CHAPTER 5

MANGROVE REHABILITATION THROUGH COASTAL DEFENSE STRUCTURES: LESSONS FROM JOHOR'S WEST COAST

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5.1 INTRODUCTION

The coastline in Peninsular Malaysia covers about 1,972 km in length. It largely includes sandy beaches (91%) on the east coast, followed by muddy beaches over 70% on the west side of

Peninsular Malaysia [1]. Coastal soils are unique and playing a natural role in the formation of species dominance zones. These areas are constantly submerged in seawater and under the influence of currents and sea waves that cause dynamic changes to species that are forced to settle on ecosystems and the physical condition of the soil is unstable and constantly changing.

Sometimes, the soil conditions along the coast become suitable for the growth of the mangrove forest plant species. Mangrove forests are an important form of protection for many coastal communities worldwide. They provide a natural form of defense for coastal properties. The existence of mangroves can reduce the impacts of storms, floods and storm surges through binding sediments and wave attenuation [2]. Mangroves also reduce shoreline erosion by dissipating tidal and wave energy to a lower level, which allows for salt marshes and reeds to grow, which in turn reduces erosion [3]. Figure 5.1 shows the significance of having a mangrove forest.

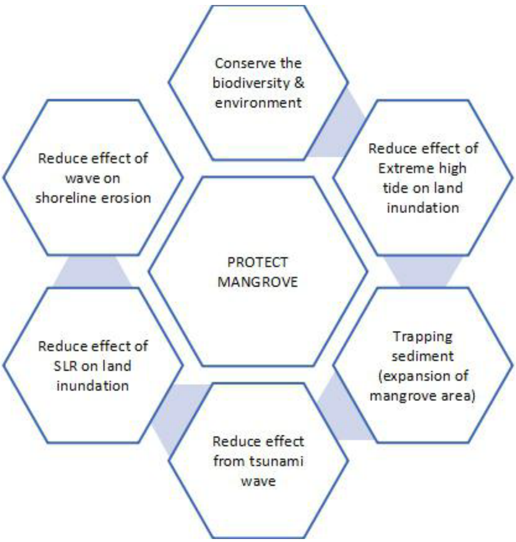

Figure 5.1: Significant of a mangrove forest

In addition to having biological diversity and social benefits, mangrove forests are also known as important ecosystems in the carbon sequestration stored as biomass of trees and soil. Mangrove ecosystems provide a natural coastal buffer, due to their ability to reduce tidal flow and to induce sedimentation, and their biological richness and high productivity have been recognized worldwide [4].

5.2 THREATS TO MANGROVES IN MALAYSIA

In Malaysia, mangrove vegetation covers an area of about 577,500 ha, with Sabah having the most extensive coverage of mangroves, accounting for 59% or 341,000 ha of the country's total whereas, Sarawak has 132,000 ha (23%) and Peninsular Malaysia 104,200 ha (18%). The areas of mangrove forest reserves have decreased at an alarming rate of 12% between 1980 and 1990, mostly through loss of forest to agriculture, urban development, shrimp ponds farming and deforestation [5].

There was 40% of mangrove areas were reduced since 1980 until 2013 due to shrimp pond farming, woodchip industry and natural phenomenon [6]. The reduction of mangrove areas is continuous and serious due to several factors. Examples of these factors include the collapsed of mangrove trees along riverbanks and shorelines due to erosion, sea level rise (SLR), tsunami and human activities (i.e. illegal logging of mangrove trees). The numbers of mangrove were decreasing along coastlines due to human activities such as over-logging and clear-cutting process, and natural phenomena such as tidal inundation, storm surges, and wave action over the past decades. These scenarios made coastal areas re-exposed to coastal flooding due to storm surges, extreme high tide and sea-level rise, as well as strong winds.

Mangrove forests are valuable ecosystems for environmental protection. Along the shoreline, there are some of mangroves were planted especially at erosion and sedimentation coastal. This method is the way to prevent or to delay the erosion process by reducing the wave's energy, thus decrease the erosion rate.

5.3 METHODS TO SAVE MANGROVE FORESTS IN TANJUNG LABOH, JOHOR

The mangrove rehabilitation effort should be intensified but not limited to the replanting program only. The intensive understanding of mangrove hotspots, wide (size), zonation and the capacity are equally important to ensure the success of the whole rehabilitation program. Construction of coastal structure is one of the methods for coastal nourishment and its function for produce more rehabilitation area at a side of the structure. The method of construction of coastal protection structure for mangrove rehabilitation and rejuvenation in this study will be useful for the government and private agencies to evaluate the coastal area especially for decision making purposes and coastal management. The coastal structure was constructed in Pusat Cerapan Data, CAGED in Tanjung Laboh, Batu Pahat. Figure 5.2 shows CAGED location.

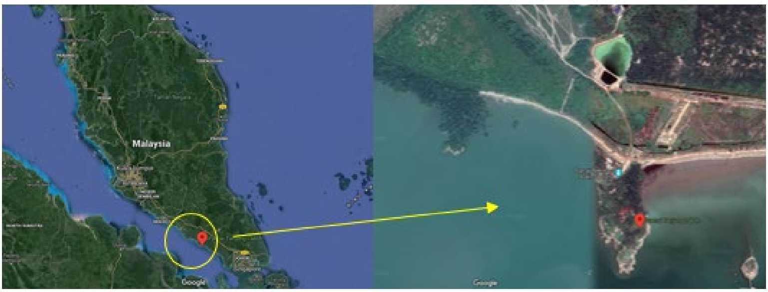

Figure 5.2: CAGED in Tanjung Laboh, Batu Pahat

The construction of coastal works to mitigate erosion and hard sea defence capable of altering the coast, such as breakwater, seawall and jetties. Other than hard structure, present beach erosion prevention methods include sand dunes, vegetation, sandbags, and sand fences. In this study, construction of jetties in CAGED are functioning as coastal protection structure for mangrove rehabilitation and rejuvenation. Jetties is the structure stretch from the shore into the water. Currents and tides of an ocean can gradually wash away a beach or other features along the coastline. Jetties protect the shoreline of a body of water by acting as a barrier against erosion from currents, tides, and waves. Since erosion is unavoidable, the problem becomes discovering ways to prevent it. This coastal nourishment activity, in the same way, it can rehabilitation the area and produce more mangrove area. UAV and GIS will monitor the changes in the study area. Figure 5.3 shows the jetty structure constructed in CAGED.

