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# Evaluating the Effectiveness of Community-Based Mangrove Rehabilitation Initiatives

**Muhammad Mardhiansyah [1,*], Nur Suhada [1], Evi Sribudiani [1], Said Zul Amraini [2] and Hafid Farhan [1]**

[1] Department of Forestry, Faculty of Agriculture, University of Riau; m.mardhiansyah@lecturer.unri.ac.id (M.M.); nursuhada@lecturer.unri.ac.id (N.S.); evi.sribudiani@lecturer.unri.ac.id (E.S.); hfdfrhn@gmail.com (H.F.)
[2] Department of Chemical Engineering, Faculty of Engineering University of Riau; saidzulamraini@eng.unri.ac.id (S.Z.A.)

* Correspondence: m.mardhiansyah@lecturer.unri.ac.id

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**Abstract**

Management actions through rehabilitation activities can restore mangrove ecosystems by involving community participation. This study aims to determine the involvement and effectiveness of community-based rehabilitation activities. This study was conducted in Teluk Pambang Village, Bengkalis Regency. The method used is qualitative, with a purposive sampling technique based on certain criteria. The data analysis used is qualitative descriptive and data processing using nvivo 12 plus software. The research findings explain that the dominant factors that encourage people to carry out mangrove rehabilitation activities are based on additional income, strengthening the issue of carbon trade economy, kinship elements, and easy access to financing through donors. The level of program understanding, target accuracy, activity management, and real changes are the most effective rehabilitation activities for the community. At the same time, the indicators for achieving goals are still considered ineffective.



## 1. Introduction

As an archipelagic country, Indonesia holds the largest area of mangrove forests globally, contributing significantly to global mangrove biodiversity and ecosystem services [1]. Mangroves play a vital role in maintaining coastal stability, providing habitats for marine life, sequestering carbon, and supporting the livelihoods of coastal communities [2, 3]. However, despite their ecological and economic importance, mangroves in Indonesia have faced significant degradation over the past few decades due to activities such as land conversion, aquaculture expansion, and unsustainable exploitation.

Riau Province has mangroves spread along river estuaries and coastlines in seven districts/cities. For two decades (2000 - 2019), the area and distribution of mangroves in Riau Province tended to decrease from 180,952.1 hectares to 161,655.5 hectares, with an average annual decrease in the area of 2,495.9 hectares, leaving Riau mangroves remaining at 145,656.9 hectares [4]. Mangrove rehabilitation programs have often been carried out in coastal areas with the hope of being able to save the mangrove ecosystem. Still, the success of the program cannot be separated from the parties' involvement.

Rehabilitation will impact climate change and boost the economy through community empowerment [5] by actively involving the community to restore the continuously declining mangrove ecosystem [6]. Restoring mangrove ecosystems provides broader benefits to communities, increasing economic income and encouraging social participation, strengthening

