Priority Determination of Dive Site Development for Tourism in Ternate City

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Abstract. Ternate is an archipelago city which is also located in the world coral triangle with underwater tourism potential which is abundant with all kinds of biodiversity. Recently, 14 dive sites have been used as tourist sites by local dive operators. However, in its development, the Ternate city government itself does not have any planning documents or references to address the development of diving tourism. The limited resources of local stakeholders make diving tourism development unable to be carried out thoroughly, and each location has different problems. Based on all the facts, this study aims to determine the development priorities of dive tourism sites in Ternate City by using two methods: Analytical Hierarchy Process (AHP) and Weighted Overlay Analysis as an analytical tool to determine the priority of dive site development by looking at the number of variables from AHP results and variable values of each dive location in Ternate City. Variables used were water clarity, coral depth, carrying capacity, coral cover, marine biota diversity, distance from the pier and the comfort level of the entry-exit. The highest percentage was marine biota diversity (60.18%), and coral cover (11%) and the final analysis produced 3 (three) development priorities, the final result of the analysis produces three priority levels. The first priority consists of eight dive sites, five dive sites are included in the second priority, and one dive site is in the third priority. This shows that to develop dive site or to develop diving tourism itself is highly influenced by marine biodiversity which means diving tourism is very dependent on environmental sustainability.

Keywords: Dive Site, Diving Tourism, AHP, Weighted Overlay

1. Introduction

In more than one last decade, the diving tourism and all business activities that support diving activities have become one of the important sectors in tourism that stimulates billions of dollars in the global industry in which the industry is developing very fast [1], [2]. This is also because of the desire of divers to interact directly with underwater marine biodiversity [3], and it is supported by good access to enjoy the underwater world through technology, training, education and the equipment made to support diving activities [4]. As many as 16% of the world's coral reefs are found in Indonesia, most of the coral reefs are spread in central and eastern Indonesia. Indonesia is also the richest and most diverse coral reef country in the world; there are approximately 590 hard coral species that represent more than 95% of the coral species in the center of the world's coral triangle [5] however, these reefs are threatened by human activities that are not environmentally friendly and the unplanned tourism growth [6].

The vision of the Ternate city spatial planning 2012-2032 and the mission of the Ternate city government which contained in the medium-term development plan 2016-2021 is to develop the marine tourism as one of the leading sectors [7], [8]. However, until now, the

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Ternate city government not yet has an updated Regional Tourism Development Master Plan document; the latest document available was issued in 2009 and that document does not contain the development of diving tourism. Even though Ternate has abundant underwater tourism potential, the government has not been able to develop this diving tourism sector apart from lack of a master plan, the problem of the limited budget budgeted annually, especially for diving tourism. Therefore this research is focused on how to formulate priorities for the development of dive sites in Ternate City based on weights and the value of each variable that will be used to support the development of diving tourism in Ternate in the future.

2. Research Method

This study is in the scope of the administrative region of Ternate City, which is one of the cities in North Maluku Province. It is located in the west of Halmahera Island, which is also part of the Coral Triangle [9], [10]. Specifically, the area of this research area is focused on 14 dive sites located on Ternate Island, Hiri Island, Mano Island and Maka Island which has been used as a diving tourism location by operators or tourists as can be seen in **Figure 1**.

