Coastline Changes in Serang City, Banten Province

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Abstract. The coastline is a dynamic land form because of the processes which come from the sea as well as from the land. Change in the coastline is the shifting position of the beach from its former place. There are many types of changes in the coastlines that are caused by many factors whether they are natural or human factors. The problem in this study is how coastline changes are caused by natural factors and human factors in Serang City. The research used Landsat 5, 7, and 8 images with 3 periods which were 1990 and 1998, 1998 and 2008, and the last period was 2008 and 2018. Abrasion and accretion is calculated based on the area, rate, distance changes, and long coastline experienced both. Land physical variables that are used in this research are topography, geology, land use and coastline, while the oceanic physical variables are ocean waves, currents, and tides. Human activities also become research variables such as sea sand mining. The result showed that coastline change happened along the coastal areas in Serang City. One of the evidence is an abrasion area that destroyed a mangrove forest in Karangantu Beach.

Keywords: Abrasion, Accretion, Natural Factors, Human Factors.

1. Introduction

Indonesia is one of the largest islands. More than 17,000 more with 81,000 km of coastline put Indonesia as a different country seen in the world [1]. One form of continuous process. There are a number of coastal developments, their determination back in the direction caused by erosion or abrasion and the beach leading to the ocean which is sedimentation [2]. Abrasion is logging the beach from its original position [3]. The accretion from the beach around the coast itself comes from its original position.
Coastal buildings using coastal erosion and sediment as an effect of nearshore currents. Change in shape, length, width and shape of the beach. The coastline continues to change over time [4].

The case of coastal abrasion has occurred on the shores of Indonesia, such as abrasion on the coast of Banten coast with a very severe tendency caused by sea sand dredging and coral mining [5]. Serang City has a ± 6 Km long beach which is located in Kasemen Subdistrict and has extraordinary natural and marine wealth. The total area of Banten Province is 11,500 km², this amount is achieved from the width of the coast of 517.42 km and the authority of the Territorial 12 Marine miles 22.2 km [6].

This measurement is very important to support the initial stage in disaster mitigation. Coastal abrasion and accretion assessments also have very good answers to regional development policies, by ensuring that they will be able to adapt to the environment with the potential of poor areas and an efficient environment. This research can be provided to local communities to better assess the development in coastal areas.

2. Method
This research area is along the coast of Serang City. Serang City Coast is located in Kasemen Subdistrict which has an area of 56.36 Km², with the following District boundaries: North is the Java Sea, South is Serang District, West is Kramatwatu District Serang Regency and East is Pontang District Serang Regency. Kasemen Subdistrict is located at a distance of ± 9 Km from the capital Serang.

Variable of shoreline change research in the form of abrasion and accretion caused by natural and human factors. Natural factors are ocean currents, geology and geomorphology. Human factors are human activities based on land use. This study uses Landsat imagery 5, 7, and 8 with a period of 4 periods, namely the 1990 period, the 1998 period, the 2008 period, and the 2018 period.

The data that has been produced and processed together is analyzed using descriptive spatial analysis. Spatial descriptive analysis is used to determine the location of the area of abrasion and accretion that occurs in the city of Serang from the beginning of the area, the rate of movement and the use of land affected by abrasion and land use in the accretion area. This analysis is also used to determine the relationship of the mainland physical actors including the height and slope of the coast, changes in the coastline, the type of land use, geology, the direction of the coast to the waves and incoming currents. Spatial variation of the coastal area is analyzed by segmentation which is then used to see the relationship with the occurrence of abrasion and accretion.

3. Result
The Serang City area is astronomically located between 50 99° - 60 22' South Latitude and 1060 07° - 1060 25° East Longitude. When using the coordinate system UTM (Universal Transfer Mercator) Zone 48E Serang City area is located at coordinates 618,000 m to 638,600 from west to east and 9,337,725 m to 9,312,475 m from North to South. If examined based on its position on other regions, almost all of Serang City is surrounded by Serang Regency. Only north of the attack city borders the Java Sea. The
The topographic conditions of Serang City are mostly lowlands which have a height of less than 25 meters above sea level. Serang City area of 266.74 km² stretches 21.7 km from north to south and 20 km from west to east [6].

Serang city is in a tropical climate, rainfall in this region is quite high and rainy days are many. But in 2014 the average rainfall fell very little compared to 2013, from 55 mm to 8 mm. The highest rainfall in 2014 occurred in August at 17.8 mm. The average air temperature in Serang City ranges from 22.2°C to 34.1°C. The biggest difference between minimum and maximum temperatures is in October. Air humidity varies between 20% to 97% [6].

Banten Bay Coast is generally composed by alluvial rock formations (Qa) with quarterly sediment compilers resulting from deposition of river sediments. Coastal geological compilers, especially Serang City, have been ± 11 thousand years old in which the formation process took place in the Holocene era, so that the rocks formed were rocked by volcanic activity, both rocks beneath the surface of the soil and rocks at the ground surface. The Banten Bay coastal geomorphology unit is Fluvial alluvial plain where the rock lithology is alluvial sediment with almost flat relief and a maximum altitude of 5 m. Topography in flat-lying coastal areas with relatively small changes in altitude between 0-5 meters above sea level. The slope of the coastal slope of Banten Bay is between 0 - 8%.

