

# Sustainable mangrove ecosystem management policy in Muaragembong coastal area, Bekasi District - Indonesia

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**Abstract.** Mangrove ecosystems in the Muaragembong Coastal Area have been used for aquaculture and ecotourism activities that provide benefits for increasing community income. In an era of technological disruption, the opportunity for ecotourism development is getting bigger. But on the other hand, there is a condition of the status of mangrove ecosystems that have been bad, which has an effect on the decline in environmental quality. This condition is because it has not been supported by management policies in Bekasi. Knowing the importance of the mangrove ecosystem, it is necessary to study of sustainable mangrove ecosystem management policy. The purpose of this study is to formulate a sustainable mangrove management policy. By using the method of descriptive analysis, super impose analysis and SWOT analysis, the results show that the management of mangrove ecosystems can be done by: (1) establishing the mangrove ecosystem area as an area designed in the spatial plan, (2) intensifying the program. mangrove ecosystem to improve the function of mangrove ecosystems; (3) increasing the role and community in managing mangrove ecosystems; (4) developing facilities and infrastructure that support the development of sustainable ecotourism activities. Through this, results can be expected for the Bekasi District Government in the context of managing the mangrove ecosystem in the Muaragembong Coastal Region successfully.

## 1. Introduction

Mangrove ecosystems are one of the most productive ecosystems in supporting many terrestrial and marine species [1]. Mangrove ecosystems have very important benefits for human life because they can be used for aquaculture, agriculture, forestry and tourism activities. What can be produced by mangrove ecosystems is fire wood, building materials, alcohol, drugs, fodder and other local subsistence use [2]. In addition, the mangrove ecosystem has functions and benefits, namely (1) as a habitat for species of wild animals such as birds, shrimp, crabs, molluscs, reptiles and crocodiles; (2) can protect coastal areas against natural disasters, including protecting coastlines from abrasion and reducing waves including tsunamis; (3) assisting in the process of deposition of sludge which can remove toxins and nutrients from the soil and deposition of soil nutrients so that the soil is fertile due to many nutrient content; (4) as a germplasm source; (5) as carbon sink; and (6) can maintain a microclimate. In addition, mangrove ecosystems provide around US \$ 1.6 billion per year in profits around the world in supporting the economy in coastal areas [3].

Even though mangrove ecosystems have important benefits in supporting human life in an economic and ecological manner, in the past few years there has been degradation of mangrove ecosystems. Based on existing data as explained by Din et al., the extent of the loss of mangrove ecosystems is quite



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significant throughout the world. From the data from 1980 - 1990, the area of mangrove ecosystem lost was around 2% every year and since 1990 there has been a decrease in the area of mangrove ecosystems by 1 -2% per year [1]. Since the 1990s, it has been estimated that logging of mangrove trees is on a large scale, so that mangrove cover has decreased by 30-86% [4], and this continues to occur globally [5]. The main threats that occur in the mangrove ecosystem are land clearing for aquaculture activities, development of coastal areas [6], wetland agriculture, logging of mangrove trees for the use of firewood and building materials, coastal area development, salt extraction [7,8]. This resulted in a decline in the quality of the coastal environment. In order to improve coastal environmental conditions, a sustainable management of mangrove ecosystems is needed in order to create a balanced coastal environment in the future, so that mangrove ecosystems can function ecologically and economically for the welfare of coastal communities.

In general, mangrove ecosystems are found in developing countries [9], so they have limitations in regulating the utilization of mangrove ecosystems in a sustainable manner, because mangrove ecosystems are shared property and all communities have the right to use these ecosystems to fulfil their daily needs. In general, the use of mangrove ecosystems is carried out by the community without taking into account the impacts caused by the utilization of the ecosystem. This is because the level of the economy of the people in coastal areas in general is low. Although there is already a management policy for mangrove ecosystems that are established at the international level through agreements and conventions to protect the mangrove ecosystem, including the Ramsar Convention (1974); Cartagena Convention (1983); and the International Trout Agreement (2011), but this does not provide effective legal protection in managing and preserving mangrove ecosystems as conservation areas [10], as is the case in the Muaragembong coastal region. In line with the development of management, in the management of mangrove ecosystems developed management of mangrove ecosystems by integrating in integrated coastal area planning [11], where the basic concept used is mangrove ecosystems are part (sub-system) of coastal systems that influence each other with other sub-systems. In Indonesia, coastal ecosystem management policies include in it the mangrove ecosystem is by compiling a policy of integrated coastal management the basis for the preparation refers to Law Number 1/2014 about Amendments to Law Number 27/2007 about the management of coastal areas and small islands.

