

MAPPING OF MANGROVE DEGRADATION AND COASTAL ABRASION BASED ON GEOGRAPHIC INFORMATION SYSTEM IN THE BREBES REGENCY CENTRAL JAVA

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Abstract

The issue of degradation of mangrove and coastal erosion are always actual . This study aims to determine the condition of mangrove vegetation and coastal erosion rate in the Brebes Regency. Research using GIS technology (Geographic Information System) and remote sensing through satellite imagery interpretation and analysis of Landsat 7 TM . Determination of the relationship model of the dynamics of ecological factors in the degradation of mangroves and coastal erosion is done through the analysis of a dynamic system with the help of soft ware Power Sim 2.0 . The results of the interpretation of satellite data using NDVI (Normalized Difference Vegetation Index) shows that the extent of mangroves in the Brebes coastal area 243.20 hectares live scattered in the Sub District of Losari 26.56 hectares , in the Sub District of Tanjung 5.60 hectares, 35.42 hectares in Sub District Bulakamba , in Sub District Wanasari 14.31 hectares and 11.31 hectares in Brebes Sub District . Mangrove vegetation density value in total for the Sub District of Losari , Tanjung , Bulakamba , Wanasari and Brebes District (Kaliwlingi and Randusanga Wetan) row 10.792 ; 19.466 ; 18,500 ; 13.034 ; 36.431 and 22.797 individuals per hectare with NDVI in a row : 0.096367 ; 0.173824 ; 0.165197 ; 0.116388 ; 0.295315 and 0.203568 with successive categories : very rare , rare , rare , rare , medium and rare . Furthermore, in the coastal region Brebes obtained 4 groups namely mangrove vegetation density : $0.1 < NDVI$ (vegetation is very rare) : 60.80 acres , $0.1 \leq NDVI < 0.2$ (rare) : 80.34 acres , $0.2 \leq NDVI < 0.3$ (moderate) : 72.92 acres and $0.3 \leq NDVI < 0.4$ (meetings) : 29.16 hectares . In general, there is harmony between the NDVI data obtained from field observations at each station . In the area of research found three types of mangrove vegetation in the number of viable count : *Rhizophora mucronata* , *Rhizophora apiculata* , *Avicennia marina* and overall *Rhizophora mucronata* has the highest density of 35 731 individuals / ha . at station 5 (Kaliwlingi , Brebes Sub District) . Mangrove degradation and coastal erosion in the area Brebes each 68 ha . / year and 63 ha . / year.

Keywords : degradation , mangrove , abrasion , *Rhizophora*

INTRODUCTION

Mangrove is a general term used to describe varieties of tropical beach community that is dominated by a few species of trees and shrubs that typically have the ability to grow in the salty waters. Brebes coastal area of Central Java Province along 65.480 kms, partly overgrown with mangrove beaches. Extensive mangrove in Brebes Regency in 2000 was 505 hectares where 210 hectares are in good condition, 205 hectares in moderate condition and 90 hectares in a damaged condition (Departement of Forestry and Plantation Brebes Regency, 2000). Ironically in 2008, precisely the extent of mangroves in coastal areas Brebes stay at 257.11 hectares (60%), scattered from Losari Sub District 25.43 hectares, Tanjung Sub District 18.95 hectares, Bulakamba Sub District 39.55 hectares, Wanasari Sub District 27, 29 hectares, and Brebes Sub District 145.89 hectares (Department of Fisheries and Marine Brebes Regency, 2008). Until 2000, covering coastal erosion Brebes accretion area of 789

hectares, while 310 hectares. From 2000 to 2008 abrasion in Brebes Regency reached 640.45 hectares with a shoreline length of 27.043 kms and accretion occurring 815.76 hectares covering the 27.147 kms long coastline.

