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COMMUNITY EMPOWERMENT IN PLANTING VEGETATION TO REDUCE COASTAL ABRASION IN WEST SUMATRA

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ABSTRACT: The length of the West Sumatra Province coastline is 420 km. The coastal area has many settlements and as a source of natural attraction for tourism industry. However, due to the increase of hydro-meteorological disaster such as abrasion, there has been considerable damage to approximately 180 km of coastal length in recent years. This paper aims to identify the relationship between the types of vegetation that grow along the coast with the abrasion rate and to identify the role of the community for conservation of vegetation. The aim is achieved through literature review, observation, and interviews with government official and communities who live on the beach. Data processing is done by analyzing the relationship between abrasion rate and vegetation type, and by conducting content analysis on interview data. It was found that certain types of plants have the ability to cope with and reduce abrasion rates. Plant breeding and planting is recommended to be a part of non-structural mitigation efforts. Community empowerment in planting and maintaining vegetation provides excellent results for sustainability.

Keywords: Community empowerment, Disaster, Abrasion, Coast, Vegetation

1. INTRODUCTION

Indonesia is one of the largest archipelagic countries in the world and has a long coastline. The Geospatial Information Agency of Indonesia (BIG) [1] states that the total length of the Indonesian coastline is 99,093 kilometers. The coastal area of Indonesia has a huge natural resource, both its term of resources and its beauty that can attracts tourists. However, the condition of coastal areas in Indonesia is very worrying due to the occurrence of abrasion [2]. Diposaptono [2] states that around 100 locations in 17 Provinces with a coastline of approximately 400 km have experienced a severe coastal erosion. Hakam et al [3] adds that some areas that are at high risk for abrasion are South Aceh and Banda Aceh City in Aceh Province, Medan City, North Jakarta Municipality, Rembang Regency in Central Java, Bali, Sikka Regency in East Nusa Tenggara, Selayar Regency in South Sulawesi, and including some areas in West Sumatra Province.

A study conducted by BWSS V [4] has identified 14 critical beaches in West Sumatra Province, namely Air Bangis Beach, Sasak Beach (Pasaman Barat Regency); Tiku Beach (Agam Regency); Pasir Baru Beach, Pariaman Beach, Ketaping Beach (Padang Pariaman Regency); Pasir Jambak Beach, Padang Beach, Bungus Beach (Padang City); and Carocok Painan Beach, Luhung Beach, Surantih Beach, Kambang Beach, Air Haji Beach (Pesisir Selatan Regency). Furthermore BWSS V [4] noted that from 420 km of total coastline of West Sumatera, 45% (approximately 180 km) of which are severely damaged by abrasion. The abrasion has negative impacts, such as the damage to houses on the beach, the destruction of roads, and the destruction of several beaches used as tourist attractions. As a result, the community's economy becomes disrupted. Therefore, it is necessary to mitigate abrasion disaster in West Sumatera Province.

Abrasion mitigation efforts can be carried out in several ways. One of them is by constructing coastal protection buildings, such as groin, jetty, and seawall. However, this method is very expensive, thus due to budget limitations not all beaches can get this kind of protection. A cheaper way is to plant / conserve plants that can reduce abrasion rates, such as mangrove trees, waru trees, coastal pines, and ketapang trees. This type of conservation has begun to be encouraged in West Sumatra, especially since 2010. Planting can be carried out by the government themselves or in cooperation with local community.

Based on above, the objective of the paper is to identify the correlation between vegetation that grows along the coast and the abrasion rate, and to explore the role of community in beach conservation.

2. LITERATURE STUDY

West Sumatra Province is very vulnerable to hydro-meteorological disaster. The type of this disaster includes flood and abrasion.

The coast is the border between land and sea which is affected by the highest tide and the lowest tide. Yuwono [5] explains that the coast is influenced by two factors: the influence of land and the influence

of the oceans. Coastlines may change due to: the dynamic of wave characteristic, abrasion, sedimentation, and beach construction [3].

