Assessment of Bunaken Island for sustainable tourism destination using the rapid appraisal for fisheries

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Abstract. Development of the tourism industry in marine protected areas (MPAs) brings a new challenge for Bunaken National Park (BNP). In 2016 new flight routes were establish to Manado, creating an increased visitor of tourists from China, producing an unusual situation that could jeopardize the coral reefs ecosystem in Bunaken Island. Encounter new policy to increase tourist volume could lead to destructive mass tourism. This paper presented a recent sustainability measurement of Bunaken Islands as a tourist destination, future challenge, and revisiting successful story management of this National Park. Data was collected from previous research, study, and collaboration with experts and an informant to assess all attributes. The data obtained were analyzed using the rapid appraisal technique for fisheries (RAPFISH). The RAPFISH analysis used 28 attributes to measure destination sustainability, based on four indices: ecological (72,83), economic (55,19), social (34,99), and institutional (47,51). Thus ecological and economic dimensions were within the status sustainability in the moderate threshold. The findings of this study could use as an early warning for future management of Bunaken National Park.

1. Introduction
One of the Sustainable Development Goals (SDGs) is to protect and manage the ocean, seas, and other marine resources for sustainable development [1]. Marine protected area (MPA) has a vital role in achieving sustainability. Still, it can only meet the goal if that area can be managed effectively and located in high marine biodiversity areas [2]. Coral reefs globally suffer from human activities, more than 60% of the World's coral reefs experience local threats such as overfishing, fishing that is not environmentally friendly, coastal development, waste pollution, and other damaging activities. In Indonesia, approximately 95% of existing coral reefs experience threats from human activities locally, with more than 35% belonging to the category of serious risks [3]. Bunaken National Park (BNP) located in the heart of the coral triangle area. More than 58 genera and sub-genera of hard corals, also more than 2000 different fish species found in BNP [4]. In collaboration with the United States Agency for International Development - Natural Resources Management (USAID-NRM) Bunaken was once a national and international example of a successful Marine Protected Area (MPA), not only for the protection of its marine biodiversity but also its achievement in involving local communities in National Park management collaboration. However, with the end of the USAID-NRM cooperation in 2004, the management performance of BNP management decreased [5].

Along with the growth of the global economy, the tourism industry expected to rise by around 5% annually. In 2016, Lion Air established a new route flight from and to eight cities in China directly to
Manado. As the trend of the oversea visitor rose to around 120,000 tourists in 2018, cause a total 1,3 million visitors annually [6], there will be concerns in coral reef conditions and management in BNP. Particularly, Bunaken Island as the most popular among the other islands [7]. A national park is a nature conservation area that has an original ecosystem, managed with a zoning system that is utilized for research, science, education, supporting cultivation, tourism, and recreation [8]. The utilization of natural resources must be limited to use with a predetermined limit to be sustainable or well-suited with the carrying capacity [9]. Studies on the carrying capacity of tourists in Bunaken National Park and Bunaken Island have been conducted [7,10,11]. This research is a preliminary study analysis of sustainability in Bunaken Island as a tourism destination. Research that combines four dimensions to analyze sustainability has never been done before in Bunaken Island. This research also examines the carrying capacity of ecologists for tourists snorkeling and divers through modification of the results from the previous study of the results of the calculation of the carrying capacity of previous studies.

2. Method

2.1. Study site
This study located on Bunaken Island, Manado, North Sulawesi Province, Indonesia. Coral reef sites use for assessment were focused on three locations, Fukui, Tawara/Alung Banua, and Likuan III. Those sites were used based on a decision from BNP through letter number SE 195/BTNB/TU/TEK/04/2019 about location activities for tourists in the BNP area (Fig.1).

