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Analysis of the Mangrove Forest Area's Ecological Function Collapse Caused by Coal Power Plant in Teluk Sepang, Bengkulu

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Abstract: Mangrove forest ecosystems have 3 functions, namely, physical function as a barrier to coastal abrasion, ecological function as a breeding ground for various species of animals and aquatic biota, as well as economic and social functions as a support for the livelihoods of people living in the region, This research aims to describe the collapse of the ecological function of mangrove forest ecosystems because the forest area is used as a place for the construction of coal-fired power plants located in Teluk Sepang Village, Kampung Melayu Subdistrict, Bengkulu City, ecological functions that collapse include the ecological function of mangrove forests as a breeding ground for various living things, the ecological function of mangrove forests as abrasion barriers and tsunami waves and the relationship between the decline in the ecological function of mangrove forests to community welfare. This research was conducted using the observation method with descriptive qualitative analysis with the aim of knowing how the impact of the collapse of the mangrove forest ecosystem because it was converted into a PLTU Teluk Sepang building.

Keywords: coal power plant, ecological function, mangrove forest, Teluk Sepang

1. Introduction

Mangrove forests are defined as a type of forest that grows in tidal areas (especially on sheltered beaches, lagoons, and river estuaries). The most important function of mangroves in coastal areas is to connect the sea to the land. Mangroves can also act as a damper for natural phenomena caused by abrasion, waves, and storms and as a buffer for other biota. Living plant communities are able to tolerate salt, including organisms that live in it (Aksomkoae, 1993).

Mangrove forest ecosystems are complex and dynamic, yet unstable. It is said to be complex because the ecosystem, in addition to being filled with mangrove vegetation, is also a habitat for various animals and aquatic biota. The type of soil underneath is a saline young soil that has a high clay content with a high base saturation value and cation exchange capacity (Kusuma, 1996). The content of organic matter, total nitrogen, and ammonium is categorized as moderate in the part near the sea and high in the direction of the mainland.

As the capital city of Bengkulu Province, the coastal areas of Bengkulu City are under increasing pressure due to various development interests, including infrastructure development. Exploitation of the coastal area occurs rapidly, resulting in an imbalance in the carrying capacity of the area, which can certainly have an impact on ecological damage. It can be seen with the naked eye that along

the coastal areas of Bengkulu City, the phenomena of abrasion, sedimentation, loss of coastal vegetation, and changes in the coastline have (Zamdial et al., 2018). Research activities on the identification of coastal area damage in Bengkulu City, as well as in various other coastal areas, are very important in an effort to anticipate, face, and overcome various forms of coastal area damage that have occurred and are likely to occur.

The Teluk Sepang coal-fired power plant is a steam power plant located in the Teluk Sepang village, Kampung Melayu sub-district, Bengkulu City, which uses local coal as a material, directed by PT Tenaga Listrik Bengkulu (TLB), which in its construction cleared ± 10 ha of mangrove forest, which has an ecological function as a breeding ground for various species of animals and marine biota, which will result in the fate of fishermen, especially crab seekers in the Teluk Sepang area. (Kanopi, 2019)

Fishermen and crabbers, as well as the construction of the Teluk Sepang coal-fired power plant, are actors in the utilization of coastal and marine resources in Teluk Sepang (L. A. Pratama, 2021). The Teluk Sepang coal power plant, as a large-scale industry that dominates the utilization area, is feared to add to social, economic, and physical problems. With the inequality of the work space sector in coastal areas and the collapse of the ecological function of the mangrove forest ecosystem, the construction project of the Teluk Sepang coal-fired power plant company further increases social inequality and places fishermen and crab seekers in low social status, resulting in fishermen and crab seekers being in unfavorable conditions (A. Pratama et al., 2021).

Based on this background, this research will analyze the collapse of the ecological function of the mangrove forest ecosystem due to the Teluk Sepang coal power plant with the aim of knowing how the collapse of the ecological function of the mangrove forest because it was used as a place for the construction of a coal power plant and the impact of the collapse of the ecological function of the mangrove forest on the welfare of fishermen, especially crab seekers in the Teluk Sepang area, Baii Island, Bengkulu City.

2. Method

The method used in this research is observation with descriptive qualitative analysis, which describes a situation to find different levels of influence based on natural words and the object under study (Sugiyono, 2014). In this descriptive qualitative analysis, research will be carried out on the impact of the collapse of the ecological function of the mangrove forest ecosystem because the area is used as a place for the construction of the Teluk Sepang coal power plant.

The data collection techniques used in this research are observation, field studies, interviews, and documentation studies to find out the impact of the collapse of the ecological function of mangrove forests due to the construction of the Teluk Sepang coal-fired power plant.

3. Result and Discussion

The coastal resources of Bengkulu City consist of coastal forest ecosystems (including mangrove forest ecosystems), marine ecosystems, fisheries resources, potential tourism services, and small islands (Pulau Tikus). Mangrove forest ecosystems are not very numerous and are located scattered, not in a large expanse. Mangrove forest ecosystems are found in the TWA (Nature Tourism Park) areas of Pantai Panjang, Dusun Kandang, Pulau Baai, Padang Serai, and the Jenggalu River. Jenggalu River. For now, the existence of mangrove forest ecosystems in Bengkulu City still has a great function and role, both for the community and as a buffer zone.

