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Mitigation of Waste Pollution in Coastal Ecosystems and Mangrove Forests in Coastal Areas

Mohammad Amin Lasaiba[1]
[1]Department of Geography Education, FKIP, Pattimura University, Ambon

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Abstract

The preservation of coastal ecosystems and mangrove forests is becoming increasingly urgent due to their vital role in maintaining the overall balance of ecosystems. The presence of mangrove forests can reduce the impact of coastal erosion and protect from threatening sea storms. Furthermore, mangrove ecosystems serve as habitats for various species. This community service program utilizes a participatory and educational approach to address plastic pollution on the coast of Batu Koneng Beach, Poka Village, Ambon Island, Maluku. The GEMPA Nature Lovers, students from the Geography Education Study Program at Pattimura University in Ambon, collaborated with the Indonesian Sea Guardians Community, the 733/Raider Infantry Battalion, and local communities. The program's goal is to raise awareness among the community and create a tangible impact in maintaining coastal environmental cleanliness. The chosen location has a significant plastic pollution issue, offering great potential for environmental preservation activities. The GEMPA Nature Lovers, a student organization passionate about the environment, constitute the program's primary participants. The program's main findings underscore the importance of awareness and tangible actions in addressing plastic pollution on the coast. By involving students, local communities, and various stakeholders, the program enhances understanding of the negative impacts of plastic pollution and the importance of preserving coastal ecosystems. These findings provide a strong foundation for developing sustainable policies and practices in waste management and protecting coastal ecosystems.

Penulis Korespondensi:
Mohammad Amin Lasaiba
Department of Geography Education, FKIP, Pattimura University, Ambon,
Corresponding Email: Lasaiba.dr@gmail.com

INTRODUCTION

With its wealth of thousands of islands and extensive coastline, Indonesia has emerged as a maritime nation boasting a precious coastal ecosystem rich in biodiversity (Mulyani et al., 2019; Aminuddin & Burhanuddin, 2023). Besides serving as a natural barrier, mangroves offer economic and social benefits to coastal communities (Wijayanti et al., 2019; Mohamed et al., 2024). However, all these benefits are under threat due to the pollution of coastal areas by waste. Plastic debris and other pollutants contaminating the waters harm mangrove ecosystems and impact human health (Fajar et al., 2018; Noman et al., 2024). Waste pollution has become an undeniable threat to the sustainability of coastal ecosystems (Nau & Sombo, 2020; Castilla & Armesto, 2024). This phenomenon underscores human indifference to the surrounding environment and a lack of awareness regarding maintaining cleanliness and environmental sustainability (Anisa et al., 2022; Hasanah et al., 2024). The danger of non-degradable plastic waste to coastal environments is evident (Abad et al., 2022; Le et al., 2023). Furthermore, industries neglecting the

environmental impact of their production activities also contribute to this problem (Ampaw et al., 2024; Azhani et al., 2019). Moreover, the adverse effects of waste pollution on coastal ecosystems disrupt marine food chains and jeopardize the survival of species dependent on coastal ecosystems (Jaelani et al., 2021; Datta, 2023).

The preservation of coastal ecosystems and mangrove forests is becoming increasingly urgent due to their vital role in maintaining the overall balance of ecosystems (Jati & Pribadi, 2017; Anu et al., 2024). The presence of mangrove forests can reduce the impact of coastal erosion and protect against threatening sea storms (Handayani et al., 2023; Das, 2024). Moreover, mangrove ecosystems also serve as habitats for various species (Azhani et al., 2019; Gnansounou et al., 2024). The importance of preserving mangrove forests cannot be because they play a significant role in maintaining the balance of the surrounding environment (Rini & Yuliani, 2019; Wang et al., 2024). Mangroves also act as natural barriers that can mitigate the adverse effects of sea storms (Wulandari et al., 2019; Sunkur et al., 2023). Additionally, the role of mangroves as nesting grounds for various species of fish and marine animals is crucial for the sustainability of coastal ecosystems (Arceo-Carranza et al., 2021; Akram et al., 2023). Also, mangroves play a vital role in climate change mitigation by reducing greenhouse gas levels in the atmosphere (Toisuta & Tutupary, 2019; Chen et al., 2024). It is essential to preserve and conserve coastal ecosystems and mangrove forests as part of efforts to maintain the sustainability of the planet and the future of generations to come (Indriawati & Retnowaty, 2018; Saoum & Sarkar, 2024). Various efforts include beach cleanups, campaigns to reduce single-use plastics and waste management (Abad et al., 2022; Abrokwah et al., 2024). Furthermore, mangrove seedling planting can enhance coastal environmental preservation, which can help strengthen coastal ecosystems (Anisa et al., 2022; Qonaah, 2019; Zahajská et al., 2024).

