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ANALYSIS OF ABRASION AND LAND ACRESSION IN COASTAL SUBANG DISTRICT, INDONESIA

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ABSTRACT

The northern shoreline of West Java always changes from year to year. This serious change needs continuous monitoring. One of them is the coast of Subang Regency. The research method used is the interpretation of Landsat satellite imagery in 1998 and Allos imagery in 2006 and field testing. By overlaying both satellite images through geographic information systems is a fast way to find out changes that occur on the north coast in Subang Regency.Based on survey results obtained accuracy of 93% and valid from 28 observation points which form the shoreline and land use. Shoreline that occurred between 1999 and 2006 more experience with the process of abrasion if compared with accretion. The phenomenon of abrasion that occurred reached 771,424 hectares, while accretion reached 177,931 hectares. Based on the results of this study, a conclusion can be drawn, namely the image of Stat Landsat and Allos can be used to determine changes in the northern coastline with an accuracy level of 93%.

KeyWords

Allos, Coastal area, Landsat, Satellite images, Shoreline change.

Introduction

Indonesia is an island nation that has a coastline of 99,093 km (BIG, 2018) and is located on three earth plates namely Indo-Australia, Eurasia and the Pacific (BNBP, 2016). Based on these two criteria, 80% of Indonesia is very at risk of dynamic hydrometeorological activity. Hydrometeorological activity will affect the waves of sea water which will erode some coastal areas. The depletion of natural resources on land enables humans to try to use resources in coastal areas. Exploitation of coastal resources causes the decline of coastal ecosystems to become uncontrollable, so that these activities will result in abrasion and accretion in coastal areas.

The abrasion or coastal erosion is a process of erosion of the coast by destructive ocean wave power and ocean currents. Damage to the coastline due to abrasion is triggered by disruption of the natural balance around the coastal area. Although abrasion can be caused by natural symptoms, but human activity in building various buildings on the seashore of humans is often cited as the main cause of abrasion. The abrasion analysis is done by making a delta morphological change of the coast backward from the original coastline.

Meanwhile, accretion is a process whereby a coastline changes towards the sea due to the addition or advancement of a coastline as a result of sedimentation and forming arising land. Accretion analysis is based on land area that is increasing or coastline advancing from its original condition. Accretion is the increase in land bordering the sea due to the deposition process, both by the sediment material carried by the river and the sediment material from the surrounding sea water activities. This form of accretion is in the form of deltas and coastal bunds with very gentle coastal conditions. From the results of the investigation it was discovered that there was an estuary / coastline that advanced towards the sea (progadation) and an estuary / coastline that retreated towards the mainland (retrogation) in addition to several places where the coastline was rather stable. The coastline naturally changes from time to time in line with natural changes such as the activity of waves, winds, tides and currents and sedimentation of river deltas. However, changes in the coastline can be increased by the disruption of coastal ecosystems such as mangrove forests as a beach buffer changed its function to be used as a fishpond area, shelter, industry and reclamation areas and then making embankments and canals and buildings around the coast.

The north coast of West Java, seen from its morphology, is divided into developed and backward beaches. Coastal events are temporary or backward in nature if there is no human intervention in them, for example in the western season the material along the affected coastline will move eastward by the longitudinal coastal current system, and vice versa if the east season, so that coastal material transferred will be returned to its original position. One of the northern beaches of West Java is Subang Regency.

Subang Regency has a coastline along 68 Km with the morphology and topography of its coast which is characterized by the shape of the beach that protrudes towards the land in the shape of the bay, such as in the Blanakan coast region, and which protrudes towards the sea in the form of a cape, such as in the Legonkulon coast region (Nandi *et al*., 2016). This causes a difference in the development of the beach in Subang, there are beaches that have abrasion and those that have accretion. Therefore, the function of mangrove forests in particular functions as a barrier to abrasion and sedimentation barrier is needed. The area of ponds that have been developed in Subang Regency reaches 10,000 hectares spread across 4 districts, namely Blanakan, Sukasari, LegonKulon and Pusakegara. The area of ponds that are in the mangrove ecosystem area, makes the quality and quantity of mangroves become very declining, in other words the economic function of mangrove ecosystems in Subang Regency is greater than its ecological function.