![Figure 1. Map of the study, located in the BNP, Manado, North Sulawesi, Indonesia. The study site was chosen based on the decisions of BNP management of location for beginner snorkelling locations and discovery diving within the BNP area. (Source: BNP Management 2019).](image)

2.2. Data collection
Elementary data collected by interviews with respondents using purposive sampling to did assessments together. Interview conducted with a public figure from Bunaken Island as key individuals in the local community, he is the former chairman of "The people who care of Bunaken Island community" or "Himpunan Masyarakat Peduli Bunaken". Also, with an expert from Sam Ratulangi University with a background in coral reef management who also has a background working with government and BNP over the years. Secondary data were used for the assessment, gathered for the analysis was collected from the previous study, published and unpublished reports, and also data from government institutions. Support was also given by the researcher from Sam Ratulangi to share the result of the study on Bunaken Island.
2.3. Rapid appraisal for fisheries

2.3.1. Identification and determination of attributes. Based on the study literature from the previous study of sustainability assessment with the RAPFISH related to ecotourism, island marine tourism, and management of coral reef ecosystems established four dimensions [13, 15, 19]: ecological (n = 8), economic (n = 6), social (n = 6), and institutional (n = 8); (Table 1). These attributes were identified because they were considered the most representative condition to be assessed in this study, namely ecotourism in the coral reef area within the national park.

**Table 1.** Attributes of assessment for a sustainable tourism destination, in Bunaken Island and RAPFISH scoring criteria. Score range was set from bad (unsustainable; 0) to good (very sustainable; highest scores vary among attributes).

| Attributes                                      | Score Scale | Indicator                                                                 | Source |
|-------------------------------------------------|-------------|---------------------------------------------------------------------------|--------|
| **Ecological Dimension**                        |             |                                                                           |        |
| 1. Coral reef condition                         | 0,1,2,3     | (0) Rise over 25%; (1) Rise below 25%; (2) Stable; (3) Decline           | [12]   |
| 2. Suitability index for snorkeling             | 0,1,2,3     | (0) Very suitable; (1) Suitable; (2) Appropriate conditional; (3) Not suitable | [13,14]|
| 3. Suitability index for diving                 | 0,1,2,3     | (0) Very suitable; (1) Suitable; (2) Appropriate conditional; (3) Not suitable | [13,14]|
| 4. Suitability of tourist carrying capacity     | 0,1,2,3     | (0) ≤ 1*DDW; (1) 1*DDW ≤ 1,5*DDW; (2) > 1,5*DDW – < 2*DDW; (3) ≥ 2*DDW | [14]   |
| 5. Protected species                            | 0,1         | (0) Presence; (1) Not presence                                           | [15]   |
| 6. Reef fish (number of species)                 | 0,1,2,3     | (0) > 75 (1) ≥ 20 – 75; (2) < 20                                         | [16]   |
| 7. Water quality around Bunaken Island           | 0,1         | (0)<standard quality; (1) >standard quality                             | [17]   |
| 8. Percentage of protected area                 | 0,1,2       | (0) High; (1) Enough; (2) Low                                            | [18]   |
| **Economic Dimension**                          |             |                                                                           |        |
| 1. Employment                                   | 0,1,2       | (0) High; (1) Fair; (2) Low                                              | [19,20]|
| 2. Increase of community welfare                | 0,1,2,3     | (0) Very good; (1) Good; (2) Enough; (3) Bad                            | [20,21,22]|
| 3. The number of tourist visit                  | 0,1,2       | (0) High; (1) Fair; (3) Low                                              | [15,19,20]|
| 4. Tourism sector as source of income           | 0,1,2,3     | (0) Not depend; (1) Low; (2) Fair; (3) High                             | [15,19]|
| 5. Utilization of resources from coral reefs     | 0,1,2,3     | (0) Not depend; (1) Low; (2) Fairly depend; (3) Depend                  | [15,19]|
| 6. Diversity of tourists (Overseas)              | 0,1,2       | (0) Very diverse (not exceeds 25%); (1) Fairly diverse (Some dominate between 25% to 50%); (3) One dominates (>50%) | [23,24]|
| **Social Dimension**                            |             |                                                                           |        |
| 1. Formal education level                       | 0,1,2,3     | (0) S1-S3; (1) High school graduate; (2) Graduated from elementary school to junior high | [15,23]|
2. Environmental knowledge and care for natural resources

0,1,2,3
(0) Very Good; (1) Good; (2) Good enough; (3) very minimal to nothing

[15,23]

3. Potential conflicts in the management of tourism activities

0,1,2,3
(0) None; (1) Low; (2) Medium; (3) High

[23,25]

4. The planning process considers the socio-economic impact

0,1,2,3
(0) Very good; (1) Good; (2) Good enough; (3) Bad

[20,21]