Introductory

Ecologically , acts as a protective mangrove ecosystem of coastal tsunami hazard , as retaining abrasion , nutrient recycling , coast guard and fisheries productivity biodiversity , dampening the rate of sea water intrusion , health support and other coastal ecosystems cantilever (Tuwo , 2011) . Excessive utilization of mangrove forests as a preservative for the manufacture of ts and decision by certain people to sell that do have an impact on the condition of mangrove forests diminishing the quality and impact of its area smaller decline in the quality of coastal resources , including habitat.

Brebes coastal areas , Central Java Province along the 65.48 km , in 1983 covered an area of 2,327 ha of mangrove vegetation . (Anomimus , 2001) . In 2008 an area of 257.11 ha of mangrove stay . By 2000 coastal erosion area of 789 ha Brebes District . akresinya while covering 310 ha . Furthermore, from 2000 to 2008 , coastal erosion in the Brebes district reached 640.45 ha . with a length of 27.04 km shoreline accretion occurred while ha.dengan 815.76 27.14 km long coastline . (Department of Fisheries and Ocean Department, Brebes , 2008) .

Mangrove forest loss will lead to coastal erosion and abrasion otherwise instrumental in the reduction of mangrove area influenced by ecological factors , social , economic and cultural communities . For the dynamical systems model of the relationship of these factors need to be studied as grounding methods / policies handling damage mangrove ecosystem and coastal erosion . Based on the identification of the problem , the problem is formulated is how the condition of mangrove vegetation and coastal erosion in coastal areas Brebes . This research is expected to benefit academically in the field of science in developing methods of handling the degradation of mangroves and coastal erosion and practically can generate recommendations for local governments and communities in addressing Brebes degradation of mangroves and coastal erosion in the region .

Material and methods

The research was conducted in the coastal region of Central Java Brebes for 7 months in May - November 2013. The first stage of assessment by using GIS technology (Geographic Information System) and remote sensing (satellite imagery) of mangrove areas to be inventoried , and then performed the inspection phase of the interpretation and analysis of satellite imagery . Landsat TM satellite image data taken on May 31, 2013 and direct field observations conducted in May-July 2013. Observation stations is determined by the number of districts that have a mangrove forest vegetation purposively based on the condition of the mangrove ecosystem , and obtained 5 stations sequentially from west to east are: the District Losari (village Karangdempel) , Cape (Village Krakahan) , Bulakamba (Village Grinting) , Wanasari (Sawojajar village) as well as the District of Brebes (village Kaliwlingi and Randusanga Wetan) .

Figure 1 . Location Observation Research Station

The data were obtained either from direct observations in the field and Landsat TM Data citrasatelit processed to obtain the structure of mangrove communities . Input data derived from Landsat data format conversion is done Space agency , pillihan image , classification , analysis and incorporation of vegetation index classification results with Normalized Difference Vegetation Index (NDVI) . Data capture in the field of mangrove ecosystems along the transect method 100 meters or 500 meters with a width of 10 meters to 20 meters , on each transect was established at each observatioⁿ station , hereafter devised plot graduated sizes each - each 10 mx 10 m to rate trees ; 5 mx 5 m for saplings / puppies , and 1 mx 1 m for seedling level , then note all the kin^d and amount of mangroves in the area of the plot (Kusmana 2005) . Processing field data using Microsoft Excel which consists of calculating the density of mangrove species , the frequency of the type , kind and index closing value relative importance of mangrove (Bengen , 2002) . Analysis of ecological factors do dynamic system with the help of soft ware Power Sim 2.0 student version . Step-by- step analysis of dynamical systems as stated by Muhamadi , et al . (2001) .

Results and Discussion

Characteristics Brebes Beach

Brebes coastal waters are shallow coastal alluvial plains and is due to some activities large and small rivers that flow into the waters . Sedimentation and erosion that occurred along the coast of Brebes influenced by the changing nature of the river and its estuary . Conditions coastal waters Brebes West region where the relatively shallow depth of 5 meters to reach is approximately 2:25 km from the coastline due to the level of sedimentation in coastal waters Brebes West part higher than the eastern part .