Preserving coastal ecosystems and mangrove forests through community empowerment, including mangrove ecotourism, is essential to raising awareness of the environment (Zhani et al., 2019; Tien et al., 2024). Furthermore, protecting mangrove forests should be a top priority utama (Handayani et al., 2023; Mafaziya Nijamdeen et al., 2024). Community participation in supporting mangrove ecosystem conservation is also a crucial step in maintaining the sustainability of mangrove forests (Wulandari et al., 2019; Mohamed et al., 2024). Educating communities about the importance of environmental conservation plays a significant role in changing human behavior toward preserving coastal ecosystems (Toisuta & Tutupary, 2019; Lu et al., 2024). Socializing mangrove preservation in village communities also needs to be enhanced to raise awareness of the importance of preserving coastal ecosystems (Nurzanah & Indrayani, 2021; Martin et al., 2024). Therefore, all parties, including governments, industries, communities, and non-governmental organizations, need awareness and concrete actions to implement environmental development programs (Qonaah, 2019; Kurniasih, 2023; Doucet et al., 2024). Furthermore, strict regulations and law enforcement against ecological violations are necessary to promote social and environmental responsibility among parties involved in industrial activities (Nurzanah & Indrayani, 2021; Mohamed et al., 2023). In addition to physical efforts, increasing ecological education and awareness should also be a focus (Jaelani et al., 2021; Sam et al., 2023).

Several activities must clean up litter from coastal ecosystems and mangrove forests in various regions. Community empowerment through multiple programs such as socialization (Nurzanah & Indrayani, 2021; Indriawati & Retnowaty, 2018), eco-educational tourism programs towards coastal park conservation (Wijayanti et al., 2019), ecotourism in environmental conservation (Azhani et al., 2019; Jaelan et al., 2021), ecosystem conservation through active participation of ecotourism area communities (Handayani et al., 2023)., beach cleanup movements (Nau & Sombo, 2020), and marine nature creation communities (Abad et al., 2022), Mangrove planting is also utilized as a strategy to improve the welfare of coastal communities (Mulyani et al., 2019), as an expression of environmental concern (Rini & Yuliani, 2019), and systematically as a solution to increase the area of mangrove forest land cover (Jati & Pribadi, 2017). Students ' beach cleaning and mangrove planting with village communities are also carried out to maintain cleanliness and ecosystem balance (Kurniasih, 2023; Indriawati & Retnowaty, 2018). Meanwhile, mangrove ecosystem rehabilitation to address pollution (Toisuta & Tutupary, 2019), as well as efforts for coastal marine environmental preservation (Anisa et al., 2022; Rini & Yuliani, 2019). are also conducted. Various local initiatives in environmental conservation, such as "saber santai" (relaxed saber) and mangrove planting, are also carried out to support coastal ecosystems (Fajar et al.,

2018) and patterns of mangrove forest preservation and their impact on communities (Jaelani et al., 2021). Implementing corporate social responsibility environmental development programs is also one effort to preserve marine (Qonaah, 2019). Furthermore, the impact of mangrove protector innovation in mangrove ecotourism is also studied to maintain environmental sustainability (Wulandari et al., 2019). Thus, the diversity of these activities demonstrates widespread commitment from various parties to preserving coastal ecosystems and mangrove forests for the well-being and sustainability of the environment.

This community service aims to enhance public awareness of preserving coastal ecosystems and mangrove forests and reducing pollution in coastal areas. A significant difference from previous research lies in emphasizing mangrove planting as an environmental effort and a means to raise awareness among local communities, reflecting a paradigm shift from an approach solely focused on the environment to a holistic approach considering the complex relationship between humans and environmental sustainability. In this context, it is essential to strengthen collaboration between institutions to enhance the effectiveness of conservation programs in supporting environmental recovery efforts through environmental education. Recommendations for future activities include the development of more integrated collaboration models among relevant sectors, such as enhancing partnerships between government agencies, non-profits, and private entities. Further studies are needed to develop environmentally friendly technologies to support mangrove ecosystem rehabilitation and early pollution detection.

