

Analysis of the impact of mangrove forest land use on coastline changes using Landsat 8 satellite imagery on the coast of Ogan Komering Ilir Regency, South Sumatra province

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Abstract

Ogan Komering Ilir Regency (OKIR) has extensive mangrove forests that play a vital role in protecting the coast from abrasion. However, over the past decade, this area has experienced degradation due to land conversion and climate change. This study aims to analyze the impact of changes in mangrove land use on shoreline changes in four key coastal sub-districts: Air Sugihan, Tulung Selapan, Cengal, and Sungai Menang, from 2014 to 2024. The method used is spatial analysis using Landsat 8 satellite imagery and the NDVI index. The results show a decrease in mangrove area from 76,409.64 ha to 66,968.75 ha, which has caused significant coastal abrasion, especially in Tulung Selapan and Air Sugihan. In contrast, Cengal has shown recovery due to rehabilitation programs. The combination of anthropogenic pressures and climate change is the main factor in the degradation. This study recommends conservation-based coastal management and the use of spatial data to support sustainable policies.

Keywords: *Mangrove, land use, shoreline change, NDVI, Landsat 8, Ogan Komering Ilir.*

Introduction

Mangrove forests are a vital ecosystem, serving as a natural coastal protector, carbon absorber, and habitat for a wide range of flora and *fauna species* found in coastal areas. Mangrove forests play a crucial role in maintaining the well-being of coastal ecosystems worldwide and provide habitats for a variety of bird, plant, and animal species (Hu et al., 2020; Kanjin & Alam, 2024). Mangrove ecosystems comprise a diverse array of tree and shrub species located in tidal zones that are periodically inundated (Assaf et al., 2022). Mangrove forests are listed as highly threatened by human land use (Y. Li et al., 2024; Thomson et al., 2024). Land use and land cover are significant global issues that are rapidly altering the global environment (Chowdhury and Hafsa, 2022; Galata, 2020; Thakur et al., 2021). Mangrove land conversion occurs when mangrove forests, which initially functioned as natural ecosystems, are transformed into residential areas, agri-

cultural land, and industrial areas (Yusuf et al., 2024). Rapid population growth in coastal areas is believed to trigger changes in land use and excessive exploitation of natural resources, leading to the degradation and shrinkage of mangrove forests in tropical regions (S. P. Sari, 2009). The development of human activities, such as land conversion for fish ponds, plantations, and infrastructure development, is a cause of damage and a reduction in the area of mangrove forests. Increasingly intensive land use for human interests has led to increased rates of sedimentation, pollution, and *nutrient enrichment* in coastal areas and their surrounding waters (Conrad et al., 2023; Thomson et al., 2024). Changes in coastal land use not only impact the mangrove ecosystem but also the physical condition of the coast. These changes in land use can make coastal areas vulnerable to abrasion, land loss, and environmental degradation, thus directly impacting increasingly critical shoreline changes. Accurate

and timely mapping of tidal topography, with high spatial and temporal resolution, is crucial for monitoring shoreline changes and mitigating impacts in coastal areas (Fitton et al., 2021; Tsai and Tseng, 2023). Remote sensing technology has facilitated the production of mangrove maps at various scales (Kanjin and Alam, 2024). Remote sensing technology has facilitated the production of mangrove maps at various scales (X. Yang et al., 2024). The use of remote sensing technology, such as Landsat 8 satellite imagery, has become an effective method for monitoring land use changes and their environmental impacts. Landsat 8 satellite imagery is an effective tool for analyzing coastline change. High-resolution satellite imagery from sensors such as Sentinel and Landsat has enabled precise and accurate mapping of changes in mangrove forest cover over time (Kanjin and Alam, 2024; Parida and Kumar, 2020). With its high resolution, the Landsat 8 satellite imagery provides long-term data for monitoring spatial changes in mangrove and coastal ecosystems. Landsat 8 satellite imagery can reconstruct coastline changes in high detail. The Ogan Komering Ilir Regency area, situated in the eastern part of South Sumatra Province, is one of the regions with mangrove forests that have altered the coastline over time. In 1992, the total area of mangrove forests on the east coast of Ogan Komering Ilir was 79,125.30 hectares; eight years later, in 2000, it decreased to 68,926.14 hectares. Then, in 2003, there were only 40,101.21 ha (Sari, 2009). The loss of mangrove trees can cause various problems, one of which is coastal abrasion, resulting in changes in the coastline. The impact of

changes in the coastline due to abrasion results in a reduction in the area. Continuous coastal abrasion can pose a significant threat to the environment in coastal areas, as the coastline erodes and collapses, ultimately plunging into the sea (Bagindo et al., 2023). To prevent the continued reduction of mangrove forest land area, it is necessary to analyze the use of mangrove forest land in relation to changes in the coastline using Landsat 8 satellite imagery along the coast. This study aims to analyze the further impact of changes in mangrove forest land use, especially on changes in the coastline, using remote sensing technology through Landsat 8 satellite imagery.

