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ABRASION DISASTER PROFILE, IMPACT AND ABRASION MITIGATION EFFORTS IN EAST JAVA PROVINCE

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ABSTRACT

Climate change causes sea waves to become stronger and affect coastlines due to abrasion. Abrasion is when local sea levels rise and drive strong waves that erode or wash away rocks, soil, and other materials. Based on data collected from the National Disaster Management Agency, there were 496 reports of disasters caused by abrasion or tidal waves. Overall, there is a trend of increasing incidents every year until it reaches a peak in 2022 with 145 reports of disaster incidents. Identifying areas prone to marine abrasion disasters based on the number of incidents in several regions, provinces, and districts is essential to carry out in order to provide appropriate mitigation measures. This research uses a systemic literature review method. This research aims to identify the general profile of abrasion disasters in East Java province. Identify the location of the incident, impact, and mitigation regarding abrasion events in East Java province. According to data from the National Disaster Management Agency, the results show that East Java Province has a high frequency of abrasion incidents, ranking first as the province with the most reports of abrasion incidents. A systemic literature review conducted on thirteen pieces of literature found that the Tuban and Situbondo areas were the most affected by abrasion incidents, with abrasion incidents occurring more frequently in the North Coast area of East Java province.

Introduction

Climate change is causing sea waves to become stronger and endanger the coastline. Rising sea levels and increasing wave intensity due to climate change can cause damage to coastal areas, leading to abrasion and accretion (Susanti & SH, 2021). Beach erosion is when local sea levels rise and drive strong waves that erode or wash away rocks, soil, and other materials (Madani et al., 2023). A study finds that climate change has made waves stronger, which will affect wave-driven coastal erosion (Bolívar & Meijer, 2016).

Based on data collected from the National Disaster Management Agency, there were 496 reports of disasters caused by abrasion or tidal waves. Overall, there is a trend of increasing incidents every year until it peaked in 2022, with 145 reports of abrasion and tidal disasters. This disaster was reported to have occurred in most coastal areas in Indonesia (Broccardo, Culasso, & Mauro, 2019). Several marine abrasion mitigation strategies can be implemented, including Strengthening the resilience of beach morphology, which involves placing additional sand on the beach to serve as a buffer against erosion, Strategic planting of vegetation to anchor the sand and ensure its stability, Hard structures such as walls or, Soft structures such as beach embankments or mangrove planting (Utama, 2020). Each Mitigation action has its trade-offs and consequences.

Therefore, it requires consideration of various criteria and parties and careful planning when implementing them (Snyder, 2019)

Identifying areas prone to marine abrasion disasters based on the number of incidents in several regions, provinces, and districts is essential to carry out in order to provide appropriate mitigation measures (Baker, 2016). East Java has the highest number of reported incidents of abrasion and tidal waves in Indonesia, based on data from BNPB. This research aims to identify the general profile of abrasion disasters in East Java province (Maulana, Wulan, Wahyuningsih, Mahendra, & Siswanti, 2016). Identify the location of the incident, impact, and mitigation regarding abrasion in East Java province.

Research Methods

This research uses a systemic literature review method. A systemic literature review is a planned review to answer a specific research question by using a systematic and explicit methodology to identify, select, and critically evaluate the research results included in the literature review (Rinjani, Panbriani, Auliya'Amalina, & Artayasa, 2022). Systematic literature review research can be considered original research because it uses a rigorous methodological approach. Several stages that can be carried out regarding systemic literature reviews include:

a. Asking Research Questions - A systematic literature review should start with a well-formulated, well-defined research question that can help in the decision-making process to determine which articles will be included in the literature review.
b. Finding Literature: Use several sources for scientific literature. As far as possible, the literature sources used can be primary literature database sources or articles published in conference proceedings.
c. Critical Evaluation of Studies: Use specific criteria to determine the validity of selected studies. This approach facilitates the decision-making process in determining which articles to include in the literature review.
d. Data Collection: Describe each study's methodological approach (variables, sample, measures, and data analysis) and findings, allowing comparisons between and among the selected studies.
e. Data Analysis and Reporting: Research must be grouped based on similarities in methodology. Numerical and graphical presentation of results should also be discussed in the review to facilitate readers' understanding of the findings.
f. Interpretation of Findings, Strength of evidence, use of findings, and new things in the literature can be highlighted.
g. Updating the Review: A systematic literature review will provide recommendations to other researchers regarding what should be addressed in the following review.

