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Original Research

Analysis of Coastline Changes in Padang Pariaman Regency, Indonesia: The Influence of Hydro-Oceanographic, Anthropogenic, and Sedimentation Factors on Coastal Dynamics

Widya Prarikeslan1†, Nurhasan Syah2 , Rery Novio1, Surya Hafizh1

[1]Department of Geography, Faculty of Social Science, Universitas Negeri Padang, Indonesia

[2]Doctoral Program of Environmental Sciences, Universitas Negeri Padang, Indonesia

†Corresponding author: Widya Prarikeslan; widya_geo@fis.unp.ac.id

Widya Prarikeslan : https://orcid.org/0000-0002-2974-8472

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Abstract: Shoreline changes on the coast of Padang Pariaman Regency are influenced by hydro-oseanographic and anthropo-genic factors. Each village has different dominant factors. This reseach aim to 1. Analyze the contributing factors to changes in village-by-village coastline. 2. Analyzing changes in village-by-village land cover in coastal areas. 3. Analyzing existing coastal protection buildings in each village. 4. Analyze sedimentation contributions from the Limau and Batang Anai Rivers. This research uses panel data regression method to determine the factors that influence shoreline changes, Digital Shoreline Analysis System (DSAS) to determine shoreline changes, SAS Planet image analysis to calculate coastal protection structures and Jaelani algorithm to analyze sediment concentration.The study reveals that vegetation loss in Katapiang village, Pilubang village, Ulakan village, and Tapakis village significantly threatens coastal stability. Ineffective coastal protection exacerbates abrasion in these areas. Additionally, climate change also increases the risk of threats to coastal areas. Land use changes in the watershed transport sediment to the estuary, which causes coastal accretion and increases the land area around Gisik Shoal. Overall, the coastline at the mouth of the Limau Watershed experienced more dominant accretion than abrasion due to the high sedimentation process that occurred in 2003-2018. While the dominant shoreline changes that occur in the Batang Anai watershed are (abrasion). Each village has a different dominant shoreline change factor. therefore the solution in each region as well. Stakeholders need to understand this condition in order to be able to manage coastal areas more effectively.

1. INTRODUCTION

The dynamics of Padang Pariaman Beach are strongly influenced by strong Indian Ocean currents reaching the coast and the dominant abrasion process occurs along the coast. Padang Pariaman Regency has 6 sub-districts out of 17 sub-districts which are coastal areas with a coastline length of ± 42.1km. The con-dition of this region is full of industrial and human activities to fulfill daily life. If it is developed well, it will support the regional economy with great potential. Abrasion occurs every year due to changes in wind direction, but in recent years this has been the worst. Currently the distance between the shoreline and resi-dents' houses is around six meters and it is feared that this distance is getting closer considering how strong the waves are still hitting the area. This abrasion not only threatens several heads families in the area but al-so residents' coconut and oil palm plantations. Regulations governing coastal/coastal ecosystem problems are currently not available/somewhat weak, or there is a lack of patrolling/monitoring of the sustainability of coastal ecosystem functions, so the use of these ecosystem resources is freer and less controlled. Ulti-mately, it will reduce the quality of coastal areas/beaches which can disrupt the sustainability of their func-tion (Val Day, 2007).

Changes in coastlines in the form of accretion (sedimentation/buildup) and abrasion. Problems arise when sedimentation changes the coastline's form, they can disrupt the coastal ecosystem, the land area expands, When the river discharge is high, siltation in the estuary can cause flooding. So, it is necessary to carry out this research so that we can find out which parts of this watershed have high abrasion and what the water quality is like so that it does not disturb the coastal ecosystem. This will also be very useful in monitoring coastal areas and its use in managing coastal areas more effectively.

The Limau and Batang Anai River Watershed is one of the watersheds in Padang Pariaman Regency. These two watersheds are the longest watersheds in Padang Pariaman Regency, economically supporting irrigation and fish cultivation activities. Along with the development of Padang Pariaman Regency, the pressure on the environment is automatically increasing and it is feared that its carries capacity will exceed. This will certainly give rise to various environmental problems/issues in this area. The main issues that are of concern to policy makers in this area include the issue of critical land and land conversion, water pollution, over-exploitation of mining in watersheds, solid waste, coastal ecosystem destruction and social, social and health problems such as community diseases (concentrated), population growth, poverty, public health and other social problems (Val Day, 2007).

Coastal dynamics is an ongoing process resulting from a variety of coastal natural phenomena, such as land usage, wave action, longshore currents, and sediment movement. Changes in coastlines are generally caused by two factors, namely modification by humans (anthropogenic factor) and sea level rise (hydrooceanographic factor). Tides, in addition to permanent changes caused by abrasion and accretion, pro-duce a unique space in that zone that is susceptible to change. (Purwanty, 2012; Geurhaneu and Susantoro, 2016). River estuaries, runoff and sediment in combination with the location of the estuary change the balance of land, sea interactions and cause abrasion or expansion of the coastline in various parts of the delta. Human activity is one of the main factors in water and sediment changes.

The objectives of this article are 1. Analyze the contributing factors to changes in village-by-village coastline. 2. Analyzing changes in village-by-village land cover in coastal areas. 3. Analyzing existing coastal protection buildings in each village. 4. Analyze sedimentation contributions from the Limau and Batang Anai Rivers.

This research presents a more comprehensive approach to analyzing shoreline change in Padang Pariaman Regency by integrating hydro-oseanographic, anthropogenic and sedimentation factors. Unlike previous studies that only focused on hydrodynamic processes or human-induced impacts, this study combines various analysis methods, such as panel data regression, DSAS for shoreline change detection, Planetary SAS for coastal protection assessment, and Jaelani algorithm for sediment concentration analysis. This comprehensive approach provides a more detailed understanding of the relationship between natural and human-induced shoreline changes. In addition, this study offers a site-specific analysis, highlighting local factors that influence erosion and accretion, which have rarely been explored in previous studies. The findings emphasize the importance of integrating land use management, sediment transport dynamics and coastal protection infrastructure to develop more effective and region-specific coastal management strategies.