Materials and Methods

Time and location of research

The research period will span 4 months, from February to May 2025, in Ogan Komering Ilir Regency, South Sumatra Province. Geographically, it is located between 104°20' - 106°00' East Longitude and 2°30' - 4°15' South Latitude. Ogan Komering Ilir Regency has an area of 17,071.33 km², comprising 314 villages, 13 sub-districts, and 18 districts (RKPD, 2023). The administrative boundaries of Ogan Komering Ilir Regency in the North are bordered by Ogan Ilir Regency, Banyuasin, and Palembang City, in the East it is directly bordered by the Bangka Strait and the Java Sea, in the South it is bordered by East Ogan Komering Ulu Regency and Lampung Province. In contrast, in the West it is bordered by Ogan Ilir Regency and East Ogan Komering Ulu.

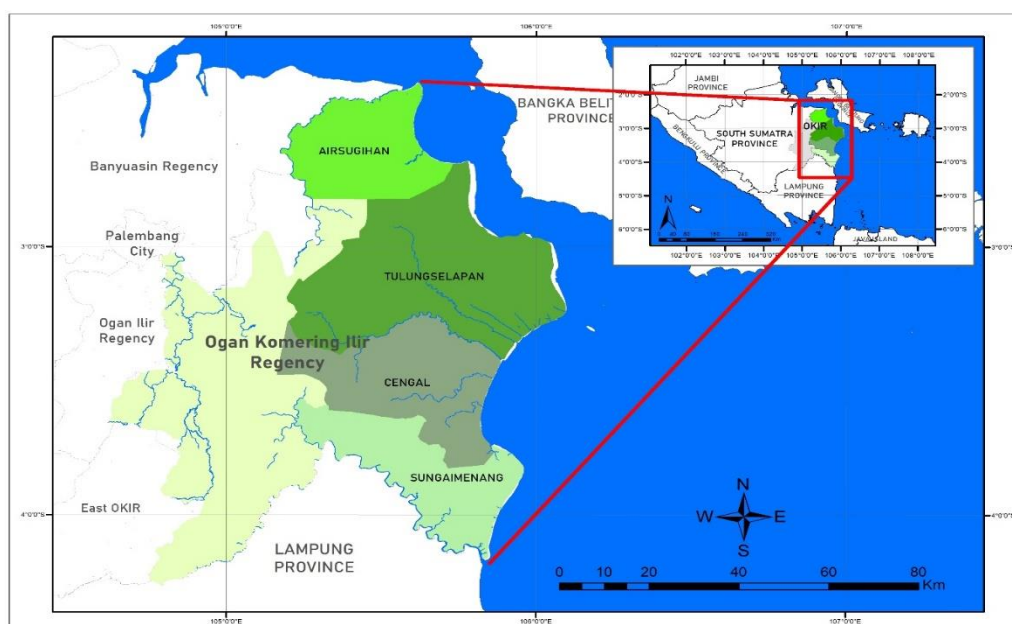


Figure 1
Map of research location

Population and sample

The population in this study was the entire mangrove forest area along the coast of Ogan Komering Ilir Regency. The sample was saturated.

Data collection and data analysis

a) Landsat 8 satellite image data. Data collection in this study utilized Landsat 8 satellite imagery, specifically bands 4 (*red*) and 5 (*Nir*), obtained from the official *USGS Earth Explorer* source in 2014, 2019, and 2024, covering the path/row area of Ogan Komering Ilir Regency, South Sumatra Province. Data selection was based on the level of cloud cover. To overcome cloud interference, the imagery used was selected with cloud cover <10% (Wang et al., 2022; Y. Yang and Li, 2023) and corrections have been made to make the NDVI results more representative. The analyzed data were sourced from the best image per year (2014, 2019, and 2024), taking into account both visual quality and data availability.

b) Geometry correction. This step ensures the image's spatial position corresponds to the Earth's actual coordinates and normalizes pixel values to account for atmospheric and sensor influences. This results in higher accuracy in calculating NDVI from Landsat 8 imagery.

