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Sedimentation And Abrasion Identification in Cikidang Fishery Port and Surrounding Coastal Area

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Abstract

Cikidang Fishery Port is one of the ports with serious abrasion and sedimentation problems. Seawater abrasion significantly affects some coastal areas that lack breakwater protection. Seawater abrasion causes the shoreline to recede further into the land, thereby narrowing the operational area of the coast. Not only that, harbour areas that are both protected and unprotected by breakwater also experience problems regarding water areas caused by ocean currents, tides, and large waves that lead to sedimentation. Sediment reduces the depth of harbour dock waters, making it impossible for ships to dock. As a fishing port that contributes significantly to the local economy, the Cikidang Fishery Port (CFP) necessitates analysis and solutions to address the issues of sedimentation and abrasion. References for this study used both primary and secondary data. We used a GPS handheld to measure the coastal area, and we conducted comparative studies using satellite images to gather secondary data. This will calculate the effective duration of the dredging process, enabling precise execution and minimizing the associated expenses.

Keywords: Abrasion, Sedimentation, Cikidang Fishery Port

1. Introduction

In 2003, construction began on the Cikidang Fishing Port (PP). The purpose of establishing PPI Cikidang is to allow fishermen to fish without directly participating in marine activities. Some of the facilities provided are an ice factory, electricity, clean water, breakwater, and TPI. Many fishermen have received various benefits from the establishment of PPI Cikidang which is currently still being developed further. However, because PPI Cikidang is still in its development stage, it still faces several shortcomings that hinder its ability to support fishing activities in the Cikidang area of Pangandaran. Several residents and fishermen confirmed that the absence of several facilities such as gas stations in the port is quite detrimental to fishermen, because all fishermen operating at PPI Cikidang must find fuel for boats and ships on land with a distance of more than 1 km. A port, as defined by Law 17 of the Republic of Indonesia, 2008, is a designated area of land and/or waters with specific boundaries, used for government and business activities. It serves as a docking point for ships, a place for passengers to embark and disembark, and a location for loading and unloading goods. Additionally, it serves as a terminal, a place for ships to anchor, equipped with shipping safety and security facilities, port support activities, and a place for intra- and inter-mode transportation transfers.

Usually carried out underwater in shallow water or freshwater areas, dredging is an excavation activity that aims to collect sediment and widen the bottom, like in the Erie Canal. ttom, such as in the Erie Canal. Waterways often use this technique to maintain navigability and establish anti-silting channels for ships. Some public beaches also use it to replenish lWe carry out dredging to establish new harbors, anchorages, or waterways, deepening existing facilities to facilitate access for larger vessels (Mutawalli, 2021).erways or to deepen existing facilities to allow access for larger vessels (Mutawalli, 2021; Timpua and Pianaung, 2019; Rejeki and Probandari, 2014).

Break Water is a coastal protection construction that is positioned parallel to or approximately parallel

to the shoreline with the aim of dampening incoming waves (Mulyono and Ladesi, 2021; Rachman, 2023; Listriyana and Handayani, 2023).

Groyne is a structure that is made perpendicular to or approximately perpendicular to the beach, functioning to control erosion caused by disturbances in the balance of longshore sand drift (Pekerjaan, 2016).

Sedimentation and seawater abrasion can also pose significant challenges for various stakeholders. Sedimentation in the surrounding area poses a significant threat to fishermen. With the decreasing water depth, the draft of ships or boats that are about to dock will gradually not meet the requirements. To prevent further sedimentation, dredging is needed at the appropriate or precise time.

We estimate the dredging time to ensure that the accumulated sediment reaches a stage where the dredging equipment can efficiently remove it, thereby keeping the equipment's cost proportionate and effective. Seawater abrasion, a common occurrence in the area around PPI Cikidang, can gradually complicate road access to the fish auction at the site. This will not only make it difficult for consumers to meet their needs, but it will also negatively impact the auction as fewer items will be sold. To overcome seawater abrasion, it is necessary to build breakwaters and groins to prevent seawater abrasion and add sediment to the designated area to increase the land area. The equipment used to detect sedimentation and abrasion is suitable for use with a handheld GPS device.