According to BNPB [6], abrasion is a process of coastal erosion by destructive sea power and ocean currents. Abrasion is often referred to coastal erosion. Coastal damage due to abrasion is triggered by the disruption of the natural balance of the coastal region caused by both by nature or human intervention. As pointed out by Opa [7], the main factors of coastline change can be divided into two, (1) hydro-oceanography factors in the form of waves, currents, and tides, and (2) anthropogenic factors, such as human activities around the coast. The increasing of coastal area development, such as for residential, tourism, fishery, and other industry has brought negative impact on the quality of coastal environment. Human intervention in the modification of coastal areas for above purposes are often not inline with the understanding of coastal dynamics behavior, resulting in impacts that tend to damage the coastal environment (Hakam et al, 2013).

According to Yuwono [5] disaster mitigation efforts against the threat of abrasion can be done with the concept presented in Fig. 1. As can be seen in the picture, the protection and security of the beach can be done with artificial protection or by doing conservation. Artificial protection is done by constructing groin, jetty, breakwater, revetment, sand nourishment, and dewatering system.

While conservation can be done with the conservation of sand dunes, conservation of mangrove forests, and sustainable coastal programs. The planting of coastal areas with vegetation is included in the conservation group. The type of vegetation grown should be adjusted to local conditions, such as soil conditions, tidal, and existing vegetation variations. Suitable vegetation on sandy beaches are: Pine (Casuarina Equisetifolia L), Ketapang (Terminalia Cattapa), Butun (Baringtonia Asiatica Kurz), and Waru Laut (Hibiscus Tiliaceus L).

In addition to tackling abrasion, planting vegetation on the seashore can also inhibit tsunami wave speeds of less than 5 meters, as illustrated in Fig. 2 below.

3. RESEARCH METHODOLOGY

The research methodology adopted in this research was case study approach on the west coast of Sumatra island that belongs to the administrative area of West Sumatera Province (Fig. 3).

