Mangrove Planting as an Effort to Prevent Abrasion on The Coast of The Pulau Ketam Kuala Perlis Forest Reserve

Fitra Syawal Harahap[1*], Hilwa Walida[2], Arman Harahap[3], Rahmadani Pane[4], Budianto Bangun[5], Agustina Nasution[6], Abdul Rauf[7], Sarifuddin[8]

[1,2]Agrotechnology Study Program, Faculty of Science and Technology, Universitas Labuhanbatu, North Sumatra, Indonesia
[3]Universitas Labuhanbatu, North Sumatra, Indonesia
[4]Information Technology Study Program, Faculty of Science and Technology, Universitas Labuhanbatu, North Sumatra, Indonesia.
[5]Information Systems Study Program, Faculty of Science and Technology, Universitas Labuhanbatu, North Sumatra, Indonesia.
[6]Master of Education Management, Postgraduate School, Universitas Labuhanbatu, North Sumatra, Indonesia
[7,8]Agrotechnology Study Program, Faculty of Agriculture, Universitas Sumatera Utara, North Sumatra, Indonesia.
[*] Corresponding Author:
Email: fitrasyawalharahap@ulb.ac.id

Abstract.

Abrasion can cause environmental damage, damage coastal infrastructure, and threaten the lives of communities living around the coast. One effort that can be made to prevent abrasion is planting mangroves along the coastal area. Mangrove forests are important habitats for marine organisms and act as coastal guards against abrasion. One area that has mangrove forests and is quite vulnerable to abrasion is Pulau Ketam Kuala Perlis. This activity aims to increase community awareness about the importance of mangroves in preventing abrasion, specifically in Pulau Ketam Kuala Perlis. The methods used include observation, interviews, and planting. The results of the Community Service Activity show that the community of understands and greatly benefits from mangrove planting efforts and abrasion prevention.

Keywords: *Abrasion; Environment; Coastline; Mangrove and Kuala Perli.*

I. INTRODUCTION

Global climate change has increased the intensity and frequency of coastal disasters, threatening coastal ecosystems and communities worldwide. Sea level rise, stronger storms, and degradation of natural habitats are multidimensional threats requiring effective and sustainable Nature-based Solutions (NbS) [1]. As an archipelagic country with the second-longest coastline in the world, Indonesia and similar regions in Southeast Asia, including Malaysia, are highly vulnerable to these impacts, necessitating interventions based on robust scientific research.Within the NbS framework, mangrove ecosystems are central as natural coastal defences. Scientifically, mangroves dissipate wave energy, stabilise sedimentation, and significantly reduce coastal erosion (abrasion) [2]. This protective function is sustainable, strengthening with vegetation growth, unlike static and costly hard engineering structures [2].Ecologically, mangroves are crucial for biodiversity and as carbon sinks. They serve as nursery grounds for marine biota and are highly efficient blue carbon sinks, storing 3-5 times more carbon per area than tropical terrestrial forests [3]. Their degradation releases stored carbon, exacerbating climate change [3].Socio-economically, mangroves underpin the well-being of coastal communities by supporting fisheries, providing resources, and offering ecotourism potential. Studies show that villages with healthy mangroves have significantly higher fisheries income [4].However, field data from the Kuala Perlis coast, particularly around the Pulau Ketam Forest Reserve, indicates increasing pressure from historical land conversion, pollution, and anthropogenic activities, reducing mangrove extent and density. Satellite imagery analysis reveals a coastal retreat of 2-5 meters per year in some areas, signalling severe abrasion [5].

This threatens the Pulau Ketam Forest Reserve's role as a conservation and natural protection area.Successful restoration depends on appropriate species and site selection, guided by ecophysiological

studies. For instance, pioneer species like Avicennia sp. and Sonneratia sp. tolerate high-energy front zones, while Rhizophora sp. thrives in calmer mid-zones [6]. Previous local research should inform planting to ensure science-based restoration, not symbolic action [6, 7].Long-term sustainability requires community adoption and maintenance. Participatory approaches integrating local wisdom with scientific data enhance success rates and local ownership. Communities understanding the tangible benefits of mangroves become their best guardians [7]. Therefore, planting must be coupled with mentoring, education, and strong local institutions .Mangroves are vital components of coastal ecosystems. Their strong root systems and dense foliage are highly effective in dissipating wave energy and reducing water flow [8]. Interviews in Village revealed previous failed abrasion mitigation efforts, such as wave-breaking embankments and planting unsuitable mangrove seedlings, highlighting the need for correct species selection and community involvement.A gap exists between knowledge of mangrove importance and effective, participatory local restoration. While prior research has mapped abrasion hotspots and species composition in Pulau Ketam [9], intensive, multi-stakeholder rehabilitation has not followed. This community service program bridges that gap, synergising research data, sustainability principles, and community empowerment to build holistic and lasting coastal resilience for Pulau Ketam Kuala Perlis.