According to Judge (2004) , Brebes District beach areas are divided into two types of beaches . Type the first beach scattered from coast to about estuary Kawad Losari , Pulogading Village , District Bulakamba . In this type of type of coastal mangrove vegetation often found on its coastline . Part beaches composed of alluvium sediments with low relief . Characteristics of the beach is generally in the form of mud flats interspersed with mangrove and there are also sand . Mud flats in the area of Losari showed rapid advancement coastline very intensive , which is caused by a very active process of sedimentation of rivers in Losari . Similarly, around the estuary Kluwut , beaches undergo a process of accretion is indicated by the presence of mangroves growing in the direction of the sea .

The second type of beaches scattered from around the mouth of the estuary Kawad to about Kaligangsa in the District of Brebes . Beach type is characterized by a coastal sediment deposition as well as the relief of the coastal plain alluvium . The sandy beach is found in several places Randusanga beach , Kaliwlingi , Sawojajar , Krakahan and Coral

Dempel.Pantai is characterized by sand beaches as coastal boundary . Fine sand -sized , brownish color , wide beach sandstone varies from 5-50 meters and slope (beach slope) of about 4 ° C - 14 ° C. Prominent features of this type of coast is the presence of sand / sandbars like in the estuary sandbank jutting toward Pemali Southwest - Northeast and in the Coral sandbank near to the District Losari . Sandbank in the region Pandansari Hamlet Village in Coral Kaliwlingi and near to the District Sejong and directly adjacent to wtilayah Cirebon , West Java is the accretion / sand dune that appears in pairan which is about 1-2 miles from the coast with a width of about 15 meters stretches about 5 km .. Both of these sandbars can be reached by boat outboard engine about 30 minutes from the beach .

On the eastern estuary Pemali (District of Brebes) , in Krakahan (Subdistrict of Tanjung) and near to Coral (District of Losari) experiencing shoreline erosion . This makes the reduction of the area of abrasion or loss of beach area / plot aquaculture farms so that activities can not be carried out again . Some farmers tried to work around this by creating a bulkhead in the dike pond using nets / waring / bamboo .

Coastal vegetation in coastal areas Randusanga , Kaliwlingi , Sawojajar , Krakahan and Karangdempel consists of various types of plant specific plants both onshore and terrestrial (land) . Specific plant species that are often found in coastal beach Randusanga include hibiscus and casuarina . Mangrove communities are often found along the coast Randusanga to several points along the coast until near to Coral .

Changes in Mangrove Conditions

Changes in the extent of mangroves in the coastal area of Brebes District 1983 to 2013 are presented in Table 1 . The tendency of a decrease in mangrove area (Y) in the coastal region of the Brebes District in 1983 as the calculation to zero (X0) following the regression equation $Y = 2,019.08 - 68.46 X$ with $R^2 = 84.50 \%$.

The density of mangrove forests

The density of mangrove species namely the total number of stands of a particular mangrove species per unit area . Rhizophora mucronata merniliki highest density at station 5 is 35 731 individuals / ha and the lowest at station 1 is 10 162 individuals / ha . R. apiculata has the highest density that is at station 6 is 420 individuals / ha and the relative is not found at stations 3 and 4 . The density of Avicennia marina highest of the five stations with the value of 500 individuals / ha and can not be found in station 4 . The density of trees , saplings and seedlings at each station.

Mangrove density according to satellite imagery can be seen from the results of analyzes using the normalized difference vegetation index (NDVI) . NDVI is a formula that can separate non- object vegetation with vegetation . To distinguish between mangrove vegetation with other vegetation (land) is to look at the vegetation distance to the beach . Vegetation found around the coast assumed as mangrove vegetation (Fiazia , 2006) . From the analysis using NDVI in coastal areas Brebes obtained four groups of mangrove vegetation density as listed in Table 3 . Extensive mangrove vegetation is greatest at the level of density is 80.34 ha rare . and the smallest is extensive mangrove density is 29.16 ha meeting .