Figure 1. Cikidang Fisheries Port Waters and surrounding coastal areas.
Source: https://earth.google.com/

2. Method

The research site is on the east coast of Pangandaran. Figure 1 illustrates the coastal area that has undergone sedimentation and abrasion. The research was conducted for 3 days from February 19 to February 21, 2021.

The study employs the historical-correlational method. This method compares current data with previous data to establish a correlation with future data estimates. We utilized abrasion and sedimentation data from both direct field surveys and previous surveys conducted by other agencies. The primary data from this study is the size of the coastline from the waters of the PP Cikidang area; if the coastline continues to shrink, abrasion occurs in the area, and if it continues to move away from the beach, sedimentation occurs in the area. The secondary data used is data from the results of measuring the coastline taken from various literature from the research results of the relevant agencies.

3. Results and Discussion

3.1 Existing condition

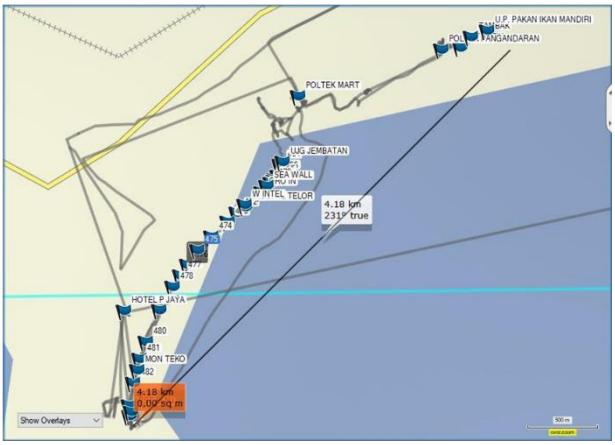

Figure 2. Coastline tracking results
Source: GPS Tracking

Figure 3. Current Satellite Image of Cikidang Fishing Port
Source: https://earth.google.com/

Figure 4. The current satellite image shows the west coastline of Cikidang Fishing Port.
Source: https://earth.google.com/

Figure 5. Satellite Image of Coastal Coastline from West Side of Cikidang Fishing Port Today
Source: https://earth.google.com/

Figure 6. Coastal Shoreline of the Area Surrounding the Current Western Breakwater
Source: https://earth.google.com/

Figure 7. Coastal Coastline of the Eastern Breakwater Area of Cikidang Fishing Port
Source: https://earth.google.com/

Abrasion continues to occur on the west coast due to strong currents from the Antarctic Ocean, which have begun to decrease since the construction of the Groin. In the period from 2006 to 2010, there was a retreat of the coastline towards the mainland along 37.44 meters.

Figure 8. Abrasion on the West Coastline in 2007
Source: https://earth.google.com/

Figure 9. Abrasion on the West Coastline in 2010
Source: https://earth.google.com/

Figure 10. Abrasion on the West Coastline in 2021
Source: https://earth.google.com/

The sedimentation process resulting from the construction of the groin in the West Coast area of PP Cikidang not only affects the morphological changes of the shoreline but also impacts the local ecosystem. With the accumulation of sediments, habitats for various marine species have begun to form in areas that previously lacked such environments. Mangrove plants and other species are starting to grow in the newly formed land, creating a more prosperous and more diverse ecosystem. Additionally, the increase in sedimentation helps strengthen the shoreline, reducing the risk of erosion that could damage the coastal environment and existing infrastructure. Thus, the construction of the groin serves as a tool to combat abrasion and contributes to the recovery and development of a healthier coastal ecosystem.

3.2 Cikidang Fishing Port Coastline

From 2007 to 2021, the coastal region experienced significant geological changes characterized by abrasion and sedimentation processes. While both phenomena were present during this period, it was notable that the sedimentation rate surpassed that of abrasion. This dynamic interplay between erosion and deposition has shaped the coastal landscape, influencing the area's physical geography and ecological and economic aspects.

