left. The method of collecting coral fish data is shown in Figure 1.

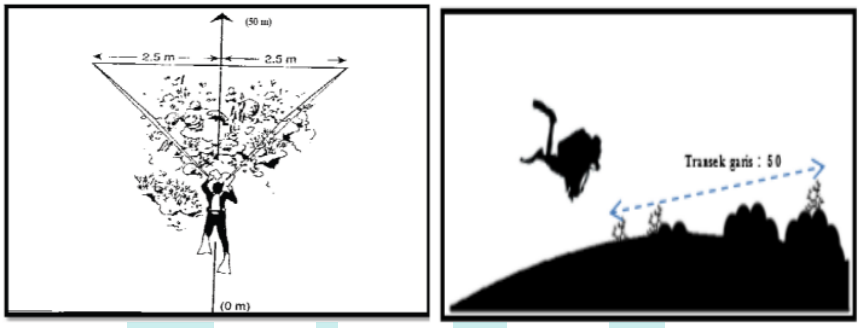

Figure 1. Method of collecting coral fish data using the visual method census (English*et al., 1997)*

5. The number of coral fish seen entering the transect area is recorded and their species are determined.
6. Unknown reef fish species are directly recorded using a photo number and documented to then be identified using a fish identification key book referring to the identification book.Allen and Steene (1996), Kuiter and Tonozuka (2001) and fish base (*www.fishbase.org*).

(c). Water Quality Parameters

ObservationThe parameters of marine tourism water quality were carried out in situ at the research location, the water quality parameters measured were current speed (cm/second), brightness (m) and depth (m) at each station withh to compare the value of each water quality parameter with the water quality standards based on the Decree of the Minister of Environment No. 051 of 2004.

Data analysis

1. Percentage of Coral Cover

Coral reef data collection was obtained based on Line Intercept Transect (LIT) at 2 depths, namely at a depth of 3 m and 10 m. This was done to determine the condition of the coral reef at the research location, so it was calculated using the coral cover percentage analysis based on that put forward by UNEP (1993).

$$\text{Ni} = \frac{Li}{L} x\ 100$$

Information:

This = Percentage of cover (%)
Lee = Category Total Length (cm)
L = Length of line transect (5,000 cm)

Data on the condition of live coral cover obtained from the equation above will then be categorized based on the Standard Criteria for Coral Reef Damage according to (Ministerial Decree of the Environment No. 04 of 2004), namely:

0.0 – 24.9% = Damaged
25.0 – 49.9% = Medium
50.0 – 74.9% = Good
75.0 – 100% = Very Good

2. Fish Density Analysis

The analysis of coral fish density at the Botutonuo marine waters research location was analyzed following the formulation (English*et al*.1997).

$$D = \frac{C}{A}$$

Information:

D = Density (ind/m^2)
C = Number of coral fish counted in the observation
A = Area of observation area (m^2)

3. Diversity Index Analysis (H')

The diversity of coral fish species obtained based on the visual census method (VCT), was analyzed using the Shannon-Wiener formulation (Krebs, 2000 in Muqsit*et al*., 2016).

$$H' = -\sum_{i=1}^{s} (pi)(ln\, pi)$$

Information :

H' = Diversity index
Pi = ∑ni/N)
this = Number of individuals of species i
N = Total number of individuals

The assessment categories for species diversity are as follows:

H' ≤ 1 = Low diversity, low distribution, low community stability
1< H' <3 = Moderate diversity, moderate distribution, moderate community stability
H'> 3 = High diversity, high distribution, high community stability

4. Analysis of Evenness Index (E)

Evenness Index (E) is used to describe the distribution of the number of individuals of each species of coral fish which is almost uniform and even, so the balance of the ecosystem is increasing. To calculate the evenness index, the type is analyzed using the Shannon-Wiener formulation formula (Muqsit et al., 2016), namely:

$$E = \frac{H'}{H'max}$$

Information:

E = Equality
H' = Species balance index
H'max = Maximum diversity index = Ln S
S = Total number of species types

The uniformity index value ranges from 0-1, with the following categories.
0 < E ≤ 0.5 = Community under pressure
0.5< E ≤ 0.75 = Unstable community
0.75< E ≤ 1.00= Stable community

5. Dominance Index (C)

Small evenness and diversity index values usually indicate the dominance of one type over another. To analyze this, use the dominance index formulation referring to Muqsit.*et al*.,(2016).

$$C = \sum_{i=1}^{n} Pi^2$$

Information:
C = Dominance Index
Pi = Proportion of the number of individuals in coral species
i = 1, 2, 3,…n

The dominance index value ranges from 0-1, with the following categories:
0 < C < 0.5 = Low dominance
0.5 < C< 0.75 = Dominance of the spring
0.75 <C < 1 = High Dominance