METHOD OF COMMUNITY SERVICE

Approach, Program Design, Location and Population, and Program Effectiveness

This community service aims to increase public awareness of preserving coastal ecosystems and mangrove forests and reducing pollution in coastal areas. A significant difference from previous research lies in emphasizing mangrove planting as an environmental effort and a means to raise awareness among local communities, reflecting a paradigm shift from an approach solely focused on the environment to a holistic approach considering the complex relationship between humans and environmental sustainability. In this context, it is essential to strengthen collaboration between institutions to enhance the effectiveness of conservation programs in supporting environmental recovery efforts through environmental education. The Geography Education Study Program at Batu Koneng Beach, Poka Village, on Ambon Island, Maluku, carried out the activities. This coastal area was selected for its notable pollution impact and high potential for environmental conservation initiatives, emphasizing the need for targeted ecological efforts to address pollution and promote sustainability in the region. The program collaborates with the GEMPA nature-loving student community, the Geography Education Study Program, and a Geography Education lecturer as a supervisor. The Indonesian Sea Guardian Community, Infantry Battalion 733/Raider, and other local communities participated. The activities took place on October 21, 2023, under the theme "Youth Action for Climate Protection" in the form of a Road to AMJI Beach Cleanup. The population was GEMPA nature-loving students from the Geography Education Study Program at Pattimura University Ambon. The GEMPA nature-loving students are an environmental student organization actively involved in environmental conservation activities. Participation in this activity will increase the active involvement of other GEMPA nature-loving students in environmental conservation efforts at the selected location and raise awareness among Geography Education Study Program students and the surrounding community about the importance of ecological preservation.

Each community conducted The program activities jointly, with different program agendas summarized in joint activities. Specifically for the GEMPA nature-loving students, the program included several designs with concrete steps, including a series of educational and waste-cleaning activities. Geography Education lecturers provided educational material on the importance of environmental preservation, the impact of waste pollution on coastal ecosystems, and strategies to responsibly reduce the use and disposal of waste by geography education lecturers. Moreover, teaching effective beach cleaning methods and waste management practices enhances participants' skills in environmental conservation efforts. GEMPA nature-loving students were directly involved in coastal waste cleaning activities, cleaning the beach of plastic waste and other debris. During these activities, they also set an example for the surrounding community on the importance of beach cleanliness and individuals' active

role in environmental conservation. Through educational activities and actual waste-cleaning actions, the program aimed to increase awareness and community participation in maintaining ecological cleanliness and stimulate environmentally friendly behavior changes. Thus, it creates a cleaner, healthier, more sustainable coastal environment and establishes strong collaboration between students and the community in environmental preservation efforts. Several indicators to measure the effectiveness of this community service program, including waste collected, participation levels, knowledge improvement, skills development, and long-term environmental impact:

1. The amount of waste collected and processed during the beach cleaning activities was the leading indicator to evaluate the program's direct impact on the coastal environment.
2. Participation in waste management and environmental conservation efforts serves as an indicator of ecological awareness and involvement.
3. The level of knowledge and awareness of students and the surrounding community regarding environmental preservation before and after the program implementation was also an indicator of the effectiveness of the educational approach in this program.
4. Improving students' skills and expertise in waste management and environmental conservation activities was also an important indicator to evaluate the program's impact on students' capacity development.
5. The program's long-term impact on the coastal environment, such as water quality changes and the local community's sustainability of environmental conservation activities, was also measured.

Implementing this community service program involves several vital stages. These stages include:

1. Preparation: This initial stage includes comprehensive program planning, problem identification, objectives, and program targets, as well as detailed work plan development. Additionally, during this preparation stage, budget determination, resource allocation, and team formation consisting of GEMPA nature-loving students with a supervisor and several other lecturers are conducted.
2. Socialization and Coordination: After the program plan, this stage involves conveying information to relevant parties, including the local community, the Village Head, all RT and RW officials, the Indonesian Sea Guardian Community, Infantry Battalion 733/Raider, and other local communities. The aim is to gain support and participation from all involved parties.
3. Activity Implementation: The implementation stage is executing the prepared work plan, which includes various activities such as educational material delivery and education, waste collection, and cleaning.
4. Monitoring and Evaluation: During the program implementation, continuous monitoring of progress and effectiveness of activities. Evaluation to assess the extent to which program objectives identify emerging problems and evaluate the effectiveness of applied strategies.
5. Report Preparation and Results Dissemination: After the program, the results and findings of the program go into a comprehensive report. This report is essential documentation for future program accountability and evaluation for similar programs. Furthermore, the program results and findings are disseminated to relevant parties through various media and forums, locally and nationally, to increase awareness and community participation in environmental preservation efforts.