Mangrove vegetation in coastal sub-district has an area of Brebes greatest density levels for all categories . Comparison of the results with the calculated image processing field data are presented in Table 5 . Category density mangrove stations observed only consists of three categories , namely category mangrove densities are very rare , rare and medium density . Category level for the rare mangrove density at station 1 , station rare category 2, 3 , 4 and 6 , while the medium density level can be found at station 5 . In general, NDVI values with values proportional to the density of mangrove vegetation .

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Frequency of mangrove vegetation types (F_i)

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Frequency indicates the type of value opportunities in the discovery of a particular kind of plot in the observation station (Bengen , 2002) . The number of plots in each observation station is 3 plots so kind that has a value equal to 1.00 F_i ; meaning that type can be found on all three plots sample observation stations , for example, *R. mucronata* at stations 3 , 5 and 6 . F_i values equal to 0.6667 suggests that the two types are found in the sample plots in one station , for example, *R. mucronata* at stations 1 , 2 and 4 . F_i value of 0.3333 indicates that the mangrove species found only in one sample plot in the observation station , for example, *R. Apiculata* at stations 1 , 2 , 5 and 6 as well as *A. marina* at stations 2 , 3 , 5 and 6 . For the F_i is equal to 0 means the species is not found in all three plots that exist , for example, *R. Apiculata* at stations 3 and 4 as well as *A. marina* at stations 1 and 4 .

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Closure of mangrove vegetation types (C_i)

Closure of mangrove species is widespread stem / basal mangrove in a given area . Based on the analysis of field data , the closure of mangrove species in coastal areas is the highest Brebes *Rhizophora mucronata* in the station 5 at 11.61 . Closure of mangrove species can also be described from the stand diameter of mangrove vegetation .

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Important Value Index (IVI)

IVI (Importance Value Index) indicates the existence of a role or influence of mangrove vegetation types in the community. IVI range is 1-300 . In general, *Rhizophora mucronata* has the largest IVI at all stations . Of all the existing stations *Rhizophora mucronata* at station 4 has the highest IVI with the lowest value is 300 and that *Rhizophora apiculata* at stations 3 and 4 and *Avicennia marina* at station 4 with a value of 0 .

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Thus the classification to see an important role in any type of mangrove communities are : $0 \leq \text{inp} < 100$: low ; $100 \leq \text{inp} < 204.3159$: medium and $204.3159 \leq \text{inp} \leq 300$ INP : high . Based on the above classification can be explained that the station has a low role of the community are: *R. apiculata* and *A. marina* while *Rhizophora mucronata* has a high role in ham [pears all stations except at station 1 that IVI its being categorized . $NDVI$ value < 0.1 is dominated by *R. mucronata* and *A. marina* ; $0.1 - 0.4$ is dominated by *R. mucronata* . Based on observations in the field , there are 3 types of mangrove vegetation that can be found in coastal areas Brebes namely : *Rhizophora mucronata* , *Rhizophora apiculata* and *Avicennia marina* . Type *Rhizophora mucronata* which locals called fart and almost evenly spread and dominate along the coast , drainage and embankment ponds in the Brebes district and *Rhizophora apiculata* and *Avicennia marina* are not always found in every station pngamatan . *Avicennia marina* is a pioneer in the mangrove community and is found in the outer zone of the shoreline of the mainland . This disebabkan by *Avicennia* root system capable of trapping sediment as his medium so as to form the mainland . The spread of mangrove vegetation based on the type of substrate where his life according to Bengen (2002) , *Rhizophora* spp . can grow well on the substrate and can tolerate muddy silt soil - sandy sedangkan *Avicennia* spp . can grow well on muddy sand substrate . This is consistent with observations in the field.

