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A Study on Zone Alteration of Mangrove Caused by Abrasion in the Marangkayu Coastal Area of Kutai Kartanegara Regency

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Abstract

This study focuses on observing various types of mangroves and mangroves that are resistant to penetration in four coastal areas, namely Tanjung Santan, Kersik, Terusan, and Pangempang. Identification of erosion levels in each area was carried out through remote sensing in 2003 and 2011 in Marangkayu District, Kutai Kartanegara Regency, East Kalimantan Province. Data collection of mangrove vegetation was carried out in four coastal areas, namely Tanjung Santan, Kersik, Terusan, and Pangempang. The results of remote sensing calculations show a shift in the rate of coastline due to erosion in Tanjung Santan around 1.39 m / year, Kersik by 2.75 m / year, and Canal around 0.45 m/year. In Pangempang, sedimentation causes an addition of about 1.09 m/year. The Mangrove Zone on the coast of Marangkayu suffered significant losses due to coastal abrasion, causing zoning changes, especially in Tanjung Santan, Kersik, and north of the Canal coast. Meanwhile, in Pangempang, mangrove zoning is still relatively normal.

Keywords: *Mangrove Zone Alteration, Abrasion Impact, Coastal Erosion.*

1. INTRODUCTION

Marangkayu subdistrict, Kutai Kartanegara regency, has coastal areas that consist of Tanjung Santan Coastal Area, Kersik coast, Terusan coast, and Pangempang. All four of these coastal areas are predominantly mangrove forests facing the open sea of the Makassar Strait and the Sulawesi Sea.

This research involved observing the types of mangroves and their impenetrability in the four coastal areas: Tanjung Santan Coastal Area, Kersik coast, Terusan coast, and Pangempang. To identify the erosion level in each area, remote sensing was used in 2003 and 2011 in Marangkayu subdistrict.

The remote sensing calculations showed that erosion in the Tanjung Santan coastline was in the average category at 1.39 m/year, Kersik coast experienced major loss at around 2.75 m/year, Terusan coast around 0.45 m/year, and Pangempang experienced accretion at around 1.09 m/year.

The impenetrable level of the mangrove forest in the northern part of Tanjung Santan Coast and Terusan Coast experienced a high level of loss due to coastal abrasion and zonation alteration. The mangrove vegetated area was dominated by Rhizophora sp and other middle zone mangroves. From the southern part of Terusan Beach to Pangempang, the mangroves were dominated by Avicennia sp and Sonneratia sp, representing the proximal zone mangrove. Therefore, Pangempang beach was classified as having a normal mangrove zone.

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Marangkayu coastal area consists of Tanjung Santan coast, Kersik coast, Terusan coast, and Pangempang, with its coastline stretching along 27.5 km. Administratively, this area belongs to Kutai Kartanegara regency (DKP Kukar 2008).

Geographically, Marangkayu coastal area is open to the Makassar Strait, subjecting it to strong winds and waves directly from the sea. Typically, along the Marang Kayu coastal area, the vegetation is predominantly mangrove forest (DKP Kukar, 2008). However, significant changes in the extent of mangroves occur every year due to coastal abrasion.

Almost along the Marang Kayu coastal area, the vegetation is mostly mangrove forest, but the vegetation varies from one place to another.

Figure 1. Remote sensing of Marang Kayu and four coastal areas.

Along Kersik coastal area, the changes of coastline which are caused by water current and wave in the specific time destroy the mangrove forest. High level of sedimentation can also cause the changes of coastal morphology which has an impact on mangrove habitat along Marangkayu coastal area.

Based on data from some conducted researches, from the area of Kersik coast to Pangempang showed the high level of abrasion (Yulistianto, 2000). Furthermore, based on the information from the society, Kersik coast has degraded around 1 km to the coastline. Mangrove ecosystems suffer from degradation due to many different causes and underlying drivers, which indirectly change the zonation of mangrove vegetation.

The morphological changes of the coastal area and degradation of mangrove habitats along Marangkayu coastal area caused by oceanography variable such as tidal energy, tidal movement and sediment transport and deposition which then become the main focus of this study. Relating the morphological changes to coastal area such as the shifting coastline and mangrove degradation become the crucial issue.