c) Image Clipping. The corrected Landsat 8 imagery was then cropped to reflect the administrative boundaries of the study area in Ogan Komering Ilir Regency. This process aimed to focus the analysis solely on the study area without interference from outside sources.

d) Calculation of NDVI (*Normalized Difference Vegetation Index*). The spatial analysis technique to determine the differences between the sea and mangrove forest plants in Ogan Komering Ilir Regency, South Sumatra Province, is the NDVI analysis by utilizing band 4 (Red) and band 5 (NIR) on Landsat 8 Oli satellite imagery, with the NDVI formula [1] as follows

$$NDVI = \frac{NIR - RED}{NIR + RED}$$

[1]

where:: NIR = Near Infrared or Infrared Band 5 Landsat 8; RED = Infrared Band 4 Landsat 8.

e) NDVI classification. The classification of NDVI values in this study uses references to research (Zaitunah et al., 2021) shared in Table 1.

Table 1. NDVI classification

NDVI value	Classification
-2.0 – 0.2	Clouds, Water, and Non-vegetation
0.2 – 0.4	Sparse Vegetation
0.4 – 0.6	Moderate Vegetation
0.6 – 2.0	Dense Vegetation

(Source: Zaitunah et al., 2021)

f) Spatial data overlay. The NDVI classification results were overlaid with the administrative map of Ogan Komering Ilir Regency to determine the distribution of mangrove vegetation in each sub-district. Interannual overlays (2014, 2019, and 2024) were also performed to observe changes in the extent and distribution of mangrove forests and to identify areas experiencing shoreline abrasion and accretion.

g) Change analysis. The final stage involves calculating the extent of mangrove cover and shoreline changes using spatial methods. The area is calculated by converting the number of pixels in each class into hectares. Next, the classification results are overlaid with the administrative boundaries of the sub-districts in the coastal area of Ogan Komering Ilir Regency to determine the mangrove area in each sub-district. Changes are calculated using the area change rate (ΔL) formula, providing information on the degradation, recovery, and dynamics of the mangrove ecosystem over time. The extent of shoreline change can be measured using equation [2]:

$$\Delta L = \frac{Lt2 - Lt1}{\Delta T}$$

[2]

where: ΔL = rate of change of area; $Lt1$ = area in the initial observation year (ha); $Lt2$ = area in the next observation year (ha); Δt = difference between the initial observation period (year) and the final observation period (year).

Results and Discussion

Landsat 8 oil image analysis data accuracy based on theory

Data accuracy in Landsat 8 image analysis is crucial for the validity of interpretation results, particularly in studies of land-use change and coastal change. Data accuracy in this study employs a semi-empirical approach (Simarmata et al., 2025), where field parameter data are measured using Landsat 8 imagery with the NDVI method in 2014, 2019, and 2024, the-

reby providing an indirect field measurement. The results of research (Pardo-Pascual et al., 2018) showed that the accuracy of the coastline, performed at a local scale on a 1450 m sandy beach segment and an 800 m embankment, using Landsat 8 and Sentinel-2 imagery, performed better than Landsat 7 imagery. Subsequent research conducted accuracy testing using QGIS software with the Kappa method through the Semi-Automatic Classification (SCP) plugin. Test samples were taken from the entire predetermined training area. The test results showed an accuracy level of 90.47% (Putri et al., 2021). In line with that, research (Patty et

al., 2025) showed that the accuracy test results for land cover classification in the study area achieved an overall accuracy value of 97.31%, which met the USGS national map accuracy standard of 90% (USGS, 2011). Thus, what is meant by accuracy testing is the process of evaluating the level of accuracy of image classification results. In this study, the theoretical approach from previous studies using the Kappa method is employed, and the accuracy used is based on the literature, with no direct field tests conducted. To provide a spatial overview of the analysis results, it can be seen in the NDVI Map below un Figure 2.:

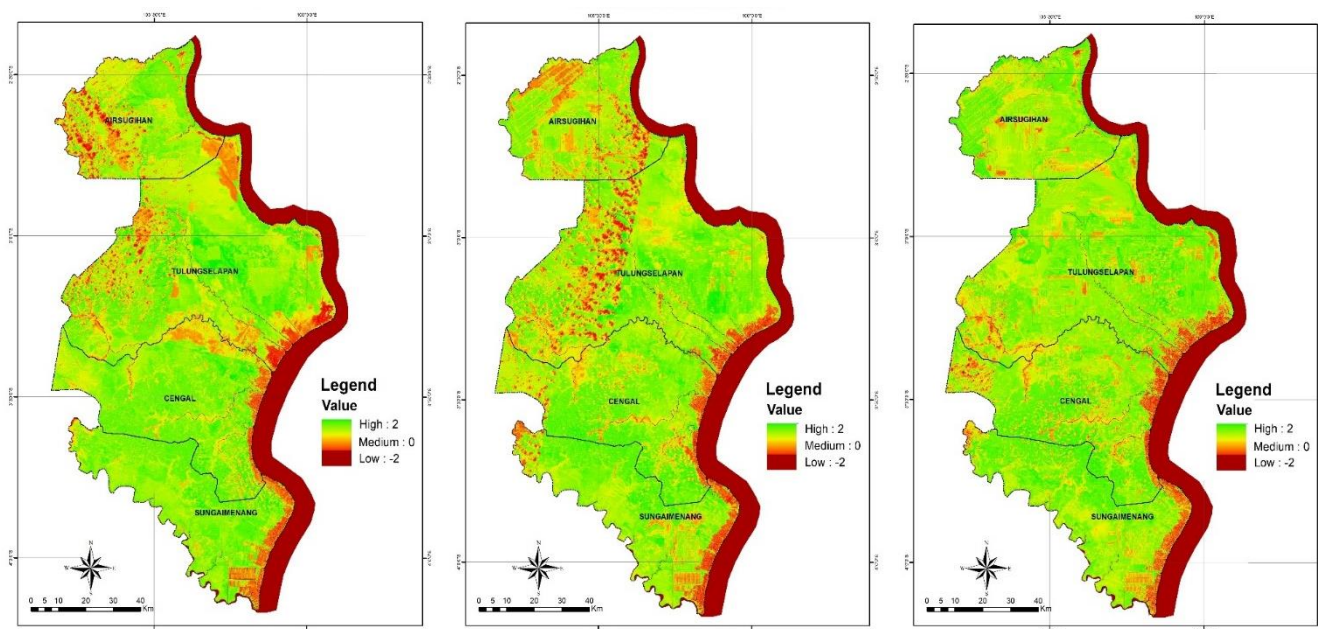


Figure 2. NDVI analysis in the coastal area of Ogan Komering Ilir Regency, South Sumatra in 2014, 2019, and 2024

Mangrove forest land use

The mangrove forests that stretch along the eastern coast of Ogan Komering Ilir Regency, South Sumatra Province, constitute a crucial coastal ecosystem. This region encompasses several sub-districts, starting at the eastern end: Air Sugihan, Tulung Selapan, Cengal, and Sungai Menang, which border Lampung Province. This entire area falls under the auspices of the Forest Management Unit (UPTD) of Region IV Sungai Lumpur-Riding. It should be emphasized that the study area does not encompass the entire land area of the sub-district, but only the coastal areas within the protected mangrove forest area. Therefore, the figures presented in the table reflect the condition of mangrove forest land use in the coastal zone of Ogan Komering Ilir Regency, not the entire sub-district. Based

on the results of vegetation analysis using the NDVI (*Normalized Difference Vegetation Index*) obtained from processing Landsat 8 satellite imagery, a decreasing trend in mangrove forest area was found. In 2014, the area was 76,409.64 hectares, whereas in 2019, it decreased to 72,458.75 hectares. In 2024, the area continued to degrade, leaving only 66,968.75 hectares, a decrease from the previous year. The following quantitative data is presented in Table.2, which shows changes in mangrove forest area per sub-district from 2014, 2019, to 2024. The figures in Table 2 are obtained from the results of Landsat 8 image processing using the NDVI method based on the NDVI classification value. The results of this NDVI classification are calculated by pixel area in hectares, then overlaid with the administrative boundaries of each sub-district to obtain the distribution of mangrove

area in each sub-district. The Air Sugihan Sub-district area is located in the north with a mangrove forest area of 25,132.78 Ha, meaning 88.16% is mangrove forest land from the total mangrove area in 2014. This area is dominated by the sparse mangrove category covering 47.29% of the total mangrove area. Meanwhile, the thick mangrove category is only a little around 0.94 Ha. However, in 2019 there was a change in the structure of land area. The area of mangrove forest experienced

a significant increase in the sparse mangrove category to 20,826.27 Ha. This indicates that there is a degradation in mangrove vegetation density, from previously denser (medium mangrove) to sparser. On the other hand, growth in the thick mangrove category is decreasing, so that the total area of mangrove forest in 2019 was 25,903.47 hectares. Meanwhile, in 2024, the area of thick mangrove forest will decrease again, remaining 0.33 hectares, bringing the total area of mangrove

