Jurnal Praktik Baik Pembelajaran Sekolah dan Pesantren
Vol. 4, No. 02, pp. 80-91
journal.iistr.org/index.php/PBSBP
DOI: 10.56741/pbpsp.v4i02.934

Community Engagement for Coastal Abrasion Mitigation at Tanjung Beach, Rangsang Barat, Riau

[1]Khusnul Basriyah*, [1]Aisyah Zumira, [2]Dwi Sulisworo
Corresponding Author: khusnulbasriyah01@gmail.com
[1] SMA Negeri 1 Rangsang Barat, Riau, Indonesia
[2] Universitas Ahmad Dahlan, Yogyakarta, Indonesia

ARTICLE INFO

Article history
Received 13 April 2025
Revised 30 April 2025
Accepted 2 May 2025

ABSTRACT

This action aims to reduce the impact of abrasion on Tanjung Motong Beach, Permai Village. The 40 Days Challenge Team of SMAN 1 Rangsang Barat, together with the community around the beach and teachers, have planted mangrove trees, which are an effective and sustainable solution to reduce the impact of abrasion. This action consists of 5 ongoing weeks, the first week is conducting surveys and observations on Tanjung Motong Beach, the second week is collecting data on abrasion on Tanjung Motong Beach, and sowing mangrove seeds. Our team sowed 250 mangrove seeds from the api-api species, the third week provided education to residents living around Tanjung Motong Beach, conducted socialization and provided education to school residents, and interviewed several residents living around the coast of Tanjung Motong Beach. The fourth week, planting mangrove seedlings on Tanjung Motong Beach, Permai Village, the fifth week monitoring the development of mangrove seedlings that have been planted, monitoring small mangrove seedlings (not old enough to be planted on the beach), and evaluating the growth and development of mangrove seedlings that have been planted on Tanjung Motong Beach. The positive impact of planting mangrove trees not only helps prevent abrasion, but also contributes to improving the quality of the ecosystem, such as increasing biodiversity and reducing damage from sea waves.

Keywords
Coastal Abrasion
Community Engagement
Mitigation
Rangsang Barat
SDGs

This is an open-access article under the CC–BY-SA license.

Introduction

Climate change is one of the most pressing environmental issues globally and has become a central topic of discussion among nations, including Indonesia. Over recent years, the impacts of climate change have increasingly affected various aspects of human life [1]. One of the ecosystems significantly impacted is the coastal environment.

Tanjung Motong Beach, located on Rangsang Island—specifically in Permai Village, Rangsang Barat Sub-district, Meranti Islands Regency, Riau Province—is one such affected area. Its geographical position, directly facing the Malacca Strait, contributes to dynamic hydrodynamic phenomena, including abrasion and accretion [2]. Being directly exposed to the open sea renders Tanjung Motong Beach particularly vulnerable to strong wave action, ocean currents, and tidal movements. Coastal abrasion is a destructive process wherein shorelines are eroded by wave and current action. Tanjung Motong Beach experiences an average abrasion of approximately 4 km^2 annually [3]. Historical satellite imagery from 1990 to 2014 indicates that severe erosion predominantly occurs in the southern part of the beach. The average erosion rate is around 9.63 meters per year, while in contrast, sedimentation occurs in the northern section with an average rate of 5.32 meters per year [4].

Continuous coastal erosion leads to the destruction of mangrove forests, reduction in beach width, shrinkage of land for coastal communities, and damage to infrastructure such as roads, bridges, and buildings [5]. Without structural mitigation efforts, the abrasion process is likely to persist [6]. One long-term preventive strategy is mangrove planting [7]. Mangroves play a critical role in stabilizing coastlines, preventing erosion, and providing habitats for various coastal species. Mangroves are generally shrub-like or tree vegetation that grow in saline or brackish coastal environments, commonly found along shorelines and tidal riverbanks with high salinity and low oxygen levels.

Fig. 1 shows the impact of coastal erosion along the shoreline of Rangsang Barat, Riau. The land near the coast has been significantly eroded, resulting in the loss of vegetation and threatening nearby settlements. This condition highlights the urgent need for coastal protection and sustainable environmental management.



Fig. 1. The coastal condition

The robust and dense root systems of mangrove trees are capable of binding and retaining coastal sediments, thus preventing them from being washed away by strong currents and waves. Proper mangrove planting allows sediment materials to become trapped within their roots, forming a natural embankment that protects the shoreline from further abrasion. Moreover, their intricate root structures help reduce water flow and wave energy, control sedimentation rates, and minimize coastal damage. In the context of disaster mitigation, mangroves are also known to reduce wind intensity from the sea and, in some regions, have proven effective in diminishing the impact of destructive tsunami waves.