The geographic process in the coastal region between Subang is very dynamic resulting in the erosion of coastal land, namely abrasion. The process of abrasion in several places causes the loss of ponds, some settlements, beach tourism, and other facilities (Wells &Ravilious, 2006). In addition, the process of transportation and sedimentation processes that continuously cause changes in the coastline that tends increasingly towards the sea, namely accretion. Usually the emergence of new lands in this area will be used by residents for various activities. The use of the new land has resulted in social conflicts, namely land grabs and legalization of land (White *et al*., 2012).

Coastal waters of Subang are located in the northern part of West Java Province and are in direct contact with the Java Sea. The characteristics of the north coast of West Java are the shape of the sloping beach and the contour of the sea depth that is not continuous with the depth of the relatively shallow coastal waters and the bottom of the mud sand waters. Some of the Subang coastal areas are sea transportation, fisheries and as a place to end waste collection from settlements originating from rivers.

Coastal areas are dynamic and vulnerable to environmental changes both due to natural processes and due to human activities. Rais (2000) argues that the coastal region is a very densely populated area and the world's population that lives in coastal areas ranges from 50-70% of the total world population. In Indonesia, 60% of the population lives in coastal areas, an increase in the number of people living in coastal areas has an impact on coastal natural resources such as coastal degradation, waste disposal into the sea, coastal erosion (abrasion), beach accretion (addition of beaches) and so on.

Changes in the coastline are mostly done by human activities such as land clearing, exploitation of minerals in coastal land which can change the balance of the coastline through an excessive supply of sediment load. With high intensity rainfall it can also affect shoreline behavior. Along the coast there are coastal segments that experience erosion, besides there are parts that experience accretion / sedimentation and stable segments (Dahuri*et al*., 2001). Ongkosongo(2006) suggested that about 70% of the mainly sandy beaches in the world experience coastal erosion and the main cause is a variety of direct or indirect human influences that cause a reduction in the amount of available sediment reserves on the coast compared to sediments offshore due to inland influences.

In some parts of the coast in the world, coastal erosion that occurred has caused huge losses in the form of residential areas, ponds, and highways. Coastal erosion is one of the serious problems of coastline degradation caused by wind, rain, currents,

and waves and as a result of human activities. Human activities such as mangrove forest clearance, sea sand mining and coral reef mining in several locations have made important contributions to coastal erosion, due to the loss of coastal protection from waves and storms (Bowden, 1980; Bengen, 2001). The beach is also a potential recreational area for the local area so its existence needs to be maintained, managed and preserved.

Material and Methods

Study site

The method used in data collection related to this work is the Triangulation method, which is a method of collecting data through a field observation approach, laboratory testing and interviews with the community / secondary data in Subang Regency. In field observations, observations and measurements of object conditions will be observed. Laboratory tests are used to evaluate the physical chemical condition of the aquatic environment. Secondary data is the data needed in this study that has been studied that comes from the reference and government of Subang Regency.

Data Analysis

Mapping the status of mangrove ecosystems will use satellite images according to the type of damage that has been identified. The scale used is 1: 50,000. The image used is the latest image that is ordered in advance at the provider. The process of analysis and digitization on screen to create a basic map. This interpretation is done in ArcGis software. To make a basic map, of course, initial data in the form of images is needed. Image data import is done in .tif format, with file type: geotive, meaning that the image data already has a coordinate system. The steps for making a basic map are as follows:

1. Transforming coordinates from the UTM system to the geography system.
2. Image radiometric correction. This correction is intended to eliminate or at least reduce the effect of atmospheric scattering on the digital value of the image. The method used is histogram leveling (histogram adjustment).
3. Discard areas that are covered by clouds so that they do not get processed.
4. Separating land and sea mintakat by digitizing land boundaries. On land mints were digitized to obtain mangrove areas and conditions of terrestrial ecosystem cover. The sea zakat is digitized to get a reef flat. Maps containing land boundaries, mangrove distribution boundaries and reef flat distribution limits are used as a basemap.

After the base map is finished, the next step is to determine the points to be visited in the field, especially the observation points. Determination of these points is done by digitizing points on the base map. The starting point is randomly determined and chosen at the location of the "reef" (the beginning of the reef slope), which is the border between the average mangrove and the sea. The next point is digitized as far as 1 km (minimum) to 3 km (maximum) along the coastline.

Resultsand Discussion

The Coastal Area of Subang Regency only exists in 4 sub-districts namely Blanakan, Sukasari, Legonkulon and Pusakagara Districts with an area of 333.57 km2 or 16% of the district area, with a coastline length of 68 km (BAPPEDA Jabar, 2007). Based on the results of abrasion and accretion analysis in the coastal area of Subang Regency, there have been changes in the coastline over the past 15 years (Table 1, Fig. 2).