5. Local communities participate in providing input in management decisions

0,1,2,3
(0) Very good; (1) Good; (2) Good enough; (3) Bad

[20,21]

6. The level of community compliance

0,1,2,3
(0) Very good (1) Good; (2) Good enough; (3) Bad

[25]

### Institutional dimension

#### 1. There is a study/research of the carrying capacity of the area related to sustainable use

0,1,2,3
(0) Very Good; (1) Good; (0) Good enough; (3) Bad

[21]

#### 2. Zoning and area use rules

0,1,2
(0) Exist, and effective; (1) Yes, ineffective ; (2) Nothing

[13,20,21]

#### 3. Coordination between Stakeholders

0,1,2,3
(0) Very good; (1) good; (2) good enough (3) bad

[19,20,21]

#### 4. Implementation of monitoring, supervision, and control

0,1,2,3
(0) Very good (1) Good; (2) Good enough; (3) Bad

[13,21]

#### 5. Research by academics and education institutions

0,1,2,3
(0) Much and periodical; (1) Many and quite periodic; (2) Quite a lot but not periodically (3) Not a lot and not periodically

[20]

#### 6. Availability of information and inventory to manage the area

0,1,2,3
(0) Very good; (1) Good; (2) Good enough; (3) Bad

[21,26]

#### 7. There is additional support from volunteer programs, local communities, NGOs and others

0,1,2,3
(0) Very good; (1) Good; (2) Good enough; (3) Bad

[21]

#### 8. The availability of a strategic management plan

0,1,2,3
(0) Very good; (1) Good; (2) Good enough; (3) Bad

[20,21]

2.3.2. Definition and scoring of attributes. The next process of the analysis is to describe and assess the attributes that correspond to RAPFISH, for every "bad" score that it is not suitable for the sustainability of Bunaken island tourism destination, and a "good" score define condition which supports better condition. Scoring of the attributes used in this study was done based on the reference to the method recommended by [26] Each rating attribute is in a bad to good threshold position.

2.3.3. Multidimensional scaling. The principle is to map the distance of perception between one unit to another using a scale. RAPFISH ordinance is placed on a two-dimensional curve, multidimensional scaling (MDS) is used to coordinate units in "bad" and "good" scales by transforming multidimensional statistics into lower dimensions while maintaining the distance characteristics between the attributes analyzed [27]. In order to meet the standard so the results of MDS analysis could be used, the S value has to be <0.25, and also, the confidence value of R² has to be as close as possible to 1 or >80% [28].
2.3.4. **Index scale of sustainability.** The scale was used to determine the sustainability status of tourism activities in the study area based on modification by [29]. The index scaling consisted of range from 0 to 100 and was split into four groups based on sustainability status (Table 2).

| The threshold value of the index | Sustainability Status |
|----------------------------------|-----------------------|
| 75.01-100                        | High                  |
| 50.01-75.00                      | Moderate              |
| 0.00-50.00                       | Low                   |

2.3.5. **Leverage analysis.** The principle of leveraging analysis is to detect the dominant attribute. Leveraging calculation allows us to see changes in ordination (bad-good position) when these attributes are removed one by one. In RAPFISH, the value of this leverage ranges from 2% to 6%, as measured by changes in Root Mean Square (RMS) [27].

2.3.6. **Monte Carlo analysis.** Monte Carlo analysis is used as a simulation method to analyze the possibility of random errors in the analysis used. The results obtained from the results of the analysis show the results obtained between the value of the Monte Carlo analysis with the ordination value in each dimension does not exceed 5%. This analysis shows that the accuracy of the model is high and sufficient to be used as a predictor of the sustainability index [30], results of MDS, and Monte Carlo analysis shown at Table 3.

| Dimension    | Results of MDS analysis | Results of Monte Carlo analysis | Difference |
|--------------|-------------------------|---------------------------------|------------|
| Ecological   | 72.83                   | 71.55                           | 1.28       |
| Economic     | 55.19                   | 55.04                           | 0.15       |
| Social       | 34.99                   | 35.11                           | 0.12       |
| Institutional| 47.54                   | 47.96                           | 0.42       |