Mangrove planting also offers numerous ecological benefits. Mangrove ecosystems serve as crucial habitats for a variety of animal and plant species, including fish, birds, and mollusks. The existence of healthy mangrove forests helps sustain coastal biodiversity, supports vulnerable species populations, and maintains the fertility of coastal waters. Thus, mangrove rehabilitation stands as a sustainable solution to mitigate coastal abrasion and preserve the integrity of coastal ecosystems against the adverse impacts of climate change. Based on this context, the 40 Days Challenge Team from SMA Negeri 1 Rangsang Barat has chosen the theme “Coastal Abrasion Mitigation at Tanjung Motong Beach, Permai Village” as the focus of their community-based problem-solving initiative.

The primary objective of this action is to mitigate the issue of coastal abrasion resulting from climate change at Tanjung Motong Beach, located in Permai Village. This initiative seeks to address the environmental degradation occurring along the coastline by implementing sustainable and community-driven solutions. Specifically, the action aims to reduce the adverse impacts of abrasion and support the restoration of the coastal ecosystem. Additionally, it endeavors to enhance public awareness and foster a sense of collective responsibility among local communities regarding the importance of preventing coastal erosion. By engaging the community in proactive measures, such as mangrove planting, the initiative also aims to create

and preserve natural habitats for a variety of animal and plant species that are native to the coastal area. These objectives collectively support a long-term strategy for environmental resilience and the preservation of biodiversity at Tanjung Motong Beach.

Materials and Methods

A. Action Design

The action implemented during the *40 Days Challenge* followed a series of structured stages aimed at mitigating coastal abrasion at Tanjung Motong Beach. The first stage involved identifying the key environmental issues affecting the beach area, particularly the extent and impact of abrasion. Following this, relevant information, data, and trends were collected through social media platforms to support the formulation of a targeted intervention strategy. Based on these insights, the team designed a scenario for abrasion prevention tailored to the local context. A crucial step in this process was the cultivation of mangrove seedlings through nursery activities, which formed the foundation for long-term restoration efforts. Simultaneously, educational activities were conducted within the school community to raise awareness about coastal degradation. Community engagement was emphasized by initiating discussions with residents regarding the causes, impacts, and solutions to abrasion in the area. The core of the intervention involved planting mangrove seedlings along the coastline of Tanjung Motong Beach. Lastly, the team conducted a post-action analysis and evaluation to monitor the development of the planted mangroves and assess the effectiveness of the intervention in Permai Village. The participants doing this action were students from SMAN 1 Rangsang Barat, Riau, Indonesia (15 students and 2 teachers). Fig. 2 captures a group of residents and facilitators actively involved in a community engagement activity. This event was part of a collaborative effort to raise awareness and promote sustainable practices in response to environmental challenges faced by the region.



Fig. 2. The participants in the community engagement action

The primary target of this initiative was to reduce the negative effects of coastal abrasion at Tanjung Motong Beach in Permai Village. Through the completion of the 40-Day Challenge, the team anticipated measurable improvements in coastal stability and a decline in erosion-related damages. To achieve this, several tools and materials were utilized. The tools included wheelbarrows for transporting materials and gloves for safety during field activities. The materials comprised mangrove seedlings, polybags for nursery preparation, mud, and *tanah sesai*—a local term for the sandy coastal soil found in the Tanjung Motong area. These resources were integral to the successful implementation of the mangrove planting and environmental restoration activities. Fig. 3 displays a collection of mangrove seeds prepared for planting as part of a coastal abrasion control initiative. These seeds play a vital role in stabilizing the shoreline, preventing further erosion, and supporting the regeneration of coastal ecosystems.



Fig. 3. Mangrove seeds for the abrasion control program

B. Action Activities

1. Week I

During the first week, our team conducted a field survey and observation at Tanjung Motong Beach. The findings confirmed that the area had been experiencing severe coastal abrasion, particularly over the past five years. This degradation is primarily caused by strong wave activity, ocean currents, and tidal fluctuations. Following the initial observation, the team collected supporting data from various credible sources and references to better understand the scale and impact of the abrasion occurring in the region. The main challenge during this phase was the difficulty of accessing the observation site due to infrastructure damage caused by coastal erosion. Most of the access roads leading

to the beach were heavily damaged and impassable by motorcycle. To address this issue, the team sought alternative routes to reach the observation area. Fig. 4 shows a group of students engaged in a discussion session as they plan and coordinate activities for the community-based abrasion control program. This collaborative effort emphasizes youth involvement in environmental conservation and community development.