Table 1. Distance of abrasion and accretion in the last 15 years on the coast of Subang Regency

District	Change of coast in the last 15 years	
	Abrasion (m)	Acression(m)
Pusakanagara	524,45 – 1206,83	-
Legonkulon	565,65 – 894,78	537,63 – 764,67
Sukasari	53,17 – 54,17	229,54 – 243,53
Blankaan	-	686,53 – 1051,55

In the coastal area of Subang, there are mangrove plants which form a green belt (Green Belt) which is quite good (Table 2). However, there has been a form of pressure on mangrove areas, namely the conversion of mangrove land into shrimp and fish ponds, as well as other uses for household needs and commodities. This statement is in accordance with Arief (2007) which says that Along with the rate of population growth and development, the function of the coastal environment in some areas has decreased or damaged. This is indicated by the process of coastal erosion / abrasion, sea water intrusion, and degradation of water products. The mangrove area is very strategic, so many interests cause the mangrove area to experience treatment that exceeds its ability to hold natural regeneration.

Table 2. Distribution of mangrove forests in the Coastal District of Subang

Districts	Forest Area (Ha)	Explanation
LegonKulon Districts		
Pangerangan	158,5	Good
Mayangan	95,8	Poor
Tegalurung	407,6	Good

LegonWetan	304,4	Moderate
Anggasari	633,4	Moderate
Blanakan District		
CilamayaGirang	267,6	Moderate
Rawameneng	280,3	Moderate
Jayamukti	243,9	Moderate
Blanakan	300,0	Moderate
Langensari	187,0	Moderate
Muara	305,0	Good
Tanjungtiga	570,0	Good

Based on the pressures on the mangrove area, the coast of Subang Regency is prone to abrasion, because there are no barriers or protectors from waves and waves heading towards the mainland, and finally abrasion and tidal floods occur in the coastal land area. The area of abrasion and tidal floods on the coast of Subang Regency can be found in the Legonkulon, Pusakagara and Sukasari areas.

Behind that, there are several areas, especially the coastal area of Subang Regency which is directly adjacent to the river mouth, there has been a buildup of sedimentation carried away from the river, in addition there are some areas that have good mangrove ecosystems so that particles carried both from the river and sea are trapped. in the mangrove area and forming new land or called accretion, this area can be found mostly in the Pamanukan and Blanakan Districts.

Figure1. Map of coastal abrasion and accretion conditions in Subang Regency

Abrasion on the coast of Subang Regency

Based on the results of the analysis of abrasion using Landsat image analysis periods of 15 years, 10 years, the last 5 years and the current map. Based on the analysis of Landsat imagery overlayed in the last 15 years, the coastal abrasion area of Subang Regency is dominated in Pusakagara District and part of Legonkulon (Tab.1, Fig. 1). The highest location of abrasion was 2003-2018 (15 years), namely in the district of Pusakagra with an abrasion length of 524.45 - 1206.83 meters. Over the past 15 years the Coastal District of Subang has experienced abrasions of 5-10 meters per year. It can be interpreted every year that the land area of some areas along the coast of Subang has been lost.

DesaPatimbankecamatanPusakanagaramenjadidesa di pesisirKabupatenSubangdengantingkatabrasiterbesar (Fig. 3), halinidisebabkankondisi mangrove disekitarpantairusakparah.Fungsi mangrove di kawasanpesisirsebagaipenahanterjadinyaabrasi (Surayo*et al*. 2012; Sunyowati et al. 2016), sehinggadenganhilangnyaekosistem mangrove mengakibatkantidakadanyapenahanuntukmenurunkankekuatangelombanglaut yang akanmengikisdaratanpantai.