Table 2. *Changes in mangrove forest area per district in Ogan Komering Ilir regency*

No	Subdistrict	Land Cover	Year					
			Area 2014 (Ha)		Area 2019 (Ha)		Area 2024 (Ha)	
			F	%	F	%	F	%
1	Air Sugihan	Water	3375.02	11.84	4533.48	14.89	6536.95	21.13
		Rare Mangroves	13480.83	47.29	20826.27	68.42	18133.25	58.61
		Medium Mangrove	11651.01	40.87	5076.72	16.68	6269.41	20.26
		Thick Mangroves	0.94	0.00	0.48	0.00	0.33	0.00
		Total Mangrove	25132.78	88.16	25903.47	85.11	24402.99	78.87
		Total	28507.80	100.00	30436.94	100.00	30939.94	100.00
2	Tulung Selapan	Water	10921.13	23.87	13334.00	29.14	20346.40	44.39
		Rare Mangroves	30133.18	65.85	20671.29	45.17	16899.21	36.87
		Medium Mangrove	4706.37	10.28	11757.47	25.69	8589.28	18.74
		Thick Mangroves	0.00	0.00	0.00	0.00	0.00	0.00
		Total Mangrove	34839.55	76.13	32428.76	70.86	25488.49	55.61
		Total	45760.69	100.00	45762.76	100.00	45834.89	100.00
3	Cengal	Water	8564.90	43.51	9409.58	51.90	9872.40	45.16
		Rare Mangroves	5584.72	28.37	5277.05	29.10	7457.34	34.11
		Medium Mangrove	5533.44	28.11	3443.81	18.99	4529.49	20.72
		Thick Mangroves	0.69	0.00	1.14	0.01	2.90	0.01
		Total Mangrove	11118.84	56.49	8722.01	48.10	11989.74	54.84
		Total	19683.74	100.00	18131.59	100.00	21862.14	100.00
4	Sungai Menang	Water	14432.71	73.07	14346.66	72.64	14663.63	74.24
		Rare Mangroves	3698.03	18.72	3777.07	19.12	3080.00	15.59
		Medium Mangrove	1620.43	8.20	1627.44	8.24	2006.78	10.16
		Thick Mangroves	0.00	0.00	0.00	0.00	0.75	0.00
		Total Mangrove	5318.46	26.93	5404.52	27.36	5087.53	25.76
		Total	19751.18	100.00	19751.18	100.00	19751.17	100.00

Source: Data Analysis, 2025

forest in the Air Sugihan District to 24,402.99 hectares. Tulung Selapan District is the largest coastal area in Ogan Komering Ilir Regency, covering 45,760.69 hectares in 2014. The mangrove vegetation in this area is mostly sparse mangroves, covering more than half of the total area. However, this condition has continued to change over time. In 2019, a decrease in area of 6,925 hectares was recorded, although there was a slight increase in the medium mangrove category. Unfortunately, this hope was short-lived. Data from 2024 showed a downward trend again, with mangrove forest area shrinking to 25,488.49 hectares, or only about 55% of its initial condition. This phenomenon illustrates the ongoing pressure of abrasion and land conversion. Meanwhile, in Cengal District, pressure on mangrove forests stems largely from the rapid expansion of shrimp farming along the coast. In 2014, the area still contained approximately 11,118.84 hectares of mangrove forest. However, in just five years, this area drastically decreased to 8,722.01 hectares. This period reflects the peak of severe degradation. However, the situation began to improve in 2024. The area of mangrove forest in Cengal actually increased to 11,989.74 hectares, thanks to support from rehabilitation and natural restoration programs. This increase is quite significant, particularly in the medium mangrove category, which reflects the potential for ecosystem regeneration. Unlike the two previous sub-districts, Sungai Menang

has had a relatively limited mangrove forest area from the start. In 2014, this area only accounted for about 26% of the total coastal forest. Fishponds were a common sight, while mangrove vegetation, particularly sparse mangroves, dominated, covering nearly 3,777.07 hectares. Although there were indications of thick mangroves emerging until 2019, the recovery trend was not significant until 2024. In fact, mangrove area rarely decreased, with the total remaining mangrove area remaining at only about 5,087.53 hectares. This indicates that pressure on the mangrove ecosystem in Sungai Menang has not been fully addressed.