This research reviews journals using the following criteria

1. Published between 2019-2023 (last four years)
2. Contains the queries "Abrasion" and "East Java."

With these criteria, 13 journals were obtained that met the following details

Table 1
list of journals for literature review materials

Author	Publication Year	Title
Ervianto, A., & Hariyanto, B	2021	Analysis of the Impact of Beach Abrasion on the Social Environment in Bancar District, Tuban Regency
Erwanto, Z., & Masluha, U	2019	Artificial Temple Reef Conservation Technology to Control Coastal Abrasion on Tabuhan Island, Bangsring Village, Wongsorejo District, Banyuwangi
Fuad, MAZ, Fajari, AK, & Hidayati, N	2021	Modeling and Analysis of Coastline Changes in Situbondo Regency, East Java.
Mutawibbillah, AF, Listriyana, A., & Leonard, R	2022	Identification and Analysis of Coastal Protective Buildings on Jalan Pantura, Situbondo Regency.
Janah, L., Nugraha, ASA, Yanti, RA, & Nuraini, L	2022	The Application of Landsat 8 OLI to Identify Shoreline Change in 2000 – 2020 in Muncar Sub-District
Chairani, C., Saraswati, R., & Shidiq, IP A	2019	Identification of changes in mangrove areas toward shoreline changes on the East Coast of Surabaya 2004-2017
Irawan, LY, Sumarmi, Bachri, S., Rosbella Devy, MM, Faizal, R., & Prasetyo, WE	2021	Coastal Community Resilience Planning Toward Disaster: A Case Study on Coastal Area in Malang Regency, East Java, Indonesia
Sadewai, AH	2022	Overcoming Coastal Damage with Mangrove Rehabilitation on Bahak Beach, Probolinggo
Miranda, NA, Bintoro, RS, & Prasita, VD	2023	The Pattern of Coastline Changes and Wave Modeling around the Expansion of PPI Popoh Tulung Agung, East Java
Utami, AUS, & Luthfi, OM	2019	Role Of Local Disaster Management Authority For Facing High Tide Disaster At Pacitan Bay
Armono, HD, Citrosiswoyo, W., & Muzaki, FK	2023	Training on Making Artificial Reefs as an Effort to Mitigate Beach Abrasion in Tlangoh Village
Putri, FNDS, Mazaya, A., & Wicakrani, DC	2022	Planning for Fly Ash and Lapindo Mud Geopolymer Concrete Tetrapods at Mimbo Harbor Breakwater, Situbondo.
Tyas, YIW, Koeshardjono, RH, Yatiningrum, A., Amani, T., Rahajeng, Y., Putri, WM, Febryanti, WW, Nirbaya, NPA, & Hasanah, A.	2023	Mangrove Planting as an Effort to Prevent Abrasion in Pabean Village, Dringu District, Probolinggo Regency

In addition to this study, researchers used disaster data related to abrasion disasters sourced from the National Disaster Management Agency (BNPB) website to identify the general profile of disasters in East Java Province.

Results and Discussion

Identification of 496 abrasion disaster incident reports obtained from the National Disaster Management Agency, which were then mapped according to the province of occurrence, can be seen in Figure 1.