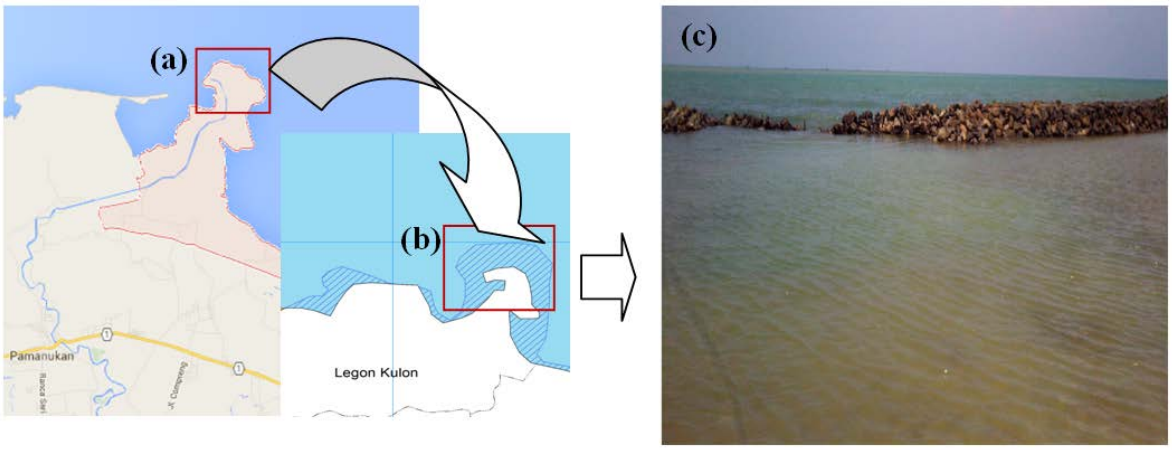

Figure 2.Abrasion on the coast of Subang (a) Patimban Bay, (b) Analysis of Patimban Bay abrasion, and (c) changes in the mainland of Patimban Bay

Besides Panimban, abrasion with a fairly wide area also occurred in Mayangan Village, Legonkulon District. This area in the period of 5 years of crushing due to abrasion is quite extensive even paralyzing the tourist area of Pondok Bali. When viewed from the mangrove vegetation of Legonkulon District, Mayangan Village is the narrowest village with poor status mangroves (Tab. 2).The impact caused by abrasion will reduce the economic level of local residents. Hundreds of hectares of rice fields and shrimp ponds and fish failed to harvest, submerging homes and tourist areas as well as the level of sea water intrusion to land increasingly higher.

Accretion on the Coast of Subang Regency

Based on the results of the accretion analysis on the coast of Subang Regency, it is dominated by the west coast area of Subang Regency, namely the western Legonkulon sub-district, Sukasari Sub-district and Blanakan Sub-district. The villages that experienced accretion were Tegalurung Village and Pangarengan, Legonkulon District; Anggasari Village, Sukasari District; the villages of TanjungTiga, Muara, Langensar, Blanakan, and Jayamukti in Blanakan sub-district. The highest area of accretion is in Belanakan sub-district with an additional land length of 686.53 - 1051.55 meters, followed by Legonkulon sub-district with an accretion length of 537.63 - 764.67 meters. When viewed from these characteristics shows that accretion villages are villages with extensive mangrove vegitation (Tab 2).

Mangroves are coastal vegetation that function as sediment traps (van Santen *et al*., 2007), in other words when transportation of mud or sand from rivers or the sea, mangrove vegetation will capture and form land. Accretion due to mangrove vegetation occurs on the coast of Subang Regency, especially in Pangarengan and Blanakan.

Accretion in the village of Pangarengan in TanjungCirewang region which was formed about 13 years ago. This Timbul land seems to be the natural barrier of Cirewang village from the direct blow of the north sea waves. The mangrove ecosystem in Pangarengan Village is included in the good category with an area of 158,5 Ha.