Figure 5.3: Jetty in CAGED, Tanjung Laboh

The Department of Irrigation and Drainage were building bunds (earthen dykes) along the coastline within mangrove areas. The projects were implemented to create more agricultural lands by reclaiming the mangrove swamps. It is also provided with rock revetment to control the erosion. Figure 5.4 shows the rock revetment along coastline in Tanjung Laboh.

Figure 5.4: Rock revetment in Tanjung Laboh

5.4 THE CORRELATION BETWEEN COASTAL STRUCTURE AND COASTAL DEPTH

5.4.1 SAMPLING POINTS

A total of 12 sampling points were set-up along the shoreline, ranging from low tide to near land areas. The points are divided into 3 zones namely zone A, zone B and zone C. Determination of the overall observation point in the field by setting a gap of 70 m from the shore direction and 50 m to the left or right of the jetty structure. Figure 5.5 shows the observation points of the actual map was based on the coordinates provided. The process to obtain a straight line is quite challenging due to the condition of mud structure. Considering the difficulties of the movement to achieve the coordinate value.

Figure 5.5: Sampling points from the top view

5.4.2 FINDINGS OF COASTAL DEPTH MEASUREMENT

Coastal depth measurements are be performed roughly at each observation point using the PS-7 Digital Sounder tool as shown in Figure 5.6(a). The depth gauge is very easy to use, and it can measure the depth of the beach surface up to a depth of 50 m. The depth gauges have a large difference error when used on uneven coastal surfaces. As the coastal area of Tanjung Laboh is muddy and flat, the difference is obtained to be low. The use of this tool is simple, by placing the tip of the tool on the water surface while pressing the button on the tool as shown in Figure 5.6(b). Depth value readings will be issued on the device in units of ft.

Based on the data obtained, the values on each grid line A, B and C each have a different depth value. Due to the fact that, when the distance from the shoreline increase, the depth of each point increases as well as shown in Figure 5.5 and Figure 5.7.

(a) (b)

Figure 5.6: (a) PS-7 Digital sounder tool; (b) How to use the PS-7 digital sounder tool

The depth that has been obtained was around 2.41 m to 2.54 as shown in the Table 5.1. Based on Figure 5.7, for gridline A the highest depth was at A1 which is 2.46 m, while the highest depth at gridline B was at B1 which is 2.49 m. However, the highest depth at grid line C was at C1 which is 2.54 m.

Table 5.1: Data for each observation point

Observation points	Coastal depth (m)
A1	2.46
A2	2.45
A3	2.44
A4	2.41
B1	2.49
B2	2.48
B3	2.47
B4	2.45
C1	2.54
C2	2.54
C3	2.52
C4	2.50

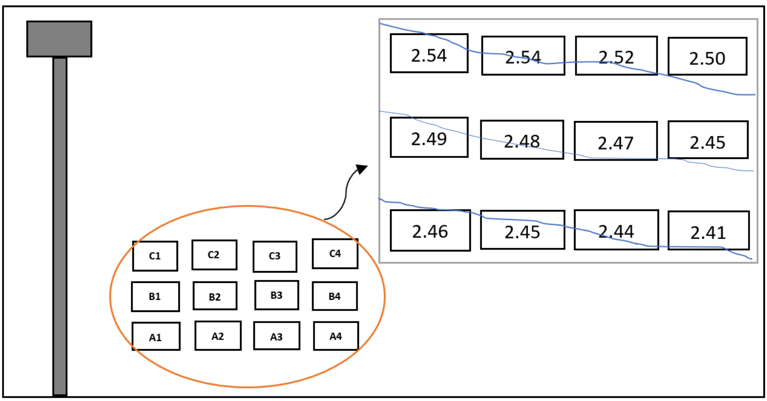

Figure 5.7: Coastal depth on each observation point

This is because observation points A1, B1 and C1 are closer to the jetty area. The wave current passed through the area were obstructed by the bamboo pier thus causes the sediments to accumulate around the jetty. This is because the wave movements that coming from the middle of the sea brought the sediment included fine sediments such as silt and clay whereas leaving coarse sediments such as sand and rock.

While depth at A4, B4 and C4 are higher than A1, B1 and C1 because these areas was not obstructed by any coastal structure or topography that could cause accumulation of sediments. The waves speed will gradually decrease as the depth increases thus waves will be slowed if there is a violation of the object on the coast such as breakers and construction structures [7]. Therefore, wave current is one of the main factors that may be prone to erosion and can be overcome by the presence of jetties or other coastal structures.

5.5 CONCLUSION

From the overall study, it can be concluded that the coastal properties in Tanjung Laboh have been achieved by using correlation of coastal depth and coastal structure. The result shows that the depth at gridline C has the highest depth value. It is shown when the distance from the shoreline increase, the depth of each point increases as well. Furthermore, the wave current passed through the area were obstructed by bamboo pie that could cause the obstruction of wave current and accumulation of sediment thus the point which are being close to the jetty has the highest depth. Therefore, the movement of wave current and the presence of coastal structure also affects the coastal depth.

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