Initially, the period from 2007 to 2009 marked a critical phase in which the coastline experienced the most substantial abrasion, measuring approximately 6.4 meters. This erosion was primarily driven by powerful oceanic forces, including solid wave action and prevailing currents relentlessly attacking the shoreline. The implications of this erosion were significant, as it threatened local infrastructure, including homes, roads, and the vital Cikidang Fishery Port. The loss of land to the sea due to erosion can lead to detrimental effects on the coastal ecosystem, including habitat loss for various species and increased shoreline vulnerability to future erosion events.

In response to the increasing threat of coastal erosion, a strategic intervention was implemented: the construction of a breakwater. This structure was designed to mitigate the impact of large waves, effectively acting as a barrier that protects the shoreline from the full force of the ocean. By absorbing and deflecting wave energy, the breakwater helps reduce the intensity of wave action on the coast, thereby minimizing the abrasion rate. Additionally, the breakwater creates a more stable environment in the anchorage waters of the Cikidang Fishery Port, providing a safer haven for fishing vessels and supporting the local fishing industry.

The establishment of the breakwater aimed to protect against erosion and played a crucial role in promoting sedimentation in the area. As the breakwater disrupted the flow of water and reduced wave energy, sediment previously suspended in the water began to settle in the calmer waters created by the structure. Over time, this sedimentation phenomenon became more pronounced, gradually accumulating materials along the coast. The sediments retained by the breakwater contributed to the formation of new land, altering the coastline and creating opportunities to develop new habitats.

As sedimentation continued to outpace erosion, the coastal landscape began to transform. The newly formed land supported vegetation growth, including salt-tolerant plants that thrive in coastal environments. This vegetation stabilized the newly accreted land and provided essential habitats for various marine and terrestrial species. The increase in plant life contributed to the overall health of the coastal ecosystem, promoting biodiversity and enhancing the resilience of the shoreline against future environmental challenges.

In addition to ecological benefits, the sedimentation process also had significant economic implications for the local community. Stabilizing the coastline and protecting the Cikidang Fishery Port created a more secure environment for fishing activities, which are vital to the livelihoods of many residents. The breakwater facilitated safer anchorage for fishing vessels, allowing for increased fishing operations and improved access to marine resources. This, in turn, contributed to the region's economic stability, supporting local businesses and enhancing food security for the community.

Furthermore, the changes in the coastal landscape have attracted attention from researchers and environmentalists interested in studying erosion and sedimentation dynamics. Understanding these processes is crucial for developing effective coastal management strategies that can address the challenges posed by climate change and rising sea levels. By monitoring the effects of the breakwater and the resulting sedimentation, scientists can gain valuable insights into the long-term sustainability of coastal ecosystems and the best practices for preserving them.

The balance between abrasion and sedimentation continued to evolve as the years progressed. While the initial phase of significant erosion raised concerns about the coastline's future, the subsequent sedimentation offered hope. The interplay between these two processes reminds us of the dynamic nature of coastal environments and the importance of proactive measures in managing them.

In conclusion, the period from 2007 to 2021 encapsulates a transformative era for the coastal region surrounding Cikidang Fishery Port. The breakwater construction marked a pivotal moment in addressing the challenges of abrasion and sedimentation. By effectively reducing wave energy and promoting sediment retention, the breakwater protected the shoreline and fostered the development of new land and habitats (Fig.11). The resulting ecological and economic benefits underscore the importance of strategic coastal management practices in ensuring the sustainability of vulnerable coastal areas. As we move forward, continued research and adaptive management will be essential in navigating the complexities of coastal

dynamics and safeguarding the future of these vital ecosystems.