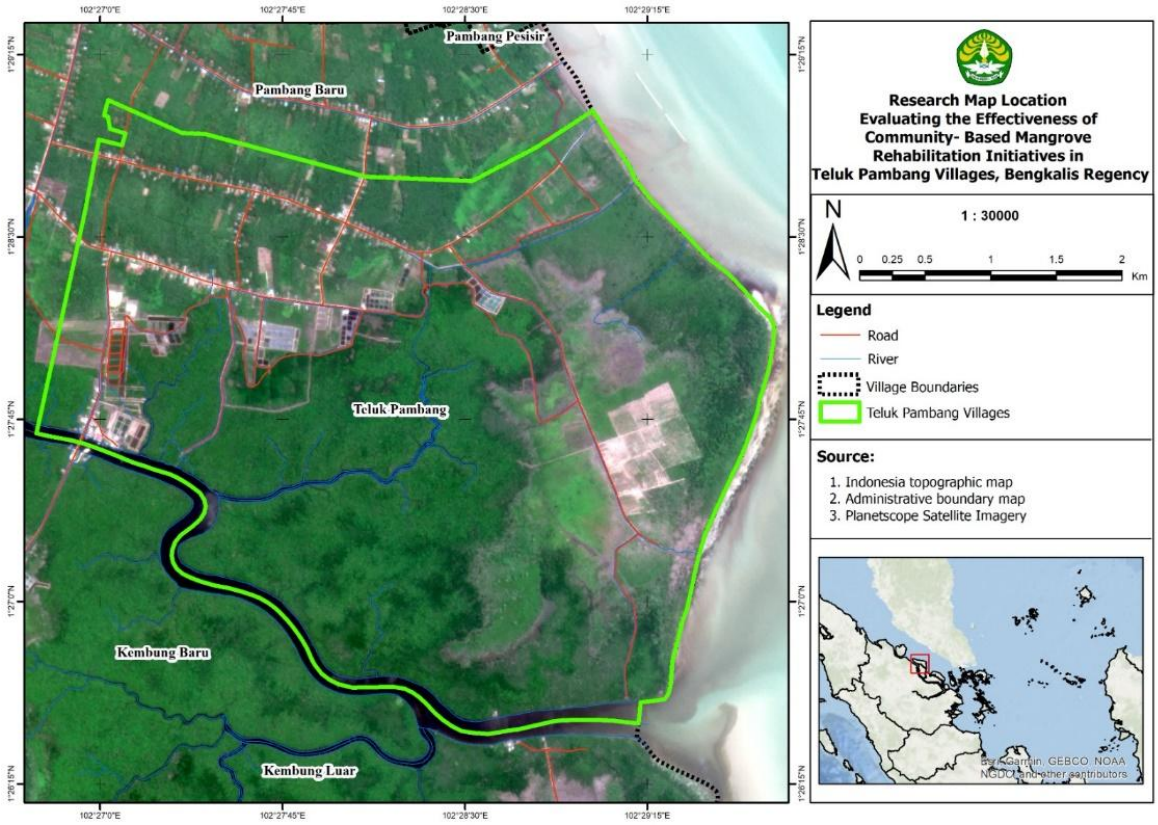


**Figure 1.** The research location in Teluk Pambang Village, Bengkalis Regency.

environmental awareness, and creating resilient coastal communities to climate change [7]. The mangrove ecosystem in coastal areas has high productivity and an important role ecologically, socially, and economically for the local community [8]. Rehabilitation activities are expected to be a solution to overcome the degradation of mangrove ecosystems in coastal areas [9].

This study aims to evaluate the effectiveness of community-based mangrove rehabilitation initiatives in addressing the degradation of mangrove ecosystems in Riau Province. By focusing on active community participation, training, and assistance, the research seeks to assess the impact of these initiatives on restoring mangrove ecosystems, enhancing the welfare of coastal communities, and fostering resilience to climate change.

The study contributes to the understanding of how community involvement can strengthen environmental awareness, boost economic opportunities, and promote sustainable practices, offering insights into strategies for successful mangrove rehabilitation that benefit both ecological systems and local livelihoods. Active community participation, training, and assistance are the keys to the success of mangrove rehabilitation and act as monitoring and evaluation steps during the implementation process.

## 2. Materials and Methods

### *2.1. Study Area and Period*

This research was conducted in Teluk Pambang Village, Bantan Subdistrict, Bengkalis Regency, Riau Province, Indonesia. The village is part of a coastal region that relies heavily on mangrove ecosystems for environmental stability, economic resources, and community livelihood. Mangrove degradation has been a significant concern in this area, making it a focal point for rehabilitation efforts. The study was carried out over two months, from October to November 2023, to capture ongoing and recently completed mangrove rehabilitation activities. The geographical boundaries of the study area are illustrated in Figure 1.

### *2.2. Research Design*

The study employed a qualitative descriptive approach to evaluate the effectiveness of community-based mangrove rehabilitation activities [10, 11]. This approach was chosen to provide an in-depth understanding of mangrove management's social, institutional, and ecological dimensions. Qualitative methods were used to gather rich, contextual data about community participation, challenges faced, and the outcomes of rehabilitation efforts.

