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Beach Cleanup: Action to Mitigate Microplastic Waste at Alue Naga Beach, Banda Aceh

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ABSTRACT

Alue Naga Beach in Banda Aceh is a coastal area with significant ecological and economic value, but it faces serious threats due to plastic and microplastic pollution. In response to this issue, a beach cleanup initiative was carried out by students from the Development Economics Department of Syiah Kuala University and the Indonesian Language and Literature Education Department of Abulyatama University as part of their community service efforts. The activity was conducted through a hands-on approach on-site, beginning with a site survey, mapping of waste accumulation points, followed by cleanup and documentation of the activity. The results of the activity showed that a total of eight bags of plastic and inorganic waste were successfully collected. Most of the waste consisted of single-use plastic, which has the potential to become a source of microplastics in the ocean. Despite limitations in implementation, the activity successfully contributed positively to beach cleanliness. It is recommended that similar activities be conducted regularly, involving the community, strengthening government support, and incorporating education

1. Introduction

Alue Naga Beach, located in Banda Aceh, is one of the coastal areas with high ecological, social, and economic value. This area not only serves as a habitat for various marine organisms but also as a popular tourist destination for both local communities and visitors. However, increasing human activities around the beach, including tourism, fisheries, and settlements, have exerted considerable pressure on coastal environmental sustainability. One of the major challenges is waste pollution, particularly plastic and microplastic debris, which increasingly threatens marine ecosystems and public health.

Aligned with the Sustainable Development Goals (SDGs), particularly Goal 14 on life below water and Goal 12 on responsible consumption and production, microplastic waste mitigation at Alue

Naga Beach is expected to serve as a community-based environmental management model that can be replicated in other coastal areas. As emphasized by the United Nations (2015), “Sustainable management and protection of marine and coastal ecosystems are essential to avoid significant adverse impacts, and to maintain their resilience and ability to provide ecosystem services.

Jambeck et al. (2015) reported that Indonesia contributes approximately 1.29 million tons of plastic waste annually, positioning the country as the second-largest contributor after China. Poorly managed plastic waste degrades into microplastic particles, which are extremely small and resistant to natural decomposition. These microplastics easily disperse in marine environments and enter food chains, from plankton to fish, and ultimately humans. The detrimental impacts of microplastics on both ecosystem and human health have become a global concern, making plastic waste mitigation and management highly urgent. According to Li et al. (2021), microplastics pose a serious threat to marine ecosystems because their minute size allows them to accumulate within the tissues of marine organisms, leading to a decline in marine biodiversity health.

Recognizing the magnitude of this issue, we conducted a beach clean-up at Alue Naga Beach as a tangible contribution to preserving coastal ecosystems. This initiative resulted from a collaboration between students of Development Economics at Syiah Kuala University and Indonesian Language and Literature Education at Abulyatama University, who share a commitment to reducing the negative impacts of plastic and microplastic waste in the area. This inter-university collaboration not only strengthened human resources and collective knowledge but also enhanced the effectiveness of implementation through synergy and structured division of roles (Aqil et al., 2025; bin Abd Karim et al., 2024; Fadhil et al., 2025; Halim et al., 2024; Halim, Kesuma, Siregar, Riyaldi, et al., 2023; Halim, Kesuma, Siregar, Syahrizal, et al., 2023; Halim, Lubis, et al., 2025; Halim, Riyaldi, et al., 2025; Hanidah et al., 2024; Lubis et al., 2025; Rivani et al., 2024, 2025).

Through this beach clean-up activity, we aim to mitigate the severe impacts of plastic and microplastic waste, thereby ensuring that Alue Naga Beach remains sustainable and continues to function optimally as a valuable natural resource for present and future generations. As highlighted by the United Nations Environment Programme (UNEP, 2018), community participation and cross-sector collaboration are key to addressing plastic pollution in coastal and marine environments. Therefore, the collaboration between Syiah Kuala University and Abulyatama University in this initiative is expected to serve as an effective model of synergy in coastal environmental conservation.

2. Methods

This community service activity was conducted through a direct beach clean-up at Alue Naga Beach, Banda Aceh. The program involved Development Economics students from Syiah Kuala University in collaboration with Indonesian Language and Literature Education students from Abulyatama University, with prior authorization from the Alue Naga Village Secretary. Field surveys were first conducted to map plastic waste accumulation points, which informed the selection of priority cleaning areas. The clean-up was then carried out collectively by manually collecting litter along the shoreline. Collected waste was transported to the nearest disposal facility for further processing in accordance with local procedures. Activity documentation included photographic records and written reports.

3. Result and Discussion

The beach clean-up at Alue Naga Beach, conducted by Development Economics students from Syiah Kuala University in collaboration with Indonesian Language and Literature Education students from Abulyatama University, successfully collected eight trash bags of waste. Most of the collected litter consisted of single-use plastics such as plastic bags, discarded bottles, styrofoam, and other types of non-biodegradable waste. These plastics are the primary sources of microplastic pollution, which, if unmanaged, will continue to threaten coastal and marine ecosystems.