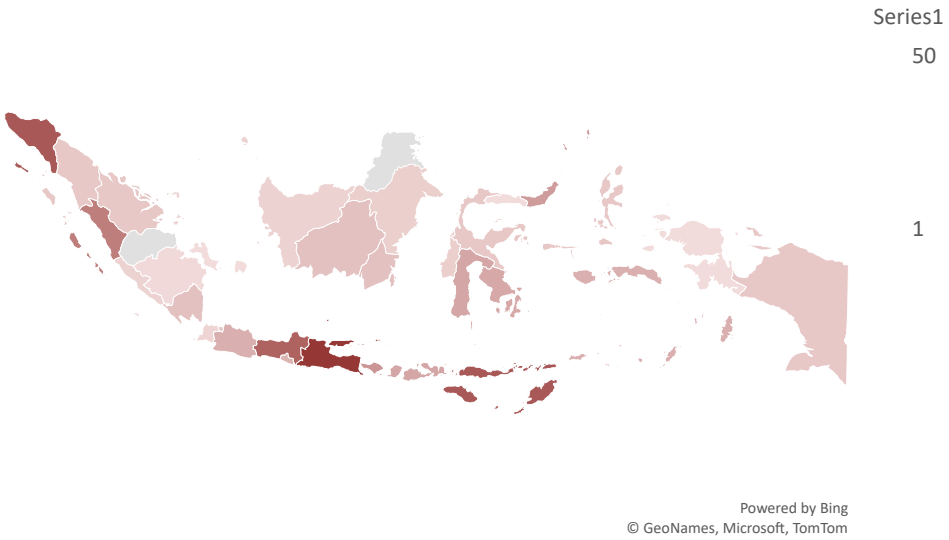

Figure 1 Distribution of abrasion incidents in Indonesia

Figure 1. Shows the distribution of the most abrasion incidents on Sumatra, Java, and Sulawesi islands. Sorting data for the ten provinces with the most reported abrasion incidents can be seen in Figure 2.

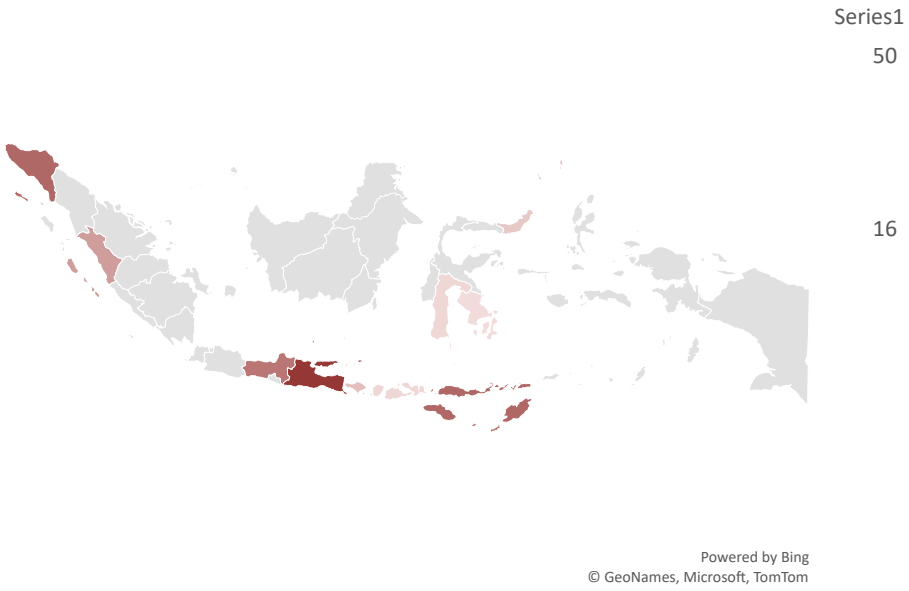

Figure 2. Distribution of abrasion incidents in the ten provinces with the highest findings

Based on the description of the distribution map, East Java province is the province with the highest distribution of abrasion incidents in Indonesia. Specifically, the location of the distribution of abrasion in the districts in East Java province is in the picture.

