Study on the Changes of TanjungBunga Coastline

Sutrisno Masita, Muhammad Arsyad Thaha, Silman Pongmanda

Abstract: ***The coast line is the boundary line between land and seawater, where the position is not fixed and may change according to the tide and coastal erosion that occur. Changes in coastlines are caused by natural factors including ocean waves, currents, winds, river sedimentation, the condition of coastal vegetation as well as volcanic and tectonic activity and human factors, including the construction of ports and facilities, mining, dredging, destruction of coastal vegetation, aquaculture, protection beach and beach reclamation. Based on the description above, this research was conducted to find out the factors that influenced the changes in the coastline in TanjungBunga and the changes that occurred. From the results of tides, bathymetry and topography, the analysis showed that the change in the coastline of TanjungBunga was caused by sediment supply from the Jeneberang River and also by the construction of the Jetty beach building at the mouth of the Jeneberang River and groin which were not built effectively. At station 0 + 100 to 0 + 400 observation points, there was a setback in 2005 and 2009. While in 2007, station 0 + 100 to 0 + 300 progressed and in 2011, station 0 + 00 to 0 + 200 experienced progress. For station 0 + 500 to 0 + 800 it has progressed from 2003 to 2011.***

Keywords: beach, coastline, tides, sediment, TanjungBunga

I. INTRODUCTION

The beach is always adjusting the profile shape such that is capable of destroying incoming wave energy. The profile shape adjusts by the natural dynamic response of the ocean. Beach dynamic process heavily influenced by littoral transport, which is defined as the movement of sediment in areas near the coast (nearshore zone) by waves and currents [1].Littoral transport can be divided into two kinds of transport along the coast (longshore transport) and transport perpendicular to the coast (onshore-offshore transport). Transported sand material is called littoral drift. Transport Perpendicular beach is mainly determined by the slope of the waves, sediment size and slope of the beach. In general, large waves move material with a slope towards the sea (abrasion), and a small wave with a long period of moving the material towards the ground (accretion). A beach experiences erosion, accretion (sedimentation) or remains stable depending on the incoming sediment (supply) and outgoing that leaves the beach.

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Beach erosion occurs when on a targeted beach there is loss / reduction in sediment which means that sediments that are transported larger are deposited can also reduce the function of the coast or coastal buildings, such as sedimentation in the estuary which can disrupt river flow and shipping traffic, as well as deposition in ports and shipping lanes [2-3].

Jeneberang River is one of the biggest rivers in South Sulawesi and this river has caused sedimentation at few capes such as TanjungBunga Beach, TanjungMerdeka Beach and TanjungBayang Beach. In a research conducted by Langkoke and Rochmanto (2011) they found a model of fluviatile delta sediment which consisted of delta plain sediment, delta front sediment, beach sand sediment, and foreshore sediment. Furthermore from their findings, they stated that TanjungBunga was one of the unstable coasts. Sakka et al., (2011) studied the changes of the coast shoreline from the year 1990-2008. Considering that the dominant of sediment transport was to the north during the arrival of the southwest and west waves, and to the south when the wave coming from the northwest, their observation for the 19years simulation showed that abrasion mainly occurred at TanjungBunga (head land) where the coast retreat 181.1 m. Meanwhile, accretion occurs in the bay area (TanjungMerdeka) where the coast advances to the sea for about 59.8 m. In the analysis of coastline changes of TanjungBunga Beach using satellite done by Danial et al.,(2013), the digital image processing results revelaed that the coastlines of TanjungBunga changes from year to year particularly due to erosion and sedimentation. In addition, it was mapped and recorded that there has been some reclamation projects along the beaches especially in year 2008 to 2010 amounting to 29 300 m^2 and involving 1907 m^2 strip of coastlines being reclaimed. With these continuous changes on the coast shoreline, there arose the need to conduct a study to investigate the factors that influenced the changes in the coastline of TanjungBunga Beach.

II. METHODOLOGY

This research was carried out in the area of TanjungBunga, Makassar city, South Sulawesi province. The picture of the research location (TanjungBunga) has been circled can be seen in Figure 1. This study was conducted for 10 years from 2004 to 2013 using AUTOCAD LAND application.

The primary data taken are tides, topography, bathymetry, whereas the secondary data included the data of shoreline changes from satellite imagery.

Fig. 1 Satellite view of Location of study (TanjungBunga Beach)

III. RESULTS AND DISCUSSION

Line change across TanjungBunga

At this stage there are some pictures taken from google earth which began in the year 2000 to 2015. The colored lines in Figure 2 depicted the changes that have occurred with the number of reclamation to infrastructure. The red line, yellow line, blue line and purple line represented year 2000, 2005, 2010 and 2015 respectively. These results were analogous with the findings obtained by Umar et al., (2015) which stated that the coast is eroding both by the large and small wave conditions (3.6~6.56 m) [7].With reference to Fig 2, is proven that so massive development happened around the year 2015. This was due to the development of groin on the Akarena Beach till so much sediment is accumulated around the groin that causes changes in the shoreline, and there is accumulation around the groin which is limited by the foundation.

Factors Affecting the Occurrence of Coastline Changes

The following are some factors that influence the occurrence of coastline changes in TanjungBunga.

a) Sediment from JeneberangRiver The supply of jeneberang river sediments leading to the river mouth causes sediment transport around the estuary and this process affect the changes in the coastline both on the left of the estuary as well as the right of TanjungBunga. The construction of the Bili-Bili Reservoir (refer Figure 3), BendungBisua and BendungKampili was followed by construction of sediment retaining construction such as Sabodam and Sand Pocket in the upper Jeneberang River section. This condition resulted in reduced supply of sediment to the estuary because it was blocked in the building which caused the sediment transport balance on the coast to be disturbed.Although, thelower Jeneberang Valley around the Bili-Bili dam experiencedlow erosion rate (less than 5 ton/ha/year)the area around the dam experiences relatively high potential soil loss [8].