Figure 11. Satellite Image of PP Cikidang Before the Breakwater was built in 2007 (left) and Satellite Image of PP Cikidang After Abrasion Period 2007 – 2009 (right)

After the Breakwater Construction was completed, the abrasion phenomenon changed into a sedimentation phenomenon that moved the coastline further towards the sea. It was recorded that the sedimentation phenomenon that occurred in the period from 2018 to the present (2021) pushed the coastline towards the sea by 4.7 meters (on average).

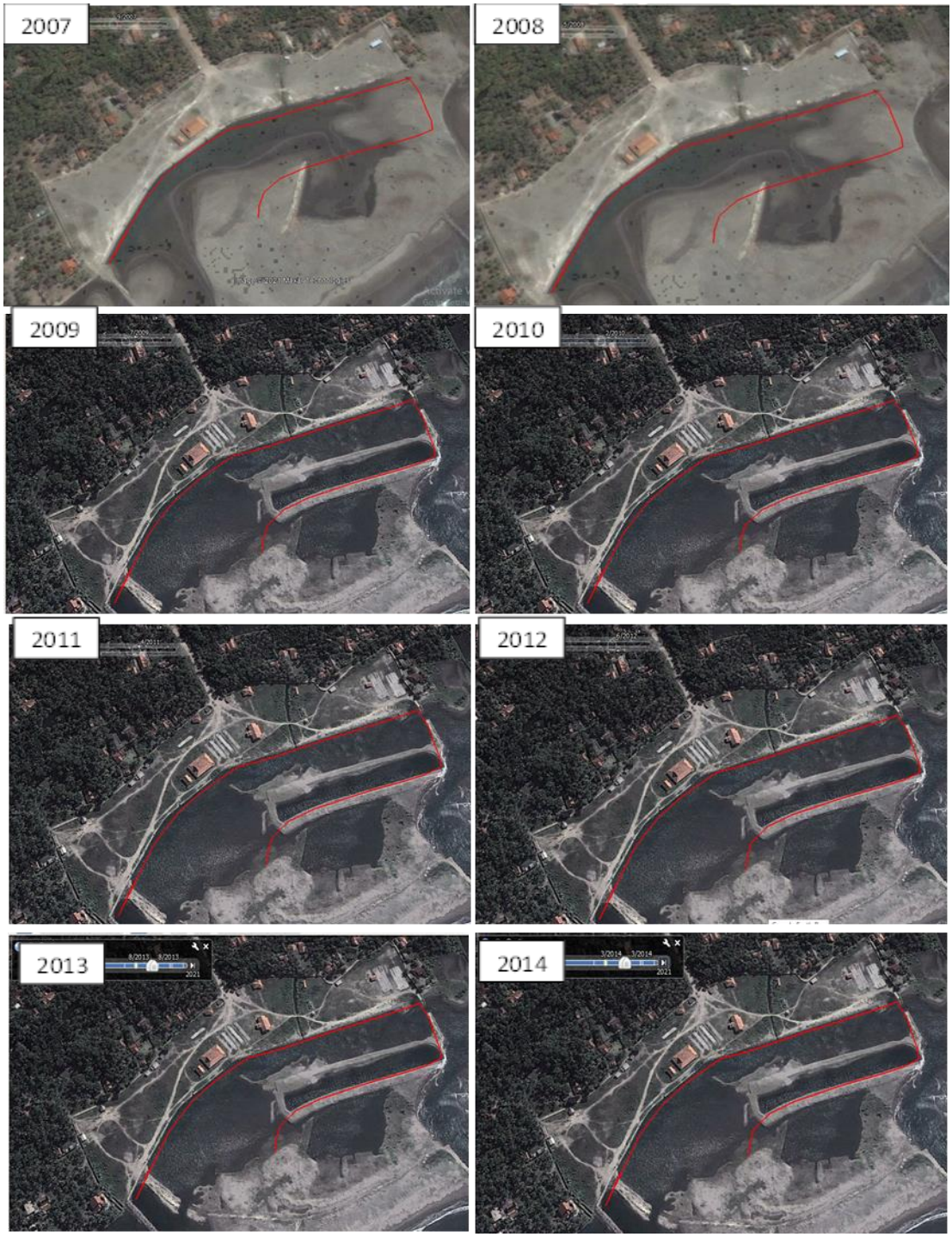

Figure 12. Satellite Imagery of the Coastal Area of Cikidang Fishing Port 2007-2014

