



The Impact of Mangrove Forest Land Conversion on the Sustainability of Biological Resources and the Environment of Tanjung Luar Village

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Abstract

Mangrove forests and coastal forests are green belts in coastal areas that have ecological and socio-economic functions. The main ecosystem in coastal areas is mangroves, which not only have economic value but also have great value for the environment. Tanjung Luar village, Keruak sub-district currently still really needs more attention and is still in the development stage, because most of the mangrove forests in the Tanjung Luar area have been converted into residential areas, shrimp ponds and salt ponds. This research aims to determine the impact of mangrove forest land conversion on the sustainability of biological resources and the environment of Tanjung Luar Village by reviewing environmental protection and management based on the environmental protection and management law. This research uses normative empirical research methods. The research results show that the impact of the conversion of mangrove forest land results in an imbalance in the marine ecosystem and has a direct impact on the community, especially people who earn a living as fishermen. Efforts that can be made to overcome this are by reforestation and reorganizing coastal spatial planning by involving the government, fisheries and marine services and the general public. Many cases of environmental pollution and damage are caused by human activities such as air pollution, water pollution, land pollution and forest damage which ultimately harm humans. Realizing the importance of living necessities and the high dependence on natural resources such as mangroves, a solution is needed to combine ecological, economic and socio-cultural aspects so that they are sustainable and thus support sustainable development programs. Several efforts that can be made to restore the condition of mangrove forests are by involving the community to get involved directly. Such as conducting socialization on the importance of the negative impacts of environmental pollution,

especially for the forest environment and the importance of mangroves for the sustainability of marine ecosystems and starting to replant mangrove forests which had previously been converted into residential areas by moving people who inhabit coastal areas with guaranteed compensation in the form of new settlements.

Keywords: Impact of Function Change, Mangrove Forest, Biological Resources

Introduction

In 2020, Indonesia has a mangrove ecosystem covering an area of 3,311,207.45 ha which is divided into forest areas and outside areas (Rahmanto, 2020). Mangrove forests in Indonesia are found in many regions, especially in Papua, Kalimantan and Sumatra (FAO, 2007). Around 3 million ha of mangrove forests grow along 95,000 km of Indonesia's coast. This amount represents 23% of the world's entire mangrove ecosystem (Giri et al., 2011). Mangrove forests grow between tidal lines, coral beaches, dead coral land topped with sand or mud, and muddy beaches (Saparinto, 2007 in Rahim and Banderan, 2007). Mangrove forests are characterized by muddy soil and the forest is always flooded with water (Fatma, 2016).

The tropical coastal mangrove forest vegetation community is dominated by several types of mangrove trees which are able to grow and develop in muddy coastal tidal areas (Rahmanto, 2002). Apart from that, the composition of the vegetation that makes up the mangrove ecosystem is relatively homogeneous because only certain vegetation can live in each existing zone. The zoning division of the mangrove ecosystem is divided into four, namely the open mangrove zone, central mangrove zone, brackish mangrove zone and mainland mangrove zone. The open mangrove zone is the zone facing the sea and is dominated by *Sonneratia alba*. The middle mangrove zone is located behind the open zone mangroves and is dominated by the *Bruguiera* sp. and *Rhizophora*. The brackish mangrove zone is located along rivers with brackish to almost fresh water and is dominated by the *Nypa* or *Sonneratia* community. Meanwhile, the mainland mangrove zone is in the brackish or almost fresh water zone behind the actual mangrove green belt and is dominated by the types *Ficus microcarpus*, *Intsia bijuga*, *Nypa fruticans*, *Lumnitzera racemosa*, *Pandanus* sp., and *Xylocarpus moluccensis*. This zone has higher species richness compared to other zones (Noor et al., 2006).

A healthy mangrove forest is a mangrove forest that can still provide benefits according to its function. Meanwhile, the main function of mangrove forests is to prevent erosion and abrasion (Anggraini, 2020). The dense mangrove vegetation is able to withstand abrasion that occurs on the beach by reducing the force of sea waves that erode the beach and can stabilize the mud substrate. The health of mangroves can be identified by looking at the fauna around them (Ambari, 2018). Fauna commonly found in mangrove forests are crustaceans such as crabs, crabs and shellfish.

