Governance of mangrove restoration and conservation to climate change resilience in Bintan Island

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Abstract. Policy of climate change mitigation and adaptation play an important role to socio-economic aspect. Controlling pollution and degradation of environment in coastal area adapted by capacity initiatives to protect marine environment from pollution and climate change. Climate change distributes micro-plastic to the ocean, including the activity of marine debris, fisheries and marine products industry, and shipping line (oil spill). Industry, agriculture in daily life contributes 80% of marine pollution, in addition, hundreds hectares of mangrove deforestation in Kepulauan Riau caused by development. According to Governmental Law No 19 year 1999 of pollution and damage control of the sea and implementation of The Bali Declaration as an adaptation of the 4th Intergovernmental Review Meeting (IGK4) to the Regional Capacity Canter for Clean Seas (RC3S) in Bali by mainstreaming protection of ocean and coastal ecosystem from the threat of chemical, waste, and micro plastic pollution. Mangrove as one of the best alternative of climate change mitigation divided into several zones, namely zone of core, zone utility and zone sustainability. The goals of this research are mapping the destruction factors and rehabilitation efforts, and also to know the interconnected key stakeholders on conserve mangrove and community based ecological mangrove restoration. Restoration and conservation of Mangrove in Kepulauan Riau, especially in Bintan and Batam, to the management of sustainable coastal through the method of Mangrove Restoration Opportunity Evaluation in collaboration between regional government, private sector, civil society, and expert. In recommendation, according to the program of Agency of Peat and Mangrove Restoration (BRGM) of Presidential Decree No 120/ 2020 by planting, survey, utility and other researches, mangrove sustainability needs consideration of the legality area and common analysis of Ministry and Provincial Government to avoid misunderstanding of taking action between conserve and build, and also taking further action of RZWP3K in Kepulauan Riau.

1. Introduction

Mangroves have important role in ecosystem, namely protecting the land and the coastal community from raising sea level and hurricane, protecting coral reef, carbon storage (Mangrove forest are having the ability to store carbon twice more effective than a tropical rainforest), vital food source (provide essential foods for locals), providing marine habitat for endangered species etc. In the other hand, mangroves are also keep the food and raw materials supply, provide the field of research and
education and commonly mangroves become ecotourism. We can say that the future of mangroves very much are depend on us, and our lives depend on those critical habitat protected by mangroves.

Protected area in Bintan Island are protected rainforest, mangrove forest, and coral reef. Previous research of environmental rehabilitation, restoration and protection in Bintan shows that those three protected areas have significant role to keep the sustainability of the environment [1]. Mangroves in Bintan are the most threatened ecosystem. Industry, shrimp agriculture in daily life contributes 80% of marine pollution, in addition, hundreds hectares of mangrove deforestation in Kepulauan Riau caused by development, especially in local settlement, mining and some of coastal tourism. However, according to Susiana, the mangrove vulnerability in area of Berakit is still in a good condition [2]. People in Bintan, especially in the coastal area, are intensely connected to the sea. Their lives depend on a healthy mangroves forest. Recent studies and recognition of mangroves importance has brought mangroves forward to the main issue of marine conservation.

Restoration strategies need urgent rethinking as many programs ended failure. One of the failure came up with the replanting the mangrove and not doing the monitoring process. Policy of climate change mitigation and adaptation play an important role to socio-economic aspect. Controlling pollution and degradation of environment in coastal area adapted by capacity initiatives to protect marine environment from pollution and climate change. Climate change distributes micro-plastic to the ocean, including the activity of marine debris, fisheries and marine products industry, and shipping line (oil spill). The community preparedness on preventing the pollution to damage the mangrove is still low, for example, in the case of annual oil sludge in Bintan that affect to the mangrove ecosystem directly [3]. Bintan Island is one small island in Kepulauan Riau Province with 1.318 km². The long-term-mangrove-rehabilitation method of mapping the destruction factors combined with the rehabilitation possible efforts never done in Bintan. The ecosystem of mangroves spread out through almost in whole coastal area, however Tanjung Uban and Pengudang area, which are the most crowded human activity, put the real danger to the sustainability of mangrove ecosystem [4]. The goals of this research are mapping the destruction factors and rehabilitation efforts, and also to know the interconnected key stakeholders on conserve mangrove and community based ecological mangrove restoration.

2. Methods
This study used descriptive-qualitative method. This was conducted from March to April 2021 by sampling random people living around the forested areas in Bintan Regency. The sample was 50 people in coastal area of Bintan Regency and some environment NGO. Materials used in this study include interview questions for informants to strengthen the answer to the research question. The location of this research was in Berakit, Pengudang, Busung, and Tanjung Uban. The additional information was collected from the experts, local communities, government agencies and other stakeholders. This paper examines the mangrove ecosystem governance through the agenda of tackling the effect of climate change and deforestation of mangrove forest in Bintan.

3. Results and discussion
The ecosystem of mangroves in Bintan is declined caused by, as mentioned in background, land conversion into fish ponds, agriculture area, and developments of urban infrastructure. Therefore, the effort of mangrove restoration and rehabilitation become important. Rehabilitation efforts done so far were commonly done by using the method of planting propagule and seeding mangrove directly, which are often turn into a failure. Even the failure repeated whenever the same method are implemented, government and the others still repeat the same method.
Table 1. Destruction factors and rehabilitation efforts.