6. Marine Tourism Suitability Analysis

The development of marine tourism activities should be adjusted to the potential of resources and their designation, because each marine tourism activity has resource and environmental requirements that are appropriate or suitable for the marine tourism object to be developed. Manembu (2013) stated that in the sustainable development paradigm, the placement of each utilization activity must be in synergy with the biophysical environment so as to form integrated management, this can be achieved in the development of marine tourism by analyzing it using parameters and criteria formulated by Yulianda (2019), as follows:

$$IKW = \sum_{i=1}^{n} (\text{Bi x Si})$$

Information :

IKW = Tourism suitability index
n = Number of conformity parameters
Bi = Weight of the i-th parameter
Si = Score of the i-th parameter

The analysis of marine tourism suitability is carried out in three stages, namely: 1) compiling a suitability matrix, 2) weighting each limiting factor/parameter, and 3) rating (giving a value) for the parameters/criteria of a designation. The compilation of the marine tourism suitability matrix includes beach tourism, marine tourism includes snorkeling tourism and diving tourism. Furthermore, weighting is carried out on each parameter based on the dominance of the parameter in the designation of marine tourism activities, then a value is given. The value (rating) aims to assess the parameters against an evaluation of marine tourism suitability. The result of the multiplication of the weight and value/price of each parameter is the score of a particular parameter in a marine tourism activity designation. The total score of each parameter is called the total score of a marine tourism activity designation. For marine tourism suitability category *snorkeling* considering seven parameters with four assessment classifications (Table 3.3) and for the suitability of marine tourism in the diving category consider six parameters with three assessment classifications (Table 1.).

Table 1. Suitability matrix for marine tourism in the snorkeling tourism category

No.	Parameter	Weight	Category			
			Score 3	Score 2	Score 1	Score 0
1	Community Cover coral (%)	0.375	>75	>50–75	25–50	<25
2	Lifeform type	0.145	>12	>7–12	4–7	<4
3	Types of coral fish	0.140	>50	30–50	10–<30	<10
4	Water clarity (%)	0.100	100	80-<100	20-<80	<20
5	Reef depth coral (m)	0.100	1–3	>3–6	>6–10	>10;<1
6	Current speed cm/sec	0.070	1–15	>15–30	>30–50	>50
7	Width of the span coral flat (m)	0.070	>500	>100–500	20–100	<20

Source: Yulianda (2019).

Table 2. Suitability matrix for marine tourism in the diving tourism category

No.	Parameter	Weight	Category			
			Score 3	Score 2	Score 1	Score 0
1	Community Cover coral (%)	0.375	>75	>50–75	25–50	<25
2	Water clarity (%)	0.150	>80	50–80	20–<50	<20
3	Coral Reef Depth (m)	0.150	6–15	15–20;	<20–30	>30; <3
4	Liferfom type	0.135	>12	>7–12	4–7	<4
5	Types of coral fish	0.120	>100	50–100	20–<50	<20
6	Current speed cm/sec	0.070	0–15	>15–30	>30–50	>50

Source: Julia (2019)

Based on Table1 and Table 2, the suitability criteria for marine tourism for the snorkeling and diving categories are as follows:

Information :

IKW≥2.5 = Very Suitable
2.0 < IKW < 2.5 = Appropriate
1.0 < IKW < 2.0 = Not Appropriate
IKW < 1 = Totally inappropriate

Biophysical Conditions of Marine Tourism

Research on the biophysical conditions of marine tourism in the barrier reef of Botutonuo Village is divided into coral reef conditions consisting of the percentage (%) of coral cover and the number of lifeforms, coral fish conditions including total abundance (tails) and the number of families and the presence of other biota besides fish which are the attraction for the development of marine tourism for snorkeling and diving.

Coral Reef Conditions

The condition of the coral reef in the barrier reef of Botutonuo Village at a depth of 3 meters and 10 meters is in moderate to good condition. The condition of the coral reef at a depth of 3 meters can be seen in Figure 4.2 and 10 meters can be seen in Figure 4.1.