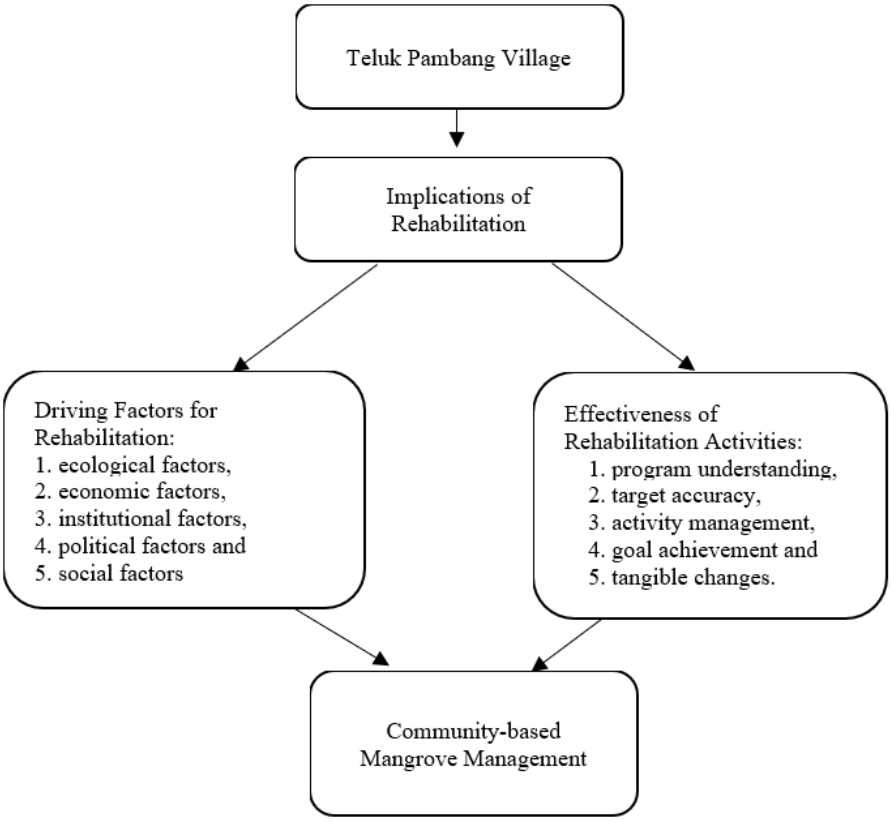


**Figure. 2.** Framework of Teluk Pambang Village rehabilitation, highlighting driving factors, effectiveness, and community-based mangrove management.

*2.3. Data Collection Techniques*

Data were collected using a combination of in-depth interviews, observations, and documentation studies to ensure a comprehensive understanding of mangrove rehabilitation activities. Semi-structured interviews were conducted with individuals actively involved in mangrove management, including community members, local leaders, and government officials [12]. These interviews provided an opportunity to explore the informants' experiences, perceptions, and insights into the challenges and successes associated with mangrove rehabilitation efforts.

Field observations were carried out at mangrove rehabilitation sites to evaluate the physical progress of mangrove planting and maintenance activities. These observations also involved assessing the level of community engagement during rehabilitation work, providing valuable insights into the practical implementation of these initiatives.

In addition, relevant documents, such as village regulations, activity reports, and government policies related to mangrove management, were reviewed to supplement the primary data. This documentation helped provide a deeper contextual understanding of the legal and institutional frameworks that support mangrove rehabilitation in the region, offering a broader perspective on the underlying mechanisms driving these activities.

*2.4. Informants*

A total of 29 informants participated in this study. Among these, 24 informants were members of six active Mangrove Management Groups (KPM) operating in Teluk Pambang Village. Each KPM provided four informants, selected to represent different roles and perspectives within the group. The KPM leader was designated as the key informant for each group, given their central role in organizing and overseeing rehabilitation activities.

In addition to the KPM representatives, five additional informants were included to provide broader perspectives on mangrove management. These informants were the village head, the former village head, and representatives from key provincial agencies, namely the Riau Province's Department of Environment and Forestry (DLHK) and the Department of Marine and Fisheries (DKP). A representative from the Nature Conservation Foundation (YKAN), an environmental NGO involved in mangrove conservation, also participated. These additional informants provided valuable insights into mangrove management's institutional, regulatory, and technical aspects.

