

# Coastal Protection with the Community Based using the Local Wisdom in North Sulawesi

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**Abstract.** The Coast Area is an area that has a physical condition where erosion occurs at other times, sedimentation occurs. Both of these conditions can be a problem in coastal areas. This is very closely related to land use in coastal areas. Another problem is that in protecting the beach by the government it is very expensive and cannot be carried out simultaneously throughout the coastal areas, so that people have to wait in uncertain times.

In North Sulawesi coastal areas are widely used as settlements, tourist areas and other public facilities. The community has its own ability both in terms of the availability of natural resources and labour, so that it can secure the coast to reduce the risk of damage in its coastal areas.

The method of building of non-structural coastal protection can be carried out by people whose construction types can be combined according to the conditions and availability of natural resources in the area.

## 1. Introduction

The coastal area is an area that is very potential to be utilized in a variety of socio-economic activities, as an area of settlement, industry, ports, aquaculture, agriculture / fisheries, tourism, and various other public facilities. But activities in this area can cause problems including erosion, abrasion, sedimentation, environmental pollution, and soil degradation.

In some places, the government has built the coastal protection by using a structural approach that requires very expensive costs and is only carried out in areas considered priority must be addressed immediately.

The community knows the problems that occur, but they still do not have the ability and knowledge to build the coastal protection. In addition, the coastal area has natural resources that can be used in securing the coast and local wisdom that has grown and developed in the region. Each coastal area has different potential and problems, so the handling can be different.

The purpose of this study was to provide an alternative design of a typical beach safety building that can be done by the community by using local resources and wisdom in the area

## 2. The Type and Function of Coastal Protection

Coastal protection construction is built to protect the coast from the destructive power of waves and ocean currents, so that in general there are several methods that can be done to protect the coast, namely:

- Strengthen/protect the beach to be able to withstand wave attacks;
- Change the rate of sediment transport along the coast;



- Reduce wave energy that reaches the coast;
- Increase sand nourishment supply
- In this type what can be done is to add sediment either naturally or through mechanization
- Reclamation to increase the benefits of land resources in terms of environmental and socio-economic aspects by means of landfill, drainage or drainage.

### *2.1. Strengthen/protect the beach to be able to withstand wave attacks*

In this method there are several types such as revetments and seawalls installed on coastal cliffs which are usually installed in areas where there are road facilities to prevent cliff avalanches due to wave attack. This type can also be installed for the purpose of preventing erosion which can damage the beach's appearance.



Figure 1: Sea wall

### *2.2. Change the rate of sediment transport along the coast*

For this function, Groin construction type is usually used. Groin is a building that protrudes from the coast to the sea, serves to capture / hold sediment movement along the coast so that the sediment transport along the coast decreases / stops. In the river mouth area, it is often called the Jetty.



Figure 2: Groin

### *2.3. Reduce wave energy that reaches the coast*

The type used for this purpose is the breakwater either over topping or non over topping. With the breakwater, the wave energy will be reduced, so that the energy reaching the coast becomes very small and does not damage the coastal area. For over topping breakwaters are installed to break the waves at the breakwater location due to changes in water depth.

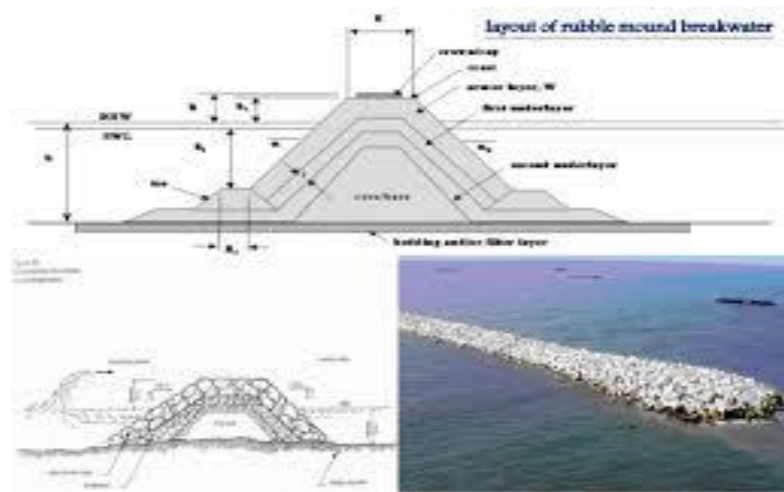


Figure 3: Breakwater

#### 2.4. Non structure coastal protection

In addition to coastal protection structures made with concrete or boulder structures, there are also non-structural types such as mangrove replanting, beach nourishment, and sand dune. This building in addition to creating natural security also improves the environmental damage that has occurred in coastal areas.