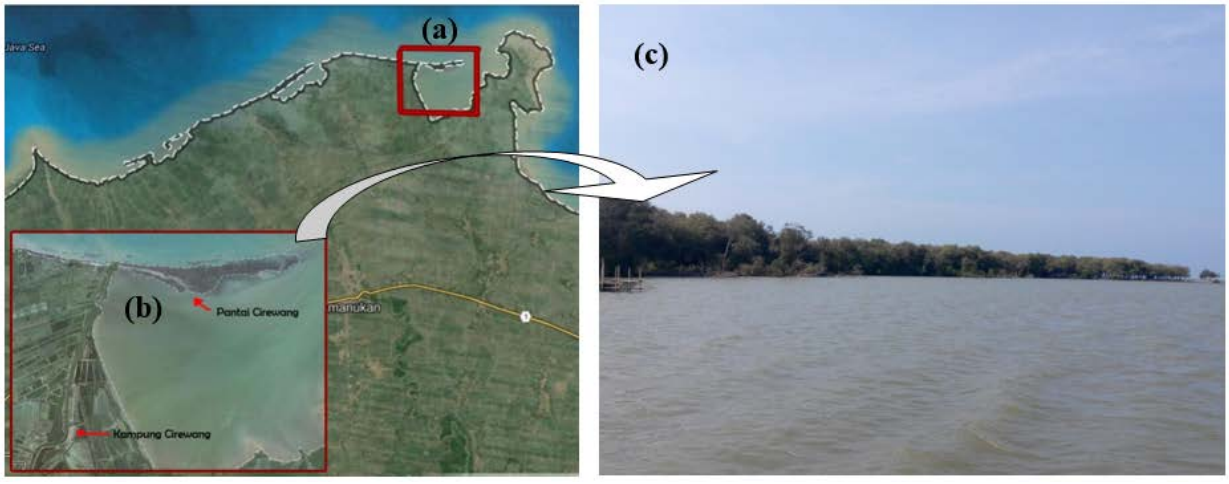

Figure 3.Accretion on the Subang Coast (a) TanjungCirewangPangarengan Village, Legonkulon District, (b) TanjungCirewang accretion, and (c) Land accretion with sand sediments in TanjungCirewang.

Accretion that occurs in the village of Pangarengan is sedimentation in the form of sand originating from the Java sea that is carried by currents to form new land. Along with the emergence of new land followed by the growth of mangreve vegetation, so that the longer the area reaches 500 m^2 this extends more than 1 km from east to west / towards the sea.

Based on the results of the study showed that Pangarengan Village experienced an increase in land due to accretion, while Patimban Village experienced a reduction in land due to abrasion.Pangarengan Village is adjacent to Patimban Village. The two villages have different mangrove vegetation (Table 2). The mangrove ecosystem in Pangarengan Village is in good condition while in Patimban Village the mangrove condition is heavily damaged. This has an effect on the level of sedimentation and reduction of ocean waves. One of the functions of mangroves is as a sediment trap and a wave barrier that will erode coastal land (Alongi& McKinnon, 2005; McLeod *et al*., 2011).

Accretion also occurs on the coast of Blanakan District, precisely in the western part of Blanakan Bay. The coastline changes that occur indicate the forward movement of the coastline, which indicates accretion. Accretion that occurred in the Blanakan Bay study area was caused by the presence of sediment runoff from the Ciasem River which was then driven by currents heading west, visible from wind windrose on the north coast of Subang which showed dominant winds heading west and southwest. Besides due to the influence of wind, sedimentation that occurred in the Blanakan Bay study area was also caused by the coast of Subang Regency in the west being more gentle than the coast in the east (BAPPEDA Jabar, 2007). The sediment was then trapped in the bay of Blanakan District.

The accretion that occurs in Blanakan Bay (Fig. 4) is different from that in Pangarengan (Fig. 3). Sediments deposited in Blanakan Bay are in the form of mud carried from rivers, while sediments in the Pangarengan area are sand carried by ocean currents. However, both processes have the same process of capturing sediment by the mangrove ecosystem.