The condition of this mangrove forest ecosystem itself has experienced degradation because it has been utilized for various interests, such as aquaculture, settlements, and the expansion of the Bengkulu City area. According to the Director General of P3K DKP (2004), mangrove ecosystems are potentially under pressure from human activities and development; moreover, the coastal area is an area with a high level of economic activity. Kustanti (2011) argues that the conversion of mangrove forests, especially for tiger shrimp ponds and fish farms, has led to the degradation of fertile mangrove forests on a fairly wide scale. Scale that is quite extensive.

The collapse of the ecological function of the mangrove forest ecosystem began with the use of land that was used as a place for the construction of the Teluk Sepang coal power plant, which was once a mangrove forest as a source of support for the livelihoods of the people there, which has now been lost and replaced (Lizalidiawati et al., 2021). Many impacts of the collapse of the ecological function of mangrove forests due to the conversion of land functions that have the function of a breeding ground for various living things and as a barrier from seawater waves are now becoming PLTU land, because in the process there will be many things that can harm humans themselves, especially for the people of Teluk Sepang residents who are directly in the PLTU environment including:

Loss of ecological function of mangroves as a breeding ground for various living things

Mangroves have an ecological function as a habitat for various types of wildlife. The diversity of fauna in mangrove forests is quite high, which can be broadly divided into two groups, namely aquatic fauna such as fish, shrimp, crabs, shellfish, and others and terrestrial groups such as insects, reptiles, amphibia, mammals, and birds (Nirarita et al., 1996). Because the mangrove forest is a breeding ground for various types of aquatic fauna ("fish, shrimp, crabs, and shellfish"), the Teluk Sepang community has lost this fauna because the mangrove forest has been cut down to make way for the construction of a PLTU.

The results of research by Martosubroto and Naamin (1979) in Dit. Bina Pesisir (2004) showed a significant relationship between mangrove area and aquaculture production. With the increasing area of mangrove area, fisheries production also increased with the equation,

$$Y = 0{,}06 + 0{,}15\ X$$

Ket: Y = produksi tangkapan (ton/th)
X = luasan mangrove (Ha)

The results of another study related to economics show that the creation of 1 ha of fish ponds in natural mangrove forests will produce 287 kg of fish and shrimp per year, but the loss of every 1 ha of mangrove forest will result in a loss of 480 kg of fish and shrimp offshore per year (Turner, 1977 in Siti Julaikha 2017).

Mangrove ecosystems on the coast of Bengkulu City span around 214 hectares in the Baai Island area, located right near the entrance to the Fish Auction Place (TPI) (Gunggung Senoaji, 2016). Of the 214 hectares of mangrove forest land, 116.24 hectares are included in the Panjang Beach-Baai Island Nature Park (TWA), while the remaining 98.38 hectares are outside the forest area.

In reality, in the field, the mangrove forest lost due to the construction of the PLTU in Teluk Sepang Village is around 10 ha, as per the results of an interview with Mr. Rustam, the field coordinator of the Blue Sky Coalition, who said that

> "almost all mangroves in the Teluk Sepang Village area have been used up because they are used for PLTU construction land, and only a few are left along the edge of the road that is crossed when going into the area, while for the calculation of mangroves in Teluk Sepang Village as a whole before the clearing, it is not known with certainty how much the overall area is.".

The construction of the PLTU cleared the most mangroves compared to other industries that were also in the Teluk Sepang area, one of which was PT Semen Padang, so that it had a huge impact on the economy of the Teluk Sepang community, which on average worked as fishermen and crab seekers in the mangrove forest.

Figure 1. View of PLTU from above

PLTU Teluk Sepang is a new development in the PLTU field that was established in 2016 in Bengkulu. specifically in Teluk Sepang District, Kampung Melayu District, Baai Island, and Bengkulu City. And started operating in 2020. It is owned by PT Pelindo II and stands on an area of 50 hectares, with a US$360 million loan from EBC (Exim Bank of China) and a US$270 million loan from ICBC (Industrial and

Commercial Bank of China). Sinohydro, a Chinese business, is responsible for its construction. PLTU Teluk Sepang uses or uses about 2,732.4 tons of coal fuel per day. Of course, the hot water waste produced is thousands of cubic meters and is directly flowed by the company right into the waves so that all marine ecosystems are disturbed. Environmental pollution also occurs as a result of the entry of energy or component substances into the environment and can be said to change the environmental order by human activities or natural processes, so that the quality of the environment decreases to a certain level, which of course makes the environmental function less and cannot function properly in accordance with its designation.

Figure 2. Coastal mangrove forest as coal stockpile

Loss of ecological function of mangrove forests as an abrasion barrier and tsunami waves

The earthquake and tsunami waves that hit Nanggroe Aceh Darussalam (NAD) and Nias Island in late 2004 have reminded us how important mangroves and coastal forests are for coastal protection. Based on the characteristics of the area, the coast around the city of Padang is still the same channel that is prone to tsunami earthquakes.