| Destruction Factors: | Rehabilitation Actions |
|----------------------|------------------------|
| Geographical different factors | 1. Ecological Assessment: Understanding both autecology and community ecology of the mangrove species at the site |
| | 2. Hydrological Assessment: Understanding the normal hydrologic pattern that control the distribution and successful establishment and growth targeted mangrove species |
| | 3. Assessment of disturbance: Examine changes in mangrove environment that inhibit the occurrence of mangrove natural regeneration; Determine the step to remove the barriers |
| Perpetrator of environment destruction | 4. Appraisal or deciding location: Community organizing activity related to the problem solving of land ownership to ensure long term access and area conservation after the rehabilitation |
| | 5. creating rehabilitation design: Designing the rehabilitation program in chosen site selected in step 4; Including technical efforts to restore the growth of mangrove naturally |
| | 6. Implementation and monitoring: Planning, implementing and monitoring; Observing the growth, level accumulated waste, estimating the cost, effect of utilization of mangrove forest for sustainability restored mangrove. |

According to Table 1, different destruction factors drive different rehabilitation actions. The methods have been well-implemented by some NGO to rehabilitate damaged mangrove forest in Indonesia. The main problem Bintan mangroves deal with are the problem of surveillance, law, and socialization of the law. According to Mongabay, one of the factor of the mass destruction of mangrove forest in Bintan is because of illegal bauxite mining that destruct hectares of protected forest where are located in Beton island, Elong island, and Koyang island. The development also directly cross the area of protected mangrove forest with area of hectares. Kepualauan Riau Province ironically is the first province selected to rehabilitation by BRGM (Badan Restorasi Gambut dan Mangrove/Peat and Mangrove Restoration Agency). According to the NGO of Akar Bhumi, rehabilitation is not just replanting the mangrove trees, but also giving education and advocating to community and organizations whom concern with the issues. The interconnected key stakeholders on conserving mangrove can be seen in the Figure 1.

![Figure 1. The interconnected key stakeholders on conserve mangrove forest in Bintan.](image)

Mangrove forest basically have the capacity to regenerate itself with certain condition and circumstances, namely normal tidal hydrology, mangrove seeding from nearby forest, and ecological mangrove restoration method is needed. According to Governmental Law No 19 year 1999 of
pollution and damage control of the sea and implementation of The Bali Declaration as an adaptation of the 4th Intergovernmental Review Meeting (IGK.4) to the Regional Capacity Canter for Clean Seas (RC3S) in Bali by mainstreaming protection of ocean and coastal ecosystem from the threat of chemical, waste, and micro plastic pollution.

Mangroves is five times in carbon absorbing and rich of their important role in tackling climate change has resulted in increase the global awareness and international support in restoring and conserving these coastal assets. As stated by Kristanti, [5] the need of practical contribution to policymaker in the climate change program in Indonesia by making cooperation with the international organization. Mangrove as one of the best alternative of climate change mitigation divided into several zones, namely zone of core, zone utility and zone sustainability. The failure of mangroves restoration in Bintan somehow caused by planting the wrong species in the wrong location, and some of socio-economic issue.

One of the strategic plan of Bintan tourism potential, stated by Karim, need to be developed by empowering local community [6]. Restoration and conservation of Mangrove in Kepulauan Riau, especially in Bintan and Batam, to the management of sustainable coastal through the method of Mangrove Restoration Opportunity Evaluation in collaboration between regional government, private sector, civil society, and expert. Mangrove in Bintan commonly also used as tourism attraction where provide tour, resort and restaurant. Desa Pengudang village, Bintan Mangrove and TRC Mangrove Bintan are two of mangrove tourism where also conserve some species with economic value, such as kelulut honey from kelulut bee that make hive in mangrove tree. Those tourism sites are also recognized by Pacific Asia Travel Association in 2003 as potential ecotourism project.

As many programs of mangrove restoration ended failure, urgency of rethinking the strategies is needed. One of the most effective way to restore the damage on mangrove forest is by inviting and involving the local community to enabling them to gain their livelihood and give they better understanding for more sustainable future. Government as the regulator may involve them, based on ecological mangrove principles, in planning, implementing and monitoring the appropriate or inappropriate of restoration. As stated by Yudiatmaja, The government should prepare more social capital before taking action to environment [7].

Regulation without awareness of local community drives to another failure of implementation. The social aspects that need improvement are knowledge of the local community, access to community to utilize mangrove ecosystem, preventing mangrove community caused damage, community awareness and community participation [8]. Local community and the local organizations may also working with the nature and encouraging natural regeneration to gain more economical and efficient restoration with several approaches. The example of the need of community development is like training of strengthening the community institutional capacity in mangrove ecosystem management in Bintan Regency (Five Fingers Management System) conducted by Ministry of Forestry and International Tropical Timber Organization in Busung Village, sub district of Seri Kuala Lobam Bintan Regency [9].

However, as seen in Figure 2, the best effort to rehabilitation of mangrove forest is by collaboration between stakeholders and supported by local community, and government have been doing the right thing as regulator by making the plan of managing special spacial area in Bintan Regency with the consideration of lowering the possibility of damaging the mangrove ecosystem. As stated In article 5 (d) RTRW Bintan Regency Government Rule of “optimizing the utilization of the efficient and balanced aquaculture and protected area, according to the needs of development and supporting ability of the region”, stated to,” defend and conserve mangrove forest” and as one of the realization of protected area in the article 1 (a) in managing mangrove ecosystem by defining and conserving mangrove forest, making the zonation of the protected area in Article 66 [10].
Figure 2. Community based ecological mangrove restoration.

4. Conclusion
In conclusion, the mapping of mangrove forest destruction factors and rehabilitation actions must be parallel and optimized by maintaining the collaborative actions between interconnected stakeholders and the community based ecological mangrove restoration and rehabilitation. In recommendation, according to the program of Agency of Peat and Mangrove Restoration (BRGM) of Presidential Decree No.120/2020 by planting, survey, utility and other researches, mangrove sustainability needs consideration of the legality area and common analysis of Ministry and Provincial Government to avoid misunderstanding of taking action between conserve and build, and also taking further action of RZWP3K in Kepulauan Riau.

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