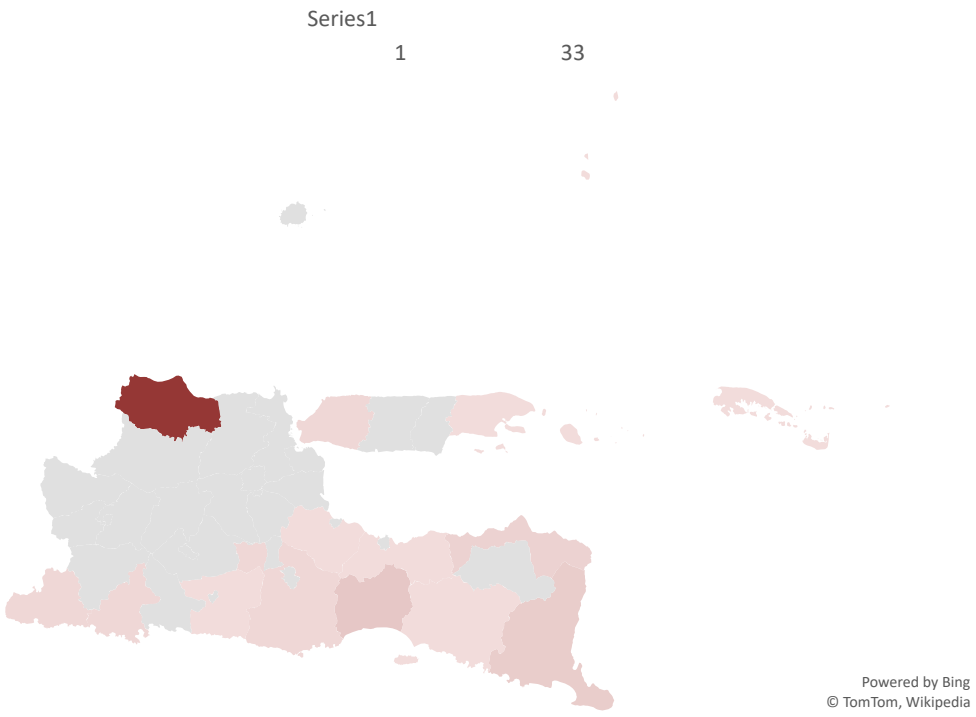

Figure 3. Distribution of abrasion incidents in East Java Province

Based on the results of a review of research in the literature, it was found that most of the incidents occurred in the northern part of East Java; some information regarding the location of the impact abrasion disaster and the forms of mitigation that have been carried out (Setyati et al., 2018).

Table 2
Identification of abrasion locations in East Java province

Location	Impact	Forms of Mitigation
Bancar District, Tuban Regency	Due to the high abrasion rate in several villages in Bancar District, which damaged their homes, several residents shifted their livelihoods. Bancar District, on the west side, has a reasonably large port and is used as a place for fish auctions, making people living on the coast of Bancar District work as fish traders and fishermen. (Ervianto & Hariyanto, 2021)	The mitigation measures that have been carried out have not been explained, but the author recommends planting mangroves in areas affected by the abrasion disaster.
Bangsring Village, Wongsorejo District, Banyuwangi	Damage to coral reef ecosystems and erosion of coastal areas (Erwanto & Masluha, 2019)	Construction of an Artificial Temple Reef

Location	Impact	Forms of Mitigation
Situbondo Regency	The area that experiences abrasion is an open area with no coastal protection, like the beach. Tampora, Banyuglugur District settlement, empty land near the Suboh District pond, settlement, and Mlandingan fish auction place. The impact of high waves causes scouring, resulting in abrasion and deterioration of the coastline and an increase in the steepness of the beach. (Fuad et al., 2021)	Mitigation measures that have been taken have not been explained.
North Beach Area, Situbondo	Erosion of buildings and infrastructure (road border areas) that have been built. (Mutawibbillah et al., 2022)	There are seven coastal protection buildings in Situbondo Regency. 6 of them are revetment beach protection buildings with a length of 2,449 meters, 1 type of jetty beach protection building with a length of 2.12 meters, and a natural BPP mangrove protection building with a length of 3,170 meters. .
Muncar, Banyuwangi District	There is a receding coastline in most of the observed areas (comparing the 2020 coastline with the 2000 coastline). Six of the seven observed villages experienced abrasion or erosion of the coastline. (Janah et al., 2022)	Mitigation measures that have been taken have not been explained.
East Coast, Surabaya	There was a reduction in the mangrove area of 168 hectares which occurred in six villages; there was the erosion of an area of 18 hectares, with the highest level of abrasion being in the Keputih village database (2004-2017) (Chairani et al., 2019)	Mitigation measures that have been taken have not been explained.
Gajahrejo, Malang	The abrasion incident impacts the tourism sector in the Gajahrejo area; the increasing wave of abrasion has caused several tourist locations to be closed due to damage to existing tourism facilities due to increased abrasion incidents. (Irawan et al., 2021)	The mitigation measures that have been carried out have not been explained. However, researchers have recommended the construction of coastal protective structures and increasing community capacity in dealing with abrasion disasters.
Bahak Beach, Probolinggo	The erosion of coastal areas has resulted in a reduction in mangrove areas (Sadewai, 2022)	Planting or rehabilitating mangroves