IMPLEMENTATION OF PROGRAM

Provision of Material and Education

In the execution of material provision and education activities aimed at increasing awareness among students regarding the issue of waste pollution, systematic and practical steps need to be considered:

1. The development of informative and engaging material is crucial. This material should encompass a profound understanding of the negative impacts of waste pollution on coastal environments and mangrove forests, including consequences for the local community and the sustainability of marine ecosystems.
2. The material should explain individuals' contributions to worsening or improving

environmental conditions and provide concrete ways to reduce waste pollution, such as responsible waste management and sustainable living practices. Material delivery activities involve various interactive methods, including lectures and group discussions. Visual media is also essential to enhance participants' interest and understanding.

3. A participatory approach where students are passive listeners and actively engage in discussions reinforces their understanding and awareness.

Furthermore, educational activities should include active student participation in coastal cleanup and mangrove planting initiatives. Through these hands-on experiences, students can comprehend the real impact of waste pollution and the practical significance of maintaining environmental cleanliness. Collaboration with the local community can extend the reach and influence of educational activities, facilitating the integration of students into sustainable ecological conservation efforts. By planning comprehensive and structured material provision and education activities, students' awareness in the Geography Education Program regarding waste pollution issues in coastal areas will increase significantly. Beyond mere awareness, the Environmental Enthusiast GEMPA students from the Geography Education Program will become active agents of change in environmental conservation efforts through individual actions and participation in collective activities to preserve the sustainability of coastal ecosystems and mangrove forests.

Waste Collection and Cleanup Activities

In coastal waste collection and cleanup activities, concrete steps involve several stages. The first step in the program implementation phase is identifying the focus areas for waste collection and cleanup, which involves a comprehensive survey and analysis of the coastal regions vulnerable to waste pollution. The team conducts meticulous field research to identify locations with high levels of waste pollution, whether along the coast, river estuaries, or other coastal areas. It is crucial to consider factors such as population density, human activities, ocean currents, and mangrove forests as potential habitats requiring protection. An in-depth analysis of the geographical and socio-economic conditions of the local community is also necessary to understand the root problems and existing needs. Once the appropriate locations, the next step is logistical planning for implementing waste collection and cleanup activities. It involves allocating resources such as funds, equipment, and workforce to execute the program effectively. Necessary equipment includes transportation facilities for waste transport, cleaning tools such as trash bins, gloves, and other safety gear, and supporting equipment like measurement and recording tools. Logistic planning is crucial to ensure that all operational needs and activities can be smoothly and effectively. Therefore, location identification and logistical planning are essential initial steps in implementing waste collection and cleanup activities in coastal areas.

After the stages of location identification and logistical planning, the next step is to coordinate with relevant parties to ensure the success of the program implementation. Collaboration with the Indonesian Sea Guardians Community (KPLI) as organizers with the theme "Youth Action Climate Guard" in the form of the Road to AMJI Beach Clean Up is a crucial step to expand the reach and impact of the activities. Cooperation with the village government and the 733/Raider Infantry Battalion is also necessary to obtain logistical support and security in conducting waste cleanup activities in coastal areas. Additionally, involving campus entities such as Pattimura University and other local communities is an effective strategy to enhance community participation, support, and human resources in these activities. After coordination with relevant parties, the next step is to socialize with the surrounding community about the goals and benefits of waste collection and cleanup activities through various media, such as community meetings, bulletin boards, social media, and informative brochures. In this socialization, explaining the importance of maintaining cleanliness in coastal environments, the negative impacts of waste pollution, and the long-term benefits of preserving coastal ecosystems and mangrove forests is essential. Providing clear and heartfelt information to the community is expected to increase awareness and active participation in waste collection and cleanup activities. Through good cooperation and socialization, this service program can achieve its primary goal of maintaining the cleanliness and sustainability of coastal environments and positively impacting the local community and the ecosystem.