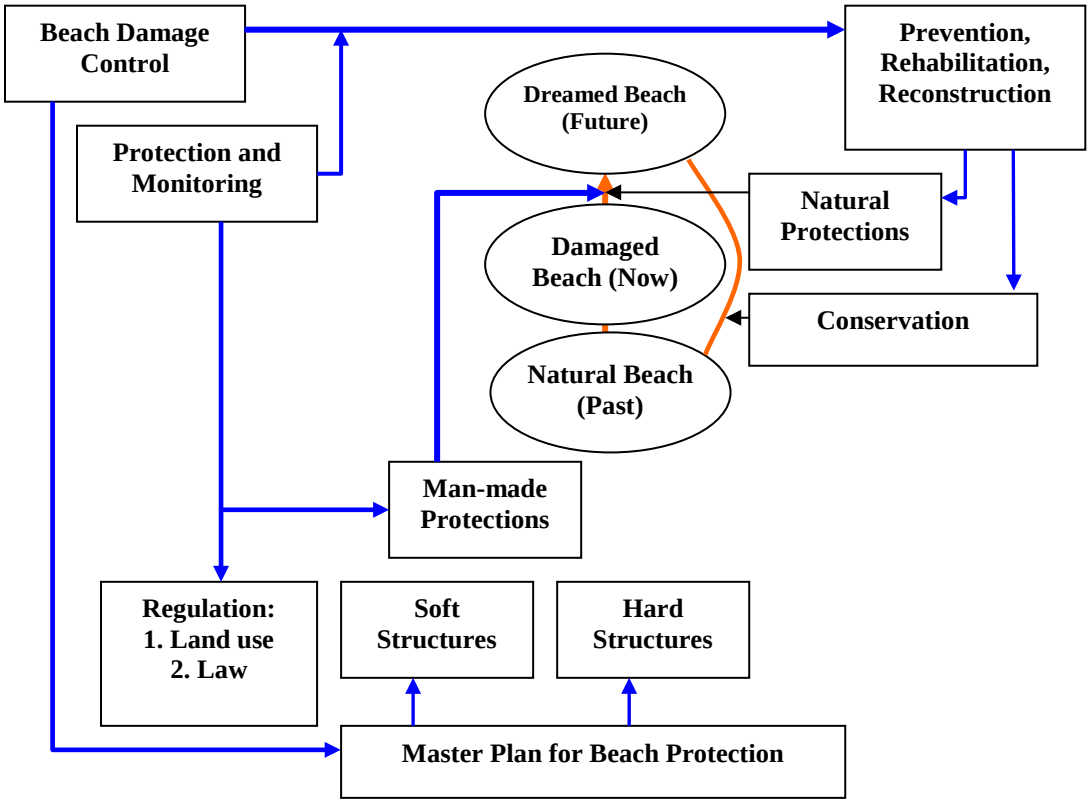

Fig 1. Basic Concepts of Beach Abrasion and Extreme Waves Handling [5]

Fig. 2. Coastal vegetation can also inhibit the rate of tsunami waves.

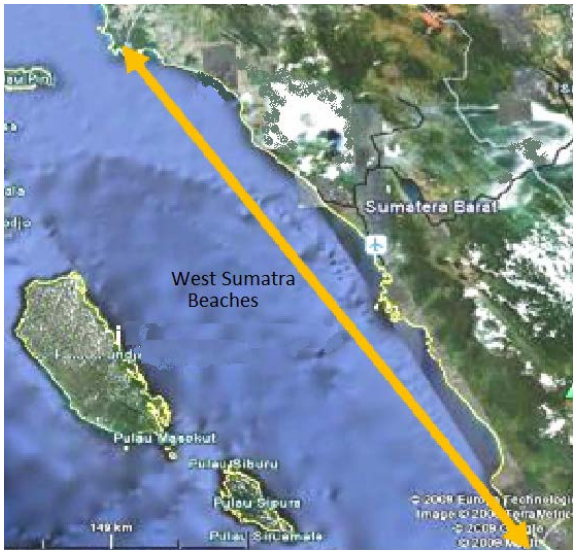

Fig. 3. The location of the coast of West Sumatra Province is the location of the case study

The first step of the study was to conduct a literature study related to coastal abrasion that occurred in West Sumatra. Journals, books, and project reports related to coastal safety are the key materials to be studied. This is done to get an overview of the abrasion conditions and what efforts have been made to mitigate abrasion disasters.

Further, interviews were conducted, both with government and community. The questions asked are related to abrasion, mitigation efforts, the results obtained from the mitigation that has been done, and how the model of community empowerment has been implemented. The number of government respondents is 4, consisting of 2 persons in the Office of Marine and Fisheries (DKP), 1 person from the Department of Tourism, and 1 person from the Department of Forestry. Interviews were conducted at the offices of each respondent. While for the community, interviews is carried out directly at the observation area. The people interviewed are individuals and some are in groups. The question posed is how severe the effects of abrasion after planting the coastal vegetation, and what their role and involvement in vegetation planting.

Along with community interviews, field observations were also conducted to see the impact of vegetation in reducing abrasion rate. The observation areas are several beaches in Regency of Pesisir Selatan, Padang, Padang Pariaman, and Agam.

After the data were collected, an analysis of the correlation between vegetation and abrasion rate was done, as well as discussion on community participation and conservation of vegetation.

4. RESULTS AND DISCUSSION

In West Sumatra, the type of vegetation that commonly planted for abrasion mitigation is the cultivation of coastal pine. Planting mangroves is very rare because mangrove requires a very special treatments and some prerequisites to grow well, such as the land has to be muddy, relative flat slope, steady ocean waves, specific tides of sea water. Such conditions are very rare on the west coast of West Sumatera. Respondents from the Office of Marine and Fisheries and Department of Forestry are also stressing above condition.

On the other hand, the cultivation of pine crops does not necessarily require special conditions. These plants can be grown easily on sandy beaches. Data from the Directorate of Coastal and Marine Department [8] shows that total land that has been planted with coastal vegetation is 52.54 ha consisting of 56,926 sea pines and 1,451 breadfruit stems. The spacing of the pine is 3 x 3 meters. Detail of planting location as seen in Table 1.