2. MATERIALS AND METHODS

Research locations

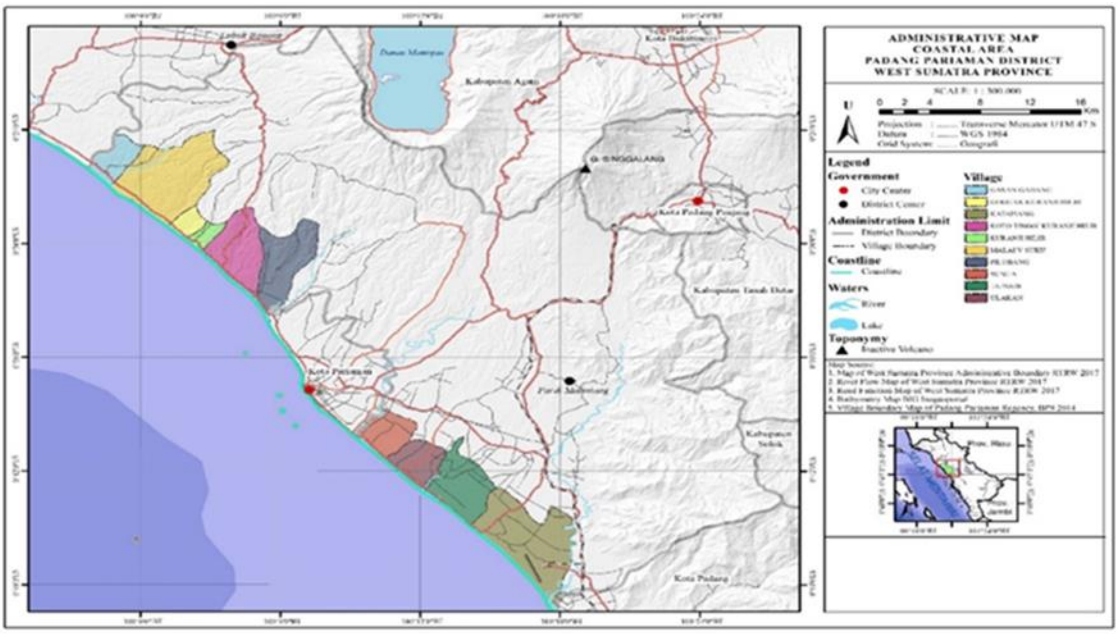

Fig 1. Map of research locations

Research locations in 10 villages in the Padang Pariaman coastal area to see sea current patterns, influencing factors, analyze existing coastal protection construction. Mitigate by analyzing and designing the groyne construction. Take the example of the Limau and Batang Anai rivers to see changes in land use and sediment distribution in the Limau and Batang Anai rivers.

The Materials and Methods The use of remote sensing satellite technology has been used in various disciplines, and there are many satellites both in polar and geostationary orbits (continuously in the same position above the earth's orbit). One of the polar orbit satellites is the Landsat series satellite, starting with Landsat-4 MSS (Multi Spectral Scanner) with a spatial resolution of 80 meters, Landsat-5 TM (Thematic Mapper) to the Landsat-7 ETM (Enhanced Thematic Mapper) satellite with a spatial resolution of 30 meters and 15 meters (Prarikeslan et al. 2022). Landsat 8 with a resolution of 30 meters and 15 meters (Prarikeslan et al. 2022). Resolution and band length of Landsat 8 and Landsat 5 imagery. The separation of land and sea uses threshold values from band 5 on Landsat TM and ETM+, and band 6 on Landsat OLI/TIRS. The The European Center for Medium-Range Weather Forecasts (ECMWF) website is used to down-load wave data. The downloaded data are deep-sea wave height, breaking wave height, and wave period in netchdf (ns) format (Prarikeslan et al. 2022). The information was downloaded with the Padang Pariaman Regulation zone facility. Each information was at that point changed over utilizing Sea Information See program. The information handled is everyday information which is able later be looked for month to month midpoints with the assistance of Mircosoft Exceed expectations program. Analysis of the effective-ness of coastal protection is carried out by overlaying the coastline map before and after the groyne and car-rying out numerical simulations of the coastline by modeling the existing coastline.

Analysis of changes in beach area in this study, the distance of a change the coastline is visible from the Calculate Statistics value. The method used to measure the distance of coastline changes between the oldest line and the newest coastline. A method where distance with a positive value (+) means the coastline is advancing and data with a negative value (-) means the coastline is retreating. Data with a positive value (+) occurs accretion and data with a positive value (-) occurs abrasion.

You can get wave data from the ECMWF website. The data that can be downloaded is in the netchdf (ns) format and includes wave period, breaking wave height, and deep-sea wave height. The coordinates of the Padang Pariaman Regency region are where data can be retrieved.

Data processing

Data processing in this analysis used R studio program. The method of looking at factors that influence changes in coastlines uses panel data regression. Panel data regression combines cross-sectional data and time series data to measure the same cross-sectional unit at different times. Therefore, data from multiple identical subjects observed during a specific time span becomes panel data. With panel data, we will have a total of NT observation units if we have T time periods (t = 1, 2,...) and N number of persons (i = 1, 2,...). When all the data points have the same number of time units, the panel of data is said to be balanced. An imbalance In the meanwhile, other data kinds include cross-sectional and time-series data. One or more var-iables will be tracked over a predetermined length of time in one observation unit in time series data. Cross-section data, on the other hand, consists of observations made at a single time from multiple observation units. (Lilja, 2016).

The panel data regression model is expressed in equation form (1) (Li & Yang, 2014).

$$y_{it} = X'_{it}\,\beta + Z'_i\,\alpha + \varepsilon_{it}$$

$$i = 1, \dots, K; t = 1, \dots, T \qquad \text{....(1)}$$

where i denotes a unit cross-section of K, while t denotes a time of T. There are p independent varia-bles in xit, not including constants. Individual specific effects are where Zi consists of constant and individ-ual specific effects, both observable and unobservable. β is a slope matrix of size px1.