The healthier the mangrove plants are, the greater the number of marine biota mentioned will be (Ambari, 2018). If mangrove forest fauna decreases or even disappears, it is certain that the mangroves will be damaged or unhealthy (Ambari, 2018).

Based on the Decree of the state minister for the Environment Number 201 of 2004 concerning Standard Criteria and Guidelines for Determining Mangrove Damage, indicators of mangrove forest damage can be observed based on standard tree density per hectare and percentage of cover. The density value of a species indicates the abundance of the species in an ecosystem and can illustrate that species with high densities have large adaptation patterns. Mangrove forests that experience light damage have a density of more than 1500 trees per hectare with a cover of $\geq 75\%$, mangrove forests that experience moderate damage have a density of between 1000 - 1500 trees per hectare with a cover of $\geq 50\% - <75\%$, while mangrove forests that experience Heavy damage has a density below 1000 trees per hectare with $<50\%$ cover. The level of mangrove forest damage is used as a reference in rehabilitation activities. By converting the level of mangrove damage into numbers, the value of the level of damage becomes more objective, consistent and clear. Apart from that, it can also facilitate rehabilitation planning activities that will be carried out. Thus, having thorough planning of rehabilitation activities will further increase the success of mangrove forest rehabilitation activities.

Mangrove forests are forests that we often see at river estuaries, tidal areas and sea shores. This mangrove plant is unique, because it is a combination of the characteristics of plants that live on land and sea. In general, mangroves play a very important role as dampeners for wind and sea waves, as well as protecting abrasion on beaches. Mangroves have a root system that protrudes from the surface of the soil [sand] or are commonly referred to as respiratory roots. This system is a way of adapting to oxygen-poor soil conditions. The importance of mangroves for coastal areas is their ability to maintain the sustainability of fish, shellfish, shrimp and other populations. Not only that, mangroves are a pleasant place for the breeding and rearing of several animal species, especially shrimp and fish. Physically and biologically, the mangrove ecosystem plays a role in maintaining other surrounding ecosystems, such as seagrass beds and coral reefs by producing nutrient substances which are able to fertilize sea waters.

Mangrove ecosystems also play a very important role in the carbon, nitrogen and sulfur cycles. Mangrove forests are natural resources that have several specific characteristics, including their unique ecological role and the potential for high economic value. Mangrove forests are natural resources whose use can be restored so they require appropriate handling, especially to prevent the destruction of these natural resources and to ensure their sustainability now and in the future. Mangrove forests and coastal forests are green belts in coastal areas that have ecological and socio-economic functions. Economically, mangrove forests are a source of non-timber

forest for local communities, in addition to the benefits of environmental services and physically play a role in protecting coastal land because they are able to break down the kinetic energy of sea waves.(Rinika et al., 2023).

The conversion of mangroves into ponds can threaten the regeneration of marine biota including fish and shrimp stocks in offshore waters. This will cause a reduction in the income of fishermen who depend on the abundance of fish, crabs and other fish caught from the sea. In general, mangroves have several links to human needs as food providers.(Ahaya et al., 2022).

Some of these descriptions show that the mangrove forest ecosystem is a collection of biological and non-biological components that are functionally related to each other and interact to form a system. If a change occurs in one of these two components, it will affect the entire existing system, both in its functional structural unity and in its balance. The sustainability of an ecosystem function greatly determines the sustainability of biological resources as components involved in the system. Thus, to ensure the sustainability of biological resources, it is necessary to pay attention to the ecological relationships that take place between the natural resource components that make up a system (Hara, 2009).