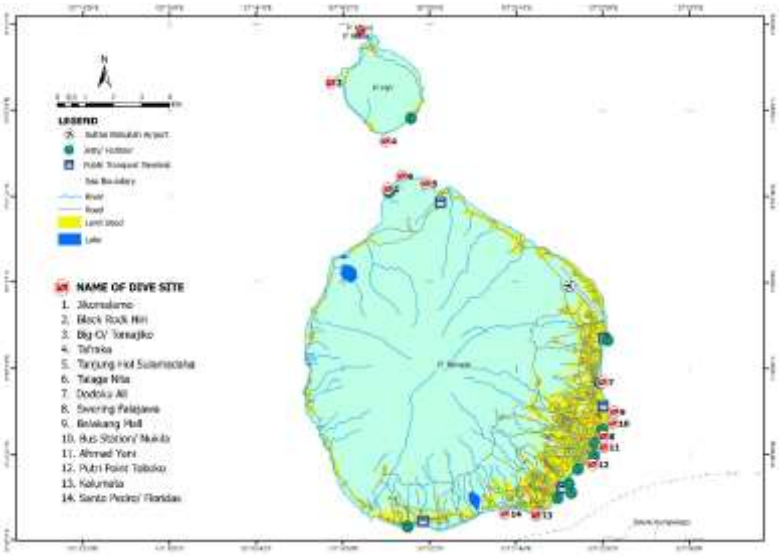

Fig. 1. Research Location Map

Before conducting data collection for this study, the first phase is determining the variables that are the focus of the research that can be measured, observed and quantified [11]. These variables were obtained by taking a literature review related to diving tourism, especially about dive sites development. Also, interviews were conducted to collect data and information about the development of diving tourism in Ternate City from related government agencies, business people, communities/organizations related to diving tourism, academics from universities, and tourists who already dived in Ternate City. The interview was using a purposive sampling method, except for tourists, which were chosen by accidental sampling method. There are two types of data in this study. The first is qualitative data, which consists of perceptions of expert respondents in determining the weight/level of interest per criteria and

sub-criteria that had been formed by filling in the questionnaire. The second is quantitative data, which is the value of each variable, used to prioritize a dive site development. This data was obtained by conducting primary and secondary surveys. Primary surveys were carried out by observing and measuring based on field observations, while secondary surveys are carried out to obtain data held by relevant stakeholders.

The second phase is to figure out the weight of the variable for determining the priority development of the dive site using the analytical hierarchy process (AHP) method. The AHP process is carried out by setting goals, criteria, and sub-criteria into a hierarchy model up to level 3, where level 1 is the goal, level 2 is criteria, and level 3 is sub-criteria. Forming of these elements are according to relative importance through a synthesis procedure called priority setting.

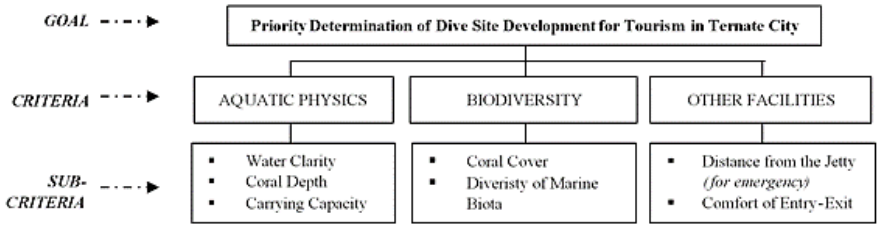

Fig. 2. AHP Hierarchy Structure *(Source: Analysis, 2019)*

After the hierarchy structure formed, the next step is to create a pairwise comparison matrix between criteria and between sub-criteria. Comparative assessment was carried out by expert respondents who in this study had chosen 6 people who were considered to be very understanding about diving tourism, namely from the Ternate Tourism Department, the Maritime & Fisheries Department, North Maluku Natural Resources Conservation, Dive Center/ Dive operator in Ternate, the Indonesian Diving Sports Association of Ternate and Lecturer from Khairun University Ternate. The matrix was filled in referring to the Saaty scale (comparison 1-9), which can be seen in **table 1**. After the matrix filled by expert respondents, then the opinions of the respondents will be calculated the level of consistency ratio. If the consistency ratio level from respondents' opinion ≤ 0.1 or $\leq 10\%$, it means that opinion is considered consistent. If not, then an answer must be corrected. AHP provides a mechanism for increasing logical consistency if the comparisons made are not sufficiently consistent [12]. The next step is to unite all the value of respondents' paired matrix and do the weighting, which results in the importance percentage level of each criterion and sub-criteria.

Table 1. Pairwise Comparison Scale/ Saaty Scale [13]

Intensity of Importance	Definition	Explanation
1	Equal importance of both elements	*Two elements contribute equally*
3	Moderate importance of both elements	*Experience and judgment favor one element over another*
5	Strong importance of one element over another	*An element strongly favored*
7	Very strong importance of one element over another	*An element is very strongly dominant*
9	Extreme importance of one element	*An element is favored by at least*

	over another	*an order of magnitude*
2,4,6,8	Intermediate values	*Used to compromise between two judgments*

The third phase is to determine the priority of the dive site development using weighted overlay analysis, which is a technique to perform spatial modeling of diverse and different importance [14]. This method is very suitable to help formulate the decision making from the existing problems with multi criteria consideration [15]. This analysis combines quantitative data (value of each variable) and qualitative data (weight of each variable). The weighted overlay analysis process is using ArcMap software through three steps.