Land cover changes were analyzed using an overlay of Landsat imaging and assessment methods. Land use changes were analyzed based on multi-temporal Landsat satellite image identification and using the overlay method.

The area area and distribution of sedimentation is carried out by image processing and Total Suspended Solid (TSS) classifi-cation according to the algorithm. So that the reflectance value becomes the TSS value. The TSS value is calculated based on the Jaelani equation in 2016 as follows:

$$logTSS\left(\frac{mg}{l}\right) = 1.5212 * \left(\frac{logRrs(b2)}{logRrs(b3)}\right) - 0.3698 \qquad \text{.... (2)}$$

Field surveys and statistical analysis are used to analyze existing coastal structures.

3. RESULTS AND DISCUSSION

Management of coastal areas, resources and stakeholder rights are handled separately from watersheds in most countries around the world. Including coastal areas as an integral part of watersheds is important because of the mutual relationship between coastal ecosystems and upstream areas. Ambiguities in coastal drainage and lowland boundaries due to multiple connections with estuaries, many small stand-alone coastal catchments, and asymmetry between surface and groundwater boundaries cause difficulties in hy-drological delineation. In addition to these natural boundaries, various units of coastal management frame-works, resource dependencies, and livelihoods pose additional boundary issues for sustainable coastal man-agement. Considering multiple coastal zone boundaries within a watershed regime is important for resource sharing and authorized interventions in watershed decisions that compromise coastal ecosystems and liveli-hoods (Sreeja, 2015; Ferrari et al. 2019).

1. Factors that influence changes in coastlines in each village in the coastal area of Padang Pariaman Regency

The hydro-oceanographic factor that influences changes in beach areas is tides. Data taken in Padang Pariaman Regency from 1988, 2003 to 2018 shows that the tide height is increasing. In 2018, the highest tides were in Ulakan and Tapakis village, while the lowest occurred in Gasan Gadang village. Koto Tinggi Kuranji Hilia village has the fastest wave propagation because it is deeper than other village, namely 6.48m. Longshore current velocity is high at Koto Tinggi Kuranji Hilia village for 1988 because it has an angle.

The largest breaking wave came 193, for 2003 and 2018 Gasan Gadang because it has value because the angle of arrival of the breaking wave is large. Anthropogenic factors that influence changes in beach ar-eas are changes in vegetation along the Padang Paraiaman coast. The largest reduction in vegetation land occurred in Katapiang village for both 1988-2003 and 1988-2018. The largest increase in land area occurred in Malai V Suku village. So, this reduction in coastal vegetation will increase the danger of coastal abrasion, terrestrial ecosystems from wind exposure, reduced land stability due to the binding of sand to the surface by the interwo-ven roots of vegetation.

The influence of changes in beach area on hydro-oceanographic and anthropogenic factors in village-by-village shows that the 10 village studied have different factors causing changes. More details can be seen in Table 1 below.

Table 1. Factors influencing changes in the coastline of each village in Padang Pariaman District .

No.	Village	Factors influencing changes in beach area	
		Abrasion	**Accretion**
1.	Gasan Gadang	Wave speed *** Current speed ** Tides *** Vegetation cover ***	Wave speed ** Current speed ** Tides **
2.	Malai V Suku	Wave speed *** Tides ***	Wave speed *** Tides * Vegetation cover **
3.	Guguak Kuranji Hilia	Wave speed *** Tides ***	Wave speed *** Vegetation cover *
4.	Kuranji Hilia	Wave speed * Current speed **	Wave speed *
5.	Koto Tinggi Kuranji Hilia	Wave speed ** Current speed ** Tides **	Tides *
6.	Pilubang	Vegetation cover *	Wave speed *** Current speed * Tides * Vegetation cover ***
7.	Sunua	Wave speed *** Current speed *** Tides *	Wave speed *** Vegetation cover ***
8.	Ulakan	Current speed **	Wave speed ***
9.	Tapakis	Wave speed ** Vegetation cover ***	Wave speed ** Vegetation cover ***
10.	Katapiang	Vegetation cover **	Wave speed * Tides **

	Vegetation cover **

***. Very influential

** . Influential

*. Less Influential

Source: Research data processing 2021

2. Analyze changes in coastal land cover in each village in the coastal area of Padang Pariaman Regency

Over the past decades, the study of land use change has become a dominant research topic., as land use change has been recognized as one of the most important factors of environmental modification in the world (Kakisina, 2014; Sarkera, 2019). More details can be seen in Table 2 below.

Table 2. Land Cover in Padang Pariaman

CLASS NAME	Area 1999 (Ha)	Area 2003 (Ha)	Area 2018 (Ha)
Build	4433,00	3094,2	10268,01
Plantation	6769,71	9976,05	6989,49
Vegetation	8674,95	7516,89	282,06
Water	3670,70	2971,8	6221,07

Longstanding human pressures and fast-paced environmental change have transformed forests and sub-tropical regions into some of the world's most threatened ecosystems, resulting in the loss of coastal ecosystem services and ecosystem services worldwide. Coastal vegetation protects us from storms and tidal waves, and acts as a refuge for many globally threatened plant and animal species. However, these global ecosystems are gradually experiencing high levels of pressure due to historical and ongoing declines in freshwater flow in river systems and salinity intrusion. The population sizes of many threatened tree species have dropped substantially, mainly due to growing salinity pressure. (Sarkera, 2019; Samin. et al. 2016).