3. **Results and discussion**

Based on the results of the analysis of the four dimensions used to measure the sustainability of tourism destinations on Bunaken Island, the results obtained by each dimension varied (Fig. 2). The general value for the four dimensions was 52.63 accumulatively (Fig. 2), express a "moderate" status of sustainability in Bunaken Island as a tourist destination. Following result 72.83 for the ecological dimension; 55.19 for the economic dimension; 34.99 for the social dimension; and 47.56 for the institutional dimension.
Figure 2. Kite diagram of four dimensions for the sustainable tourism destination of Bunaken Island, Manado, North Sulawesi, Indonesia. The overall value for the sustainability status was 52.63, indicating sustainability as a "moderate" status of tourism destination in Bunaken Island. Based on the threshold value of the index in Table 2.

3.1. Results

3.1.1. Ecological dimension. The results from RAPFISH analysis in the ecological dimension show the index value 72.83 [Fig. 3 (a)], is within the value moderate in the sustainability status threshold, these index values also the highest compare to the result from other dimensions. Result from leverage analysis, the root mean square (RMS) value from other all attributes showed that most sensitive attribute which affecting the ecological dimension was the suitability of tourist carrying capacity ($R^2 = 12.18$).

3.1.2. Economic dimension. Besides the ecological dimension, the economic dimension also within the sustainability status threshold value moderate with the index value 55.19 [Fig. 3 (b)]. From of the six attributes in the economic dimension, the result from leverage analysis display diversity of tourist (overseas) as the most sensitive attributes ($R^2 = 4.93$) and followed by the number of tourist visits ($R^2 = 3.86$).

3.1.3. Social dimension. Analysis from the attributes in the social dimension was in range sustainability low, with an index value 34.99 [Fig. 3 (c)]. That indicated that the involvement of the community in Bunaken Island was low, or the resident not happy with the performance of the management and could not have positive feedback from the rising number of tourists. Thus supported by the result of analysis leverage that the most sensitive attribute was Potential conflicts in the management of tourism activities ($R^2 = 3.94$) and Knowledge level of environmental benefits or local wisdom ($R^2 = 3.62$).

3.1.4. Institutional dimension. The index value for the institutional dimension was 47.51, meaning that attributes categorized into the low sustainable category [Fig. 3 (d)]. The results of leverage analysis from eight attributes show that the most sensitive attribute was Coordination between Stakeholders ($R^2 = 4.16$).
3.2. Discussion

3.2.1. Ecological dimension. The ecological dimension has the highest sustainability index compared to other dimensions (72.83), mostly caused by conditions and quality of the natural ecosystems. That affects the suitability index of snorkeling and diving, which are also other measurement attributes, as well as the resources of reef fish and protected species, which are one of the attractions of Bunaken Island tourist destinations. Based on the attributes used in the study, the bio-physical component of Bunaken Island becomes the main attributes that support the sustainability of the ecological dimension of Bunaken Island. The bio-physical component is the potential of natural resources and natural processes that occur in the waters around Bunaken Island. However, due to the incompatibility of the suitability of tourist carrying capacity, that attribute became an inhibiting factor that affects the sustainability in the ecological dimension. Carrying capacity is a technique to maintain the condition of the destination, in this case, the natural ecosystem to avoid alteration in the physical environment [31].

The condition of coral cover on Bunaken Island experienced fluctuation during 30 years of management. Status of coral reefs on Bunaken Island increased by 11.3% between 2001 and 2002 due to the establishment of a patrol system to dealing with using cyanide and explosives practice in fishing, also support by collaborative management and the revision of the use of zoning [32]. Although monitoring activities working out periodically, the results of previous studies indicate that there has been a decline in the percentage of coral reefs on Bunaken Island, tourism activities and management has to be considered as factors that influence the damage to these coral reefs.

3.2.2. Economic dimension. The economic dimension is within the threshold of moderate sustainability (55.19) based on results from RAPFISH analysis. The high number of tourist visits mainly supports the value of sustainability. These show the good development of tourism activities in the city of Manado. But for foreign tourists are still dominated by tourists from China. It makes the diversity of tourists from foreign countries low because of the dominant market. One of the main points in managing Bunaken Island or Bunaken National Park is how to manage as much income from tourists as possible to manage and care for the environment of Bunaken Island to become a sustainable destination. The diving industry in Manado developed more than 20 years ago [33].