2. LITERATURE REVIEW

2.1 Mangrove ecosystems and habitats

Mangroves are typical vegetation found along the sheltered coastline in the tropics and grow well in the temperature from 19° to 40° with the tolerance no more than 10° C. Various types of mangroves grow in the coastline and near the saline water, thus are

typical ecosystems because can grow and live well in the transition zone between land and sea (Kusmana, 2008).

Mangrove forests play an important role as sediment traps which are brought by tidal waves whether from the sea or the river. Mangrove forests do not only protect the coast from tidal waves and wind but also as a place for diverse animals, both terrestrial and marine ecosystems. Besides its high biodiversity, mangrove ecosystems function as a genetic pool to support all the living systems around the forest areas (Harianto, 2009).

The characteristics of mangrove forests are depicted as follows:

1. Generally grow in the intertidal area with wetland or sandy characteristics.

2. The area which is covered with water whether every day or only when the tide is high. The frequency of water classifies the composition of mangrove vegetation.

3. Get enough freshwater supply

4. Protected from the big wave and strong tidal waves

Mangrove habitats are classified as follows (De Haan in Bengen, 2007):

1. Brackish water zone with salinity around 10-30 ppt is described as follows:

a. The area which is covered with water once or twice a day for 20 days in a month, a type of mangrove which can only be found is Rhizophora mucronata.

b. The area which is covered with water 10-19 times in a month, a type of mangrove which can be found is Avicennia (A. alba, A. lauta), Sonneratia griffithii and Rhizophora sp.

c. The area which is covered with water less than 9 times in a month, Rhizophora sp/Bruguiera sp is usually found.

d. The area which covered with water only for a few days in a year, Bruguiera gymnorhiza grows predominantly and Rhizophora apiculata is usually found.

2. Fresh water zone to brackish water zone, the salinity is around 0-9 ppt, this area is characterised as follows:

a. Nypa can be found in the area which is influenced by ocean tides.

b. The area which is covered with water in particular time, Hibiscus is dominantly found.

Generally, mangrove habitats across the intertidal zone often lead to distinct zonation. According to Giesen in Welly, et al (2010), four conspicuous zones are described as follows:

a. The exposed mangrove (this zone is towards water front). Generally, this zone is dominated by Sonneratia alba, Avicennia alba and Avicennia marina.

b. Central mangrove (middle zone between land and sea). Rhizopora, sp grows predominantly in this area, and Bruguria sp sometimes can adjust in this zone.

c. The rear mangrove (back mangrove, landward mangrove, the area which is the nearest to the mainland. This area is usually covered with water only when the tide is high. Bruguiera, Lumnitzera, Xylocarpus and Pandanus sp grow well in this area.

d. Brackish stream mangrove (the river stream with brackish water). In this zone, Nypa frutican, Sonneratia caseolaris and Xylocarpus granatum can be found.

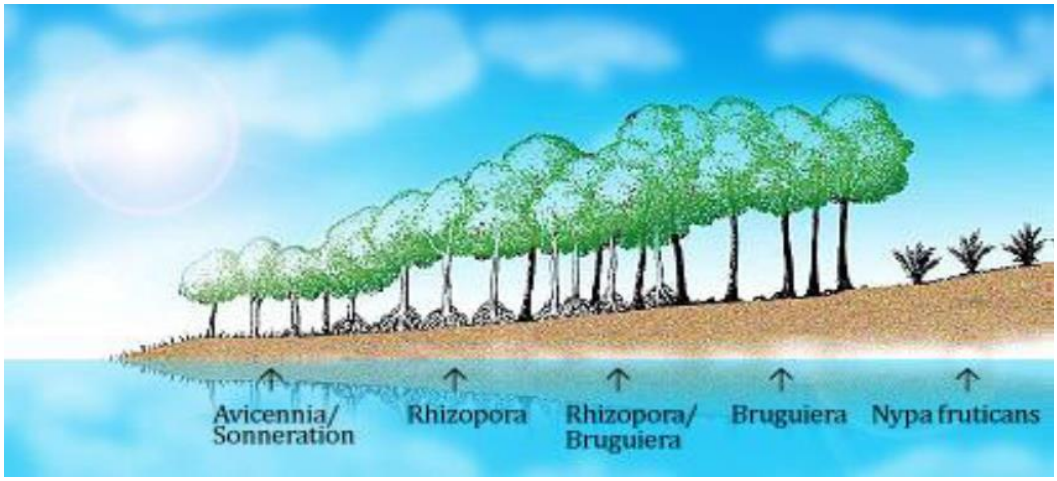

Figure 2. Types of Mangrove Based on Coastal Zone

Source: (www.sahabatbakau.com in Welly, 2010)