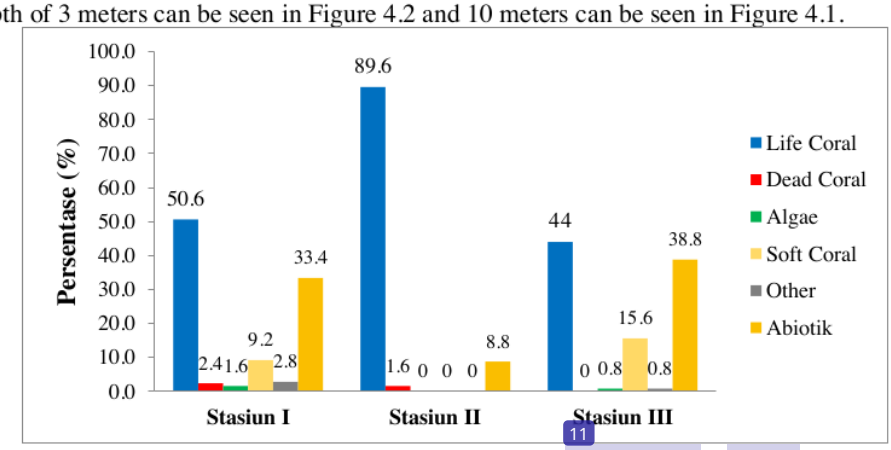

Figure 1 Percentage of Lifeform Coverage at a Depth of 3 Meters

Based on Figure 1, it shows that the condition of coral reefs at 3 observation stations at a depth of 3 meters is included in the moderate to very good category. Very good conditions are found at station II with a percentage value of life coral of 89.6%, good conditions are found at Station I of 50.6%, and moderate conditions at Station III of 44%. Based on the Decree of the Minister of Environment No. 4 of 2001 concerning the standard criteria for coral reef damage, the percentage of live coral reefs in the moderate category is 25-49.9%, the good category is 50-74.9% and the very good category is 75-100%.

Figure 2. Condition of coral reefs at station 1.

The condition of Life coral that shows a good category at station I is because the location of station I is far from settlements and far from river mouths so that there are no sediments that will go to the location to damage life coral. While for station II has a very good condition because it is also far from settlements so that there is a lack of human activity such as mining sand and gravel so that there is no complaint and lack of sedimentation. And in the location of the area of station I and station II have good brightness, where by having good brightness, it will not block sunlight from entering the waters so that coral will continue to grow.

The low percentage of coral cover at station III at a depth of 3 meters was caused by the high Abiotic cover caused by destructive fishing activities (fish bombing) carried out by migrant fishermen around the 1990s to early 2000s around the barrier reef and coral bleaching due to global warming in the early 2000s on the southern coast of Tomini Bay, Gorontalo, as well as sand and gravel mining and sedimentation due to agricultural activities from the mainland. Bombing was carried out by fishermen in order to get fish quickly and easily (Ilham et al., 2017). Meanwhile, the higher the rate of sediment accumulation, the higher the ecosystem conditions that are disturbed by sediment because it can reduce the penetration of incoming light, thereby slowing down or stopping the photosynthesis process of coral reefs (Sidabalok, 2019).

At a depth of 3 meters in Botutonuo waters, there are 3 categories of coral cover, namely Branching coral, Massive coral, and Algae. The types of coral cover found include Coral massive, Acropora submassive, Acropora digitate, Sand, Soft coral, Acropora tabulate, Coral branching, and Rock. At station I there were 27.20% Branching coral with a frequency of occurrence of 42, Massive coral as much as 16.80% with a frequency of occurrence of 28, and Algae as much as 1.60% with a frequency of occurrence of 3. At station II there were 79.00%

Branching coral with a frequency of occurrence of 16, Massive coral as much as 6.80% with a frequency of occurrence of 7, and no algae were found. At station III there were 8.80% Branching coral with a frequency of occurrence of 15, Massive coral as much as 9.80% with a frequency of occurrence of 11, and Algae as much as 0.80% with a frequency of occurrence of 1.

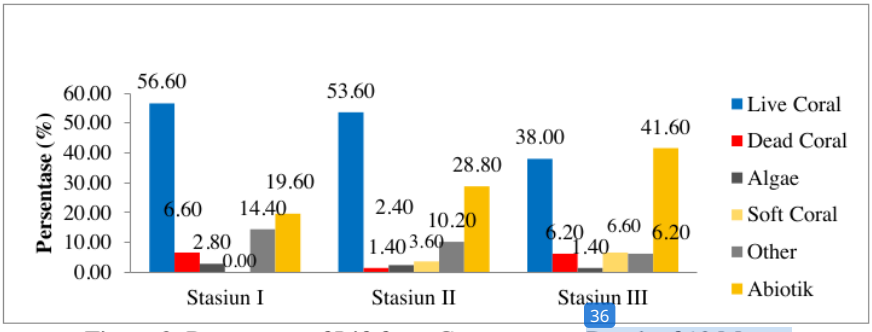

Figure 3. Percentage of Lifeform Coverage at a Depth of 10 Meters

The low coral cover at station III at a depth of 10 meters was caused by the high Abiotic cover and Death Coral. According to Lalang (2022), the high presentation of abiotic components such as coral fractures and dead coral will affect coral growth due to sedimentation in the waters, causing death and reducing the brightness of the waters, disrupting the physiological processes of corals, especially for photosynthesis and causing corals to have to expend a lot of energy to actively clean sediment from the surface.

