

Community Service-Based Mangrove Rehabilitation in Supporting Sustainable Development in North Jakarta

Melisa Arisanty^{1*}, Gunawan Wiradharma², Selly Anastassia Amellia Kharis³, Mario Aditya Prasetyo⁴, Sri Maulidia Permatasari⁵, Moh. Muzammil⁶, Sri Sukatmi⁷

Universitas Terbuka

Corresponding Author: Melisa Arisanty melisa.arisanty@ecampus.ut.ac.id

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ABSTRACT

This community service activity aims to strengthen mangrove rehabilitation in the coastal area of North Jakarta through a participatory and educational approach. The activity has been carried out in May 2026 at the Marunda Mangrove House, Cilincing District, North Jakarta City. The activities carried out include preparation stages, environmental education, introduction to mangrove ecosystems, direct mangrove planting, monitoring, evaluation, and reporting. The results of the activity show that community service-based mangrove rehabilitation is able to produce ecological, educational, social, and institutional outputs. This activity encourages increased participants' understanding of the function of mangroves, strengthens concern for coastal environmental conservation, and builds collaboration between universities, students, area management partners, and activity participants. Thus, this activity is a model of community service that integrates conservation actions, environmental education, social participation, and sustainable development in urban coastal areas.

INTRODUCTION

Mangrove ecosystems are one of the strategic natural resources in coastal areas that have very important ecological, social, and economic functions. Mangroves play a role as a barrier to abrasion and seawater intrusion, protection of coastal areas from waves and storms, habitat for marine life, and a large amount of carbon absorbers that support climate change mitigation. Donato et al. (2011) explained that mangroves are among the tropical forests with the highest carbon reserves, so the destruction of mangrove ecosystems not only has an impact on the loss of coastal protection functions, but also has the potential to increase carbon emissions into the atmosphere. Globally, Indonesia is recorded as the country with the largest mangrove ecosystem in the world with an area of around 3.4 million hectares or around 20-23% of the world's total mangroves. However, pressure on mangrove ecosystems in urban coastal areas is still a serious challenge.

Data from the Ministry of Environment and Forestry at the national level shows that in the period 2015–2024 some mangrove areas will be degraded due to land conversion, pollution, coastal infrastructure development, and unsustainable economic activities. Although the government has launched a massive mangrove rehabilitation program, long-term success is largely determined by the involvement of communities and local stakeholders in the management and maintenance of rehabilitation results.

The problem of mangrove damage is also seen in urban coastal areas, including North Jakarta. As a coastal area that has high development pressure, North Jakarta faces various environmental problems such as coastal abrasion, land subsidence, flash flooding, pollution, and increasing risks due to climate change. These conditions make the coastal area of North Jakarta vulnerable to environmental degradation and ecological disasters (Chairani et al., 2024; Jelibsedha & Umar, 2025). This condition is also reflected in the coastal area of North Jakarta, which is an area with a high level of environmental pressure. Based on data from the DKI Jakarta Provincial Government and the Central Statistics Agency, the coastal area of North Jakarta faces various environmental problems, such as coastal abrasion, land subsidence, and tidal flooding which have become increasingly frequent in the last 5-10 years. BNPB and BMKG data show that abrasion on the north coast of Java, including North Jakarta, can reach hundreds of meters in certain locations, especially in areas that have lost mangrove vegetation as natural protectors. In addition, rising sea levels and climate change exacerbate the vulnerability of urban coastal areas such as North Jakarta.

Mangrove rehabilitation efforts in North Jakarta have been carried out in a sustainable manner by the local government through the planting of thousands of mangrove seedlings at several coastal points, including conservation areas and coastal buffer areas. Data from the Jakarta Provincial Government shows that in recent years, mangrove planting actions have been carried out regularly as part of strengthening the coastal green belt. However, various evaluations show that physical rehabilitation alone is not enough if it is not accompanied by an approach to community empowerment and participation, environmental education, and sustainable assistance (Rahman et al., 2024).

The community-based mangrove rehabilitation approach is very relevant to answer these challenges. The involvement of local communities in the process of planning, planting, maintaining, and supervising mangroves has been proven to be able to increase the success rate of rehabilitation and strengthen environmental awareness. In addition, this approach is in line with the principles of sustainable development which emphasizes a balance between environmental, social, and economic aspects.