Abrasion and Accretion

Abrasion occurs when the amount of sediment transported by sea is greater than the amount of sediment that is deposited so that the shoreline will be on the skids . Abrasion can occur due to weathering of rock or due to increased wave energy , or because penuruanan durability cliff by chemical weathering , physical or biological (Bengen , 2001) . Meanwhile , the

accretion occurs when the amount of sediment deposited is greater than the ability of marine sediment transport, so it will increase coastal plain (coastal forward).

Until 2000, abrasion Brebes District 789 covering an area of 310 hectares while akresinya acres. as stated by the Brebes District Environment Office (2003). From 2000 to 2008, coastal erosion in the Brebes district reached 640.45 acres with a shoreline length of 27.043 km, which means an average erosion of the coast to coast inland as far as 236.83 m within a period of 8 years or 29.60 m per year, while accretion occurs covering 815.76 hectares with a coastline length of 27.147 km (Department of Fisheries and Ocean Department, Brebes, 2008). The area of abrasion and accretion through 2008.

Reduction of mangrove area is also heavily influenced by public economic activities, especially farming land clearing. Besides the land accretion also appeared embossed with a total area 64.147 ha and a total circumference of 12185.78 m in four places, namely in District Wanasari number of 3 pieces each with a circumference of 13.653 ha and 6.968 to 2137.15 m 1270.67 m in circumference Sawojajar villages and 35.309 ha with a circumference of 6927.81 m in the village Sawojajar / Kaliwlingi, in addition to an area of 8.217 ha also met with a circumference of 1850.15 m in the Village Kaliwlingi District of Brebes (Department of Fisheries and Ocean Department, Brebes, 2008). Mangrove forest loss will lead to coastal erosion and abrasion otherwise instrumental in the reduction of the mangrove area. By 2000 coastal erosion area of 789 ha Brebes District. akresinya while covering 310 ha. Furthermore, from 2000 to 2008, coastal erosion in the Brebes district reached 640.45 ha. with 27.043 km long coastline, which means an average erosion of the coast to coast inland as far as 236.83 m within a period of 8 years or 29.60 m per year, while 815.76 acres of accretion that occurs with 27.147 km long coastline. Based on direct observation in the field in areas such as around the mouth of abrasion suffered gangsa time shown by the fallen tree and coastal protection (fencing) which was built by the community. Symptoms of coastal accretion in Brebes can be seen the burnt - scorched sand and mudflats are covered by mangrove vegetation seedling as seen in the estuary Kabuyutan. Ardani (2004) stated that during the period 1991-2002, abrasion that occurs in the coastal area of Brebes 696.848 ha or approximately 63.350 ha, per year and accretion area of 1 115 847 hectares or 101 441 ha per year and there are 38.09 ha / year of sediment from the stream that carries the charge and mass of suspended sediment from the surrounding area. The area is experiencing erosion, among others: the mouth of the river west Wanasari Pemali to the District, the eastern mouth of the river and surrounding estuary Pemali gangsa. Accretion occurs in Cisanggarung estuaries, bays in District Bulakamba, estuaries and on beaches Pemali Randusanga.

Mangrove Forest Rehabilitation

Mangrove rehabilitation activities in coastal areas Brebes conducted and coordinated by the Department of Agriculture, Forestry and Soil Conservation Brebes realized since 2004. As of December 2004 planting mangrove along the coast of Brebes area of 500 hectares. Land has been replanted consists of an area of 325 hectares and a stretch of dike embankment measuring 175 hectares in 13 villages in five districts in the coastal Brebes (Fiazia, 2006). Planted mangrove species are *Rhizophora mucronata* with LXL meter spacing. One hectare of land planted seedling stem *R.mucronata* ± 2000. Based on a satellite image of the delineation of May 31, 2013, long beach Brebes is obtained: 56.68 Km. Based on the Decree of the Minister of Agriculture and Minister of Forestry No. KB.550/264/kpts/4/1984 and No. 082/Kpts-H/1984, dated 30 April 1984, the width of the green belt of mangrove forest is 200 meters, so the coastal Brebes should have belt of mangrove forest area of 113.36 km or 1133.60 ha. Extensive mangrove forests in coastal areas Brebes based on

analysis of Landsat TM imagery dated May 31, 2013 amounted to 243.20 ha . and results of rehabilitation activities undertaken since 2004 is 746.24 ha , so it is necessary to increase mangrove rehabilitation area of 387.36 ha again .