Coastline Changes

Coastline change is a shift in the boundary between land and sea caused by abrasion (shoreline erosion) or sedimentation (land buildup due to material deposition). Ogan Komering Ilir (OKI) Regency has the longest coastline in South Sumatra Province, with a strategic geographical location because it borders directly on the Java Sea and the Bangka Strait. Over the last two decades, the coastal area of Ogan Komering Ilir Regency, South Sumatra Province, has undergone significant changes, particularly in the form of erosion. This phenomenon is closely related to changes in the area of mangrove forests, which function as natural barriers to the coast against ocean currents and waves. Therefore, spatial analysis of coastline changes is important as a basis for making sustainable develop-

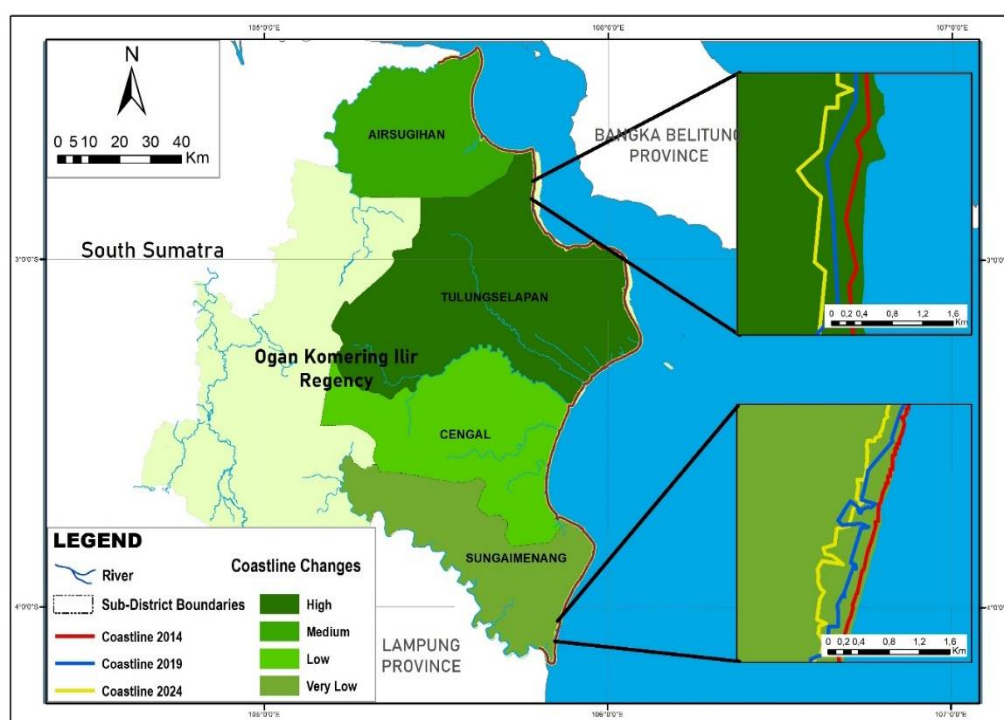


Figure 3
Map of coastline changes on the coast of Ogan Komering Ilir Regency in 2014, 2019, and 2024

ment policies in coastal areas. As a follow-up to this analysis, the map in Figure 3 was obtained from the results of the NDVI analysis of Landsat 8 imagery, which has been calculated and classified to determine the area of mangrove forests. The data was then cropped according to the boundaries of the protected forest area and overlaid with the administrative boundaries of Ogan Komering Ilir Regency, allowing the position of the coastline changes to be clearly seen within the research administrative area. The coastline change map can be seen in the following figure:3. Based on the interpretation of the coastline change map processed from Landsat 8 satellite imagery, a significant abrasion pattern is visible in the coastal area of Air Sugihan District. During the 2014-2019 observation period, this area was recorded as experiencing abrasion of 1,158.46 hectares. However, the abrasion rate increased drastically in the 2019-2024 observation period, to 2,003.48 hectares. This decrease in coastline area is due to the reduction in the previously significant mangrove forest area. Research data indicate that the decrease in area occurred in the sparse and medium mangrove categories between 2019 and 2024. The worst abrasion occurred in Tulung Selapan District, located in the southeastern part of Ogan Komering Ilir Regency. An overlay of the abrasion map shows that the area affected by abrasion between 2014 and 2019 reached approximately 2,412.87 hectares. Meanwhile, in the following five-year period (2019-2024), abrasion increased significantly to 7,012.40 hectares. New imagery reveals that several areas, once natural buffers in the form of mangroves, have now been transformed into open land inundated by seawater. This is related to the decline in the total mangrove area in the region. Unlike the two previous sub-districts, Cengal Sub-district showed a relatively small decrease in abrasion. Abrasion occurred on 844.69 hectares from 2014 to 2019, decreasing to 462.82 hectares from 2019 to 2024. This decrease indicates that conservation and rehabilitation efforts are beginning to have a positive impact. This area is also a mangrove conservation area targeted by the Ministry of Environment and Forestry's (KLHK) restoration program, which began in Cengal in 2020 (RKPD, 2023). In contrast, the Menang River area experienced slight land reclamation, amounting to 86.05 hectares, during the 2014-2019 period, followed by an abrasion of 316.97 hectares between 2019 and 2024. This accretion phenomenon is related to the natural process of sedimentation influenced by the flow of large rivers that flow into this area, as well as the re-