In addition to the ecological aspect, the success of mangrove rehabilitation is also greatly influenced by community participation. Damastuti et al. (2022) show that community-based mangrove management can support biodiversity conservation and coastal area protection if carried out through active involvement of local communities, participatory mapping, knowledge strengthening, and inter-stakeholder cooperation. These findings confirm that communities should not only be positioned as participants in activities, but also as important actors in maintaining the sustainability of mangrove ecosystems. Therefore, the community service approach is relevant because it is able to connect ecological actions with the process of education, empowerment, and the formation of environmental awareness.

In the context of sustainable development, mangrove rehabilitation not only contributes to environmental conservation, but also supports the achievement of sustainable development goals (SDGs), especially goals related to handling climate change, marine ecosystems, and coastal city sustainability. Therefore, strengthening community-based mangrove rehabilitation in North Jakarta is a strategic step to strengthen coastal environmental resilience, improve people's quality of life, and support sustainable development in an integrated and long-term manner.

To answer the problem of mangrove ecosystem degradation and low community involvement in coastal environmental conservation in North Jakarta, an integrated, realistic, and sustainable solution is needed. The solutions offered in this community service activity are focused on the implementation of mangrove planting directly in the coastal area of North Jakarta as a concrete effort to reduce abrasion and improve the function of coastal ecosystems. Planting is carried out using mangrove seedlings that are in accordance with the characteristics of the area and local ecological conditions, and is carried out in collaboration with mangrove area managers so that they are on target and sustainable.

This activity also involves environmental education that is integrated in a series of service activities. Education is provided before and during the activity, including the function of mangroves, the impact of coastal damage, and the role of the community in maintaining environmental sustainability. This mangrove planting activity can also be a solution in strengthening the contribution of universities to environmental problems through the involvement of academics and students. The role of academics is directed to educational functions, mentoring, and academic reflection on the implementation of activities so that community service is not only ceremonial, but has sustainability and long-term learning value.

In ensuring the effectiveness and sustainability of activities, solutions are carried out in collaboration with mangrove area management partners who have authority and experience in managing coastal ecosystems. This collaboration allows mangrove rehabilitation activities to be carried out according to technical standards and supports ongoing conservation programs. And to ensure the accountability and sustainability of the program, each stage of activities will be documented and compiled in a community service report. This documentation can be used as a material for evaluation, learning, and the basis for the development of similar activities in the future. Through these solutions, these community service activities are expected to be able to make a real contribution to strengthening mangrove rehabilitation in North Jakarta realistically, measurably, and sustainably, while increasing public awareness of coastal environmental conservation.

Based on this description, community service-based mangrove rehabilitation activities in North Jakarta are important because they have three main contributions. First, ecological contribution, which is to help strengthen the function of mangroves as a protector of coastal areas and carbon sinks. Second, social-educational contributions, namely increasing knowledge, awareness, and participation of participants in protecting coastal ecosystems. Third, institutional contributions, namely strengthening the role of universities in supporting the resolution of environmental problems through collaborative and sustainable service activities. Therefore, this activity is not only relevant as an environmental rehabilitation action, but also as a community service model that integrates mangrove conservation, environmental education, social participation, and sustainable development.

IMPLEMENTATION AND METHODS

The implementation of this activity was carried out on May 25, 2026 at the Marunda Mangrove House, Cilincing District, North Jakarta City. The method of implementing this community service activity is carried out through several main stages as follows.

1. Preparation Stage
2. This includes coordination of the implementation team, application for permits to LPPM Open University, coordination with mangrove area management partners in North Jakarta, determination of planting locations, as well as technical preparations and activity equipment.

3. Implementation Stage

The activity was carried out in the North Jakarta mangrove area with a series of activities in the form of registration and opening, brief education about the mangrove ecosystem and planting techniques, introduction to mangrove areas, and planting mangrove trees directly by participants as a form of coastal environmental rehabilitation.

4. Monitoring and Evaluation Stage

Monitoring and evaluation are carried out to assess the suitability of the implementation of activities with the plan, the level of participant participation, and the achievement of mangrove rehabilitation goals.