At present, the condition of the mangrove ecosystem found in the Muaragembong Coastal Area of Bekasi Regency has been used by the community for economic activities that benefit instantly, namely for aquaculture activities (ponds), and ecotourism activities. From the results of the 2013 study, the total economic value of mangrove ecosystems was calculated based on use value (shrimp capture, crab fishing, manufacture of mangrove processed foods, sea water intrusion restraint) and non-use value (average value of community willingness to preserve mangrove ecosystems) is Rp. 23,690,709,886, - [12]. Whereas from the results of research conducted in 2016 using the CVM (Contingency Valuation Method) approach, the value of mangrove ecosystems in the coastal region of Muaragembong was IDR 248,334,264,647 per year [13]. This shows that the value of mangrove ecosystems in the coastal area of Muaragembong increased significantly in increasing people's income, especially in the era of technological disruption, the opportunity to develop mangrove ecotourism became increasingly large, which will have a direct influence on increasing the income of Muaragembong people in the future. But on the other hand, there are obstacles to the condition of the mangrove ecosystem that has been bad [13], because there is no management policy that can regulate the sustainable use of mangrove ecosystems in Bekasi Regency. The current policy of Bekasi Regency is only the District Spatial Plan with a scale of 1: 50,000, which cannot regulate in detail the management of the mangrove ecosystem. This results in all communities utilizing this ecosystem without paying attention to the impact that these uses have on, and the sustainability of this ecosystem in the future. Given the importance of mangrove ecosystems to increase community income and maintain the balance of the coastal environment of Muaragembong, a policy study of mangrove ecosystem management needs to be carried out in a sustainable manner. Based on these conditions, the purpose of this study is to formulate a sustainable management policy for mangrove ecosystems in the coastal area of Muaragembong.