Planting trees in large numbers and densely along the coastline will form coastal forest stands which can provide several benefits, including reducing beach abrasion, reducing beach sand abrasion, protecting land ecosystems from wind exposure, stabilizing land due to the binding of sand to the surface by the network. vegetation roots, accelerate the formation of new soil and habitat for flora and fauna, and improve the microclimate. Establishment of an initial stand of prawn cypress can then develop a supportive site for subsequent types of vegetation and protect the annual crop cultivation area behind the stand (Nugroho, 2017; Tuheteru & Mahfudz, 2012).

The results of research conducted in Padang Pariaman Regency show that there are several locations with a reduction in vegetation land area, namely Katapiang village, Pi Lubang village, Ulakan and Tapakis village, so this will endanger the current condition of the coast. The land use situation and local social conditions, including the coastal land use situation and the daily lives of local communities, both existing and planned, are very necessary. Land use data is needed to determine protection and areas available to reduce changes in coastal areas. Furthermore, everyday life situations (e.g. records of current interactions between local people and the forest, whether they extract materials from the trees for daily life etc.) are essential for assessing the sustainability of vegetation, its future management and maintenance. Information about house materials is also important to determine the reduction in flow strength needed to protect houses near the coast (Diposaptono, 2012; Pujianiki, 2004). The availability of land along the coast for coastal vegetation must be clear. Considering coastal vegetation as an effort to mitigate the dangers of changes in beach area, it requires a large area to work effectively.

3. Analyze existing coastal protection developments in coastal villages.

To protect the coast from waves coming close to the shore parallel to the shoreline a breakwater system can be used. The breakwater is composed by a set of separate continuous elements, positioned at a distance of one wavelength from each other. Each breakwater serves to dissipate some of the energy and reflect incoming waves, thereby reducing wave height and coastal abrasion. Sediments will tend to be deposited in areas with lower wave energy such as the sheltered area behind the breakwater.

Breakwaters normally have crest heights between +0.5 and +1.5 m and widths that vary depending on the energy scattered. These structures may also be lined with stone or concrete armor units depending on the intensity of the waves. The depth at the toe varies between 3 and 5 m and commonly matches the depth of the natural trunk (if present).

Effective shoreline protection is beneficial in reducing wave action on abrasion. Beach sediment is transported along the coast, moved to sheltered areas behind breakwaters and deposited in areas of lower wave energy. More details can be seen in Table 3 below.

Table 3. Data on the number of coastal protection structures in the coastal area of Padang Pariaman Regency

No	Kecamatan	Beach Length (Km)	Village	Coastal Protection Buildings
1	Batang Anai	11.44	Ketaping	-
2	Ulakan Tapakis	8.38	Ulakan	2 jetty and 5 groin
			Tapakis	-
3	Nan Sabaris	1.68	Kurai Taji	-
			Sunua	-
4	Sungai Limau	11.76	Pilubang	1 jetty and 3 groin
			Kuranji Hilir	2 jetty
			Koto Tinggi Kuranji Hilir	-
			Guguak Kuranji Hilir	2 jetty
5	Batang Gasan	8.50	Malai V Suku	2 jetty
			Gasan Gadang	2 jetty

Source: Statistical Analysis System (SAS) Planet Satellite Image Data.

Based on the data in table 3, there are still many beaches that do not have coastal protection structures. Installation of coastal protection that is not optimal will worsen abrasion that occurs in the surrounding area. The coastal protection system is divided into protection system into active and passive defens. The former results in a localized increase in beach sediment due to wave reduction which is often followed by an abrasion process; The second guarantees a simple protection of the shoreline by separating the cause (waves) and the object of protection. Based on the change of form of the action of hydraulic factors such as sea level variations, wave action, etc. Hard and soft defense is a type of division of protection system. Hard-passive protection systems include so-called appropriate breakwaters (elongated protection systems), which are placed on the beach as a reinforcing part of the beach profile. This structure is used in emergency situations, is economical and quickly executed and provides an immediate protective effect. Split breakwater, and groins or narrow construction, generally normal to the shoreline are common constituents of hard-active protection systems. The combination of reflection and dissipation of incoming wave energy reduces wave action. Breakwaters can be constructed as a set of small emergent structures or fully submerged structures (coupled breakwaters). Their depth is generally 3-4m coinciding with the depth of the natural bar (if any). These structures vary in width depending on the energy to be dissipated.

Groynes are used to reduce the effects of transport along the coast. The effect of a single groyne is beach sediment accretion on the updrift side and abrasion on the downdrift side; both effects extend some distance from the structure. Commonly positioned at 23 times its length and intercepting sediment transportation, it can extend from the backshore to the seaward limit of the surf zone (long groins). Parallel and normal breakwaters are usually armored rubble mound structures with stone or concrete protective units, but there are also examples of structures made with alternative piles or (submerged) groynes made with sandbags, etc. Soft protection systems include artificial ones, which are formed by sediment placed on eroded parts of the coast to compensate for the lack of natural supply of coastal sediments. Sediment is extracted from seabed deposits or from land and selected to the right size. Grain diameters should if possible be equal to or larger than the in-situ sediment, to ensure the maximum width increases with respect to the fill volume. If not, it will require frequently and costly maintenance interventions. To reduce the number of periodic maintenance interventions, beaches can be protected by breakwaters, which limit sediment loss, (generally submerged and parallel to the breakwater shoreline) and control the distribution of beach sediment along the shoreline (Benassai, 2006; Nurisman, 2018).

4. Analyze sedimentation contributions from the Limau and Batang Anai Rivers

Quantification of runoff and soil abrasion is a major challenge, not only in water resources management and environmental planning but also in irrigation, water and wastewater systems. As water resources and sediment transport problems continue to grow, demand is increasing for innovative approaches that provide better understanding and management of water resources. More details can be seen in Table 4 below.

Table 4. Sedimentation in 1998, 2003, and 2018 in Batang Anai

No.	Year	Sedimentation	
		Value (mg/L)	**Distribution (ha)**
1.	1988	-1,37 – 1,77	945
2.	2003	0,39 – 1,18	1.108
3.	2018	0,58 – 1,19	1.107

Source: Data Analysis using GIS in 2021.

