Assessing the potential of coastal ecosystems to develop marine tourism in Pramuka Island, the Kepulauan Seribu National Park, Jakarta, Indonesia

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Abstract. Coastal zones play an important role in providing various valuable ecosystem services. However, it is also sensitive and vulnerable to environmental changes due to human overpopulation and interactions between the land and ocean. Pramuka Island, located in the Kepulauan Seribu National Park, can potentially be developed as a marine ecotourism area. Some coastal ecosystems on the island can be promoted as tourist attractions. The existing coral reefs, sea turtles, and mangrove forests are potential resources that can be used as tourism objects. However, the different objectives of marine ecotourism and ecosystem conservation might raise management conflicts in relation to land use on the island. This research aims to propose a strategy for the management of Pramuka Island by synergizing the conservation interest with the development of marine ecotourism area. It employs the ecology based Management-Driven Pressure State Ecosystem Service and Response (EBM-DPSER). The results showed that government policy is in need to reduce conflicts between conservation and economic interests.

Keywords: coastal ecosystems, marine tourism, Pramuka Island

1. Introduction

The rapid and widespread growth of tourism throughout the Indonesian archipelago has been a phenomenon. The development of marine ecotourism contributes significantly to high economic growth. However, this growth has a major impact on the ecology, social and culture of local communities. It is estimated that 60% of coastal tourism areas are used for swimming, sunbathing, beach sports and beach walking, whereas 25% of the areas are used for sailing, cruising, fishing, surfing, skiing, and parasailing [1]. Meanwhile, only 15% are used for diving and snorkeling. Recent data shows that the tourism sector has contributed around IDR 120 trillion (USD 8,381,644,199.20) to the national GDP in 2014. It increased to IDR 200 trillion (USD 13,969,406,998.67) in 2017. Thousand Islands are a group of islands consisting of small islands with an area of 853.75 hectares [2].

2. Materials and Methods

2.1. Materials

The research materials used for this study are obtained from the previous studies [3-8], table 1 presents a list of researchers and the title of their research.
Table 1. List of research

| No | Name of researchers/Year | The title of research                                                                 | Location                                                                 |
|----|--------------------------|--------------------------------------------------------------------------------------|--------------------------------------------------------------------------|
| 1  | Rudianto (2015) [3]     | Pari Island management: based on good governance                                      | Pari Island in Thousand Islands.                                         |
|    |                          | The composition of coral and reef fish community structure as an indicator of marine | Pramuka, Panggang and Sekati Islands.                                     |
|    |                          | ecotourism supports coastal restoration on Pramuka, Panggang and Sekati Islands,     | Thousand Islands National Park, DKI Jakarta                               |
|    |                          | Thousand Islands, DKI Jakarta                                                       |                                                                          |
| 2  | Hari (2016) [4]         | Characteristics of habitat of hawksbill turtle (*Eretmochelys imbricata*) in Pramuka   | Pramuka Islands.                                                        |
|    |                          | Island, Thousand Islands, DKI Jakarta                                               |                                                                          |
| 3  | Gemasabi (2017) [5]     | Marine ecotourism region development strategy based on restoration on Pramuka Island  | Pramuka Islands.                                                        |
|    |                          | Hundred Islands National Park.                                                       |                                                                          |
| 4  | Puspa (2016) [6]        | Perception and community participation on hawksbill turtle conservation (*Eretmochelys* | Pramuka Islands.                                                        |
|    |                          | imbricata*) on Pramuka Island, Thousand Islands, DKI Jakarta                        |                                                                          |
| 5  | Rizki (2016) [7]        | Seagrass meadow ecosystems are on the reef flat with root structures in the waters.  | Pramuka Islands.                                                        |
| 6  | Putra et al. (2014) [8] | The mangrove ecosystem found in Pramuka Island is an artificial ecosystem covering an | Pramuka Islands.                                                        |
|    |                          | area of 2 ha.                                                                         |                                                                          |

2.1.1. Conditions of ecosystem. The coral reef ecosystems around the waters of Panggang, Pramuka and Sekati Islands have an average coral cover of 50-56 percent. Based on this value, the condition of the coral cover can be considered to be in good condition [6]. However, there was an average decrease of 6.77 percent of the coral cover due to the high number of tourists visiting the area.