latively stable presence of mangroves until 2019. Increased pressure on coastal ecosystems began to be felt after 2019, including the addition of coastal settlements, land clearing for agriculture, and extreme weather changes, which resulted in the coastline experiencing abrasion again.

Discussion

Data accuracy in satellite image analysis, especially with Landsat 8, is a crucial factor in ensuring the validity of spatial interpretation results. In the context of land use change and coastline change studies, Landsat 8 satellite imagery is one of the most effective tools for environmental analysis. In this study, Landsat 8 imagery with *Operational land imager* (OLI) sensors is a source of remote sensing data that has a spatial resolution of 30 meters and can record an area of 185 Km x 185 Km in one image capture (U.S. Geological Survey, 2019), with its ability to record multispectral data to detect land use changes and coastline changes during the 2014, 2019, and 2024 periods, with the NDVI (*Normalized Difference Vegetation Index*) method that utilizes Band 4 (Red) and Band 5 (NIR) with a high level of accuracy. This method was chosen based on its success in various previous studies. This is supported by research (Utomo & Septinar, 2022) which shows that the accuracy of Landsat 8 satellite imagery for mangrove forest land classification yields an overall accuracy of 93%, considered quite good. Furthermore, research by (Lasaiba, 2022) recorded an image interpretation accuracy level of 94.1%. These two findings indicate that the method used meets the national map interpretation standards of the USGS, which require a minimum accuracy of 90% (USGS, 2011). Therefore, the validity of the resulting data interpretation is considered valid to support the conclusions drawn from the analysis. The validation accuracy of Landsat 8 imagery in identifying mangrove areas has met the applicable requirements for remote sensing imagery. The results of the analysis of changes in mangrove forest land use in Ogan Komering Ilir Regency, areas in the Air Sugihan, Tulung Selapan, Cengal, and Sungai Menang Districts, show that this phenomenon is complex and influenced by various factors. These factors are attributed to deforestation and various human activities (H. Li et al., 2024), including land clearing for aquaculture, land expansion, tourism use, and other land use changes (Chaiklang et al., 2024). In the Tulung Selapan and Cengal areas, which have extensive coastlines and brackish waters, the conversion of mangrove areas into fish ponds is often considered a

promising economic option. A report (Badan Pusat Statistik, 2022) states that more than 45% of the Tulung Selapan community depends on coastal activities for their livelihoods. However, adequate education and regulations regarding environmental conservation are lacking. Fishery cultivation will continue to be a major driver of changes in mangrove ecosystems in Indonesia, followed by the expansion of oil palm plantations (Ilman et al., 2016; R. Sari et al., 2023; Serial, 2023), which are significant contributors to mangrove ecosystem degradation, particularly in the Air Sugihan District. According to the Regional Development (RKPD, 2023), the conversion of mangrove land to oil palm plantations is a significant factor in coastal ecosystem damage in this region. Although some areas are ecologically unsuitable for oil palm cultivation, economic pressures and weak oversight of land permits continue to lead to illegal land clearing practices. For example, in Sungai Menang District, widespread illegal logging of mangroves continues for various purposes, including firewood and building materials. These factors not only cause significant reductions in area and damage the sustainability of mangrove forest habitats (Zega et al., 2023), but also accelerate seawater intrusion and soil erosion. Population growth resulting from displacement and transmigration programs has driven an increased demand for residential land and infrastructure, such as docks and ports. This has increased ecological pressure on coastal areas (Zhai et al., 2025), particularly mangrove forest ecosystems, and has triggered the fragmentation of natural habitats (Ramena et al., 2020). Weak coordination between coastal area management agencies and the lack of law enforcement against spatial planning violations have also driven uncontrolled land conversion, accelerated the loss of ecosystem connectivity, and threatened the sustainability of mangrove biodiversity. Climate change, including rising sea levels, changes in rainfall (R. Liu et al., 2025; Samal et al., 2023), and temperature fluctuations, also adds pressure to the ecosystem (Ahmady and Rahman, 2025). In addition, forest fires in Ogan Komering Ilir Regency in 2014 resulted in the loss of mangrove vegetation in the Air Sugihan and Tulung Selapan areas, as shown in Map 4.2. In the long term, this condition can lead to the natural decline of mangrove vegetation, which is no longer able to adapt quickly to environmental changes. This has accelerated the process of coastal degradation, which in turn impacts the dynamics of shoreline change (Adenugba et al., 2024). Shoreline changes in Ogan Komering Ilir Regency are a direct result of the