Mangrove forests in the world reach an area of around 16,530,000 ha, spread across Asia 7,441,000 ha, Africa 3,258,000 ha and America 5,831,000 ha, while in Indonesia it is reported to be 3,735,250 ha. Thus, Indonesia's mangrove forest area is more than 50% of Asia's mangrove forest area and almost 25% of the world's mangrove forest area (FAO, 1994 in Onrizal, 2010). As an archipelagic country consisting of more than 17,504 islands, Indonesia has a coastline of approximately 95,181 km, where some coastal areas are covered with mangrove forests with a width of several meters to several kilometers. Indonesia's mangrove forests are very diverse because the physiographic conditions of Indonesia's beaches vary greatly. Mangrove forests grow abundantly along muddy beaches with weak waves, especially in areas that have large river estuaries and deltas where the water flow contains a lot of mud and sand sediment, as found in Sumatra, Kalimantan and Irian Jaya, but in places where there are no river mouths. , mangrove forests usually grow quite thin. Mangrove forest ecosystems can be divided into three main types, namely coastal/delta forms, river estuary/lagoon forms and island forms, all three of which are found in Indonesia (Eddy et al., 2015).

With such great potential and its importance in the context of the nation's economy, sustainable planning and management of coastal and marine areas, especially mangrove management planning, is a necessity for coastal communities. The main ecosystem in coastal areas is mangroves, which not only have economic value but also have great value for the environment. Environmental services from ecosystems are preservation, comfort and beauty, other services are gas regulation for

the balance of Co₂ and O₂ in the atmosphere, climate regulation, genetic resources, regulating the tropic dynamics of species and populations. (Eddy et al., 2015) .

In relation to the mangrove ecosystem, it is home to biodiversity such as birds, snakes, mammals, crabs, sponges, tunicates and functions to absorb nutrients and sediment flowing from rivers and provides protection from waves and storms and functions as a nursery, spawning and maintenance place for many marine species such as shrimp and sea salt (Ahaya et al., 2022) .

East Lombok Regency has a coastline of 220 km and has mangrove forests with an area of 1,589.81 ha, the largest of which are in the Jeowaru, Keruak, Pringgabaya, Sambelia and Mangrove Area Management areas in Gili Sulat. Especially in Tanjung Luar Village, Keruak sub-district, currently it still really needs more attention and is still in the development stage, because most of the mangrove forests in the Tanjung Luar area have been converted into residential areas, shrimp ponds and salt ponds. (East & Regional, 2011) .

Article 33 paragraph 3 of the 1945 Constitution of the Republic of Indonesia states that "Earth, water and the natural resources contained therein are controlled by the state and used for the greatest prosperity of the people". Referring to this article, quite a few people think that everything in Indonesia can be used for the prosperity of the people and quite a few people do this without considering environmental balance. For example, changing the function of land for development and public interests without considering spatial planning, comfort, public safety and environmental sustainability (Kusumaningtyas & Chofyan, 2012) .

The implementation of development in relation to the environment and spatial planning, which so far has tended to be unplanned and unsustainable, has had an impact on decreasing the quality and function of the environment, including the natural resources therein . (Kresnasari et al., 2022)

The mangrove damage encountered so far has occurred due to several reasons. The results of the problem analysis show that the main cause of damage is the need for regional development, especially residential areas or development of economic infrastructure, such as ports and industrial areas. Apart from that, mangrove damage is also caused by human factors, including the flow of chemical waste and illegal logging activities for building materials or raw materials. Meanwhile, the natural causes of mangrove damage are rising sea levels, waves and tsunami events.

Much damage to natural resources is caused by human activities. The population, especially for the Keruak area, in 2019 according to census data was approximately 53,993 people (East Lombok Regency Central Statistics Agency). Along with the increase in population, land that was previously mangrove forests was converted into residential areas, this of course has a very bad impact on environmental pollution, where daily human activities produce waste, especially household waste,

especially irrigation and its discharge directly into the sea. Many cases of environmental pollution and damage are caused by human activities such as air pollution, water pollution, land pollution and forest damage which ultimately harm humans. As happened in the Mangrove forest which has changed its function to become a settlement and pond in the village of Tanjung Luar, Keruak District (Minarni, 2017).

The demand for economic development which prioritizes the development of physical infrastructure such as residential development, pond construction and so on causes the conversion of mangrove forest land that is inappropriate and exceeds the carrying capacity which leads to damage to the mangrove forest ecosystem and environmental degradation. Realizing the importance of living necessities and the high dependence on natural resources such as mangroves, a solution is needed to combine ecological, economic and socio-cultural aspects so that they are sustainable and thus support sustainable development programs. The ecological aspect of mangrove use must maintain the function of mangrove land as a coastal ecosystem. Socio-cultural and economic aspects must pay attention to sustainability in meeting the living needs of the community, especially for those who depend on coastal ecosystems such as mangroves for their livelihoods (Abdillah et al., 2016).