From table 4 above it can be explained that in the 1988 period the sedimentation value for Batang Anai was -1.37 mg/L to 1.77 Mg/L and the sedimentation distribution area was 945 ha. Meanwhile in 2003 the sedimentation value decreased to 0.39 mg/L – 1.18 mg/l but the area of distribution increased to 1108 ha, from the year period studied, in 2003 the distribution was the widest. Another thing happened in 2018, where the sedimentation value increased compared to 2003, namely 0.58 mg/L – 1.19 mg/L, and the distribution area decreased to 1,107 ha, which may be caused by changes in land cover., river currents and the influence of climate or waves. More clearly, TSS analysis results are shown in the following Sedimentation Map: : More details can be seen in Figures 2, 3 and 4.

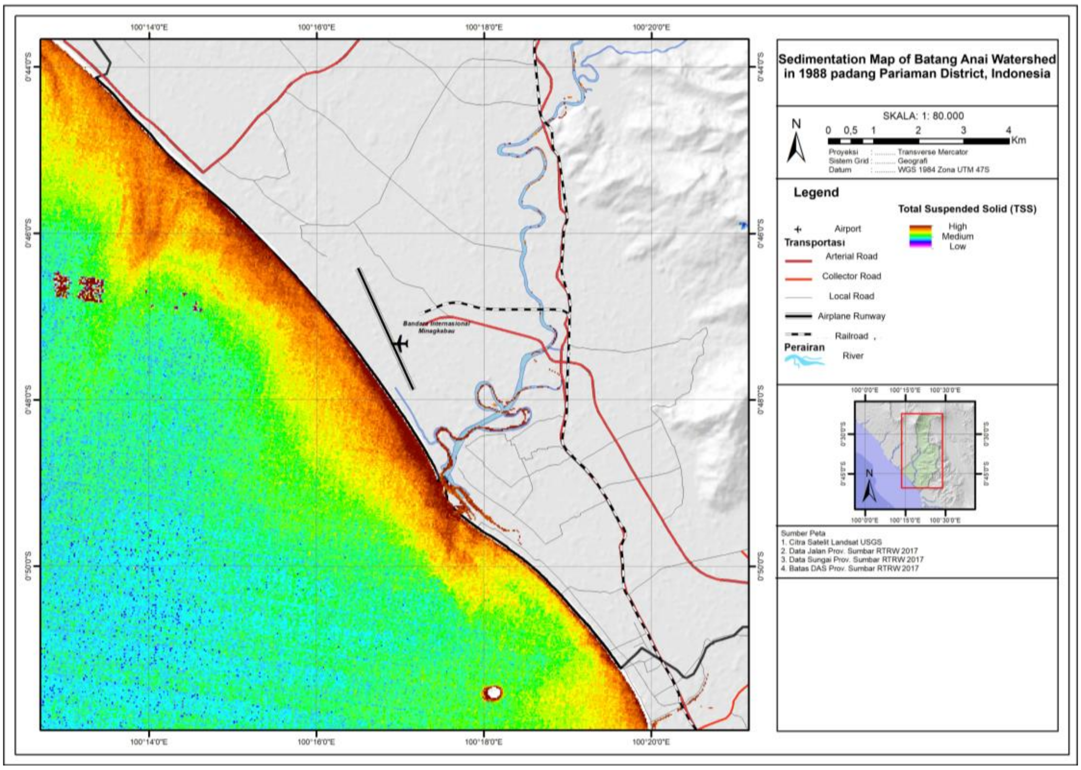

Fig 2. Map of Sediment Distribution in 1988 in Batang Anai

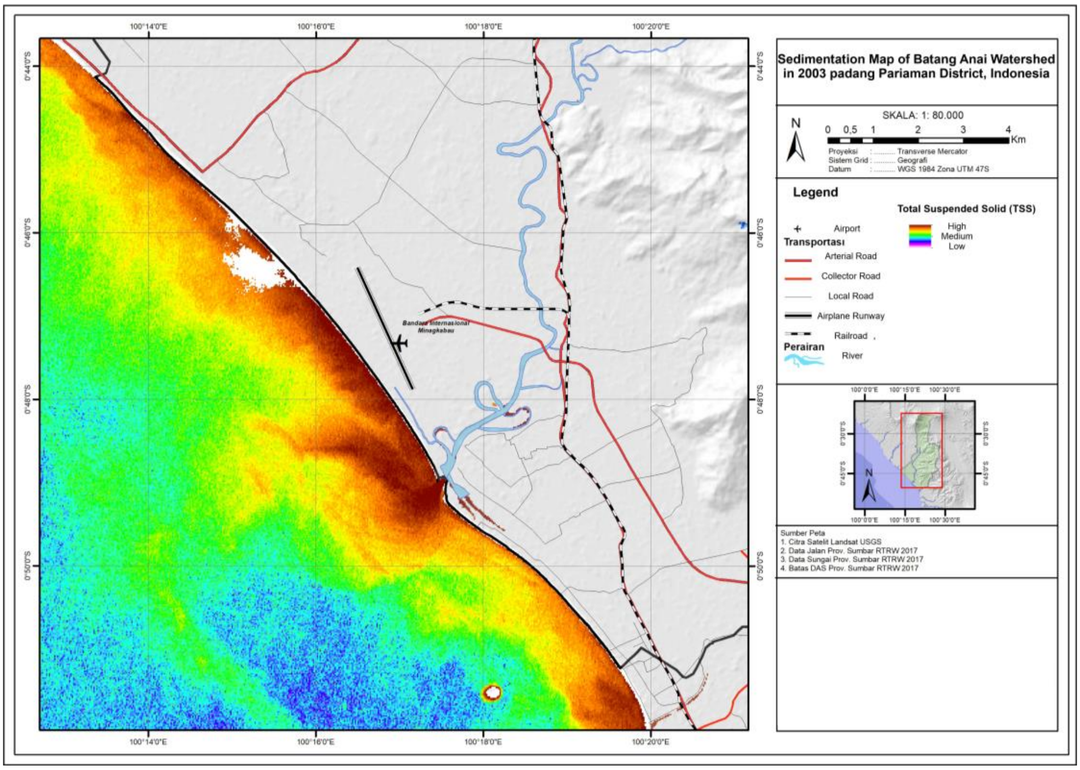

Fig 3. Map of Sediment Distribution in 2003 in Batang Anai

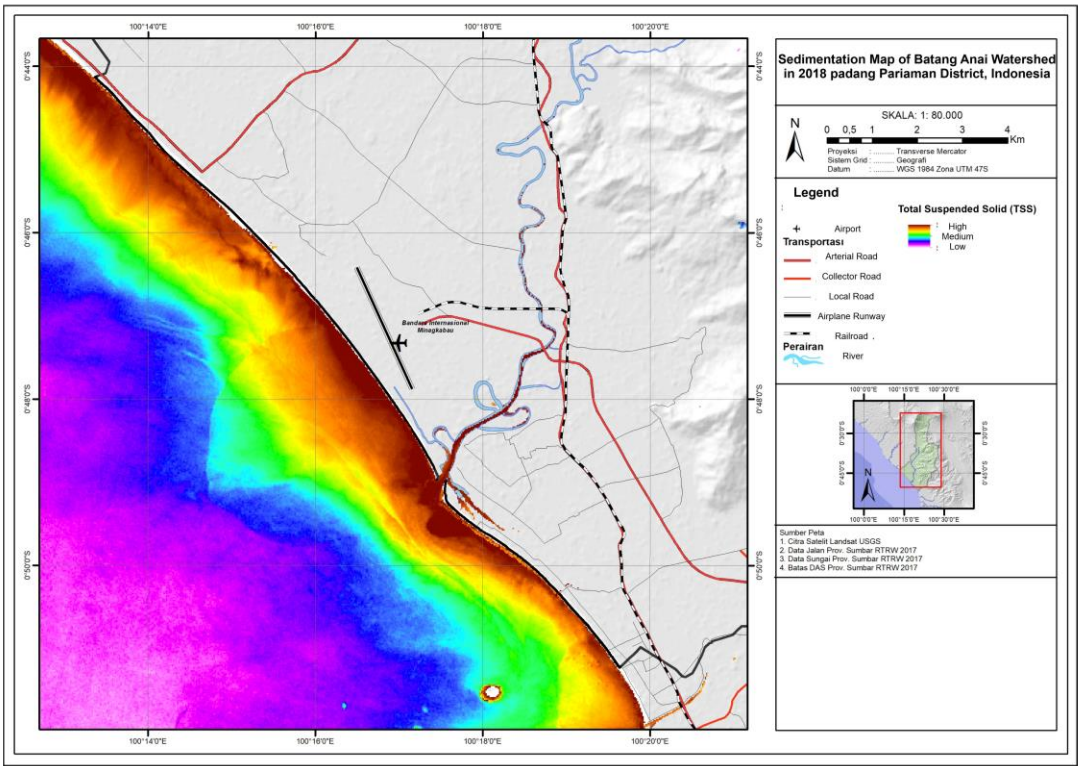

Fig 4. Map of Sediment Distribution in 2018 in Batang Anai

As seen in the map from the TSS analyzed in Figures 2,3 and 4, around the Batang Anai estuary the greatest sedimentation occurs, brown color indicates a high level of sedimentation, while other colors have smaller values along with changes in ocean bathymetry. From 1988, 2003 and 2018, the distribution of sediment along the Batang Anai coast can be seen. Sedimentation in the Batang Anai estuary from 1988 to 2018 was caused by geological sedimentation processes, which will cause changes in the coastline, and the dominant coastline change that happened in the Batang Anai watershed are (abrasion) which is caused by hydro-oceanographic factors and at the mouth of the river there is a sedimentation process which is influenced by land cover factors and sea currents, causing (accretion) at the mouth of the Batang Anai watershed. This is in accordance with the research of Ledheng and Hano'e (2023), river estuaries tend to experience greater accretion than abrasion due to the large accumulation of sediment from the river. More details can be seen in Table 5 and Figure 5,6,7.

Table 5. Distribution of sediment that occurs in the Sungai Limau village:

No.	Year	Sedimentatios	
		Nilai (mg/L)	Luas Persebaran (ha)
1.	1988	0,31- 1,91	957,28
2.	2003	0,99 – 1,85	826,32
3.	2018	1,16 – 2,12	1789,00