interaction between natural factors and increasingly intensive human activities in coastal areas. A significant factor is the degradation of mangrove forests, which serve as a natural buffer against ocean waves and abrasion (Wei et al., 2021). Many mangrove areas have been converted into ponds, fish farming ponds, and oil palm plantations, especially in the Tulung Selapan, Cengal, and Air Sugihan Districts. The loss of mangrove vegetation reduces the coastal area's ability to absorb ocean wave energy (Das et al., 2023; H. Li et al., 2024), thus accelerating coastal erosion and gradual shoreline shifting.

Furthermore, the development of coastal infrastructure, such as ports, embankments, and settlements, also alters the dynamics of the coastal environment (Miatta et al., 2025). Reclamation and landfill activities for development purposes often overlook long-term ecological impacts. Land use that is not in accordance with its ecological function causes disruption of water flow, increased sediment deposition, and increased vulnerability of the area to abrasion and flooding (Akdeniz and İnam, 2023; Borzi et al., 2025). In some locations, overlapping spatial use between protected areas and agricultural land causes uncontrolled land conversion, resulting in physical changes to the coastal landscape (He et al., 2023). Climate change factors exacerbate these conditions. Sea level rise (Nghiningwa et al., 2025), increased extreme rainfall, and erratic tidal patterns accelerate the abrasion process (Shalsabilla et al., 2022) in the coastal areas of Ogan Komering Ilir. This is further compounded by natural events such as peatland fires, which cause the loss of vegetation along the coastline, particularly in and around Air Sugihan. This combination of human and natural factors is driving significant shoreline changes (Lu et al., 2025), manifesting as both land erosion and the shifting boundary between land and sea, which occurs annually. Coastline changes have significant impacts on the social, economic, and ecological conditions (Y. Liu et al., 2024) of coastal communities in Ogan Komering Ilir Regency. One of the most apparent impacts is the loss of productive land, including agricultural land and settlements, which is eroded by abrasion. In some areas, such as Tulung Selapan and Cengal, communities face direct threats from the sea, which is increasingly approaching their residential areas. Furthermore, damage to coastal infrastructure, such as embankments and piers due to abrasion, disrupts the economic activities of fishermen and fish farmers (Zhang et al., 2024), who are highly dependent on stable access to the sea and brackish waters.

Ecologically, shoreline changes disrupt the habitats of mangroves, waterbirds, and other marine life (Appoo et al., 2024). As the shoreline shifts, many tidal areas that previously served as breeding grounds for mangrove and fish species are submerged or lost. Habitat fragmentation also accelerates the decline in biodiversity and reduces the ecological function of coastal areas as natural buffers (Gunawan et al., 2024). If these conditions continue without integrated, conservation-based coastal space management, the sustainability of coastal ecosystems in Ogan Komering Ilir Regency will be increasingly threatened in the long term.

Conclusions

Based on the results of research conducted on the analysis of the impact of changes in mangrove forest land use and shoreline changes on the coast of Ogan Komering Ilir Regency, it can be concluded that there has been significant degradation in the area and quality of mangrove forests from 2014 to 2024. The most significant decline in mangrove area occurred in the Tulung Selapan and Air Sugihan Districts, primarily due to land conversion for fish ponds, oil palm plantations, and settlements. The ecological impact of these changes triggered increased shoreline abrasion, particularly in areas where significant mangrove vegetation cover was lost. In contrast, Cengal District showed a recovery trend due to the conservation program that began in 2020. Factors such as uncontrolled coastal development, weak spatial planning supervision, and the impact of climate change further exacerbate coastal conditions. Analysis of Landsat 8 imagery using the NDVI method has proven effective in monitoring land cover changes with high accuracy, making it a suitable basis for developing sustainable coastal area policies.

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