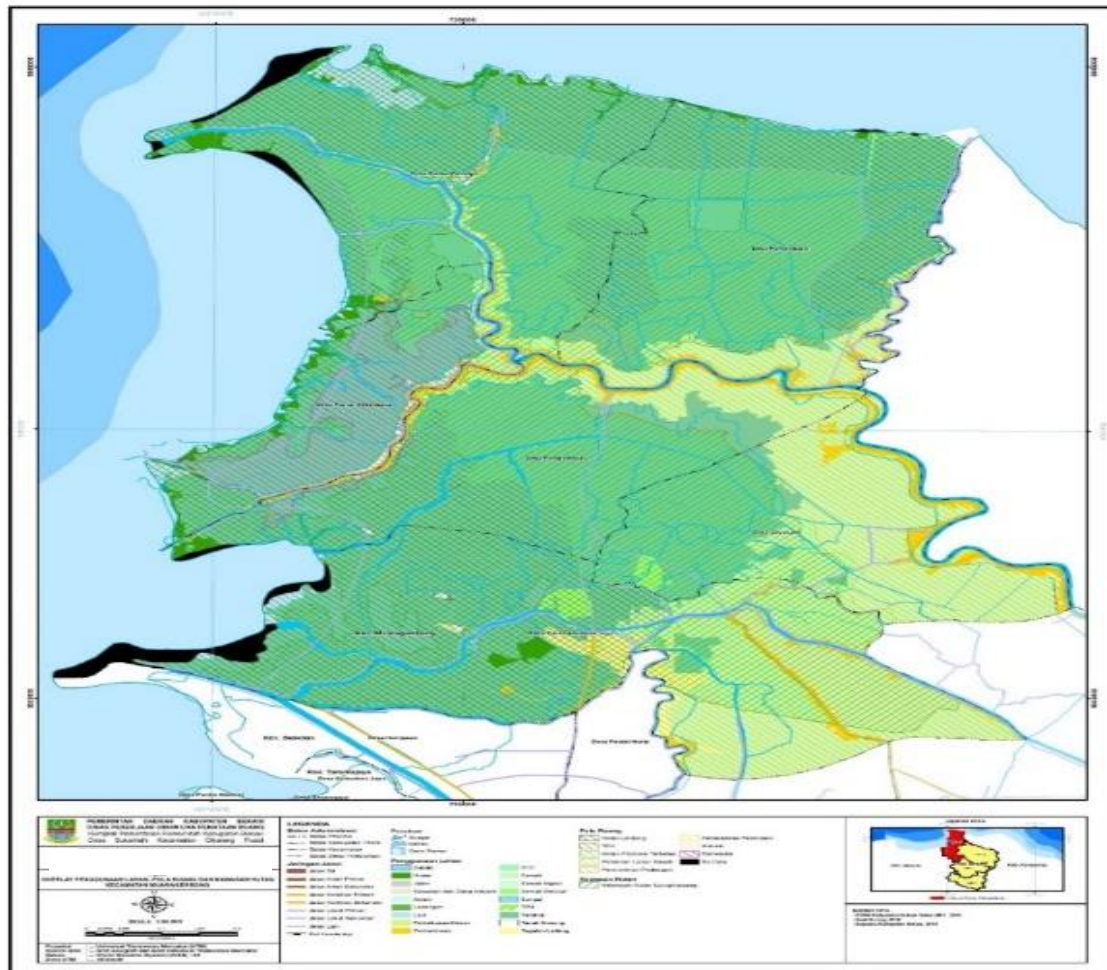
## 2. Methods

The study area is the Muaragembong coastal area in Muaragembong District - Bekasi Regency, has an area of 140.09 km<sup>2</sup>, has 5 (five) coastal villages, namely Pantai Bahagia Village, Pantai Bakti Village, Pantai Harapan Jaya Village, Pantai Mekar Village, Pantai Sederhana Village. Muaragembong District, administratively has a boundary with Jakarta Bay in the west, Karawang Regency in the east, Java sea in the east and Babelan District in the south. To achieve the objectives of this study used primary data (in the form of existing land use data, socio-economic activities carried out by the community in the use and management of mangrove ecosystems), and secondary data (in the form of Bekasi Regency Spatial Plan 2011-2031, Development Plan Medium Term 2017 - 2022, Muaragembong Subdistrict in 2018 figures) The method used in collecting primary data is (1) mapping the identification of existing land use using work maps sourced from the 2017 image map; (2) conducting interviews with the community and local government related to regulating the use of space in this case the Office of Public Works and Spatial Planning of Bekasi Regency. Those who were used as respondents in interviews with the community as perpetrators of socio-economic activities in the Muaragembong mangrove ecosystem area, were randomly chosen which could represent all of the existing activities. All available data were analyzed using: (1) descriptive analysis method to provide a profile of coastal areas and mangrove ecosystems; (2) analysis of super impose between existing land use maps with spatial pattern plan maps, which can provide an overview of the shift in spatial use; (3) SWOT analysis that aims to formulate a sustainable management policy for mangrove ecosystems in the future based on the potential and problems of managing mangrove ecosystems.

## 3. Results and discussion

### 3.1. Profile of the Muaragembong region

The Muaragembong coastal area is dominated by forest areas, which is 76.88% of the coastal area. From the forest area in the Muaragembong coastal area, it is dominated by mangrove ecosystems which are directed to function as protected forests. Existing, the use of mangrove ecosystem land that is directed to function as a protected area, there has been a shift in the use of aquaculture development by 82.84%, while the other has changed its function into settlements and food crop farming (rice fields). For more details, the shift in land use found in the Muaragembong coastal area can be seen in figure 1.



**Figure 1.** Map of land use shift analysis.

The shift in land use that occurs in the coastal area of Muaragembong is in line with the increasing number of residents every year. Based on statistical data from Muaragembong sub-district, the population of the Muaragembong coastal region in 2017 is 31,875 people, with an average population growth rate of 1.36% per year. Villages that have the highest density are found in Pantai Mekar Village, with a population density of 534 people / km<sup>2</sup>, while the lowest population density is in Pantai Bakti Village with a density of 197 people / km<sup>2</sup>. For more details, the number and population density of the Muaragembong coastal region in 2017 can be seen in table 1.