The first step is to convert vector data into a raster containing the variable / sub-criteria attributes per dive site as in **table 2**. After that, the following steps are the raster data that are reclassified or determine the dive site priority class based on each indicator of each variable by using the ArcMap reclassify tool which makes it easy to reclassify each raster. For dive sites that show a poor indicator or a low value will be given a high value of importance, which also has a high priority. Then the last final step is to determine the priority of dive site development is to do an overlay weighting analysis whose process combines the weights in the sub criteria with the reclassification value of each sub-criteria. Each inputted raster is weighted according to the level of importance, which has a total value of 100%, referring to the AHP results that have been done beforehand. Changing the percentage of the value of importance will determine the output produced [15].

3. Result and Discussion

3.1 Description of Research Location

Ternate City is a part of the autonomous region of North Maluku province, which has the characteristic of an island city consisting of 8 islands, namely: Ternate island, Moti island, Hiri island, Tifure island, Mayau island, Gurida island, Makka island and Mano island. Ternate City is located at the 0º-2ºN and 126º-128ºE with temperatures ranging from 24ºC - 31ºC and air humidity 69% -102%. The total area of Ternate City is 579,541 Ha which is dominated by sea area of 563,334 Ha (97.2%) and a land area of 16,206.9 Ha (2.8%).

Because it is located in the Coral Triangle area, the condition of coral reefs in Ternate and its surrounding areas has a pretty high coral diversity. At least there are 144 species of rock corals [16] and identified 9,127 reef fish originating from 37 tribes and 245 species found in Ternate and surrounding areas [17]. Also, Ternate, have an endemic species that is Hemiscyllium Halmahera, which is a type of bamboo shark/walking shark that has a different color pattern. Dominated by brown with several dark polygons that have a length of 65.6 cm - 68.1 cm [18] this type of shark does not move by floating or swimming like a shark in general but they are using its fins and pelvis to walk. The following is an overview of the dive sites in Ternate City, which can be seen in table 3, which are grouped according to the research variable.

Table 2. Overview of Dive Sites in Ternate City

No	Name of Dive Site	Water Clarity (%)	Coral Depth (m)	Carrying Capacity (people/ day)	Coral Cover (%)	Diversity of Marine Biota	Distance From the Pier (Km)	Comfort of Entry-Exit
1	Jikomalamo	85	7	35	80	Low	0,14	Comfortable

2	Black Rock Hiri	90	15	56	70	High	8,29	Comfortable
3	Big-O/ Tomajiko	90	10	74	80	Very High	4,43	Comfortable
4	Tafraka	75	5	290	50	Medium	1,82	Comfortable
5	Tj. Hol Sulamadaha	85	4	94	75	Low	1,82	Adequate Comfortable
6	Talaga Nita	80	10	60	70	High	0,82	Comfortable
7	Dodoku Ali	65	10	52	40	Medium	0,12	Adequate Comfortable
8	Swering Falajawa	70	5	122	30	High	0,24	Uncomfortable
9	Belakang Mall	65	9	304	30	Medium	0,81	Less Comfortable
10	Bus Station/ Nukila	65	4	520	65	Medium	0,43	Less Comfortable
11	Ahmad Yani	20	20	73	10	High	0,62	Uncomfortable
12	Putri Point Toboko	15	20	110	15	High	0,55	Uncomfortable
13	Kalumata	75	10	174	65	Medium	1,81	Adequate Comfortable
14	Santo Pedro/ Floridas	80	15	546	75	High	2,94	Comfortable

Source: Primary Data, 2019.

3.2 Determine the importance level of criteria and sub-criteria

In this phase, it is necessary to determine the criteria and sub-criteria weights by comparing the level of importance between the criteria and between the sub-criteria based on the results of filling out the questionnaire by the expert respondent. The results of the comparison questionnaire on the importance of criteria can be seen in **table 3**.