Figure 3: Replanting Mangrove

### 3. Beaches in North Sulawesi Province

North Sulawesi Province is at the northern end of Indonesia and as a border with the Philippines has a coastline length: 1,837 km with land area: 2,200 km<sup>2</sup>. The North Sulawesi Provincial Government has designated North Minahasa Regency as a Tourism Special Economic Zone (Kawasan Ekonomi Khusus Pariwisata) so that many coastal locations in this district are made into tourist locations such as Paal Beach, Pulisan Beach, Baho Beach and others. (BPS Kabupaten Minahasa Utara, 2015). Elsewhere, there are many residents, even sub-districts and a district capital has located on the coast area.

Currently there is one new location that is visited by many local and foreign tourists, which is called the surrounding community as Dosa sand Beach, which is near the island of Nain. This beach is a white sand beach that will appear at low tide.



Figure 4: The sand beach of Nain Island

In addition, in Minahasa District there are also coastal areas that are used as tourism locations by local and regional communities such as the Rerer village beach. And many coastal areas in northern Sulawesi used as a tourist attraction by the local and regional community. Besides that, in the coastal area it is widely used for residential areas, the center of economic activities and public activities.



Figure 5: White sand beach in Rerer village



Figure 5: Coastal Area as a centre of economy and settlement

#### **4. The Problems of Coastal Area in North Sulawesi Province**

The problems of coastal settlements in North Sulawesi Province are:

1. The occurrence of coastal erosion so that the coastline is getting worse and many trees and houses are gone.
2. The occurrence of run-up waves that enter the residential area, making the residential area inundated
3. Sedimentation due to longshore sediment transport.
4. Trash that comes from the sea or discarded by visitors.

The problems of coastal tourism areas in North Sulawesi province are:

1. The occurrence of coastal erosion so that the coastline is getting worse and many trees and tourist areas are getting smaller.
2. The occurrence of run-up waves that enter the tourist area,
3. Sedimentation due to longshore sediment transport
4. The presence of mangroves that have been damaged to be used as firewood so that natural coastal protection is damaged and the breeding area of fish culture is lost and the area behind it is coastal erosion
5. Trash that comes from the sea or discarded by visitors.

#### **5. Potential of Natural Resources and Local Wisdom in North Sulawesi**

Natural resources in North Sulawesi that can be used for protection the coastal areas are widely available around the coast such as:

1. Mountain stones. There are many mountain stones of a size that can be lifted and moved with human strength. The Mountain stones will be used on building structures by arranging it to get a barrier for waves that will attacking the beach or used as a barrier to the longshore sediment transport.
2. Bamboo. There are many bamboo that can be used as pillars and plaits to drain the beach security building before placing a mountain stone which is useful to maintain the stability of the building and sediment barrier or run up waves
3. Wood. There are lots of wood that can be used as poles and walls for sediment barriers or wave run-ups
4. Palm fiber. It is often used by the public as a filter to hold the soil granules so that they do not come out of the original place so that they can maintain the stability of the soil.
5. Mangrove. There are many mangrove seeds that will be used to replant damaged mangroves.

Local wisdom is much influenced by the culture of the sub ethnic community in the place. Whereas the culture that developed at this time was much influenced by religion so that matters related to mysticism had been greatly reduced even in some places none existed at all.

#### **6. Typical Design of Coastal Protection Construction with the Local Wisdom in North Sulawesi**

##### *6.1. To Reduce Erosion Due to Wave Attacks*

To reduce coastal erosion due to wave attacks can be done in various ways, namely:

1. By breaking waves in the area before the beach. To break waves before the beach can be done by blocking the waves so that the waves break and reduce the depth of the water, because the waves will break if the water depth is almost the same as the wave height.

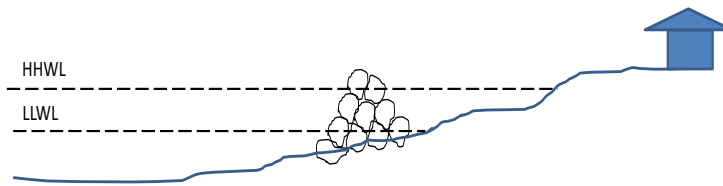


Figure 6: Breakwater

By making a submersible breakwater placed in the area before the beach by placing mountain stones arranged in order to reduce the depth of the water so that waves are expected to break in this place. If this type is used, it is necessary to consider the way for the boat to enter the coast.

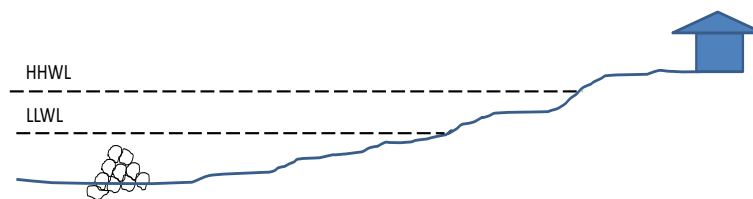


Figure 7: Submersible Breakwater

2. Fortify the beach. Fortifying beaches can be done by building Sea Wall or revetment.
3. By making fortresses from mountain stones, bamboo/wood and sand or a combination of various materials.