Figure 1 Collecting trash from bush areas in coastal areas



Figure 2 Garbage cleaning is carried out along the coastline



Figure 5 Group photo of students from Syiah Kuala University and Abulyatama University after carrying out collaborative beach clean-up activities

Photographic documentation demonstrated the enthusiasm and cooperation among students during the activity. Some students were observed collecting waste directly from sandy and bushy areas, while others transported filled trash bags to designated collection points. A group photo at the end of the activity highlighted the tangible outcome of the clean-up, as shown by the number of trash bags collected.

This activity had an immediate positive impact on the coastal environment. By removing accumulated waste, the beach became cleaner and more comfortable for visitors. Furthermore, reducing plastic waste on the beach contributes to minimizing the potential entry of microplastics into marine ecosystems, which pose risks to marine biodiversity and human health. Microplastics, defined as plastic particles ranging from 1 nanometer to 5 millimeters, are increasingly prevalent in both marine and terrestrial environments due to ineffective plastic waste management. They originate from two major sources: primary microplastics, intentionally produced in small sizes (e.g., microbeads in cosmetic products), and secondary microplastics, which result from the degradation of larger plastics through UV radiation, abrasion, and other natural processes. Their presence has been documented across various ecosystems, from shallow waters to deep-sea sediments, and even in remote mountain lakes. Microplastics can enter food chains through direct ingestion by marine organisms, including zooplankton, fish, and seabirds, eventually affecting human health via contaminated seafood consumption.

In addition to physical risks, microplastics pose chemical threats, as they often contain or adsorb hazardous substances such as heavy metals and persistent organic pollutants (POPs). These chemicals can cause endocrine, immunological, and reproductive disorders in marine organisms. The ingestion of microplastics by aquatic biota may therefore result in both physical and toxicological

impacts. Given their size similarity to benthic organisms and plankton, microplastics can be easily assimilated by coastal marine species.

Global strategies to address this issue include banning microbeads, improving waste management, developing eco-friendly textile technologies, and enhancing consumer education. Nevertheless, further research is required to fully understand the ecological and health impacts of microplastics. Remediation approaches currently under exploration include physical methods (e.g., filtration, sedimentation), chemical techniques (e.g., oxidation, photocatalysis), and biological strategies (e.g., plastic-degrading microorganisms and enzymes). Preventive efforts, such as the adoption of biodegradable polymers, are also critical to reducing the production of new microplastics. Equally important is community awareness of microplastic pollution and its consequences. Education on the environmental and health impacts of microplastics can encourage individuals to reduce single-use plastic consumption, choose eco-friendly products, and support sustainable environmental policies. Although this activity did not directly involve community participation, coordination and formal approval from the Alue Naga Village Secretary ensured compliance with local regulations and secured village-level support. This coordination is essential for sustaining community service initiatives in the long term.

Several challenges were encountered during implementation, particularly limited time and manpower, which prevented the clean-up from covering the entire coastal area. Thus, while this beach clean-up contributed significantly to waste reduction, ongoing efforts and broader collaborations are needed to ensure the sustainable cleanliness and conservation of Alue Naga Beach. The results of this initiative demonstrate that a well-planned and coordinated beach clean-up can serve as an effective strategy to reduce plastic and microplastic pollution in coastal areas. Moreover, it reflects the active role of university students in environmental stewardship and supports local-level conservation efforts.

4. Conclusion

The beach clean-up at Alue Naga Beach, carried out by Development Economics students from Syiah Kuala University and Indonesian Language and Literature Education students from Abulyatama University, successfully reduced the accumulation of plastic and microplastic waste in the coastal area. The dominant waste collected consisted of single-use plastics, such as plastic bags, bottles, and styrofoam, which are the primary sources of microplastics that threaten marine ecosystems and public health. This activity not only improved the cleanliness of the beach but also contributed to reducing potential microplastic pollution, which is difficult to degrade naturally.

Despite receiving support from the village government, challenges remained, including limited time and manpower as well as the lack of direct community participation. Inter-university collaboration strengthened resources and improved implementation effectiveness, thereby supporting efforts to create a cleaner coastal environment. Enhancing community participation through education is essential, while the village government also needs to strengthen waste management infrastructure to ensure effective handling. Addressing microplastic pollution requires strong commitment, effective cross-sector coordination, and active participation from all stakeholders. With collective awareness and collaboration, environmental sustainability and community health can be safeguarded from the threats posed by microplastics.

Beach clean-ups should be conducted routinely and systematically, accompanied by educational programs to raise awareness of microplastic hazards and responsible waste management. Strengthening synergies between universities, government, communities, and the private sector is crucial to achieving sustainable waste management.

It is recommended that this initiative be continued with broader involvement, particularly from local communities. Strong governmental support and adequate waste management facilities are critical, along with further research on the sources and impacts of microplastics to develop more precise mitigation strategies. The collaborative model demonstrated in this program can be replicated as an effective example of coastal environmental management in other regions. Through joint efforts, Alue Naga Beach can be preserved and continue to provide benefits for present and future generations.

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