Table 3. Comparison Between Criteria

No	Respondents	Comparison of Importance Between Criteria			CR (%)
		AP: BD	AP: OF	BD: OF	
1.	Ternate Tourism Department	0.20	3.00	7.00	7
2.	Ternate Maritime & Fisheries Department	0.33	3.00	5.00	4
3.	North Maluku Natural Resources Conservation	0.14	3.00	9.00	8
4.	Khairun University Ternate	0.33	3.00	5.00	4
5.	Dive Center	0.33	5.00	7.00	7
6.	Indonesian Diving Sports Association of Ternate	0.11	0.14	3.00	8

AP: Aquatic Physics; BD: Biodiversity; OF: Other Facilities; CR: Consistency Ratio

The next step is to convert the combined of importance criteria by six respondents and then normalize the matrix and repeat iterations until the difference between iterations does not

change or equal to zero with the help of AHP Calculator [19]. Based on these steps, we get the criteria and sub criteria weights as in **table 4.**

Tabel 4. Final Results of Weighting Criteria and Sub Criteria

No	Criteria & Sub-Criteria	Weight (%)	Total Weight (%)
Aquatic Physics Criteria			**18.25**
1	Water Clarity	52.00	9.49
2	Coral Depth	13.99	2.55
3	Carrying Capacity	34.01	6.21
Biodiversity Criteria			**70.97**
4	Coral Cover	15.18	10.77
5	Diveristy of Marine Biota	84.79	60.18
Other Facilities Criteria			**10.78**
6	Distance from the Pier	34.35	3.70
7	Comfort of Entry-Exit	65.61	7.07

Source: Analysis, 2019

The results of the total weight in the above sub-criteria are obtained from the calculation by multiplying the percentage of weight values with the total weight of the criteria. The weight of variable that influences the development of dive sites in Ternate City is biodiversity criteria (70.97%). The diversity of marine biota variable has a very large influence on these criteria (60.18%) and also becomes a variable with the strongest influence among other variables. The second criterion which has the highest value is the Aquatic physic criteria (18.25%) with the largest influence is the water clarity (9.49%), and the criteria with the lowest weight are the other facilities criteria (10.78%) with the highest influence variable is the comfort of entry-exit (7.07%). Based on these results, in general, tourists doing recreational dives are to interact with diverse underwater life [3] because underwater conditions with a high level of diversity of marine biota have a competitive advantage over other locations with a low level of diversity [20].

3.3 Priority determination of dive sites development

In determining the priority of the dive site development, this study used ArcMap software, the percentage of variable importance values from AHP and result in raster data that has the value of addition the score of each variable according to the weight and classification. Based on the results of the analysis, there are three priority levels of development sites from the value reclassification from each dive site and the percentage level of variable importance. Eight dive sites are the top priority, five dive sites are the second priority, and one dive site is the third priority. The detail can be seen in **table 5** and **figure 3.**

Tabel 5. The results of determination priority of dive sites development in Ternate City

No	Name of Dive Sites	Priority Level
1.	Ahmad Yani	1

2.	Putri Point	1
3.	Bus Station/ Nukila	1
4.	Kalumata	1
5.	Belakang Mall	1
6.	Dodoku Ali	1
7.	Tj. Hol Sulamadaha	1
8.	Jikomalamo	1
9.	Black Rock Hiri	2
10.	Tafraka	2
11.	Talaga Nita	2
12.	Swering Falajawa	2
13.	Santo Pedro/ Floridas	2
14.	Big-O/ Tomajiko	3

Source: Analysis, 2019

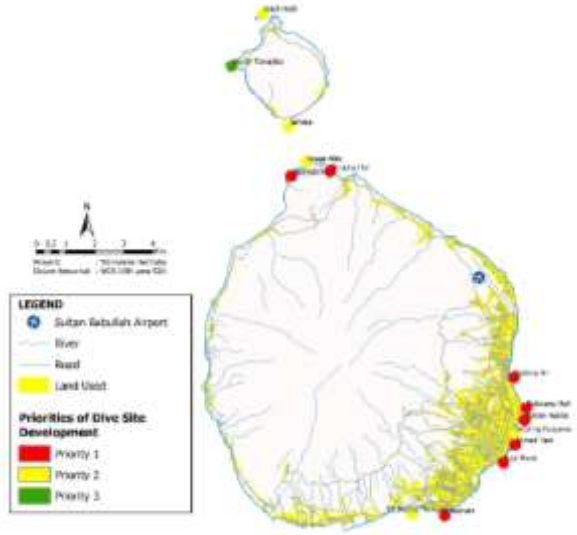

Fig. 3. The results of determination priority of dive sites development in Ternate City