The pattern of surface currents in the territorial waters of the Northern Province of Banten (Serang District, Serang City and Tangerang Regency) follows the pattern of sea-level currents due to the influence of Munson's wind and low tide which causes the movement of ocean currents. The territorial waters of the northern part of Banten Province are on the main axis of the Muson wind, so the current of the season formed flows towards the east during the western season period (December-February). Likewise, the flow of the season flows predominantly westward during the eastern season (June-August). The current velocity range in both seasons is between 20-15cm / second.

Banten Bay Beach is part of the coast of North Java Island, where the depth of the waters is very much different from the depths of the waters of the southern part of Java Island. The depth of the coastline of Banten Bay ranges from 0 to 20 masl (meters below sea level) which enters shallow water.

The type of tides in the waters of the northern part of Banten Province is a single daily tide, which means that in one day there is one tide and one ebb. Wave height that occurs in the waters of the Northern part of Banten Province (Serang City) in the west season is around 2.6 m with an average of 1.03 m. While in the east season it is around 1.9 m with an average of 0.76 m. As well as in the transition season the wave height is generally relatively low less than 0.5 m. The northern territorial waters of Banten Province above the Sunda Shelf connecting the islands of Sumatra, Kalimantan and Java have a depth of less than 40 m. In Banten Bay the condition of the sea depth ranges from 0-20 m below sea level with the seabed in the form of coral and sand mixed with sand.
4. Discussion

4.1 Abrasion and Accretion in 1990 - 2018

![Figure 1. (a) Landuse 1990 in Serang City](image)

| Coastline change | Area       |
|------------------|------------|
| Abrasion         | 378650.52 km² |
| Accretion        | 354862.33 km² |

Table 1. Abrasion And Accretion in Serang City

Based on the results of shoreline processing from Landsat 5, 7 and 8 images which are then overlaid, the results are shown as in Table 1. In general, changes in coastline over the past 17 years from 1990 to 2018 have more coastlines (abrasion) than coastlines advanced (accretion). The most abrasion occurred in the eastern region of the study and the highest accretion occurred in the northern region of the study.
4.2 Land Use in 1990 and 2018

Table 2. Landuse Change in Serang City

| Landuse    | 1990               | 2018               |
|------------|--------------------|--------------------|
| Settlement | 2178.94 km²        | 2278.73 km²        |
| Fish Pond  | 4557.305.43 km²    | 9332.338.83 km²    |
| Mangrove   | 784058.92 km²      | 316382.48 km²      |

Landuse change are analyzed in 3 time interval, which are 1990-1998, 1998-2008, and 2008-2018’s period. Landuse change impact the coastline change in Serang City. Human activities are also contribute to the coastline change, which in coastal area development. Among others the settlement development and the fish pond development.

4.3 Dynamics of Change in Coastlines 1990 -2018

The area affected by strong abrasion is located in the Pulau Dua Nature Reserve or the eastern region of the research area, as seen in the results of the research with a large rate and area of abrasion. This region is located in the current condition that moves from the southwest and northwest in the west season and northeast to southeast in the east monsoon. The dominant current that influences the occurrence of abrasion is the west monsoon, with the direction of the coast to the west, the west monsoon that comes will move parallel to the coastline so that it tends to cause material displacement and can cause abrasion in the region.

Areas that affected by considerable accretion are in the estuary of the Cibanten River, located in the western part of the research area directly adjacent to the Java Sea, with sea depth reaching 5 m, it can be said that this accretion area is in shallow seas, this shallow sea conditions support reclamation that exists, in case that the land-making
constituents which are the result of the reclamation are not easily eroded by flows or waves. That is because the shallow and sloping coastline is more likely to result in accretion than abrasion. Areas that affected by accretion due to natural factors are around the estuary, where the addition of land occurs naturally due to the material carried by the river flow which is then sedimented in the estuary, the area formed depends on the flow velocity of each river, area in the area of research location which are formed due to natural accretion forming a large area.

5. Conclusion
From the results of the Study of Coastline Change in the Coastal City of Serang, Banten Province shows that in the study area from 1990 to 2018 there was an abrasion of 378650.52 km² and accretion of 354862.33 km². Abrasion and accretion in the city of Serang is caused by human activities in the coastal region. The change in coastline is also affected by the geological structure in the northern part of Banten. Composed of alluvial deposits consisting of lava rock and pliocene breccias. These sediments are very susceptible to erosion by wave energy, currents, and weathering processes mainly by water. Another factor is the current speed and direction of the Sea. The average current velocity from the Java Sea is 0-5 cm / second. There are 3 rivers along the study area, this river affects the change in coastline, namely accretion at the estuary.

6. References
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