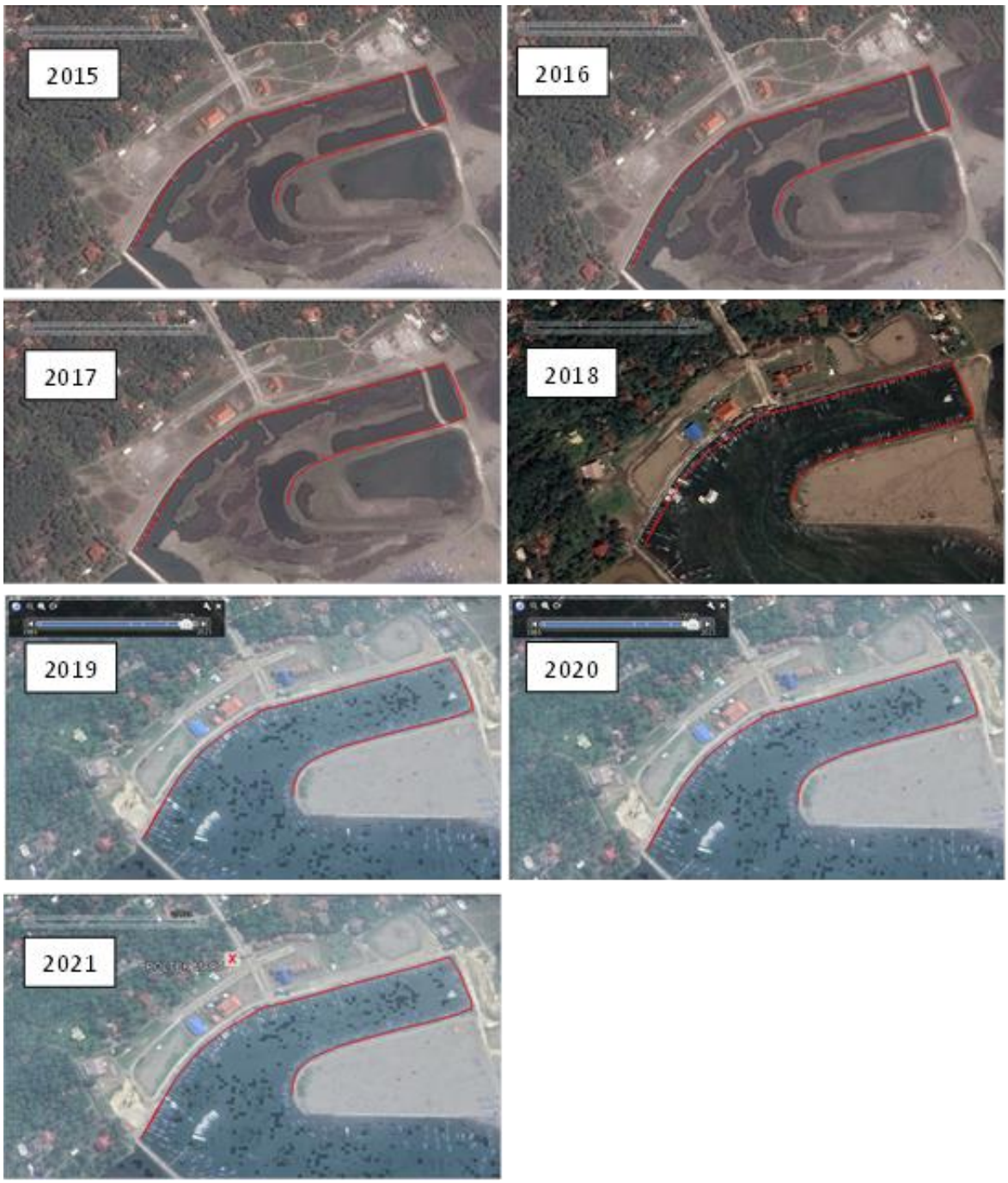

Figure 13. Satellite Imagery of the Coastal Area of Cikidang Fishing Port 2015-2021

Impact of Breakwater and Groin Construction in Cikidang Fishing Port and Surrounding Waters As the comparison of images 22 to 24 shows, after the breakwater was built, the abrasion slowly stopped, and sediment began to collect in the coastal area to build new land.