It was reported that areas with relatively good mangroves and coastal forests tended to be less affected by the waves. Research results show that mangroves 200 m wide with a density of 30 trees/100 m2 with a stem diameter of 15 cm can reduce about 50% of tsunami wave energy (Harada and Fumihiko, 2003 in Diposaptono, 2005).

Sea waves as high as 1.09 m in Grajagan Bay, Banyuwangi, with a wave energy of 1,493.33 joules were reduced by mangrove forests to 0.73 m (Pratikno et al., 2002). The results of research by Istiyanto et al. (2003), a laboratory model test, concluded that mangrove groves (*Rhizophora* spp.) reflect, transmit, and absorb tsunami wave energy, which is manifested in changes in tsunami wave height through the groves. These results indicate that the presence of mangroves along the coast can minimize the effects of tsunami waves that hit the coast.

In fact, Teluk Sepang Village, Kampung Melayu Sub-district, and Bengkulu City are in a red zone prone to tsunami disasters. This is stated in Regional Regulation No. 14/2012 on the Bengkulu City Spatial Plan (RTRW) 2012-2023 in Article 44, Paragraph (2), which states that tsunami disaster-prone areas, as referred to in paragraph (1), include areas along the coast in Muara Bangkahulu District, Teluk Segara District, Ratu Samban District, Ratu Agung District, Gading Cempaka District, Sungai Serut District, and Kampung Melayu District.

Figure 3. The condition of Teluk Sepang mangrove forest

Tsunamis hit Bengkulu in 1797 and 1833 and were later rocked by an earthquake with a magnitude of 8.9 on the Richter scale (SR) and tsunami waves up to more than 30 kilometers. On June 4, 2000, Bengkulu was again rocked by an earthquake with a magnitude of 7.3 SR, and on September 12, 2007 with a magnitude of 7.9 SR. So that the government regulates the area according to disaster vulnerability as stipulated in the Bengkulu City RTRW Regional Regulation (article 11) related to strategies to realize disaster area management as referred to in (article 6 letter e), it consists of 1) Maintaining the extent of protected areas as an effort for disaster adaptation and mitigation; 2) Limiting the development of built-up cultivation areas in areas prone to natural disasters.

However, a 10-hectare stretch of mangrove that functions as a coastal green belt as well as a tsunami disaster mitigation effort has actually been lost and converted into a place to build a coal-fired power plant; in other words, the construction of the Teluk Sepang coal-fired power plant stands on a tsunami-prone red zone area. In addition, mangroves are also able to bind dissolved soil sediments from rivers so as to minimize coastal erosion or abrasion.

The relationship between the collapse of the ecological function of mangrove forests as a breeding ground for living things to the economy of the Teluk Sepang community.

The decline in the ecological function of mangrove forests in Teluk Sepang Village due to the construction of PLTU has caused fishermen to experience economic imbalances, especially land fishermen whose livelihoods are crab seekers in the mangrove forest area of Teluk Sepang Village, because land fishermen rely heavily on income for family needs from crab fishing in the area.

The results of our interview with a resident of Teluk Sepang Village, namely Pak Aung "who used to work as a land fisherman looking for crabs now turns into a satay trader, in the past looking for crabs was very easy because the population was still large and the mangrove forest area was still wide, in one night alone you could get 3 - 4 Kg of crabs with various types of commodities, namely grade A, B and C in one night of searching and at a price of ± Rp 50 - Rp 150 per kilo according to the type of grade each , and many residents in Teluk Sepang Village participated in looking for crabs because the income generated was considered quite decent, but after the construction of the PLTU which cleared 10 hectares of mangrove forest area, looking for crabs was also difficult sometimes to get one kilo of crabs could be 3 - 4 nights of searching, causing many residents of Teluk Sepang Village to feel worse off with an increasingly unequal economic situation.

From the results of these observations, in general, the coastal areas of Bengkulu City, especially the Teluk Sepang area, have experienced degradation. There are four types of damage to the coastal areas of Bengkulu City: coastal forest damage, beach damage, river estuary damage, and mangrove forest damage. The damage is related to land conversion into settlements, stalls, ponds, and tourist attractions. Other problems are abrasion, pollution (garbage and coal), coastal forest degradation, and a reduced green belt. This has a further impact, especially on the situation and condition of the people who still depend on the area for their livelihood.

4. Conclusion

Approximately 10ha of mangrove forest in Teluk Sepang Village was converted into a coal-fired power plant, reducing the ecological function of the mangrove forest as a breeding ground for various living things, an abrasion barrier by sea water as a spawning ground and supporting the economy of the Teluk Sepang Village community. The construction of the PLTU made the crab population smaller and the people who became inland fishermen experienced economic inequality. The construction of PLTU in the tsunami red zone area will make Bengkulu prone to disasters. The government should reconsider building a PLTU in the Bengkulu region because there will be very many impacts besides the construction of the PLTU can be included in the APBD, because the impact of the damage caused both on land, air and water cannot be avoided so that later it will add to the problems of the government and the region, and the ideals of creating wonderful Bengkulu will be constrained.

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