Methods

The existence of East Lombok Regency Regional Regulations regarding KKLD has not yet been fully realized for all regions because the East Lombok regional government is more focused on the tourism sector. It is clear that tourist areas such as Gili Sulat, which is famous for its mangrove forest tourism, are the main priority, whereas The Tanjung Luar area, which is one of the highest suppliers of fresh fish in Lombok, is very far from being feasible, starting from the dock embankments and mangrove forests which have been converted into residential areas and ponds. (Hafni, 2016) .

Conversion of forest land use is a problem that is increasingly occurring. Article 19 of Law Number 41 of 1999 concerning Forestry states that land conversion is a change in the designation of a forest area. Changes in the designation of forest areas occur through the process of exchanging forest areas and releasing forest areas (Blu et al., nd) . Environmental protection and management based on Article 1 paragraph (2) of Law Number 32 of 2009 concerning Environmental Protection and Management (UUPPLH) is a systematic and integrated effort carried out to preserve environmental functions and prevent environmental damage and/or pollution. life which includes planning, utilization, control, maintenance, supervision and law enforcement (Wattimena et al., 2021) .

Based on the results of interviews and analysis of respondents' perceptions, local residents' perceptions of mangroves are based on general knowledge about the

benefits of mangroves in general which are obtained through word of mouth among residents of Tanjung Luar village. Such as functioning to prevent abrasion and level the ground surface or lift the soil. They don't know the benefits of mangroves for fish which are used as a nursery for small fish. The general opinion of the community cannot be a measure of community awareness to carry out rehabilitation of mangrove forests which have now been converted into ponds and residential areas. The scale of salt ponds and shrimp ponds is dominant and increasingly high which swallows up most of the mangrove forest, they cannot plant mangroves in the middle of pond plots or around pond walls and embankments, this will complicate the process of harvesting salt and pond shrimp. (Praxis et al., 2023)

Discussion and Result

Mangrove forests are coastal forest ecosystems consisting of groups of trees that can live in environments with high salt levels. One of the characteristics of mangrove plants is that they have roots that stick out to the surface. Mangrove forests are a group of woody plant species that grow along protected tropical and subtropical coastlines and have a kind of coastal landform with an anaerobic soil type. (Wijaya & Yulianda, 2019)

Several years ago, when human pressure on mangrove forests was still relatively low, the use of mangrove forests intended to improve the economic level of the community was not a problem, but in the following years, especially in the Tanjung Luar area, human pressure on mangrove forests has increased quite drastically, both in terms of quality. and quantity, so the impact is very worrying on the fate of mangrove forests in the Tanjung Luar area. Regarding the condition of mangrove forests in the Tanjung Luar area, it is very worrying, where the existence of mangrove forests in this area has experienced a drastic reduction in area caused by the conversion of mangrove forest land into residential areas, ponds and others. (Priyanta, 2015) .

In the past, the Tanjung Luar area could only build semi-permanent stilt houses due to lack of land, so around 2001 mangrove cultivation began to be carried out by the East Lombok government in this area, this of course has positive and negative impacts on the environment and society, the positive impact is on the community Those who previously only had semi-permanent houses on stilts can now build permanent houses with brick walls and the negative impact is a decrease in the mangrove forest area which results in damage to the environment and ecosystem. (East & Regional, 2011) .

Basically, forest areas can be utilized by taking into account their nature, characteristics and vulnerabilities, and it is not justified to change a forest area that has a protective function and an in-depth and comprehensive study must be carried

out. The use of forest areas must be adjusted to their main functions, namely conservation, protection and production functions. The suitability of these three functions is very dynamic and the most important thing is that their use must be synergistic (Akbar et al., 2017)

The Functions of Mangrove Forests Mangrove forests have a big function for human life, some of the functions of mangrove forests are as follows: Can withstand sea water currents which can erode coastal land. Absorbs carbon dioxide gas and produces oxygen as well as a place for marine biota such as small fish to find shelter and find food.