Seagrass meadow ecosystems are on the reef flat with root structures in the waters. The density of seagrass *Thalassia hemprichii* is 95.068, followed by *Enhalus acoroides* which is 2.185, *Cymodocea rotundata* which is 2.038, *Halophila ovalis* which is 0.384, and *Syringodium isoetifolium* which is 0.325.

The mangrove ecosystem found in Pramuka Island is an artificial ecosystem covering an area of 2 ha. Mangrove species in Pramuka Island are *Rhizophora stylosa* in the tidal area [8].

Seagrass meadow ecosystems are on the reef flat with root structures in the waters. Seagrass ecosystem in Pramuka Island includes *Enhalus acoroides, Thalassia hemprichii, Halophila ovalis, Cymodocea rotundata, Halodule uninervis*, and *Syringodium isoetifolium*. Based on data from the office on Pramuka Island, the density of seagrass *Thalassia hemprichii* is 95.068, followed by *Enhalus acoroides* which is 2.185, *Cymodocea rotundata* which was 2.038, *Halophila ovalis* which is 0.384 and *Syringodium isoetifolium* which is 0.325.

Habitats for hawksbill turtles (*Eretmochelys imbricata*) are getting more scarce. Hawksbill sea turtles (*Eretmochelys imbricata*) on Pramuka Island live in their habitat in the form of bush plants. The
potential predator of turtle eggs is monitor lizard (*Varanus* sp.). Another threat is nest theft by humans. In Pramuka Island, turtle hatchery, cultivation, and release centers have also been developed [5].

The average depth of the Thousand Islands waters is 7.66 meters. The depth of waters that are suitable for marine tourism, especially for swimming ranges from below 3.5 meters. The brightness is 7.08 percent and the temperature is 30–34°C. In terms of the odor parameter, the waters are odorless. The second parameter is the chemical parameter, which consists of pH, salinity, and dissolved oxygen (DO). The average value of pH in the waters of Thousand Islands is 7.66 - 9; the salinity is 31.5 \(\%\) - 34 \(\%\); the dissolved oxygen (DO) is 5.44 -7.55 (ppt). The water quality in the waters of the Thousand Islands is suitable for marine ecotourism activities. [4] [6].

Community participation influences maritime tourism activities on Pramuka Island. The involvement of local residents in managing natural resource economy is still limited to capturing fisheries, seaweed cultivation, and small-scale fish farming. Meanwhile, the marketing of fisheries business is still controlled by middlemen [2]. The role of the local community in developing marine ecotourism is still limited. This is due to limited access to business opportunities, capital and human resources.

2.2. Methods

Ecosystem-based management (EBM) must focus on ecosystem services because they reflect social goals, values, desires, and benefits. Taking into account environmental services into a holistic management strategy improves the management in facing diversity that interacts with humans and nature which are positive and negative. To facilitate this inclusion, the conceptual model classifies conceptions, pressure, state, impact and response (DPSIR) existing services (figure 1).

![Figure 1. The EBM-DPSER Model [9].](image)

3. Result and Discussion

The location of the research area can be seen in figure 2 below. The suitability of mangrove ecotourism in Pramuka Island obtained a value of 279. This value indicates that Pramuka Island has the potential to be developed [10]. Meanwhile, the calculation of the carrying capacity of ecotourism indicates that the capacity of the area is 114 people in a day considering the sustainability of the mangrove ecosystem.
3.1. Ecosystem services

Ecosystem Services are the benefits that humans get from ecosystems. Ecosystems such as coral reefs, reef fish life, water quality conditions, mangrove ecosystems, seagrass ecosystems, turtle life, and social, economic and cultural conditions, are considered very suitable to be developed further as a marine ecotourism area. Thus, the existence of ecosystem conditions on Pramuka Island still provides positive services to the local community as well as to tourists visiting Pramuka Island.