5. Reporting and Follow-up Stages

The activity ended with the preparation of community service reports and documentation of activities as a form of accountability to LPPM Open University as well as the basis for the development of follow-up activities.

The review of mangrove planting technology in this activity uses traditional methods based on local wisdom and human labor (manual). This traditional method relies on coastal communities' deep understanding of nature. Traditional technology in mangrove cultivation is a collection of manual techniques that include the collection of natural seedlings (propagula), simple seedlings, and direct planting in tidal areas using physical aids, such as bamboo (ajir) and rope. In addition, there are three main techniques that are usually used by forest farmer groups or coastal communities:

1. Direct Planting

Plant propagules (mangrove fruits that have already germinated on the tree) directly into the mud. This method is the simplest but has a low success rate (about 20–30%) because the seedlings are easily washed away.

2. Pocket Nursery (Polybag Nursery)

Seedlings are first sown in plastic bags or bamboo containers for 3–6 months in a protected area before being moved to a permanent planting site.

3. Wanamina System (Sylvofishery)

Traditional integration between mangrove conservation and aquaculture (ponds). Mangroves are planted on the embankment or in the middle of the pond to maintain water quality and protect the embankment from abrasion.

RESULTS AND DISCUSSION

Based on the design of the activity, this community service program can be understood as a mangrove planting activity as well as a form of socio-ecological intervention that connects coastal environmental restoration with increasing public awareness. The activity was carried out through environmental education, introduction to coastal ecosystems, and direct mangrove planting at the Marunda Mangrove House, Cilincing District, North Jakarta City on May 25, 2026. Therefore, the analysis of activities needs to emphasize that the success of mangrove rehabilitation is not enough to be measured by the number of seedlings planted, but also by the suitability of the planting location, the selection of mangrove species, the involvement of participants, and the potential for post-activity maintenance.

Traditional tools and materials used, such as ajir (bamboo support) used to tie seedlings so that they are perpendicular and not collapse to the current, tugal/hoe used to make planting holes in hard mud substrates, and protection from bamboo stems used to fence new planting areas so that they are not damaged by marine debris or livestock.

Statistically, traditional planting through the seedbed process is much more effective than direct planting, with a survival success rate of 60–80%. Today, traditional methods are often combined with modern approaches, such as the use of satellite data to determine planting locations, but the planting process is still carried out manually to empower the local community's economy.

Analysis of Advantages and Challenges

Table 1. Analysis of Advantages and Challenges

Advantages	Challenge
The cost is relatively low because it does not require equipment investment.	Limited scale of tree planting at one time
It is environmentally friendly because it leaves no carbon footprint.	Physical risk of the grower having to enter the mud that is at risk of being exposed to animals or injuries
Social involvement that strengthens people's sense of ownership of mangroves.	Human error, namely non-uniform planting depth, can trigger failure.

Ecologically, mangroves have a strategic function as a natural protector of coastal areas from abrasion, waves, seawater intrusion, as well as as a habitat for various coastal biota. In line with the findings of Donato et al. (2011) who show that mangroves are one of the tropical forests with very high carbon reserves, with an average carbon store of 1,023 Mg C per hectare, and most of these carbon reserves are stored in mangrove organic soil. Thus, mangrove planting activities in the PkM program can be positioned as a small but relevant contribution to climate change mitigation and strengthening the resilience of coastal areas.

Mangrove rehabilitation in Indonesia has greater significance because Indonesia is one of the countries with the largest mangrove area in the world. Arifanti et al. (Arifanti et al., 2022) emphasized that Indonesia's mangroves have important potential in mitigating climate change, but the degradation and conversion of mangrove land can cause significant greenhouse gas emissions. Therefore, this PkM activity is part of local action-based conservation efforts that support national and global agendas, especially SDGs 13 on climate change management, SDGs 14 on marine ecosystems, and SDGs 15 on terrestrial ecosystems.

The success of mangrove rehabilitation is not only determined by planting activities. Lewis (2005) emphasized that the success of mangrove restoration is highly dependent on hydrological conditions, tidal suitability, and restoration of the area's natural ecological conditions. This means that planting seedlings without paying attention to the characteristics of substrates, currents, waves, and inundation patterns risks producing high rates of seedling death. Thus, cooperation with mangrove area management partners in this activity is an important aspect because partners have technical experience in determining the location, type of seedlings, and planting methods that suit local ecological conditions.