Source: Data Analysis in 2021

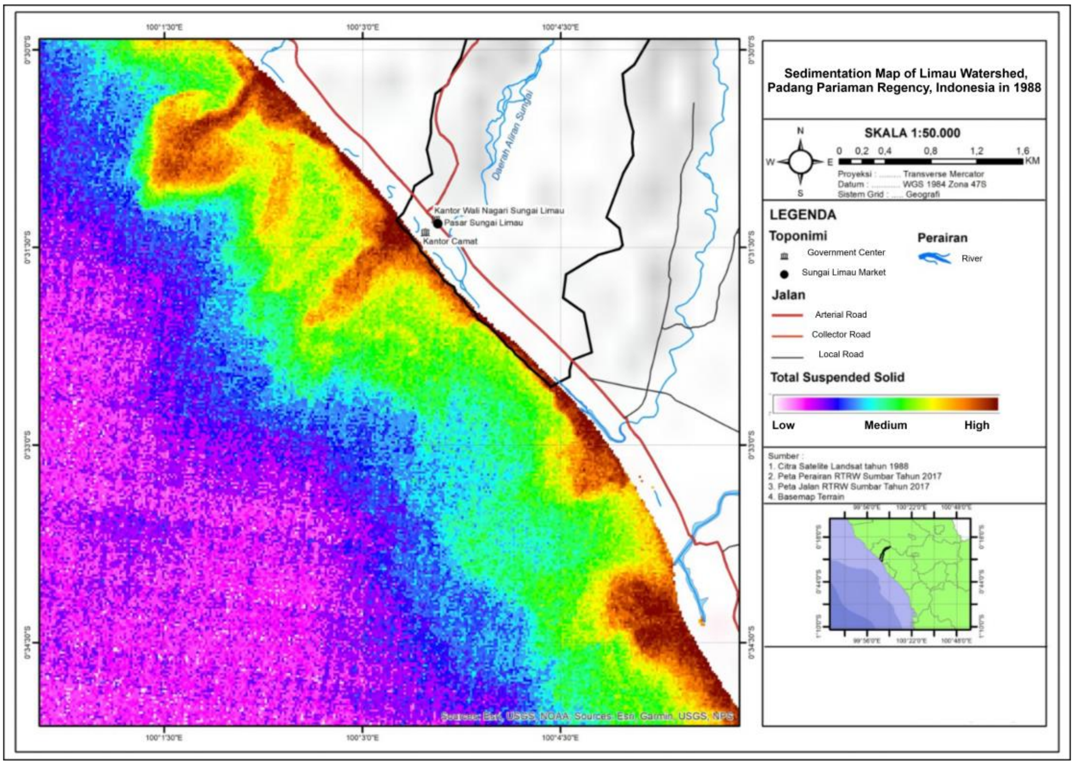

Fig 5. Sediment Distribution Map of 1988 in The Limau Watershed

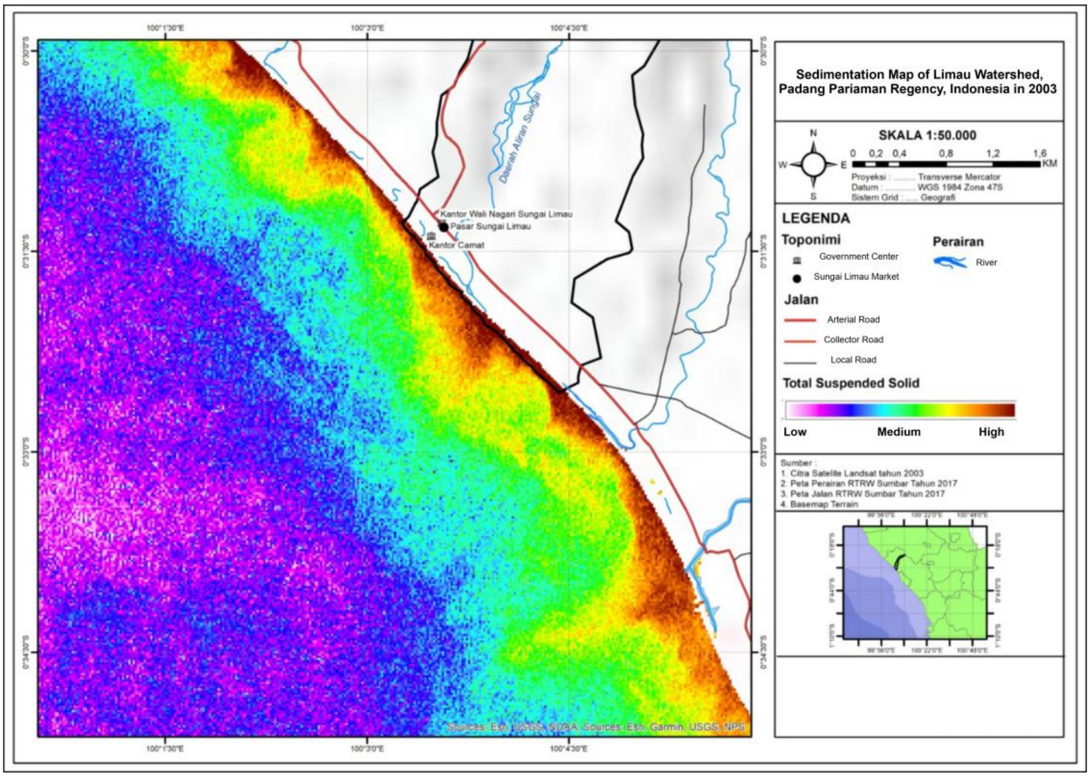

Fig 6. Sediment Distribution Map of 2003 The Limau Watershed

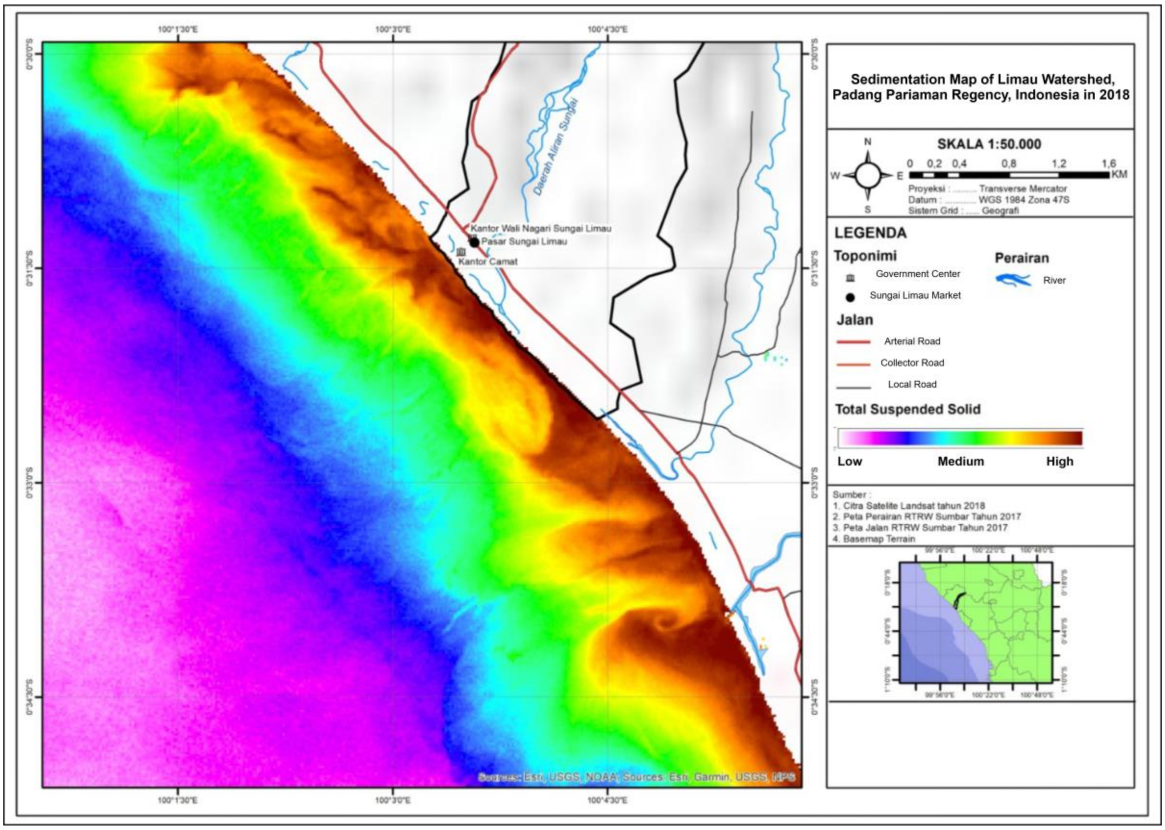

Fig 7. Sediment Distribution Map of 2018 in The Limau Watershed

Based on research findings, changes in the coastline that occurred in the Limau watershed experienced deterioration (abrasion) and progress (accretion) of the coastline. Changes in coastlines will affect the area of the beach. Changes in coastlines are caused by two factors, namely abrasion and accretion, the amount of abrasion and accretion brought each year is influenced by several factors, namely one of land use change is a contributing factor in the center of a watershed that will transport sediment material to the river mouth which causes coastal accretion resulting in an increase in the land area around the Gisik Shoal. The abrasion process that occurs at river estuaries makes the land in the estuary shrink and reduces the land area in coastal areas. Beach abrasion that occurs is caused by the transport of sediment, causing sediment to move from one place to another. Abrasion activity is increasing due to land use because of abrasion, an accretion or sedimentation phenomenon will occur which results in land appearing in other places. Overall, the coastline at the mouth of the Limau Watershed experienced more dominant accretion than abrasion due to the high sedimentation process that occurred in 2003-2018. Changes in the coastline in the Limau Watershed occurred because they were influenced by sea waves, ocean currents, changes in land cover and tide events.

There are several physical factors that determine the biological production process in relation to phytoplankton turnover due to physical factors, including: first, the frequency of destabilization of the water column which determines the nutrient level in the mixed layer. Second is the average light intensity in the mixed layer, which is a function of fresh-water run-off and solar radiation. Third, the average in the mixed layer. Water bodies that receive run-off with high levels of clay will increase the turbidity of the water for a long time, especially during the rainy season, which will reduce light intensity and disrupt the photosynthetic activity of aquatic plants and reduce the ability of fish to search for food because vision is blocked by particles. -sediment particles in the water.