**Table 1.** Population and Population Density of the Muaragembong Coastal Region, 2017.

| No.          | Village             | Area (Km <sup>2</sup> ) | Population (person) | Population Density (person/Km <sup>2</sup> ) |
|--------------|---------------------|-------------------------|---------------------|--|
| 1.           | Pantai Harapan Jaya | 51,94                   | 6.601               | 127  |
| 2.           | Pantai Mekar        | 14,57                   | 7.774               | 534  |
| 3.           | Pantai Sederhana    | 12,00                   | 3.464               | 289  |
| 4.           | Pantai Bakti        | 34,42                   | 6.791               | 197  |
| 5.           | Pantai Bahagia      | 30,10                   | 7.245               | 241  |
| <b>TOTAL</b> |                     | <b>143,03</b>           | <b>31.875</b>       | <b>223</b>                                   |

From 2017 data and the results of interviews conducted with the community, it was found that the total population according to education level was dominated by people who finished elementary and junior

high school, while the population with high school education was very small. This shows that the level of quality of human resources in the Muaragembong Region is categorized as low. This affects the way of utilizing mangrove ecosystems and spatial use in the Muaragembong coastal area, due to a lack of understanding of the community in utilizing the area in a sustainable manner, thus giving an impact on the quality of the coastal environment.

Meanwhile, from the total population of Muaragembong it was dominated by pond farmers and fishermen 49.85%, as farmers 15.95%, as traders 10.57%, as industrial workers 3.02%, as civil servants, military / police and retirees 1.31%, as employees 10.70%, and as an entrepreneur 6.10%. From this condition it can be concluded that the economic activities of the people in the Muaragembong Region are very dependent on the fisheries sector both capture fisheries and aquaculture, where economic activities are influenced by the condition of the mangrove ecosystem. Aquaculture activities found in the Muaragembong coastal area are carried out by clearing land in the mangrove ecosystem, by cutting down mangrove trees to be used as ponds. This is very damaging to the existence of the mangrove ecosystem, so it has an impact on the destruction of mangrove ecosystems in the coastal area of Muaragembong.

Besides fisheries, agriculture and trade activities, other economic activities developed in the mangrove ecosystem in the Muaragembong coastal area are mangrove ecotourism activities. The mangrove ecotourism activities found in the Muaragembong area have already become widely known and sought after by tourists, because there are interesting animals in the mangrove ecosystem area that are "Lutung". Mangrove ecotourism activities that began to develop in the coastal region of Muaragembong, are supported by the community, where the community has a role as a tour guide. Problems in facing the Muaragembong coastal region in the development of mangrove ecotourism activities are not yet supported by the availability of adequate ecotourism facilities and infrastructure, including adequate boat preparation, the mangrove ecotourism path is not yet available properly, the unavailability of competent human resources in mangrove ecotourism development, because limited understanding of the community in developing mangrove ecotourism attractions.

### 3.2. *The conditions of mangrove ecosystems in Muaragembong region*

The mangrove ecosystem found in the Muaragembong coastal region has 23 species, and is dominated by Api-api (*Avicenna* spp.), Bakau (*Rhizophora* spp.), Pedada (*Sonneratia caseolaris*). While the associated forests consist of 13 dominant species ed by Bintan (*Cerbera odollam*), Kiser (*Fimbristylis verruginea*) and Ketapang (*Terminalia catapp*). The type of vegetation found in Muara Tawar Air consists of 11 types dominated by Kiser (*Fimbristylis verruginea*) and Nipah (*Nypha fruticans*). data, there are as many as 158 types of birds found in the Muaragembong. Of these number of types, 7 species are endemic and 6 types of protected groups under IUCN criteria. Blue Shrimp King *Alcedo coerulecens* and Layang - Langang Batu *Hirundo*, which is located in the northern part of the Citarum River and Bungin River, including the Egret Silver (*Egretta int ermedia*), Small Egret (*Egretta garzetta*), and Cangak Abu (*Ardea cinerea*). Seabirds, such as Cilakang Christmas (*Fregata Andrews*) and Dara-Sea (greater crested and small Dara-sea) which are migrant bird species, are found around the coast. While Black Rice (Black Cormorant Rice-bird) are found in a fishing platform in the middle of the sea. There are 15 species of mammals which are dominated by Long Tailed Macaques (*Macaca fascicularis*) and Surili (*Presbitis cristata*). There are six types of reptiles, among the other CITES Appendix, among the Tortoise and Lizard forest (*Varanus salvator*). Types of fish that are found in mangrove areas are fish (*Periophthalmus* sp). In addition, there are also a number of fauna such as butterflies, mosquitoes, gats, and mangrove crabs [12].