3.2.3. Social dimension. The analysis showed that the social dimension sustainability index was 34.99. The magnitude of the social dimension is in the range of 50.01-75.0, which is included in the low sustainable category. These due to the high potential for conflict in tourism activities on Bunaken Island. There was a demonstration rejecting the policy of making a "floating pontoon" as a place for tourists to lean on Bunaken Island. Also, residents protest over the incident of tourists who stepped on a coral reef. The conflict also shows the community's knowledge and concern for the benefits of coral reefs. Interviewees said that 90% of the public had an understanding of recycling some plastic components for decoration during holidays. This shows that the environmental knowledge of the people of Bunaken Island is quite good.

3.2.4. Institutional dimension. The analysis showed that the institutional dimension sustainability index was 47.51. The institutional dimension is in the range of 50.01-75.0, which are included in the low category. Previous research reports there is no coordination among policymakers, especially after the Board Management of BNP (BMBNP) has not actively made the monitoring, supervision, and control components not optimal [34]. Support from other institutions was not like before, especially since there were no programs such as NRM through USAID after that, TNB's performance was
considered to decrease from year to year [5]. Those conditions generate poor value on attribute "coordination between stakeholders", which is the premise of our result.

At this point, the impact of management strongly affecting the condition of coral reefs on Bunaken Island. One of the most fundamental lessons from past BNP is that most stakeholders strongly believe that one of the greatest strengths of Bunaken management councils is the diversity of stakeholder representatives [32]. Evaluation of management effectiveness is a very important aspect of the successful management of any MPA. The evaluation provides a broader understanding of management progress, how effective management has been, and what can be done to improve management performance [5]. Problems in the institutional dimension of Bunaken National Park began to emerge when USAID-NMR stopped supporting management in 2004.

3.3. The concept for sustainable tourism in Bunaken Island

The concept was build based on the result from leverage analysis which displays which attributes that act as a key function of the sustainability from each dimension (Fig. 4). Suitability of tourist carrying capacity is the most sensitive attribute in the ecological dimension. Leverage analysis indicates that attribute could become an inhibiting factor for the ecological dimension if not managed properly. It supports the basic principle of using national parks as conservation areas for tourism activities. Carrying capacity as a tool for management must be designed to avoid damage to the presence of fragile ecosystems, animals, and plants within the conservation area. If the carrying capacity fails to reduce the impact of damage within the national park area, the management must adjust the number again, the carrying capacity should not be fixed [35] but must be adjusted to the condition of the ecosystem based on the results of monitoring activities.

![Figure 4](image)

**Figure 4.** The result from leverage analysis of all attributes of the RAPFISH ordinations for sustainability destination tourism in Bunaken Island, Manado, North Sulawesi, Indonesia. Ecological, economic, social, and institutional, based on the standard error (%).

In this study, we took it a step further by offering a new number for the ecological carrying capacity of tourists visiting the island of Bunaken based on previous data and research. Based on the analysis, results obtained 63.840 divers per year for carrying capacity of diving tourism categories and 175.200 for carrying capacity of snorkeling tourism categories. That means there are 3990 divers per dive sites per year in 16 diving sites in Bunaken Island, thus supports recommendations [36], which gives a threshold of 4000-6000 divers per location per year. These results also support studies conducted by [7], which recommend the same results. Those results can be changed if the condition of coral reefs on the island of Bunaken continues to decline, the management must determine the limit of acceptable change (LAC) that can be accepted for coral reefs on the Bunaken Island.
Leverage analysis from the economic dimension shows the diversity of foreign tourists and the number of tourist visits as the most sensitive attribute on the economic dimension. The not diverse market was identified as an interfering factor, that could lead to some negative condition in future sustainability. The dominance of tourists from China is not surprising, economic growth that occurred in China made an increase in the number of citizens who have middle and upper incomes, so the ability to travel also increased [37]. A similar thing happened in Bali, an increase in tourists from China coming to Bali continued to increase from year to year. However, at the same time in Bali, there was a "zero-dollar tour" (ZDT) practice, which naturally reduced local income in the tourism industry in Bali. The Bali government is aware of this and taking firm action against these harmful practices [38]. A similar thing can happen in Manado if the supervision of the tourism industry is not done properly. (ZDT) practices that not only harm local tourism businesses but Chinese tourists themselves, creating a bad impression for these tourism destinations. ZDT practices cannot yet be proven to have happened or not in Manado, but the local government must be aware of the issue. There is a very detailed report written by [38] regarding the practice of ZDT in Bali.