Location	Impact	Forms of Mitigation
Tulung Agung, East Java	Erosion occurs in the area north of the Popoh fish landing base; the results of the erosion then become sediment transport towards the direction of the Popoh fish landing base (Miranda et al., 2023)	Mitigation measures that have been taken have not been explained.
Pacitan Bay	The increase in the intensity of sea waves and abrasion events impacts the ecosystem's condition, especially the coral reef ecosystem in Pacitan Bay. Most of the coral reefs have experienced death and damage. (Utami & Luthfi, 2019)	Mitigation measures that have been taken have not been explained.
Tlangoh Village, Tanjong Bumi District, Bangkalan Regency	This abrasion is of great concern to the people around Tlangoh Beach, who depend on this beach for their economic livelihood. It is feared that increasingly severe abrasion will reduce tourist visits, which could reduce income for the people there. With the current abrasion conditions, the people of Tlangoh Village, especially those living around the beach, feel anxious because the damage to the beach will reduce tourist visits as well as disrupt fishing activities around the beach (Armono et al., 2023)	By placing simple protective stones (but not effective yet), researchers are training to create artificial coral reefs to reduce waves and abrasion.
Mimdo Harbor, Situbondo	The extent of erosion in the outer area of the pool in Mimbo Harbor (Putri et al., 2022)	Formation of concrete tetrapods mixed with geopolymer fly ash and Lapindo mud
Dringu District, Probolinggo Regency	The abrasion event resulted in erosion and damage to several coastal border areas in the villages of Pabean and Dringu (Tyas et al., 2023)	Mangrove planting in front of the village area.

Based on the information obtained, most areas affected by abrasion have not carried out mitigation efforts, so the resulting impacts are worsening. Mitigation efforts using natural mitigation by planting mangroves are the most frequently used option because of their ease and low cost.

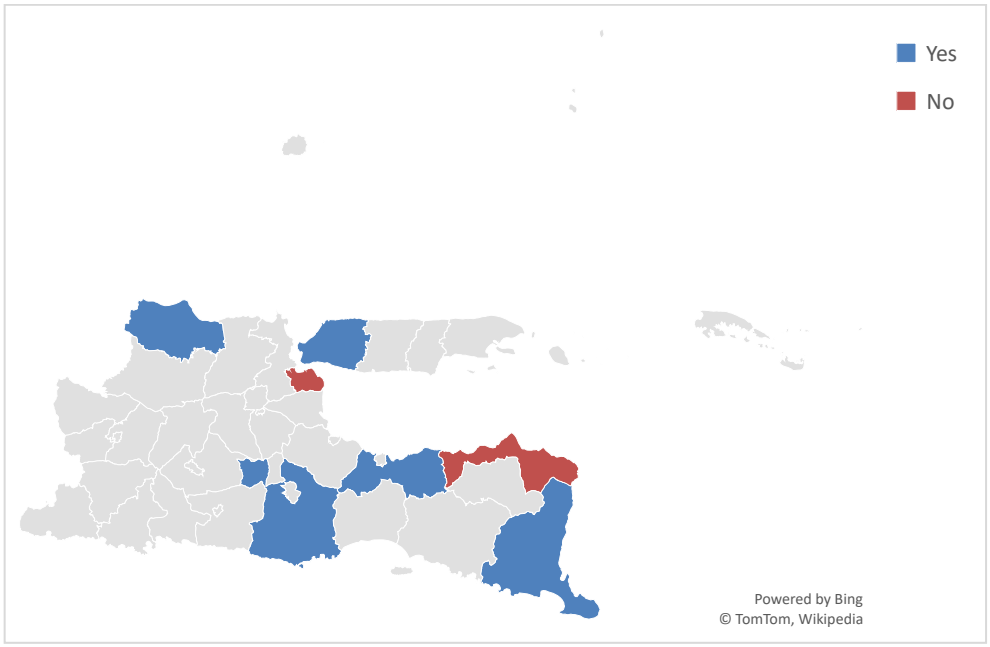

Figure 4. Distribution of mitigation measures for abrasion incidents

Figure 4 shows the distribution of abrasion incident areas in East Java Province based on a systematic literature study; not all areas affected by abrasion incidents have been handled or mitigated, and there are still abrasion incidents that have not been mitigated.

Conclusion

East Java province is one of the provinces with a high frequency of abrasion incidents, ranking first as the province with the most reports of abrasion incidents according to data from the National Disaster Management Agency. A systemic literature review conducted on thirteen pieces of literature found that the Tuban and Situbondo areas were the most affected by abrasion incidents, with abrasion incidents occurring more frequently in the North Coast area of East Java province.

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