2.2. The changes of coastline

Generally, coastlines experience changes from time to time. Those changes are caused by wave, wind, tides, water current, and sedimentation in the river delta. Another driver is the conversion of mangrove forests which serve to protect the coastal areas, but have been switched to the aquaculture ponds and land reclamation. The changes of the coastlines based on the sedimentation pattern can lead to the peninsula formation and bay areas. Abrasion in the coastal areas has more negative impact because it can degrade the land, while accretion has both positive and negative impacts on the environment. The positive impact of accretion is the increasing number of aquaculture ponds and farming lands. While the negative impact is the water level becomes shallower which makes the fisherman's ship cannot enter the river. Moreover, the sea level near the dock or port becomes shallower which can disturb the fisherman's activities (Setyandito, 2007). In this case, the degradation of the coastal area and accretion become the main focus of this study. The degradation of coastal area is classified as follows:

a. The degradation of sandy coastal area, namely Erosion.

b. The degradation of gravelly coastal area, namely abrasion.

Erosion level is divided into:

1. Slightly eroded : <0.5m/year
2. Moderately eroded : 0.5 – 2.0m/year
3. Heavily eroded : 2.0 – 5.0m/year
4. Very eroded : 5.0 – 10.0m/year
5. Extremely eroded : >10m/year

3. METHODS

This research was conducted in Marangkayu coastal areas, Marangkayu subdistrict, Kutai Kartanegara Regency, East Kalimantan Province, which consisted of four coastal areas, they were: Tanjung Santan Coast, Kersik Coast, Terusan Coast, and Pangempang. The research location was shown in the picture below:

Figure 3. Kalimantan Map and Study Area

(http://4.bp.blogspot.com)

Data of mangrove vegetation were collected in each area of Tanjung Santan coast, Kersik coast, Terusan coast, and Pangempang coast. To identify the degradation of coastline which was caused by erosion or abrasion, remote sensing was utilised from 2003 to 2011 in the four Marangkayu coastal areas.

4. RESULTS AND DISCUSSION

4.1 Remote sensing analysis

Remote sensing analysis in Marangkayu coastal areas which was taken in March, 2003 (Google Earth) and in September 2011 (Quickbird) and was divided into four segments of coastal areas showed that land degradation occurred in each coastal area. Below is the description:

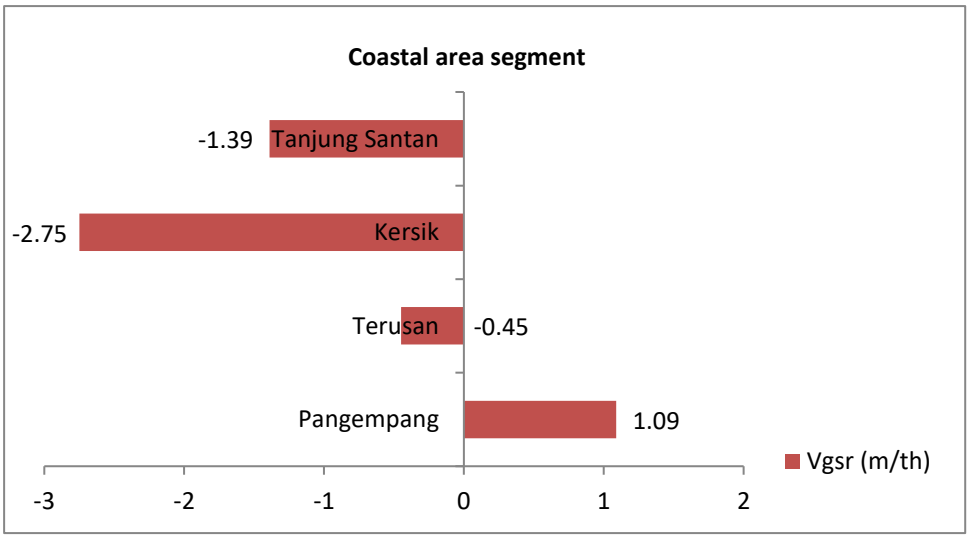

Figure 4. Remote sensing analysis which showed the coastline degradation

In Tanjung santan coastal area, erosion occurred around 1.39 m/year, Kersik Coast experienced erosion 2.75m/year, erosion in Terusan coast was estimated around 0.45 m/year and accretion in Pangempang was 1.09m/year. By identifying the length of

coastline in each coastal area, the width of eroded land could be calculated annually. The result can be seen in table 1 as follows:

Table 1: the width of eroded land in each coastal area

No.Sg	Coastal area	Cw (m^2)	Time (Year)	Cwa (m^2/year)	l (m)	Vcc (m/year)
A	Tanjung Santan	(38.498)	8,5	(4.529)	3.249,6	-1,39
B	Kersik	(213.457)	8,5	(25.113)	9.139,5	-2,75
C	Terusan	(29.659)	8,5	(3.489)	7.785,5	-0,45
D	Pangempang	83.742	8,5	9.852	9.071,8	1,09
	Total	(197.872)	8,5	(24.734)	29.246,4	-0,85

Remarks:

Cw : Changes of width for 8.5 years (March 2003 – Sept 2011)

Cwa : Changes of width per year (m2/year)

Vcc : Velocity of coastline changes per year

L : Length of coastline in each coastal segment

*) Total Pj. GP : 29.246,4m (Based on remote sensing data pixel)

4.2 Mangrove vegetation analysis

4.2.1 Tanjung Santan Coastal Area

Data of mangrove impenetrable area was collected by observing the types of mangrove found along Marangkayu coastlines. Rhizopora sp grew predominantly (56.47%) in this area. The composition of mangrove in Tanjung Santan was shown in the picture below:

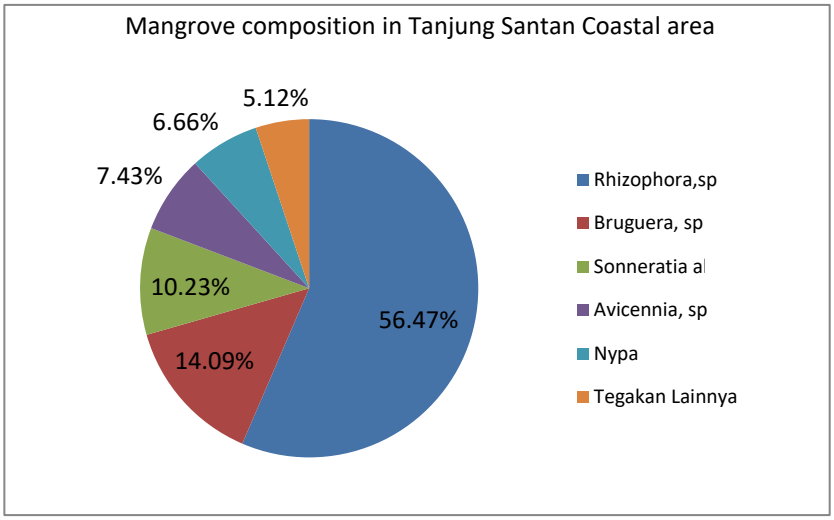

Figure 5. Mangrove composition in Tanjung Santan Coastal area.

4.2.2 Segment B or Kersik Coastal area

The composition and impenetrable level of mangrove in Kersik coast was also dominated by Rhizopora sp, it was around 63.21 % and described in the picture 6 below:

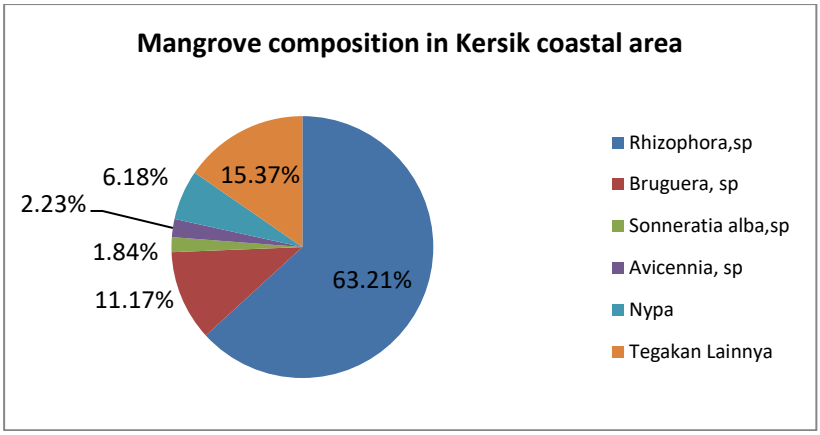

Figure 6. Mangrove composition in Kersik Coastal area

4.2.3 Segment C or Terusan coastal area

The composition and impenetrable level of mangrove based on the calculation in Terusan coastal area was depicted in picture 7 as follows:

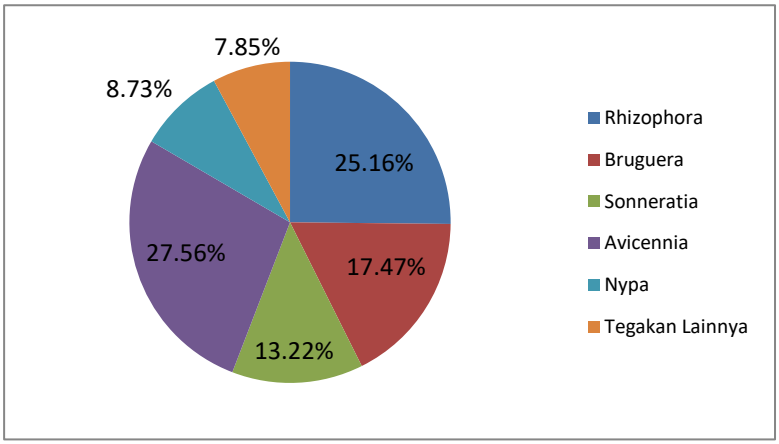

Figure 7. The composition of mangrove in Terusan coastal area

In Terusan coastal area, Avicennia alba, sp grew predominantly, around 76.92% with impenetrable level 1.000 trees/ha.

4.2.4 Segment D or Pangempang coastal area

The composition and impenetrable level of mangrove based on the data calculation in Pangempang area was dominated by Sonneratia, the composition was shown in picture 8 below:

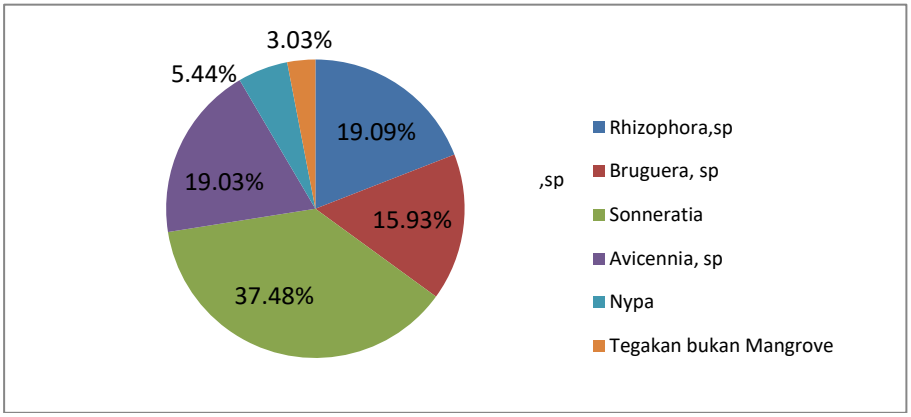

Figure 8. The composition of Mangrove in Pangempang coastal area

The impenetrable level of mangrove per hectare in each coastal area was shown in picture 8. The impenetrable level of mangrove per Ha in every segment of coastal area.

4.3 The analysis of mangrove zone in Marangkayu coastal area

Mangrove vegetation survey in Marangkayu coastal area showed various types along the shore. The observation demonstrated that in Tanjung Santan and Kersik coastlines, middle zone mangrove could be found predominantly. This might happen because of zone shifting which was caused by high abrasion. While in Terusan coastline, particularly in the northern part, degradation occurred and zonation alteration happened. Moreover, in the southern part of Terusan coast to Pangempang mangrove zonation was classified to have a natural habitat.

5. CONCLUSSION

Remote sensing calculations showed that shifting coastline rates due to erosion in Tanjung Santan were 1.39 m/year, Kersik coast was 2.75 m/year, and Terusan coast was 0.45 m/year, while in Pangempang, sedimentation had led to accretion at around 1.09 m/year. The Mangrove Zone in the Marangkayu coastal area experienced high loss due to coastal abrasion, leading to zonation shifting, particularly in the Tanjung Santan area, Kersik, and the northern part of the Terusan coast. Meanwhile, Pangempang was still classified as having a normal zonation.

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