After the coordination and socialization stages, student waste collection activities can be implemented

in ways, from beach cleaning to collecting waste along the coastline—tools such as nets or trash bins to manage scattered waste in coastal waters. Active student participation in this activity not only aids in waste collection but also provides an opportunity for them to be directly involved in coastal environmental conservation and reinforces the importance of maintaining environmental cleanliness. Classifying and sorting waste effectively during the waste collection process is essential to facilitate recycling or better waste management in the future. By sorting recyclables such as plastic, glass, or metal, they can be from organic or non-recyclable waste. Taste will help optimize the benefits of the collected waste and reduce its negative impact on the environment. During waste collection activities, students can also record the types of waste collected and note the volume or weight of the waste successfully gathered. This data can be used as an evaluation to assess the success of this service program in reducing the amount of waste in coastal areas. Moreover, information about the most commonly found types of waste can serve as a basis for developing more effective waste management strategies in the future. Thus, waste collection activities help clean coastal environments and provide valuable data for planning and better waste management in the future.

Once the waste is collected, the next step is cleaning activities involving waste transportation to processing or appropriate disposal sites. This process requires collaboration between GEMPA nature-loving students and other relevant parties to ensure the collected waste is according to regulations and standards. Waste transportation uses garbage trucks to transport waste from the beach. The proper processing or disposal of waste is crucial to prevent environmental pollution and protect coastal ecosystems. This process also includes further cleaning actions around the collection area to ensure no waste is left behind and to maintain environmental cleanliness. Additionally, these cleanup activities can raise awareness among the local community about the importance of maintaining environmental cleanliness and managing waste properly. By actively involving the local community in cleanup activities, it creates greater collective awareness and a culture of sustainable ecological cleanliness. Thus, cleanup activities are not just physical actions to clean up waste but also part of broader efforts to create a cleaner, healthier, and more sustainable environment for all parties.

After the waste collection and cleanup stages, the next step is a comprehensive evaluation of these activities. This evaluation includes an analysis of the quantity and types of waste successfully collected and the impacts achieved through these activities. The team sorts and groups the waste based on its kind to determine usage patterns and waste accumulation trends in the coastal areas focused on by the activities. This data serves as a basis for evaluating the effectiveness of strategies used in waste collection and mapping areas vulnerable to waste pollution. Moreover, the evaluation also involves an analysis of the positive impacts achieved through waste collection and cleanup activities. These positive impacts include increased awareness of the surrounding community about the importance of maintaining cleanliness in coastal environments, a reduction in waste-polluting waters, and increased involvement of students and the community in environmental conservation activities. The evaluation comprehensively involves all GEMPA nature-loving students and professors. The results of this evaluation serve as a basis for developing recommendations and strategies for better future improvement to enhance the service program's effectiveness in addressing waste pollution in coastal areas sustainably.

Collaboration with Relevant Parties

In implementing this program, collaborative efforts with relevant parties are vital to success and significant impact. Collaboration with local governments is a strategic step to obtain support regarding permits, resource allocation, and access to data and information related to coastal environmental conditions. The team strives to establish good communication and cooperation with local environmental or maritime agencies to ensure the program aligns with applicable policies and regulations. Furthermore, collaboration with environmental organizations such as NGOs or environmental foundations provides access to knowledge and additional resources for advocacy, education, and ecological campaigns. By working with these institutions, the service program can have a broader reach and gain more robust support from the community. Collaboration with non-governmental organizations (NGOs) is also crucial in implementing this program. NGOs often have extensive networks at both local and national levels, as well as specialized

experience and expertise in environmental issues. Collaboration with NGOs enriches the program with new, innovative, and community-based approaches. Furthermore, NGOs can assist in fundraising, volunteer mobilization, and capacity building through training and workshops. By leveraging collaboration with these relevant parties, the service program can become more effective and sustainable in waste pollution mitigation efforts in coastal areas.