II. METHODS

This community service activity was conducted on April 30, 2025, located on the coast and estuary. The number of participants in this activity was 40 people, consisting of village officials, community leaders, and students participating in the Innovation Project Exhibition (IPROPEX) 2025. Materials used in this activity included: Mangrove seedlings, Waru seedlings, gravel, mud (as wave breaks during planting). Tools used: wooden stakes (wooden pegs), crowbars, machetes, mini shovels, and raffia rope. The methods used in this community service activity were observation, interviews, and planting.

Observation

At this stage, Agrotechnology students conducted observations on the coast and estuary to see suitable locations for planting mangrove seedlings. Site observation was carried out the day before planting. Observation was conducted together with village officials, several community leaders, and Science And Technology Students Of Labuhanbatu University students from Universitas Labuhanbatu.

Interview

At this stage, the Science And Technology Students Of Labuhanbatu University team conducted interviews with community leaders regarding the types of mangrove plants suitable for planting on the coast and estuary for the Innovation Project Exhibition (IPROPEX) 2025, the correct method for planting mangrove seedlings, and how to care for mangrove plants.

Planting

At this stage, the Science And Technology Students Of Labuhanbatu University team invited all village officials and community leaders to participate in planting mangrove seedlings. The number of seedlings provided by the Science And Technology Students Of Labuhanbatu University students was 40 mangrove seedlings. The planting process started from the coastline and continued to the estuary.

III. RESULT AND DISCUSSION

Mangrove planting on Kuala Perlis Forest District, was carried out by students and the community living around the beach, guided by village officials and community leaders. A total of 40 mangrove tree seedlings were planted. The benefits derived from this mangrove planting activity on the coast and estuary include: Shaping students who can practice environmental care activities, understanding the benefits and impacts of the coastal environment, especially when damaged or unsustainable, and increasing students' knowledge about the correct way to plant mangrove trees. The target of the mangrove planting activity on Kuala Perlis Forest, is for students to implement care for the coastal and shoreline environment so that it forms part of their character in daily life and is passed on to their respective living environments. This community service activity involved Science And Technology Students Of Labuhanbatu University students from Universitas Labuhanbatu assisted by village officials and community leaders. Students are expected to

become pioneers or seeds in maintaining and preserving the environment in their respective places of residence. Students are expected to influence or transmit this character within their family circles and communities in their places of residence.

Fig 1. Mangrove planting process

IV. CONCLUSION

The community service activity of mangrove planting in Pulau Ketam Kuala Perlis Village is very important as it can increase community understanding of the importance of mangroves and can also reduce or prevent coastal abrasion in Pulau Ketam Kuala Perlis. Mangroves play an important role in protecting the coast from abrasion. The strong roots of mangroves can bind soil and reduce the speed of sea waves reaching the shore. Mangrove planting efforts need to be supported as a sustainable strategy to maintain the future sustainability of the coastal environment.

V. ACKNOWLEDGMENTS

Jabatan Perhutanan Negeri Perlis Pulau Ketam Kuala Perlis Forest Reserve – Malaysia

REFERENCES

[1] Cohen-Shacham E, Walters G, Janzen C, Maginnis S. Nature-based Solutions to address global societal challenges. Gland, Switzerland: IUCN; 2016. DOI: 10.2305/.2016.13.en

[2] McIvor AL, Möller I, Spencer T, Spalding M. Reduction of wind and swell waves by mangroves. Natural Coastal Protection Series: Report 1. Cambridge, UK: The Nature Conservancy and Wetlands International; 2012. DOI: 10.13140/RG.2.1.2312.0485

[3] Donato DC, Kauffman JB, Murdiyarso D, Kurnianto S, Stidham M, Kanninen M. Mangroves among the most carbon-rich forests in the tropics. Nat Geosci. 2011;4(5):293-7. DOI: 10.1038/ngeo1123

[4] Sasmito SD, Sillanpää M, Hayes MA, Bachri S, Saragi-Sasmito MF, Sidik F, et al. Mangrove blue carbon stocks and dynamics are controlled by hydrogeomorphic settings and land-use change. Glob Chang Biol. 2020;26(5):3028-39. DOI: 10.1111/gcb.15056

[5] Selvam V, Karunagaran VM, Ravichandran KK, Eagan S. Remote sensing and GIS for mapping and monitoring mangrove forest changes in the coastal region of Perlis, Malaysia. ***Int J Ecol Environ Sci***. 2019;45(4):345-54.

[6] Kathiresan K, Bingham BL. Biology of Mangroves and Mangrove Ecosystems. Adv Mar Biol. 2001;40:81-251. DOI: 10.1016/S0065-2881(01)40003-4

[7] Primavera JH, Friess DA, Van Lavieren H, Lee SY. The Mangrove Ecosystem: A Practitioner's Guide to Ecological Mangrove Restoration. Bangkok: IUCN and The Nature Conservancy; 2012.

[8] Ahmad S, Ismail N, Mohd Hatta FM. Assessment of Mangrove Forest Degradation in Pulau Ketam, Kuala Perlis Using Remote Sensing Technique. IOP Conf Ser: Earth Environ Sci. 2021;736(1):012045. DOI: 10.1088/1755-1315/736/1/012045.