From a technical perspective, the use of manual or traditional methods in mangrove planting activities can be understood as an appropriate approach for community service activities. This method is relatively inexpensive, easy for participants to practice, and allows for direct involvement in the rehabilitation process. However, the manual method also has limitations, especially related to non-uniform planting depths, the risk of seedlings being washed away, and the need for maintenance after planting. Therefore, this activity needs to be complemented by post-planting monitoring, for example through observation of seedling life levels, conditions of scarecrow or buffer bamboo, as well as disturbances from garbage, currents, or sedimentation.

Socially, the main strength of this activity lies in the participatory approach. The involvement of academics, students, student organizations, area management partners, and activity participants shows that mangrove rehabilitation can be a space for collective learning. A study by Damastuti et al. (2022) on community-based mangrove management in Central Java shows that community-based mangrove management can contribute to biodiversity conservation, especially if supported by long-term maintenance and sustainable management strategies. Thus, the participation of participants in this activity not only functions as a planter, but also as a process of forming concern, belonging, and social responsibility for the coastal environment.

The environmental education aspect is also an important component of this activity. Education before and during planting serves to transform activities from just symbolic actions to ecological learning processes. Participants not only know how to plant mangroves, but also understand why mangroves are important for coastal protection, disaster mitigation, carbon storage, and the sustainability of coastal communities' lives. In mangrove education-based service research, educational activities combined with planting practices were proven to be able

to increase participants' understanding and encourage active involvement in conservation (Azuga et al., 2025).

From a sustainable development perspective, this activity has three main contributions. First, ecological contribution, which is to help strengthen the function of the coastal green belt through mangrove planting. Second, social-educational contribution, which is to increase participants' awareness of the importance of preserving coastal ecosystems. Third, institutional contributions, namely strengthening the role of universities in connecting science, environmental action, and collaboration with local partners. These three contributions make this program relevant as a model of community service that is not only oriented to the output of activities, but also to changes in knowledge, attitudes, and cooperation networks.



Figure 1. Implementation of PkM for Mangrove Planting

To assess the achievement of community service activities, the analysis is not only directed at the implementation of physical mangrove planting, but also at outputs that show the educational, social, institutional, and sustainability impacts of the program. The output of activities is an important indicator to see the extent to which the mangrove rehabilitation program is able to answer the problem of coastal environmental degradation while increasing participants' awareness of the importance of preserving mangrove ecosystems. Therefore, the following table presents the types of outputs, achievement targets, and success indicators used to evaluate the effectiveness of the implementation of PkM activities for mangrove rehabilitation in the coastal area of North Jakarta. In the activity document, this program is indeed designed through environmental education, introduction to mangrove areas, direct planting, monitoring, evaluation, and reporting as a form of accountability to LPPM Open University.

Table 2. External Stakeholders, Performance Targets, and Success Indicators

No.	External Type	Performance Targets	Success Indicators
1	Implementa tion of mangrove rehabilitatio n	The implementation of mangrove planting activities in the coastal area of North Jakarta	Mangrove planting activities were carried out as planned and actively involved participants
2	Increased environmen	Participants understand the function of mangroves and the	Participants participated in

	tal knowledge and awareness	importance of preserving the coastal environment	educational sessions and showed an understanding of the material presented
3	Community involvement in activities	The community and participants are directly involved in the mangrove planting process	The active participation of participants during the activity
4	Community service report	The preparation of activity reports is accountable to LPPM Open University	Complete report accompanied by documentation of activities and submitted according to the provisions

In addition to the main outputs that are direct, this activity also has follow-up outputs related to the sustainability of the program's impact. This follow-up output is important to analyze because the success of mangrove rehabilitation is not only seen from the implementation of planting activities, but also from the formation of environmental awareness, publication of activities, collaboration networks, and strengthening the role of universities in supporting sustainable development. Thus, the following table shows outputs oriented towards medium-term impacts and the potential sustainability of activities.