The condition of the mangrove ecosystem in the Muaragembong coastal region has been degraded, this can be seen from the tree density level. The tree density of mangrove ecosystems ranges from 59 - 1450 trees / ha [12]. The highest level of mangrove density is found in Pantai Harapan Jaya Village, which is 1450 trees / ha, while the lowest level of mangrove density is in Pantai Bakti Village, which is 59 trees / ha. Referring to the Decree of the Ministry of Environment Number 201 of 2004 on Standard Criteria and Guidelines for Determining Mangrove Damage, the status of mangrove ecosystems within

the falls within the criteria of bad status, with tree density ranging between 59-1450 trees / hectare [12]. This condition affects the coastal environment.

### 3.3. SWOT analysis

The SWOT analysis aims to formulate a sustainable management strategy for mangrove ecosystems based on internal factors and external factors that influence ecosystem management in the Muaragembong coastal region. Internal factors include the formulation of potential and problems, while external factors include opportunities and challenges in the management of mangrove ecosystems. Based on the findings obtained in the Muaragembong coastal region, the potential of mangrove ecosystems found in the Muaragembong coastal area for future management of mangrove ecosystems includes: (1) mangrove ecosystems have the potential to be developed for mangrove ecotourism activities; (2) mangrove ecosystems have been utilized for processed food, sports equipment, fuel wood, building materials which make a significant contribution to the income of the community, so as to improve the welfare of the community. On the other hand, the problems in the sustainable management of mangrove ecosystems in the coastal area of Muaragembong are: (1) the ability of human resources to process mangrove ecosystems in a sustainable manner; (2) limited understanding of the community about the importance of mangrove ecosystems in protecting the coastal environment from the influence of the sea; (3) The income level of the people in the coastal area of Muaragembong is still low, so that people tend to utilize the mangrove ecosystem without regard to the sustainability of the ecosystem for the future; (4) the quality of the mangrove ecosystem has been damaged; and (5) there are no rules that regulate the utilization of mangrove ecosystem in a sustainable manner, so that the community can utilize the mangrove ecosystem in accordance with their respective desires without regard to existing spatial rules.

External factors that influence the management of mangrove ecosystems sustainably can be detailed as follows: (1) opportunities for the development of mangrove ecotourism activities, because the demand for tourist attractions is starting to be high both by domestic and foreign tourists; (2) demand for high fisheries production, thus becoming an opportunity to increase community income; (3) the high interest of investors to develop the Muaragembong coastal area for industrial activities, because of its strategic location directly adjacent to DKI Jakarta (Tanjung Priok Port), and (4) High sediment intake to the Muaragembong coastal region originating from the Citarum River, which is a challenge in area management especially for the development of mangrove ecotourism activities.

## 4. Conclusion

Mangrove ecosystems have an important role in supporting the lives of coastal communities in Muaragembong. In fact, the mangrove ecosystem in the coastal area of Muaragembong is in poor condition, so the role of mangrove ecosystems in supporting the income of the Muaragembong coastal community cannot run as expected, which causes the community's income level to be still low. Based on this, policies that can be applied in managing mangrove ecosystems sustainably in the coastal areas of Muaragembong are as follows:

- Determining the mangrove ecosystem area as a protected area in the regional spatial plan. In the Bekasi Spatial Plan, the Muaragembong coastal area has been designated as a protected area. What is needed in this case is controlling the use of space from the spatial plan that has been set. This requires commitment from all stakeholders involved in spatial use.
- Intensifying the mangrove ecosystem rehabilitation program to restore the function of the mangrove ecosystem by involving the community. This can be done by increasing the participation of Muaragembong coastal communities in rehabilitating the mangrove ecosystem.
- Developing sustainable ecotourism development. This can be developed by increasing the provision of facilities and infrastructure that support mangrove ecotourism activities.

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