Breakwater breaks waves that will cause abrasion in coastal areas, so the waves' strength degrades. With the reduction in wave strength, the currents that hit the coast will only carry sediment that will build new land.

In images 25 and 26 we can see that the coastal areas eroded by abrasion are overcome by groins that collect sediment in coastal areas.

Groins prevent sediment from leaving certain areas so that the sediment forms new land and prevents further abrasion.

Positive Impact of Breakwater Construction

a. Abrasion stops

b. The coastline no longer moves towards the mainland

c. Large waves have been broken by the breakwater so that the waves that hit the port are not dangerous and do not interfere with port activities

Negative Impact of Breakwater Construction

a. Sedimentation occurs on a detrimental scale

b. The depth of the boat or ship mooring area decreases

c. Too shallow waters make some boats or ships unable to moor

d. Requires maintenance dredging (expenditure)

Impact of Groin Construction

With the construction of groins in coastal areas, the abrasion phenomenon stops, and the lost land recovers due to the sediment piled up by the groin. Ocean currents no longer erode the land, which is the result of sediment piled up by the groin.

Impact of Breakwater Construction

The construction of a breakwater at the Cikidang Fishing Port causes sedimentation, making the mooring waters shallow. Fishermen are increasingly complaining about this problem.

However, if a breakwater is not built and abrasion continues, the coastal area will continue to erode, causing the port area to shift further with greater construction costs. In addition, large waves that are not broken by the breakwater will make it difficult for fishermen to moor.

Based on the comparison of the coastlines listed above, it can be seen that after the construction of the breakwater, not only the Cikidang waters are no longer affected by abrasion, but the waters around the Cikidang Fishing Port are also no longer affected by abrasion. With the cessation of abrasion, the coastal areas where ocean waves have eroded can be rebuilt by the sedimentation that has been built. With the correct dredging time estimate, the costs incurred for maintenance will be more affordable than moving the location of port activities if abrasion is allowed to continue. Therefore, the construction of the breakwater is considered to have a positive impact.

4. Conclusion

In the west coast area, there was an abrasion of 37.44 meters from 2006 to 2010, and it stopped since the construction of the groin. After the construction of the groin, there was sedimentation of 40.69 from 2014 to the present. In the coastal area of the Cikidang Fishing Port, abrasion occurred. Still, with the presence of a breakwater, the direction of the abrasion was diverted to a mooring pool, and gradually, the phenomenon changed from abrasion to sedimentation. Abrasion in the Cikidang Fishing Port from 2007 to 2009 was 6.4 meters, and sedimentation until now was 4.7 meters. There was no abrasion in the east coast area but significant sedimentation. It was recorded that the sedimentation phenomenon that pushed the coastline ranged from 23 meters to 62.47 meters from 2014 to the present (2021). The abrasion in the coastal area before the construction of the groin and breakwater occurred quickly and was detrimental to various parties. The continuously decreasing coastal area causes activities in the coastal area to be disrupted. With the construction of a breakwater at the Cikidang Fishery Port, large waves from the sea that always make it difficult for boats and ships to dock are broken so that the currents hitting the coastal area become calmer, and boats and fishing boats can dock adequately. However, with the construction of a breakwater, sedimentation occurs quickly, making the docked waters shallow. Dredging activities are carried out to overcome sedimentation events. With the construction of groins in coastal areas, coastal areas eroded by abrasion begin to rebuild by sedimentation held back by groins.

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