Figure 1. Waste Cleaning Activity in the Coastal Area for AN MANGROVE's Coastal Anniversary Celebration

EVALUATION AND ANALYSIS

Program Implementation Evaluation

The evaluation of this community service program is a crucial stage in assessing its overall effectiveness and success. The review encompasses both the process and the outcomes achieved. Process evaluation is essential to ensure that all planned stages are efficient. It begins with evaluating program planning, analyzing the alignment of strategies with

program objectives, allocating adequate resources, and clearly understanding the roles and responsibilities of all involved parties. Process evaluation also assesses the implementation of activities, including how well they adhere to the established schedule, the quality of implementation, and the level of community participation. Coordination among relevant parties ensures seamless and effective communication and collaboration among teams, local governments, environmental institutions, and non-governmental organizations (NGOs). Moreover, process evaluation includes analyzing resource management during program implementation, encompassing financial management, equipment, and workforce. This evaluation helps identify the efficiency and effectiveness of resource utilization and assess whether adjustments or improvements in resource management are needed. During process evaluation, analyzing the challenges faced during program implementation and the steps taken to overcome them is crucial. Understanding these obstacles enables the service team to derive valuable lessons and formulate improvement strategies for future programs. Through this comprehensive process evaluation, the community service program can continually enhance its quality and effectiveness in addressing coastal waste pollution.

Outcome Evaluation

The evaluation of program outcomes is crucial in assessing the real impact generated by the activities on the community and the surrounding environment. This evaluation includes an assessment of various achievements during program implementation, such as the positive impact on the targeted population and the environmental conditions around the program site. It involves analyzing predefined success indicators, which may include increased community awareness of the importance of ecological conservation, a reduction in coastal area waste, or increased community participation in environmental preservation activities like mangrove planting or recycling programs. The extent to which the program has successfully achieved its predetermined goals by analyzing these indicators. The results of this evaluation serve as vital feedback for improvement and the development of future programs. Knowing what has succeeded and where improvements are needed allows for strategic adjustments to enhance program effectiveness in the future. Moreover, this evaluation serves as a basis for recommendations for relevant stakeholders, including governments, environmental agencies, and non-governmental organizations, to continue and enhance this community service program. Thus, outcome evaluation is crucial in ensuring the sustainability and effectiveness of environmental conservation efforts conducted through community service programs like this. Overall, the program implementation evaluation to ensure that the community service program significantly impacts the community and the surrounding environment. This evaluation is also essential to ensure the efficient use of resources and to improve program quality in the future. Therefore, careful and thorough assessment is critical to ensuring this community service effort's long-term continuity and sustainability.

Program Effectiveness Analysis

The program effectiveness analysis aims to evaluate the program's impact in addressing coastal waste pollution. One aspect analyzed is the increase in community awareness regarding waste pollution issues, and the importance of environmental conservation includes evaluating the effectiveness of material delivery and education activities in enhancing the understanding and cheerful behavior of the community towards waste issues. The analysis also assesses the program's influence on the quantity and types of waste collected in coastal areas, including the overall reduction in waste, improved waste management, and increased community participation in waste cleanup activities. Furthermore, the program's effectiveness through its impact on environmental health and the sustainability of coastal ecosystems involves assessing changes in ecological conditions, such as improved seawater quality and the sustainability of mangrove ecosystems after program implementation. This analysis shows how successfully the program has contributed positively to addressing waste pollution issues in coastal areas, providing a basis for improvement and program development in the future.

Challenges and Obstacles

During the implementation of the community service program, several challenges and obstacles have emerged, influencing the effectiveness and smooth progress of the program. One major challenge is the need for more community awareness and participation in waste cleanup activities and environmental conservation efforts. Sometimes, communities must be

fully aware of the importance of maintaining ecological cleanliness and the negative impact of waste pollution on coastal ecosystems. This lack of awareness can be a severe obstacle to waste cleanup efforts due to insufficient support and active participation from the local community. To overcome this challenge, we must conduct continuous material delivery and education activities, involve various community groups, and strengthen communication between the service team and the local community. Through ongoing education, community awareness of the importance of environmental conservation will increase, motivating them to participate actively in waste cleanup and environmental preservation activities.