Referring to the results of the analysis above with field observation data, the eight dive sites in the first priority development have high importance values on almost all variables. In the diversity of marine biota variable, which has the highest weight, the dive site is generally classified as medium and low categories, especially in Jikomalamo and Tanjung Hol Sulamdaha. It has the highest level of importance. Based on a survey of tourists, Jikomalamo is the most favored dive site because it is also a well-known beach tourism location in Ternate. Jikomalamo is also equipped with sufficient facilities as well as Tanjung Hol Sulamadaha. However, this also has a negative impact because this area is vulnerable to coral damage due to tourist activities both divers and non-divers who sometimes make direct contact with the ecosystem that is in the sea [21] whereas marine tourism activities are highly dependent on natural resources, including coral reefs. If there is damage, it will reduce the quality of tourist attractions [22].

For coral cover condition, Ahmad Yani and Putri Point have the lowest percentage where 10% for Ahmad Yani and 15% for Putri Point, whereas in diving, tourists are willing to pay

more to enjoy the diversity and beauty of coral reefs [23]. Moreover, for water clarity variables, Ahmad Yani only got 20% and Putri Point 15%. Even though without realizing it, humans assess the good or bad of water just by looking at its water clarity [24]. The lower the clarity level will highly affect the value of attractions [25]. According to field observations, this is because both dive sites are very close to the port and because community activities are mainly waste problems. Ahmad Yani and Putri Point still used as dive sites because there will be many macro objects/ muck dive. In this first priority development, it is also necessary to pay attention to the Bus Station dive site, which is the most artificial dive site in Ternate because this is located in the reclamation area.

The second priority dive sites development generally have lower importance than the first priority. Except for the comfort entry and exit variables in Swering Falajawa has high importance because of the type of shore entry and shore exit, which are slippery and rocky conditions that make divers not feel safe and comfortable. So, it is important to improve that entry and exit facilities [26] and the variable distance from the pier, on this dive site is also often found walking shark which is an endemic species from Ternate. The Black Rock Hiri dive site has the highest importance because it is the most distant dive site from the pier, which is 8.29 Km.

For the third development priority, Big-O/ Tomajiko dive site generally has a low importance value for almost all variables except for the variable distance from the pier (4.43km) and the carrying capacity is only 74 people/day. For locations that only support a small amount of tourist activity, it is very necessary to apply regulations that limit the number of visitors, so it will not disturb the surrounding ecosystem [27]. Also, the carrying capacity is one of the management reference indicators for sustainable tourism. Based on carrying capacity, targets and performance goals for sustainable tourism can be determined as well as how or approaches to achieving targets and objectives can be formulated [28].

Just like another marine tourism, diving has also generated concerns about the impact of these activities on the ecosystem because this tourism is very dependent on environment sustainability. Everything about sustainable tourism development should be of importance substantial [29][30]. It is because the diving tourism activity is integrated into two systems: human activities and marine biodiversity so that the development of diving tourism is how to utilize existing ecosystems sustainably without causing negative impacts. The development also must pay attention to principles such as the balance of each development sector, community participation, conservation both in terms of environment and local wisdom, integrated development and law enforcement [31].

4. Conclusion

Development of dive sites as dive tourism locations in Ternate City is divided into three development priorities influenced by the variable diversity of marine biota (60.18%), and the highest criteria are biodiversity (70.97%). This shows that environmental sustainability is a major factor in developing diving tourism, so to developing it must prioritize conservation values, one of which is by applying the concept of ecotourism where this concept can be a powerful strategy to support the sustainable marine tourism, because this ecotourism concept, if implemented with good management, besides still accommodating the needs of tourists, ecotourism will also help preserve the ecosystem that is used for tourism.

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