Despite the diversity of tourists visiting, an increase in the number of tourists is a positive thing for the development of tourist destinations. But this can be a problem when the increase in the number of tourists is not fit with the carrying capacity recommendation. This condition is undoubtedly a challenge for managers to find solutions that are good for the environment and also the economy. [39] proposes a solution is to raise prices at least double the price paid by tourists today, thus will not decrease the amount of income but potentially increase, and at the same time, it is expected to regulate the number of tourists visiting.

Conflict in the management of tourism activities in the community occurs when people feel unfavourable, included, or even harmed by tourism activities. The people of Bunaken Island are aware of their coastal resources, even though the community is still mostly dependent on gardens, livestock, and marine products. The negative view of the Bunaken Island community is mostly due to two things, the destructive tourism activities and, at the same time, the application of rules in the tourism area is considered not to involve community involvement.

The local government of Manado may see BNP as a facility to generate income for the city of Manado, not as an asset that must be protected and invested to generate higher and sustainable income for the city of Manado in the future. This view supported by dissatisfaction with the performance of Bunaken National Park in terms of revenue from ticket sales [21]. If the government views the Bunaken National Park as a source of income, that most likely could jeopardize the sustainability of BNP as a conservation object because Bunaken requires adequate funding in infrastructure and equipment to manage the area of 89,000 hectares [32]. Meanwhile, the effectiveness of managing and sale of tickets to enter the park also needs to be reviewed.

Coordination and synchronizing policies or programs between agencies in among stakeholders who managed BNP are in very low performance [5]. Leverage analysis identified that attribute as an inhibiting factor for sustainability shows that coordination among stakeholders as a key role in the institutional dimension that influences sustainability in BNP management. It's complicated, the situation that the BMBNP does not have the right to provide penalties to the relevant agencies that are members if it does not carry out programs or activities that are following the results of coordination that have assigned. In contrast, the BMBNP is an organization or institution that has absolute authority to formulate policies or programs in the management of BNP, not just an institution that coordinates cross-institutional programs [34]. One of the principles in the evolution of successful management of Bunaken National Park conservation is stakeholder participation through partnerships [32].

The concept of sustainable tourism on Bunaken Island must be based on the suitability of carrying capacity, supported by managing the diversity of tourists visiting the destination and income from the number of tourists visiting the area. Management of tourism activities is also to avoid potential conflicts in the management of tourism activities. All that can be achieved by carrying out coordination with all stakeholders involved in tourism activities in Bunaken National Park, especially on Bunaken Island.
Much research has been conducted both on Bunaken Island and Bunaken National Park, and many management strategies are offered to Bunaken in each period. Through this research, the sustainability index of the destinations of Bunaken Island has been measured. The index value shows that sustainability is in the moderate sustainable category but the lowest range of values towards a low sustainability threshold, meaning that if tourism on Bunaken Island was not managed correctly, it could turn into low sustainability in the future. The results of this study can use as an early warning for better management of Bunaken National Park in the future.

4. Conclusion
The sustainability of Bunaken Island was reviewed based on conditions affected by the escalation number of foreign tourists, shown increasing popularity as a tourist destination, especially from China. Build upon the RAPFISH analysis, Bunaken Island, as a Tourist Destination, has sustainability status "moderate" from ecological, economic, social, and institutional dimensions. Most likely support by the ecological dimension, the result showed Bunaken Island has still great potential to be tourist destination after almost declared as National Park 30 years ago. In the economic dimension, sustainability support by the increase of visitors, but at the same time, there is a concern about the diversity of the foreign market. The dominance market may lead to unfavourable situations in the future. Moreover, management should be aware because of the results from the social and institutional dimensions that show low status in sustainability. It means there was still a potential problem with the community in Bunaken Island with the current condition and also with the management of BNP. Furthermore, to achieve better results, BNP should have to look back their success story from 2002 to 2004 when BNP co-management became a role model to other National Park in Indonesia.

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