Adjustment of Strategies

Based on the evaluation and analysis of the community service program's implementation, several strategic adjustments are needed to enhance the program's impact in the future. One key strategy is increasing efforts in material delivery and educating the community about the importance of environmental cleanliness and the adverse effects of waste pollution. Delivery and education should be continuous and targeted, involving various community groups and local educational and governmental institutions. By improving community understanding of these issues, collective awareness, and greater motivation will be created for participation in waste cleanup and environmental preservation programs. Additionally, it is essential to strengthen collaboration between various stakeholders, including local governments, educational institutions, non-governmental organizations, and the private sector. Close and synergistic cooperation between multiple stakeholders can enhance program effectiveness and broaden its impact. By building strong partnerships, the community service program can gain more significant human resources, finances, and infrastructure support and expand access to various resources and networks needed to carry out activities more efficiently. Moreover, increased utilization of information and communication technology (ICT) can also be an effective strategy to enhance the impact of the community service program. Digital platforms and social media can be employed to disseminate information, garner support, and mobilize community participation in waste cleanup and environmental conservation activities. By leveraging this technology, the program can reach a wider audience and effectively communicate essential messages about maintaining environmental cleanliness and preserving coastal ecosystems. By implementing these strategies, the community service program can achieve a more significant impact in addressing waste pollution in coastal areas and strengthen community awareness and participation in environmental conservation.

DISCUSSION AND IMPLICATIONS

Discussion of Service Results

In discussing the results of this community service program, the findings and outcomes need to comprehensively understand their impact on mitigating coastal pollution. One crucial finding is the increased awareness among the community regarding the importance of maintaining environmental cleanliness and the adverse effects of pollution. Through intensive material and educational activities, the community gained a deeper understanding of the sources of pollution, its consequences on coastal ecosystems, and their role in preserving the environment. Thus, this community service program successfully built collective awareness and motivation for active participation in waste cleanup efforts and environmental conservation. Furthermore, the program also made a tangible impact on mitigating coastal pollution through waste cleanup activities. Collaboration between nature-loving students, local communities, and various stakeholders resulted in the collection and cleanup of a substantial amount of waste polluting coastal areas. As a result, the coastal environment became cleaner and more conducive to the life of various marine species, enhancing the well-being of communities relying on natural resources in the vicinity. The relevance of these findings and outcomes to related research lies in their contribution to global efforts to sustain coastal ecosystems and reduce the negative impact of waste pollution on marine environments. Through an integrated participatory and educational approach, this community service program sets an example of how collaboration among stakeholders can yield concrete solutions for environmental preservation. These findings and outcomes are essential references for future research and community service programs aiming to sustain coastal ecosystems in various regions.

Implications of Findings

The implications of the findings from this community service program significantly impact various policy, practice, and research aspects in the field of waste pollution mitigation and coastal ecosystem preservation. Firstly, the heightened awareness of the importance of maintaining environmental cleanliness and the adverse effects of waste pollution in coastal areas can serve as a foundation for more effective policy-making in waste management and promoting responsible environmental behavior may include stricter waste management regulations, single-use plastic use, and public awareness campaigns on proper waste disposal. This awareness can encourage sustainable practices in coastal-based industries and tourism sectors, such as using eco-friendly materials and more efficient waste management. Moreover, the findings from this community service program can lay the groundwork for further research in waste pollution mitigation and coastal ecosystem preservation. Subsequent research can focus on a more in-depth analysis of waste sources and distribution patterns in coastal areas, evaluating the effectiveness of various waste management methods and identifying more efficient intervention strategies involving local communities and other stakeholders. Furthermore, research can also encompass social, economic, and cultural aspects related to waste pollution issues to understand better the factors influencing human behavior regarding waste disposal and ways to shift it towards more sustainable practices. The implications of these findings can strengthen the knowledge base and contribute to developing policies and best practices to sustain coastal ecosystems and reduce waste pollution globally.

CONCLUSION AND RECOMMENDATIONS

This community service program has provided vital findings that underscore the importance of awareness and tangible actions in addressing waste pollution in coastal areas. By engaging various stakeholders, including students, local communities, and other stakeholders, the program successfully increased understanding of the adverse effects of waste pollution and the importance of preserving coastal ecosystems. Through educational activities, material provision, and waste cleanup, the program encourages responsible environmental behavior and enhances active involvement in maintaining coastal and mangrove forest cleanliness. This program's findings positively impact locally and offer inspiration and valuable lessons for environmental conservation efforts in various regions and contexts. As a recommendation, this community service program can be expanded and enhanced through closer collaboration with local governments, non-governmental organizations, and the industrial sector to broaden its reach and impact. Sustainable strategy development is also necessary to ensure the program's long-term sustainability, including adequate funding, continuous monitoring of its effectiveness, and integration with broader environmental policies. Regular evaluations should assess program progress and adjust strategies according to evolving needs. Establishing networks and knowledge exchange among higher education institutions, local communities, and other stakeholders can also enhance this program's overall sustainability and effectiveness.

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