Fig. 4. Student discussion preparing the action

2. Week II

In the second week, the team focused on collecting data related to the abrasion at Tanjung Motong Beach and initiated the mangrove seedling nursery. A total of 250 mangrove seeds from the *Avicennia alba* species were cultivated in polybags filled with a planting medium composed of mud and *tanah sesai*, a local coastal sandy soil. The polybags were placed in saline water zones to support the acclimatization process. Challenges faced during this phase included unexpected changes in tidal schedules, limited seed availability, and unsafe nursery conditions due to sharp glass debris, wooden branches, and muddy terrain. Additionally, the team encountered non-technical challenges, such as opposition from some local government officials regarding the selected nursery site. To overcome these obstacles, the seed planting schedule was adjusted to early morning hours when tidal levels were low. The team also used protective gear, including rubber boots and walking sticks, to ensure safety in muddy areas. In response to administrative concerns, the team engaged in dialogue with village officials, received feedback, and relocated the nursery to a safer, officially approved site.

3. Week III

In the third week, the team conducted educational outreach programs targeting residents near Tanjung Motong Beach and school communities. This included socialization efforts and direct interviews with coastal residents. Technical challenges included fluctuations in tidal schedules that hindered access to certain areas during community outreach. Weather disturbances, particularly rain, also disrupted scheduled school-based educational activities. As a solution, the team rescheduled community engagement sessions to coincide with low tide conditions, ensuring accessibility to the targeted areas. For the school program, the venue was

moved indoors from the originally planned outdoor location, and participation was limited to Grade 10 students to accommodate the available indoor space while ensuring effective delivery of the educational content on coastal abrasion. Fig. 5 shows the project team delivering a socialization session and encouraging active participation from 10th-grade students. This activity aimed to raise awareness about coastal erosion and involve young learners in practical environmental solutions.



Fig. 5. The Team conducted socialization and participation of the 10th-grade

4. Week IV

The primary activity during the fourth week was the planting of mangrove seedlings at Tanjung Motong Beach. However, the seedlings cultivated during Week II were still too immature for transplantation to the shoreline. To address this, the team received a donation of 65 mature mangrove seedlings from residents, which were suitable for direct planting along the coast. The planting activity involved team members, schoolteachers, residents, and village officials from Permai Village, Rangsang Barat District. Technical challenges encountered included tidal schedule shifts, immature seedlings, hazardous planting areas with broken glass, and slippery, muddy conditions. A non-technical challenge was the low level of community participation, which was due to the initial planting schedule being set during less convenient hours. In response, the planting schedule was revised from late afternoon to morning hours (08:00–10:00 WIB) to align with favorable tidal conditions. Safety measures were implemented, including the use of proper tools and protective clothing. To accommodate community involvement, the planting was scheduled over the weekend, though this limited participation to a smaller group of volunteers and officials. Fig. 6 shows participants planting mangrove seedlings along the coastline as part of the abrasion control program. This hands-on activity contributes to shoreline stabilization, enhances biodiversity, and fosters community involvement in environmental restoration efforts.



Fig. 6. The planting of mangrove seedlings

5. Week V

The final week focused on monitoring the growth and development of both the newly planted and nursery mangrove seedlings. The team evaluated the survival rate and environmental conditions affecting seedling viability. Monitoring results revealed that approximately 50% (25–30 seedlings) of the planted mangroves failed to survive. Contributing factors included seedlings being washed away by tidal surges and livestock, particularly goats, consuming the mangrove leaves. Additionally, the region experienced a "high tide phenomenon" over the past 10 days, characterized by higher-than-normal tides with prolonged durations, resulting in coastal flooding in the Permai Village area. Fig. 7 depicts a group engaged in a discussion session focused on monitoring and evaluating the progress of the mangrove planting and community engagement program. This step is essential for assessing the impact, identifying challenges, and planning future improvements for coastal protection initiatives.



Fig. 7. Monitoring and evaluation discussion

Discussion

A. Implementation Analysis

The initial phase of the project focused on identifying and analyzing the primary environmental issue at Tanjung Motong Beach. Observations and field assessments conducted during the first week revealed that the main problem facing the area is severe coastal abrasion.

This phenomenon is driven by strong ocean waves, deforestation of coastal vegetation, and climate change-related factors. These findings align with previous studies highlighting similar causes of coastal erosion in the Rangsang area and nearby regions [4],[8].

In the following weeks, the team collected data and information from various credible media sources, analyzed trends, and designed prevention scenarios, including the cultivation of mangrove seedlings. Historical data indicated a worsening trend in coastal abrasion from 1984 to the present [4]. The cultivation of Avicennia alba mangrove seeds in polybags yielded positive results, with most seeds showing good growth, a method proven effective in other community-based mangrove restoration projects [4], [9].