Apart from that, Mangrove Forests also have physical functions, including: Maintaining the coastline to remain stable, protecting beaches and rivers in areas of erosion and abrasion, withstanding strong winds from the sea, preventing the process of accumulating mud, maintaining buffer areas and filtering sea water into fresh water on land. Processing toxic waste, producing oxygen and absorbing carbon dioxide.

The conversion of mangrove forest land in the Tanjung Luar area for development and industrial purposes is currently causing many problems. One of the problems that creates the most dilemma in this situation is the community's economic problem. Like coastal fishermen who previously earned their living by exploiting coastal ecosystems, they are threatened with a decline in income due to the conversion of mangrove forest land into residential and industrial areas resulting in the narrowing of marine ecosystem sustainability. Data shows that the highest number of Tanjung residents who work as fishermen reached 2432 people (Tanjung Luar Village Profile 2020)(Rahmi, 2020).

To achieve development and industry there tends to be a tug of war between the interests of preserving natural resources. Environmental damage caused by industrial activities and exploitation of biological resources. As a result of the conversion of mangrove forest land, mangrove forests in Tanjung Luar are experiencing an imbalance, loss and reduction in the ecosystem within them, so that it has the potential to threaten the lives of coastal communities, the income of surrounding communities will decrease, and biodiversity is an important value for tourism and education. and medicines are feared to be extinct (Hara, 2009) . Some of the impacts of the conversion of mangrove forest land which are directly felt by the community in Tanjung Luar Village, Keruak District:

- a. The condition of the community's well water, the condition of the community's well water has a salinity level that is not very high under normal conditions, when it rains, the water smells fishy and has a color, and often when it rains it's not just the fish floating in the waters but the well water content. residents become salty and contain little oil so residents cannot use it for their daily needs, so people have to buy clean water for cooking purposes.

- b. The number of fish catches and biodiversity has decreased, the current condition of fisheries is greatly reduced due to the reduction in mangrove forests, as previously explained, one of the functions of mangrove forests is as biodiversity. The existence of mangroves as litter producers and their unique, always flooded roots provide shelter, forage and nursery areas for small fish, which are no longer comfortable. Then these fish species will move and try to find another, better location. Apart from the loss of fish species, several other species such as birds which are part of the mangrove forest ecosystem are also decreasing.
- c. Beach erosion, beaches in the Tanjung Luar area often experience abrasion so that the sea area rises towards residential areas, even when high tides often result in residents having to evacuate temporarily to avoid high tides reaching their homes. One of the causes of beach abrasion is human activities such as beach reclamation, sand mining, uncontrolled beach infrastructure development, and excessive fishing which can cause changes in water flow and disrupt the balance of coastal ecosystems. This can speed up the process of coastal erosion. The impacts of coastal abrasion include: (Ruli Sunandar, 2023)
 - a) Loss of Marine Habitat: Coastal erosion causes the loss of marine habitat which is important for the lives of various species, such as coral reefs, sea grass and mangroves. This loss of habitat can threaten the sustainability of coastal ecosystems.
 - b) Coastal Ecosystem Damage: Beach erosion can cause damage to coastal ecosystems, including the loss of coastal plants such as coconut trees and mangroves. This plant plays an important role in maintaining coastal stability, reducing the impact of waves, and protecting land from erosion.
 - c) Threats to Beach Infrastructure: Beach infrastructure such as roads, settlements, hotels and other tourist facilities can be threatened by coastal erosion. The loss of the shoreline which functions as a protector can increase the risk of flooding, landslides and structural damage.
 - d) Danger to human life: Coastal erosion also poses a danger to human life living on the coast. Soil loss due to abrasion can result in forced displacement, harm fishermen's livelihoods, and increase the risk of natural disasters such as floods and tsunamis.

For fishermen looking for fish, there are two points of view regarding mangroves, namely according to large fishermen and small fishermen. For large fishermen, the presence or absence of mangroves does not really matter to them, because the amount of catch is influenced by the number of boats fishing. However, on the other hand, for small fishermen who fish by the sea, they really feel the benefits of mangrove forests because their catch will be more, such as mangrove crabs, brackish water fish, shellfish and so on (Lugina et al., 2017).