3.2. State

The ecosystems on Pramuka Island provide great benefits to the growth of flora and fauna and support the lives of local people. The coral reefs which are in good condition are 50-56 percent. Data on coral transplants in 2011 show that transplantation is successful and useful. The condition of the transplantation needs to be done at a place on Pramuka Island where the coral is damaged. Mangrove density shows good conditions and developments. Therefore, mangrove forests must be maintained and conserved by considering the preservation of mangroves for the future. The growth condition of the ecosystem is supported by the quality of the waters both physically and chemically. Based on the depth, brightness, temperature, odor, salinity, DO, and pH, the island is considered feasible to be developed as a marine ecotourism area. Hawksbill turtles (*Eretmochelys imbricata*) are dominant in the area and intensive breeding is carried out to reduce the decline of the turtle population. In terms of social conditions and cultural economy, the local community supports the management of coastal ecosystems. However, the awareness of the community to participate in preserving natural resources needs to be further enhanced. Further, suitable index travel shows that the area is suitable for snorkeling and diving.

3.3. Pressure

Generally, the pressure that causes changes to ecosystem services can be classified into two, general and specific pressures. In general, the pressure that can cause changes to ecosystem services on Pramuka Island is climate change that occurs globally, for example, the rising sea level which can be adapted through ecosystem restoration activities. On the other hand, the decrease in groundwater level is due to the reduced vegetation cover resulting from changes in land use, clear-cutting, disposal of liquid waste, solid waste disposal, and oil spills. Besides that, the population growth will affect ecosystem services in the future.

3.4. Drivers

Drivers are the main cause of changes in ecosystems. The drive can be a combination of biophysical, human and institutional actions or processes. The main causes of ecosystem changes are anthropogenic activities mainly related to the irrational use of natural resources, while growth will affect the density of Pramuka Island, which in turn affects the quality of the environment. Besides that, clean water is badly needed on Pramuka Island. The use of excess groundwater will cause subsidence.
3.5. **Responses to ecosystems services**

Responses to ecosystems services such as coral reefs, reef fish life, water quality conditions, mangrove ecosystems, seagrass ecosystems, turtle life, and social, economic and cultural conditions, are considered very suitable to be developed further as a marine ecotourism area. However, the number of local population and migrants should be considered in Pramuka Island due to seeking job opportunity. Therefore, the ecosystem services should be strictly conserved by issuing government regulations related to coastal environmental maintenance. The role of government starts from the assessment stage, whereas the planning and management stage that starts from the regional scale to local scale. Stakeholder collaboration is informed, invalid and empowerment. From the three stakeholders, which are the community, government and private sector, the most influential one are the government [11].

3.6. **Responds to state**

Responses to the state are related to issues of coral growth, mangrove forest, water conditions, sea turtle conditions, and socio-economic conditions of the community that needs to be included in government policies on spatial planning and utilization. But what needs to be considered is the threat to every human activity that always affects the extent of coastal ecosystems. For this reason, the government must firmly reject any human activity that wants to expand its business or build new areas in coastal ecosystems.

3.7. **Responses to pressure**

Responses to pressures are related to changes in land use, climate change, decreasing groundwater levels, and increasing population growth. For this reason, the government together with the public and the private sector are jointly committed to addressing or adapting to environmental threats. For this reason, mutual agreement is needed between all stakeholders.

3.8. **Responses to drivers**

Responses to the drivers are related to the causes of changes in the ecosystem environment on the coast. The government together with the community and the private sector together are responsible for the destruction of coastal ecosystems. Besides that, the decrease in the availability of clean water is also a scenario in the planning, implementation and utilization stages.

5. **Conclusions**

Assessing the potentials of coastal ecosystems to develop maritime tourism on Pramuka Island is a prerequisite for compiling a strategic plan document for the next five years with the DKI government as a formulator. Then, the Thousand Islands regional government can implement it in the form of action plans based on spatial planning. An important part of the strategic plan document is to save and maintain existing ecosystems to be able to provide optimal services for local communities, tourists and the private sector who invest their funds in Pramuka Island. The development of Pramuka Island as a marine ecotourism area must consider ecological, economic, social and cultural aspects. Several facilities and infrastructures are needed such as rain harvesting to increase rainwater recharge by making infiltration wells, making clean water installations by making desalination, making waste and waste processing and making groundwater usage rules in the small island region.

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