Based on the type of substrate and the condition of the beach (accretion or erosion) , the mangrove species that can be planted for mangrove rehabilitation activities in the District of Losari until Wanasari types *Rhizophora* spp . and *Avicennia* spp . Meanwhile, around the estuary gangsa types *Rhizophora* spp . According Bengen (2002) , mangrove species planted for retaining abrasion is *Rhizophora* spp . and if only planted for reforestation types *Avicennia* spp .

Analysis of Dynamic Systems

Based on the foregoing data and hence can be designed dynamic system modeling of ecological factors (economic and social) that affect the condition of the mangrove vegetation in coastal areas Brebes . In general, mangrove vegetation is affected by the addition and subtraction of mangrove area . The addition of mangrove area is affected by several factors which new growth and mangrove reforestation . Reduction of mangrove area affected by coastal erosion as natural factors caused by the influence of ocean currents and waves of illegal logging by the community and other relevant parties . The model can not be simulated due to the volume of illegal logging and its influencing factors (socio - economic - cultural society and policy / government regulations) will be assessed in the study phase 2 (second year) .

From the dynamic model framework above shows that the presence of mangroves in coastal areas affected by the addition of Brebes District (reforestation and new growth) and the reduction of mangrove (coastal erosion and illegal logging) . From the data obtained in the study phase (years) a new first dynamic model can be constructed framework of ecological processes associated with the presence of mangrove vegetation in coastal areas Brebes . To be able to develop strategies and methods of treating damaged mangroves in the coastal area of research is still needed Brebes related to socio - economic factors to the degradation of mangroves and coastal erosion .

Mangrove Area Spatial

Landing beach space utilization Brebes in 2012 giving emphasis reforestation of mangrove forests in the District Wanasari , Bulakamba and cape . Mangrove planting areas are proposed in three areas , namely in the District Losari Cisanggarung estuary , estuary Kluwut District of Bulakamba , and in the East River estuary Pemali District of Brebes .

Conclusion

The area of mangroves in coastal areas Brebes at the end of 2013 stayed 243.20 ha . spread in the Losari beach Subdistrict 26.56 ha . , Tanjung 5.60 ha . , Bulakamba 35.42 ha . , Wanasari 14.31 ha . and in the District of Brebes 161.31 ha . with mangrove vegetation density categories respectively : very rare , rare , rare , rare , medium and rare . In the area of research found three types of mangrove vegetation in the number of viable count : *Rhizophora mucronata* , *Rhizophora apiculata* , *Avicennia* ye. Rhizophora mucronata and overall has the highest density is 35 731 individuals / ha . at station 5 (Kaliwlingi , District of Brebes) . During the period 1991 - 2002 , abrasion that occurs in coastal areas Brebes area of 696.848 ha . . The area is experiencing erosion , among others : the mouth of the river west Wanasari Pemali to the District , the eastern mouth of the river and surrounding estuary Pemali gangsa . Furthermore, from 2000 to 2008 , coastal erosion in the Brebes district reached 640.45 ha . Jaju degradation of mangroves and coastal erosion in coastal areas Brebes , respectively 68.46 ha . / Year and 63.35 ha . / Year . To comply with the mangrove

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forest green belt width of 200 meters is necessary to increase mangrove rehabilitation area of 144.16 ha . again . Suggested mangrove species planted for mangrove rehabilitation is a type of Rhizophora and Avicennia .

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