For the non-fish farming community, they are more neutral towards the existence of mangrove forests because, apart from not interacting directly with mangroves, there is not much known about the benefits of mangroves, because in the Tanjung Luar area it is very difficult to find highly educated people. Based on respondents' perceptions of mangrove forests, they are still passive and neutral. This can be supported by several strategies, namely:

a. Persuasive Strategy

Persuasive strategies are carried out in the form of coaching. The coaching activity is an effort to increase understanding and awareness of community groups regarding the importance of mangrove forests and their conservation, environmentally friendly pond management and the importance of community organizations engaged in preserving the surrounding environment.

b. Educational Strategy

Educational strategies are carried out through training. The training activity aims to improve community skills in terms of mangrove forest rehabilitation which includes nursery, planting and fruit selection.

c. Facilitative Strategy

This strategy is carried out by providing business assistance, which is one of the efforts to increase community participation in mangrove forest rehabilitation. The business assistance provided can be in the form of direct or indirect assistance, apart from that this assistance is aimed at improving the social and economic conditions of the community.

In managing mangrove forests Community participation is very much needed because very important part success and sustainability of management The mangrove forest is the community itself. Community participation is participation community in the identification process problems and potential that exist in society, selection and decision making about alternative solutions to deal with problems, implementation of efforts to overcome problems, and community involvement in the process evaluate the changes that occur.

Overall, the three community participation development strategies implemented contribute to community participation in mangrove forest management. This strategy can be realized by involving the government from the forestry, maritime and fisheries departments, local regional government and the community directly. Efforts that can be made are by planting seeds, not just relying on seeds from nature (Ritonga et al., 2022). Apart from that, the quality of the seeds planted must also be taken into account to support quality reforestation. Furthermore, other efforts that can be made are by reorganizing coastal spatial planning, residential areas and also vegetation. Development strategies can grow and increase public understanding and awareness of the importance of preserving mangrove forests. Training strategies can improve the community's ability to carry out mangrove forest management. The

business assistance strategy is the most important thing because everything requires full support from the government and the community itself, whether it is assistance in the form of capital or services (Hasantua et al., 2017). There are several types of community participation that can be carried out to preserve the Mangrove Forest in Tanjung Luar Village, Keruak District.

1. **Planting Participation:** Mangrove planting activities are most often carried out in order to preserve or maintain the existence of mangroves in coastal areas. Mangrove forest planting activities carried out by the government are very important for the community because by planting mangroves, they can withstand high tides, mangroves can also be used as ecotourism and can be used as fish ponds.
2. **Participation in Mangrove Forest Utilization:** The level of community participation is seen from the number of benefits and results received by the community from the mangrove forest. The benefits and results of mangroves can be direct or indirect.
3. **Preservation Participation:** Preservation is an effort or activity to care for, protect and develop conservation objects that have value to be preserved.
4. **Participation in Extension and Training Activities:** Extension and training activities carried out by government agencies aim to build community participation in conserving mangrove forests.

Conclusion

The impact of the conversion of mangrove forest land in Tanjung Luar Village, Keruak District into residential areas and ponds. This is very detrimental for residents in the area. The impact that is directly felt is the condition of the well water which changes color and smells during the rainy season, forcing them to buy clean water supplies to meet their daily needs. Apart from that, the number of fish catches and biodiversity is decreasing, the condition of fisheries is currently very reduced, this is threatening the economy of the people who work as fishermen, especially small fishermen who catch brackish water fish, shellfish and crabs and the final impact is coastal erosion, where the condition of the Tanjung Luar beach is very worrying where most of the pier embankments has experienced damage caused by coastal erosion.

Several efforts that can be made to restore the condition of mangrove forests are by involving the community to get involved directly and this can be done with several strategies, namely: Development strategies can foster and increase community understanding and awareness of the importance of preserving mangrove forests. Training strategies can improve the community's ability to carry out mangrove forest management. The business assistance strategy is the most important thing because

everything requires full support from the government and the community itself, whether it is assistance in the form of capital or services.

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