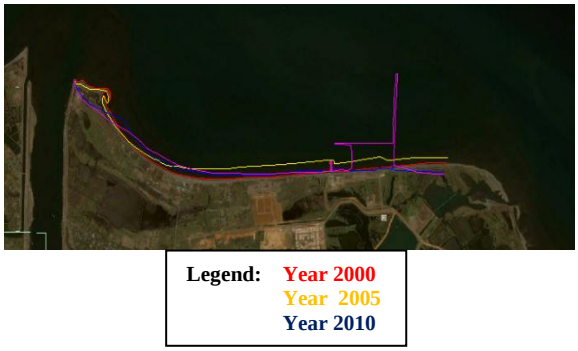

Fig.2 Combined shoreline changes across TanjungBunga

Fig. 3 Satellite image of Bili-Bili reservoir

Sea currents

River sediments transported to the estuary experience the resultant force with longshore ocean currents. This process causes sediment from the Jeneberang River to tend to move towards TanjungBunga which causes sedimentation to the front of Losari beach (sand spit). Besides that, ocean currents are also influenced by the wave season both western and eastern monsoon season. Figure 4 showed the direction of ocean current.

Fig. 4 Direction of current in TanjungBunga

Building Construction Beach (Jetty, Groin, and Revetment)

The jetty built at the Jeneberang River estuary aims to stabilize the Jeneberang River estuary. The influence of the construction of this jetty resulted in the retreat of the coastline from the estuary to the TanjungBunga beach. To overcome the retreat of the coastline, the groin is constructed perpendicular to the coast (refer to Figure 5).

However, the groins that are built do not work effectively to maintain or advance the coastline because the distance and length of the groin are not effective. At the downstream part of the groin, there is a scour and in the upstream part of the groin there is accumulation of sediment.

Besides that, the construction of the TanjungBunga beach reclamation to Losari Beach resulted in an imbalance in sediment transport.

Fig.5 Satellite image of the built groin at TanjungBunga beach

Analysis of Changes in TanjungBunga Coastline

Changes in the coastline are determined by the amount of sediment coming in and out of each coastal segment. If the incoming sediment is higher than the outflow, the beach will experience sedimentation, and if the sediment entering it is less than the outflow, erosion will occur. In Figure 5, the change in coastline for the first five year and after 10 years is shown. During the fifth year, it sediments have been formed by the coast.

Fig. 6 Coastline change for the 1st year, 5th year and 10th year

Figure 7 presented the data of changes in TanjungBunga coastline from year 2003-2011. From the figure, it can be inferred that the change size for each station observed is not the same. At 0 + 000 and Station 0 + 100 stations, a relatively large coastline decline occurred from 2003-2011, this was due to the dominant sediment moving northward, but not balanced by the supply of sediment from the river, due to distance relatively far away (± 2.0 Km - 2.4 Km). At Station 0 + 300 in 2005, there was a coastal setback of ± 5.94 m, in 2007 it advanced ± 0.77, while in 2009 and 2011 it returned back ± 5.00 m and ± 3.47 m. At Station 0 + 400, shoreline decline continued from 2003-2011, this was due to the dominant sediment moving towards the north, but not offset by sediment supply from the Jeneberang River due to the relatively long distance (± 2.0 Km - ± 2.4 Km. At Station 0 + 500, Station 0 + 600, Station 0 + 700, and Station 0 + 800 there is a considerable beach progress. This is due to the large supply of sediment from the Jeneberang River. In the graph, there is a significant beach progress at Station 0 + 800 in 2011.It can be seen from the picture of a regular sedimentation process at TanjungBunga beach, that the farther a point is viewed from the sedimentation source (Jeneberang River estuary), the greater the potential for shoreline retreat. In addition, the relatively straight form of the beach (Station 0 + 300-Station 0 + 500), tends to be more stable than the shape of the winding beach. This is due to the angle of dating of relatively broken waves along the coastline.

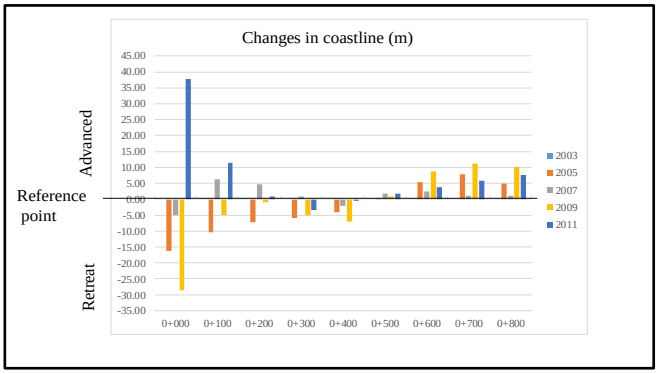

Fig.7 Changes in TanjungBunga coastline from year 2003-2011

IV. CONCLUSION

Factors affecting the coastline changes are the supply of sediment from the Jeneberang River, Sea wave and beach construction (jetty, groin, and revetment). The presence of sediments left behind on the beach and eroded from the coast results in changes in the shape of the beach and the construction of groynes which caused sediment accumulation in the area around the groin. At station 0 + 000 until station 0 + 400, there was a setback in 2005 and 2009, while in 2007 station 0 + 100 until station 0 + 300 progressed and in 2011 station 0 + 00 to station 0 + 200 progressed. For station 0 + 500 until station 0 + 800, it progressed from 2003 to 2011.

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