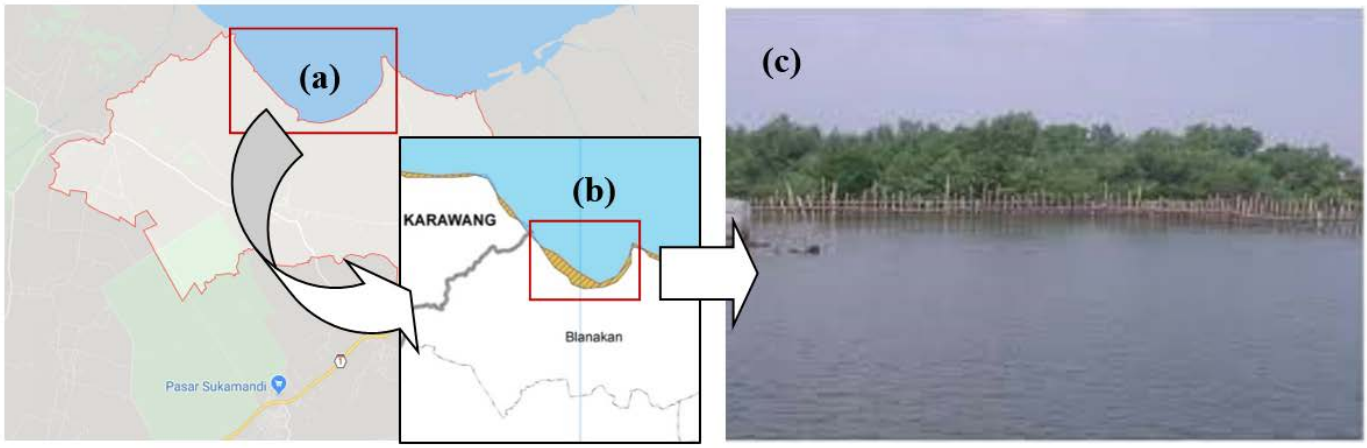

Figure 4.Accretion on the Subang Coast (a) Blanakan Bay, (b) Accretion of Blanakan Bay, and (c) Land accretion with mud sediments in Blanakan Bay.

Mangrove ecosystems in Blanakan grow in river deltas that carry sediment in the form of mud material and ponds belonging to the surrounding community. As an area that has many river mouths that form a delta, Blanakan District is a fertile area that can be sustainably overgrown with mangroves. However, due to the uncontrolled use of mangroves, especially to be used as ponds and mangrove cutting for fuel, mangroves in this area suffered damage. According to Syamsudin (2007), the area of mangrove that was severely damaged was largely forest growing in community-owned ponds due to uncontrolled use of mangrove wood and community ignorance of the function of mangroves for the environment including human life.

The greatest coastline progress occurred in the Blanakan bay area and occurred in the interior of the Blanakan Bay coastal area. In the bay there is a ciasem river estuary, thus obtaining a very high level of sedimentation and finally the area becomes the widest accretion area.

Based on Figure 4, the potential for accretion in the SubangKabuapten Coast looks greater in the bay area, namely on the Blanakan coast. From the analysis of the potential accretion, policies must be immediately taken to avoid conflicts over land ownership, namely by planting mangroves.

The advancing coastline and the development of river mouths towards the ocean at a speed of 750 meters / year in the area between MuaraCiasem to the Cilamaya New estuary. Siltation in river mouths is caused by high material content, consisting of alluvial and alluvial sand that originates from the southern areas of the investigation area (Directorate of Geology, 1963), which are carried by the river and due to the low gradient of the rivers themselves and the weak river flow in the river estuary areas cause river flooding especially during the rainy season, often accompanied by drifting trees or tree branches (Suriadarma, 1981). Siltation-siltation that occurs due to routine flooding with a high enough frequency to produce flood waste deposits year after year and the development of river mouths far enough towards the sea. This explanation explains the presence of terrestrial sediments which are clay to sandy beaches and sediments which are generally clay to silt in advanced estuaries / beaches.

Coastal accretion is the change in coastline to the high seas due to the process of sedimentation from land or rivers toward the sea. Sedimentation processes on land can be caused by land clearing, large volume of freshwater runoff due to prolonged rain

and the process of transporting sediment from river bodies to the sea. Coastal accretion can also cause siltation to occur evenly towards the sea which will gradually form a plain in the form of deltas or arising land. The process of coastal accretion usually occurs in coastal waters that have many river mouths and small wave energy and areas that are free from storms.

The impact of beach accretion when viewed from a strategic aspect is the increase in area in an area and silting that can interfere with navigation and shipping lines. The impact if viewed from an environmental aspect is the occurrence of changes or even the loss of a habitat from its ecosystem. The extent of mangroves will increase if their habitat in areas that have high sedimentation also increases. This condition in some places will also be associated with the increase of habitat that is overgrown by seagrass beds due to high nutrient supply from sediments. If there is a reef habitat on the beach it will cause the death of coral reef animals because it disrupts the metabolic function of coral animals and increases turbidity and decreases sunlight penetration.

Social impacts become important impacts in the accretion area. The reason is that the ownership rights of the accreted land are still unclear, so many people recognize the ownership rights of the land, so that those who first find that the accreted land belongs to him, so it can be sold. This is a social impact that will arise namely social conflict.

Conclusion

During 15 years the loss of land on the coast of Subang Regency occurred in Pusakagara District with a value of 524.45 - 1206.83 meters and addition of land in Blanakan District with a value of 686.53 - 1051.55 meters. Increasing and decreasing land on the coast of Subang Regency due to wave strength, sedimentation and density of mangrove vegetation around the coast of Subang Regency, Indonesia.

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