Educational outreach was a major activity in the third week. Educational sessions were delivered to both school communities and residents, significantly increasing awareness and understanding of the abrasion issue. These sessions covered the causes, impacts, and potential mitigation strategies. As a result, residents became more open to dialogue and were willing to collaborate on addressing the coastal challenges. Similar community engagement strategies have been shown to enhance the sustainability of coastal rehabilitation programs [10], [11].

During the fourth week, the team proceeded with the planting of mature mangrove seedlings along the beach. Due to the immature state of previously cultivated seedlings, 65 mature mangrove plants were donated by the local community. The planting was conducted in collaboration with residents, school representatives, and village officials. Although most seedlings began to grow, several did not survive due to tidal surges, consumption by local livestock, and unusually prolonged high tide phenomena—conditions also reported as limiting factors in similar coastal restoration efforts [6],[12].

In the final week, monitoring and evaluation of the planted and nursery mangrove seedlings were conducted. Results showed that approximately 50% (25–30 seedlings) failed to survive. Factors such as wave action, livestock interference, and extreme tidal conditions contributed to this mortality rate [5], [10].

Despite these challenges, the team successfully met its primary objective of initiating mangrove planting as a strategy to mitigate coastal abrasion while promoting environmental awareness among the local population. Nevertheless, continued monitoring and stronger community and governmental engagement are necessary to ensure long-term success and sustainability [6],[13].

B. Environmental and Social Impact

The ecological impact of the mangrove planting program was evident through early signs of reduced abrasion and increased biodiversity along Tanjung Motong Beach. The presence of new mangrove vegetation contributes to the stabilization of coastal ecosystems and supports long-term environmental sustainability. This aligns with previous findings that mangroves act

as natural barriers against wave energy, effectively reducing erosion and providing critical habitat for marine biodiversity [4],[6],[8].

The initiative demonstrates that reforestation of coastal vegetation is a viable and effective strategy for mitigating environmental degradation caused by both natural and anthropogenic factors [2],[9]. Studies have shown that strategic planting of species such as Avicennia and Rhizophora along vulnerable coastlines can significantly decrease the rate of shoreline retreat and promote ecosystem recovery [6], [12].

From a social perspective, the project had a significant impact on raising community awareness, particularly regarding environmentally harmful activities such as waste disposal and deforestation. The involvement of local schools encouraged environmental stewardship among youth and fostered a culture of ecological responsibility. Similar education-driven coastal conservation efforts have demonstrated long-term benefits by instilling environmental values and mobilizing communities for sustainability action [10], [11].

In the long term, successful mitigation of coastal abrasion is expected to protect essential coastal resources that support the community's primary livelihoods, such as fisheries and tourism. This is consistent with regional development studies that emphasize the link between coastal ecosystem health and socio-economic resilience [3], [6], [11]. Additionally, the program opens opportunities for employment in conservation-related fields, including mangrove cultivation and eco-tourism initiatives, as echoed in recent literature on community-based environmental management [10]-[12]. These outcomes highlight the potential for community-based environmental action to contribute to both ecological resilience and socio-economic development [13],[14].

Conclusion

Based on the actions undertaken by our team to address coastal abrasion at Tanjung Motong Beach, Permai Village, several conclusions can be drawn. First, abrasion in this area is a serious issue that has led to the degradation of coastal ecosystems, land loss, and disruptions to the daily activities of residents. Immediate and sustained efforts are essential to preserve environmental sustainability. Second, the collaborative mangrove planting initiative led by the 40 Days Challenge team from SMAN 1 Rangsang Barat, in cooperation with the local community and educators, has proven to be an effective and sustainable solution for mitigating the impact of abrasion. Third, the successful implementation of this program not only involved the participation of residents but also significantly increased public awareness regarding the importance of preserving coastal environments. This collaborative spirit was key to the program's overall success. Lastly, the positive impact of mangrove planting extends beyond abrasion control—it also enhances ecosystem quality by increasing biodiversity and reducing

damage from wave activity. These findings underscore the importance of community-based environmental action in achieving both ecological protection and social empowerment.

Conflict of Interest

The authors declare that there is no conflict of interest.