Fig. 4 shows the cultivation of sea pine at Tiku beach, Agam Regency. On the right it can be seen young pines are still protected with fence.

If it has grown up, the sea pine looks very beautiful and can make the shore area becomes shady. In some areas, beaches that have been successfully planted sea pine have turned into a tourist attraction as shown in Fig. 5.

Fig. 4. Planting pine on the beach of Tiku

Field observations shows that sea pine plantation can reduce abrasion rate (Fig. 6 and Fig. 7). The investigation on the effects of the sea pine to the coastal abrasion also has been observed [9]. The one of advantage the tree for coastal protection

is the shoreline change can be limited. It is better than the use of hard structures which can create accretion and erosion [10] in the shoreline. Fig. 6 shows the height difference between the shoreline due to the roots of the pine trees that still hold the sand. While Fig. 7 shows the ability of pine culls to retain coastal erosion.

Table 1. Location of pine cultivation in West Sumatera Province

No.	Regency	County	Total Area (m2)
1	Pasaman Barat Regency	Nagari Sasak	12,292.0
2	Pasaman Barat Regency	Nagari Katiagan	10,850.0
3	Agam Regency	Nagari Tiku V	44,883.0
4	Agam Regency	Nagari Tiku V	41,496.0
5	Padang Pariaman Regency	Nagari Sungai Limau	48,258.0
6	Padang Pariaman Regency	Nagari Kataping	49,914.0
7	Pariaman City	Nagari Manggung	37,970.7
8	Pariaman City	Nagari Pasir Sunut	46,370.0
9	Padang City	Kel. Pasio Batigo	18,342.1
10	Padang City	Kel. Pasio Batigo	9,684.7
11	Pesisir Selatan Regency	Nagari Surantih	31,380.0
12	Pesisir Selatan Regency	Nagari Sungai Tunu Barat	33,959.0
13	Pesisir Selatan Regency	Nagari Punggasan Utara	42,377.0
TOTAL			525,426

In addition to the above field observations, the results of interviews with communities living in coastal areas also show that pine cultivation has been able to reduce the rate of abrasion. According to the community, the rate of abrasion is faster in areas not cultivated sea pine compared with areas planted by sea pine. Another positive impact that is not less important is to be a source of income for the local community. With more beautiful and shady beaches planted by sea pine, more tourists come the location. People can sell food and rent tents to tourists who come.

The success of pine cultivation is not easily obtained. According to one respondent, there was initially a refusal from the community to participate in the planting. The public doubts the success of this program. However, over time, by looking at the results that have been obtained by society, now community is asking their beach to be also planted by sea pine.

Fig. 5. Adult sea pines make the beach area become shady and become a tourist destination

Fig. 6. Beach line height difference

Fig. 7. Sea pine roots are able to reduce the rate of abrasion

The success of this program lies in the empowerment of local communities. In the early stages, government conducted a socialization of the program. After that, formed a community group that will be responsible for planting and maintaining the plant. The formation of community groups is carried out by taking into account the economic and social conditions of the local community. Community groups can be established through the lowest administrative government unit in the village, called jorong, or can also be carried out by youth community.

Fig. 8. Fence for young sea pine

Treatment to sea pine is only needed when the plants are still young. In this case, communities are responsible for watering and making fences (Fig. 8).

The fences are made so that the cattle of the community such as goats or cows do not eat young new leaves. Because fencing and maintenance cost money, the government gives some money to the community to make the fence as well as to maintain it. Because the local community has been given the responsibility, then of course people will maintain the plants very well. This shows the sense of belonging of the community because it is empowered by the government to participate in this conservation program.

According to community information, sea pine plants can grow rapidly. At the age of 1.5 - 2 years, the height of the tree can reach 3 meters.

5. CONCLUSION

The conclusions that can be drawn from this research is the planting of coastal vegetation, in this case the sea pine, can reduce the abrasion rate. After the plants become mature, the cultivated coastal area is transformed into a tourist destination that can increase the income of the community. Local community empowerment for planting and maintenance is an important element in coastal conservation success.

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