Global climate change is frequently assumed to be influenced by natural change, although there is clear proof that climate change has been amplified by human activities. As a driving factor, this puts multiple stresses on mangroves and other coastal ecosystems, especially temperature increases/fluctuations (both in air and water), increased CO2 levels in the atmosphere and hydrosphere, changes in rainfall sometimes followed by flooding, and rising sea levels, as well as extreme events in the atmosphere and hydrosphere, notably storms, hurricanes, cyclones, and El-Nino/Southern Oscillation (ENSO) patterns, all of which lead to increased wave action. Predicted increases in temperature and CO_2 levels will probably increase photosynthesis and growth rates of mangroves, and may, in fact, cause mangroves to move downward, thus increasing their extent. However, the other climate change factors mentioned above may have major negative impacts on mangroves. Climate change and related factors are putting many coastal areas at increased risk, including coastal abrasion, sea inundation and flooding in low-lying areas, changes in sedimentation, and rising water levels. Coastal wetlands, such as salt marshes and mangroves, are expected to be adversely affected by sea level rise, especially in areas where land is limited or sediment is abundant. This calls for adaptation measures that integrate the protection and conservation of coastal and marine ecosystems. (Salik, 2015).

4. CONCLUSIONS

Hydro-oceanographic and anthropogenic factors influence changes in coastlines on the coast of Padang Pariaman Regency. Where each village has different dominant factors. The results of research conducted in Padang Pariaman Regency show that there are several locations with a reduction in vegetation land area, namely Katapiang village, Pi Lubang village, Ulakan and Tapakis village, so this will endanger the current condition of the coast. The land use situation and local social conditions, including the coastal land use situation and the daily lives of local communities, both existing and planned, are very necessary. Installation of coastal protection that is not optimal will worsen abrasion that occurs in the surrounding area. Climate change can have major negative impacts on mangroves. Climate change and related factors are increasing risks in most coastal areas, such as increased coastal abrasion, inundation and flooding of lowland areas, changes sedimentation rates, and increased sea levels.

For communities, the research has helped to provide a better understanding of the risks posed by shoreline change, due to ineffective coastal protection and vegetation degradation. By identifying vulnerable areas, the research promotes community participation in coastal conservation efforts, such as reforestation and sustainable land use practices, to mitigate the impacts of shoreline change. For policy makers his study is useful as a scientific foundation for more effective shoreline management. By considering the specific factors driving coastal change - whether hydro-oseanographic, anthropogenic or sedimentation-related - decision-makers can implement targeted policies to address the root causes of shoreline instability that are tailored to the characteristics of each region and ultimately aim to ensure the long-term sustainability of coastal areas.

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