References

[1] N. Adamo, N. Al-Ansari, and V. Sissakian, "Review of climate change impacts on human environment: past, present and future projections," *Engineering*, vol. 13, no. 11, pp. 605–630, 2021.
[2] D. P. Handoyo *et al.*, "Pemodelan Numeris Perubahan Garis Pantai (Studi Kasus di Pantai Tanjung Motong Kabupaten Kepulauan Meranti)," *Jurnal Sains dan Teknologi*, vol. 13, no. 2, Sep. 2014.
[3] I. Muhtar and G. Meiwanda, "Mitigasi Bencana Abrasi Pantai di Desa Permai Kecamatan Rangsang Barat Kabupaten Kepulauan Meranti," *Jurnal Hukum, Politik dan Ilmu Sosial (JHPIS)*, vol. 1, no. 4, pp. 60–65, Dec. 2022.
[4] A. R. Hakim *et al.*, "Analisis Laju Abrasi Pantai Pulau Rangsang di Kabupaten Kepulauan Meranti Dengan Menggunakan Data Satelit," *Jurnal Sains dan Teknologi*, vol. 13, no. 2, pp. 57–62, Sep. 2014.
[5] D. Amos and S. Akib, "A review of coastal protection using artificial and natural countermeasures—Mangrove vegetation and polymers," *Eng*, vol. 4, no. 1, pp. 941–953, 2023.
[6] S. Sutikno *et al.*, "Model Numerik Untuk Simulasi Alternatif Perlindungan Pantai Berbasis Sistem Informasi Geografis," in *Proc. Annual Civil Engineering Seminar*, Pekanbaru, 2015.
[7] E. J. Simamora *et al.*, "Studi Pengaruh Abrasi Pantai Menggunakan Data Satelit Terhadap Perkembangan Alat Tangkap di Pulau Rangsang Kabupaten Kepulauan Meranti," *Jurnal Akuatika Indonesia*, vol. 7, no. 2, Sep. 2022.
[8] B. M. Arkhurst, M. Poku-Boansi, K. K. Adarkwa, "An assessment of how national level coastal resilience strategies promote indigenous knowledge and affect local level adaptation in Ghanaian communities," *Environ. Sci. Policy*, vol. 137, pp. 1–11, 2022.
[9] D. L. Setyowati, P. Hardati, A. I. Benardi et al., "The role of the disaster preparedness group in adapting abrasion to communities affected by abrasion on the North Coast of Rembang, Central Java," in *Proc. Int. Conf. Educ. Social Sci. Human.*, Atlantis Press, 2021.
[10] F. A. Matos, F. Alves, C. Coelho, M. Lima, et al., "Participatory approach to build up a municipal strategy for coastal erosion mitigation and adaptation to climate change," *J. Mar. Sci. Eng.*, vol. 10, no. 6, 2022. [Online]. Available: https://www.mdpi.com
[11] N. Hamid, D. L. Setyowati, J. Juhadi, A. S. Priyanto et al., "Sustainable development of the coastal environment through participatory mapping of abrasion-prone areas," *J. Environ. Manag.*, 2021.
[12] C. Coelho, M. Lima, F. M. Alves, P. Roebeling et al., "Assessing coastal erosion and climate change adaptation measures: a novel participatory approach," *Environments*, vol. 10, no. 2, 2023.
[13] E. McKinley et al., "'Going digital': Lessons for future coastal community engagement and climate change adaptation," *Ocean & Coastal Management*, vol. 205, 2021.
[14] S. Fathoni, S. Sutisna, M. Supriyatno, "Community-based disaster risk reduction efforts in facing the threat of abrasion disasters at Bungin Beach, Bekasi Regency during the COVID-19 pandemic," *IOP Conf. Ser.: Earth Environ. Sci.*, vol. 1179, no. 1, 2023.

Authors



Khusnul Basriyah, M.Pd. is a dedicated Physics teacher at SMA Negeri 1 Rangsang Barat, Riau. She was born in Segomeng on April 1, 1995, and holds a Master's degree (M.Pd.) in Physics Education, graduated from Universitas Ahmad Dahlan, Indonesia. Passionate about science education, she actively contributes to the development of innovative teaching methods in her school. (email: khusnulbasriyah01@gmail.com).



Aisyah Zumira, M.Pd., is a committed Biology teacher at SMA Negeri 1 Rangsang Barat, Riau. She was born in Pekanbaru on April 25, 1995, and holds a Master's degree (M.Pd.) in Biology Education from Universitas Pendidikan Indonesia. With a strong passion for teaching and inspiring students in the field of life sciences, Aisyah continually strives to enhance the quality of education in her school. (email: aisyahzumira@gmail.com).



Dwi Sulisworo is a Professor in Educational Technology and currently a faculty member in the Doctoral Program in Education at Universitas Ahmad Dahlan (UAD), Yogyakarta, Indonesia. His research interests focus on learning strategies through the integration of information and communication technology (ICT) to enhance educational outcomes. (email: dwi.sulisworo@uad.ac.id).