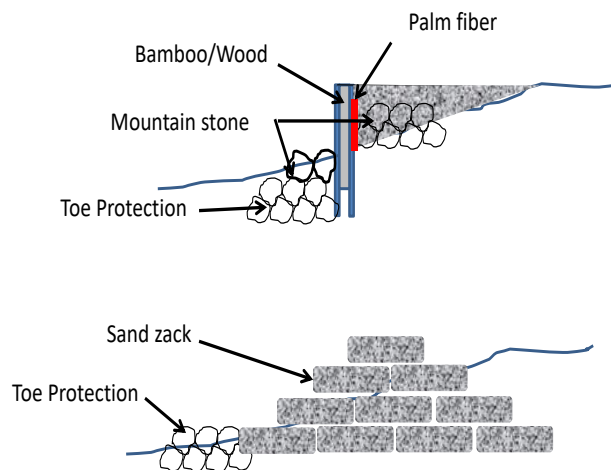


Figure 7: Sea wall

## 6.2. To Reduce Wave Run-up

To reduce wave run-up it can be done by making a revetment or sea wall and allowing it to pass through the sandbar after that holding it by making a canal behind the sandbar.

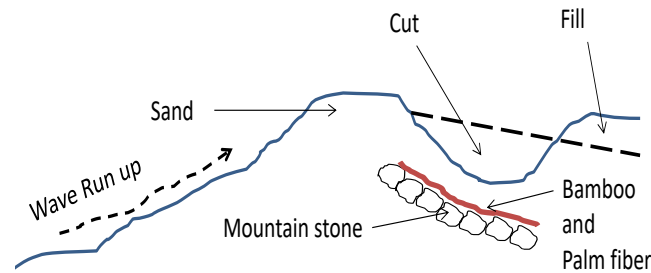


Figure 8: Canal behind the sandbar

### 6.3. Restrain the Rate of Longshore sediment Transport by Create the Groin

Groin is a beach security building that is built perpendicular to the coast, serves to hold sediments along the coast. For construction that can be done by the community, it is made with materials that are around the location and easy to implement. Here is the type of groin that can be made by the community.

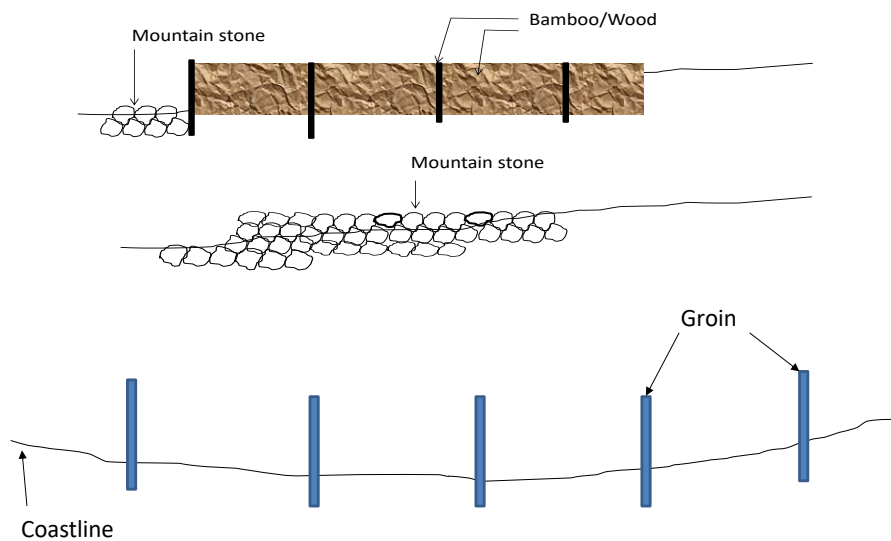


Figure 9: Groin

### 6.4. Replanting the Mangroves

Mangrove planting is carried out in damaged mangrove forests in order to reduce the wave energy that enters the coastal area and restore the lost breeding grounds of fish. In replanting mangroves, it is better to do this by adjusting the cropping pattern so that it is expected that when the size of the large mangrove trees is obtained from the beach and tourist attractions that utilize mangrove forests.

## 7. Conclusions and Suggestions

Communities can be protecting their own coastal areas by utilizing local wisdom by looking at the situation and conditions of the coast and using simple methods.

Typical designs previously described can be used on beaches in North Sulawesi adapted to the conditions and circumstances of existing beach.

It is recommended for coastal engineers to be able to provide experience and knowledge to the community about the method of coastal protection so that people can secure their own beaches while waiting for the government to build permanent coastal protection.

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