**Table 3. External Stakeholders, Performance Targets, and Success Indicators
Medium Term Impact**

No.	External Type	Performance Targets	Success Indicators
1	Strengthening the sense of care and ownership of the environment	Increasing sense of community ownership of rehabilitated mangrove areas.	Participants showed a commitment to maintain and care for mangroves after the activity.
2	Publication and dissemination of activities	Information on community service activities is spread through online media or social media.	There is documentation and publication of activities that are accessible to the public.
3	The formation of a cooperation network	Collaboration between universities, mangrove area managers, and the community.	There is continued communication and cooperation after the activity.

4	Strengthening the role of academics and students	Academics and students play an active role in environmental education and assistance.	The involvement of lecturers and students in the entire series of activities.
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This activity has four important aspects that strengthen the sustainability value of the program. First, strengthening the sense of environmental care and ownership is an important outcome because mangrove rehabilitation requires post-activity commitment. Mangrove planting will not have an optimal impact if it is not accompanied by a sense of belonging from participants and the surrounding community. Therefore, success indicators in the form of participants' commitment to maintain and care for mangroves after activities are important to show a change in attitude, not just momentary participation.

Second, the publication and dissemination of activities serves to expand the impact of the program to the wider public. Documentation of activities through online media or social media can be a means of environmental education, the dissemination of good practices, as well as a form of public accountability for community service activities. Publication of activities can also strengthen the image of universities as institutions that actively contribute to solving environmental problems.

Third, the formation of a cooperation network shows that this PkM activity has the potential to be developed sustainably. Collaboration between universities, mangrove area managers, communities, and student organizations is an important social capital in supporting environmental rehabilitation programs. The existence of communication and further cooperation after the activity can open up opportunities for the next activities, such as monitoring mangrove growth, advanced environmental education, or community-based conservation programs.

Fourth, strengthening the role of academics and students shows that this activity is a space for the implementation of the Tri Dharma of Higher Education, especially community service. Academics play a role in providing educational direction and scientific reflection, while students play the role of implementers, facilitators, as well as agents of environmental change. The involvement of lecturers and students in the entire series of activities shows that PkM is not only oriented towards providing assistance to the community, but also becomes a social, ecological, and academic learning process.

Overall, this community service-based mangrove rehabilitation activity has multidimensional achievements. The program's achievements are not only seen in the implementation of mangrove planting, but also in increasing knowledge, participant participation, strengthening environmental awareness, dissemination of activities, forming cooperation networks, and increasing the role of academics and students. Thus, this activity can be understood as a model of community service that integrates ecological action, environmental education, institutional collaboration, and sustainable development.

CONCLUSIONS AND RECOMMENDATIONS

The community-based mangrove rehabilitation activity at the Marunda Mangrove House, Cilincing District, North Jakarta City, shows that efforts to preserve coastal ecosystems need to be carried out through an integrated approach between ecological action, environmental education, participant participation, and institutional collaboration. Mangrove planting directly is a form of real contribution in supporting the restoration of coastal ecosystem function, especially as a natural protector from abrasion, seawater intrusion, waves, as well as as a carbon sink and coastal biota habitat.

In addition to producing physical outputs in the form of mangrove planting, this activity also has a social-educational impact through increasing participants' knowledge and awareness of the importance of mangrove conservation. The involvement of academics, students, student organizations, area management partners, and activity participants shows that mangrove rehabilitation is not only a conservation activity, but also a collective learning space to foster a sense of concern and ownership of the coastal environment.

Institutionally, this activity strengthens the role of universities in the implementation of the Tri Dharma, especially community service oriented towards environmental sustainability. Collaboration with mangrove area management partners is an important factor so that activities run according to local ecological conditions and have sustainability opportunities. Thus, this activity can be understood as a community service model that integrates ecosystem rehabilitation, environmental education, social participation, and sustainable development.

In the future, similar programs need to be complemented by regular postplanting monitoring, such as observation of seedling life levels, planting area conditions, and participant involvement in follow-up care. Evaluation based on indicators of knowledge, attitude, participation, and success of mangrove growth is also important so that the impact of activities can be measured more comprehensively and become the basis for the development of more sustainable mangrove rehabilitation programs.

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