Suitability of Snorkeling Tourism

Table 3. Suitability Index for Snorkeling Tourism

Location	Area (m²)	Mark IKW	Category
Station I	13,200	2.27	In accordance
Station II	12,400	2.33	In accordance
Station III	15,200	1.66	It is not in accordance with

Based on table 4.4, it shows that all stations at a depth of 3 (three) meters have an area of 40,800 m2.^{2}with an IKW value of 1.66 – 2.33 which is included in the snorkeling tourism suitability category, it is in the category of not suitable to suitable.

Suitability of Diving Tourism

Table 4. Diving Tourism Suitability Index

Location	Area (m²)	Mark IKW	Category
Station I	3,500	2.31	In accordance
Station II	3,600	2.50	In accordance
Station III	3,500	1.94	It is not in accordance with

Based on table 4, it shows that all stations at a depth of 10 meters have an area of 10,600 m2 with an IKW value of 1.94 - 2.33 which is included in the category of suitability for diving tourism in the category of not suitable to suitable.

The IKW value at station III is in the category of not suitable for Snorkeling and Diving Tourism. Because the location is close to a settlement where the community near the area carries out sand and gravel mining which causes sedimentation. As well as bombing carried out by migrant fishermen in the 1980s to the 2000s. In addition, in the area there is a seasonal river estuary where the river carries sediments from the mainland so that coral cover occurs at station III.

Regional Carrying Capacity

Botutonuo Beach has an area provided for snorkeling and diving activities. There are three stations and different locations that have been provided to carry out these activities. The carrying capacity of the area can be calculated based on the area that has been analyzed for its suitability related to the type of activity that will be carried out or has the potential so that the carrying capacity value will be different for each activity.

Table 5. Carrying Capacity of Snorkeling Tourism Areas

Location	Lp (m2)	Land (m2)	Wt (Hour)	Wp (Hour)	DDK (Person/Day)
Station I	13,200	500	6	3	53
Station II	12,400	500	6	3	50
Station III	15,200	500	6	3	61

Table 6. Carrying Capacity of Diving Tourism Areas

Location	Lp (m2)	Land (m2)	Wt (Hour)	Wp (Hour)	DDK (Person/Day)
Station I	3,500	2,000	8	2	14
Station II	3,600	2,000	8	2	14
Station III	3,500	2,000	8	2	14

The carrying capacity of the area for snorkeling activities varies, namely at station I it is around 53 people/day and station II it is around 50 people/day, while for diving activities at stations I and II it is around 14 people/day. While at station III, both snorkeling and diving tourism are included in the unsuitable category. So that the total number of diving tourists who can visit the Botutonuo tourist waters is a maximum of 131 people/day. The carrying capacity of the area is influenced by how wide the tourist area is used for an activity, the wider the area, the higher the carrying capacity of each location, because each visitor needs space to observe and enjoy the beauty of the underwater world, either for snorkeling or diving. According to Ismail et al., (2023) that the area that can be used by visitors considering the ability of nature to receive visitors will require a fairly large space to carry out activities such as diving or snorkeling to enjoy the beauty of the underwater world.

Botutonuo Marine Tourism Development Strategy

Based on observations and interviews, data was produced which can be seen in Table 4 and Table 5.6.

Table 6

No	Internal Factors			
	Strength (Strength)	**Weight**	**Score**	**Total Value**
1	High biodiversity	0.103	3.2	0.3282
2	the beauty of the underwater is good	0.128	3.3	0.4231
3	Transportation access is very easy	0.103	3.7	0.3795
4	Positive community support	0.128	3.6	0.4615
5	Accommodation available	0.103	3	0.3077
	Amount	0.564		1.9000
	Weakness			
1	Domestic waste is not managed properly	0.103	3.1	0.3179
2	Ecotourism human resources are still low	0.128	2.9	0.3718
3	There is no legality for tourism zoning yet	0.103	3.1	0.3179
4	Infrastructure is not optimal	0.103	2.9	0.2974
	Amount	0.436		1.3051

Based on the table above, it shows that strengths and weaknesses have positive numbers. Several attributes in the internal strategic factors of strength show high values, including transportation access, community support, and underwater beauty. While aspects of weaknesses such as domestic waste have relatively high values. This means that domestic waste at the location has a small impact on tourism conditions.

CONCLUSION

Based on the results and discussion, the conclusions are as follows:

1. The biophysical condition of the waters of Botutonuo Village is in good condition as indicated by the high diversity index value;
2. The level of land suitability for snorkeling and diving tourism at stations II and III is in the suitable category, while station III for each of these tourism sites is in the unsuitable category;
3. The carrying capacity for snorkeling tourism at station I is 53 people/day and station II is 50 people/day, while the carrying capacity for diving activities at each station is 14 people/day;

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