*2.5. Data Analysis*

The qualitative data collected through interviews, observations, and documentation were processed and analyzed using NVivo 12 Plus software [13]. NVivo enabled systematic coding, categorization, and thematic analysis of the data. Key themes, such as the effectiveness of rehabilitation efforts, community participation, and institutional support, were identified and analyzed to assess the outcomes of mangrove management initiatives. The software also facilitated the organization of complex qualitative data, ensuring a robust and transparent analytical process.

*2.6. Research Framework*

The research framework adopted for this study is presented in Figure 2. This framework illustrates the relationships between key variables, including community participation, institutional support, and the ecological outcomes of mangrove rehabilitation. It serves as a guide for understanding how various factors influence the effectiveness of community-based mangrove rehabilitation initiatives.

**3. Results and Discussion**

*3.1. Driving Factors for Mangrove Rehabilitation Activities*

Driving factors have implications for the interest and motivation of the community to participate in forest and land rehabilitation activities. This aligns with the Indonesian Ministry of Forestry Regulation No. P.39/Menhut-II/2010 concerning the implementation of forest rehabilitation and reclamation activities, which covers political, social, economic, ecological, and institutional aspects. The driving factors within each available variable are also influenced by supporting factors contained within those variables. Each formed driving factor correlates with shaping the community's motivation and interest to participate in rehabilitation activities. This is illustrated in the project map in Figure 3.

The implications of the driving factors impact community groups' involvement in mangrove planting, whether through their own initiative or encouragement (stimulants) from external parties. Communities' significant dependence on coastal resources increases sensitivity to conservation efforts when financial aspects are involved, given their economic limitations [14].

Based on the abstraction in Figures 3 and 4, the main findings about economic variables are the main driving factors for the community in carrying out mangrove rehabilitation activities. The economic value in the form of short-term benefits obtained from rehabilitation activities comes from various processes, starting from the production of seedlings such as mangrove seedlings (*Rhizopora apiculata*), api-api (*Avicennia marina*) and perepat (*Sonneratia alba*) for Rp2,000 per seedling, planting in the program area with a labor wage of Rp150,000 per person per day, maintenance, and monitoring through routine patrols. Economic growth is also supported by the potential for ecotourism and the utilization of non-timber forest products

The political driving factors have not yet provided significant short-term economic responses because carbon trading lacks certainty and clear policies regarding its implementation and has not yet had a direct economic impact on the community. Other driving factors with ecological rehabilitation goals are indicated by increasing tidal conditions and high waves entering villages and flooding houses due to illegal logging of mangrove trees and decreased catches of fish, crabs, and other marine products. The ecological sustainability of mangroves is crucial as they serve as natural habitats for various terrestrial and marine biota types, acting as nursery grounds, breeding sites, genetic reservoirs, and shelters [15]. This motivates the community to get involved in rehabilitation activities to maintain the balance of the mangrove ecosystem by reducing mangrove logging activities.

*3.2. Effectiveness of Mangrove Rehabilitation Activities in Teluk Pambang Village*

The rehabilitation activities in Teluk Pambang Village aim to preserve the mangrove ecosystem and empower the community to improve their well-being. Sustainable mangrove management, through programs implemented by various stakeholders and self-managed efforts by the community, provides an overview of the effectiveness of mangrove rehabilitation activities. Evaluation of the effectiveness of mangrove rehabilitation is measured based on the following parameters: (1) program understanding, (2) target accuracy, (3) activity management, (4) achievement of objectives, and (5) tangible changes.

*3.2.1. Program Understanding*

The program understanding parameter is divided into socialization, training, and program assistance during rehabilitation activities. According to studies, assistance is a top priority to obtain information related to rehabilitation activities more quickly, thereby minimizing potential errors. The presence of companions as pioneers of community independence strategically influences community empowerment efforts in Teluk Pambang Village. Interviews with the community reveal that assistance influences their motivation to work and their commitment to achieving planning goals and

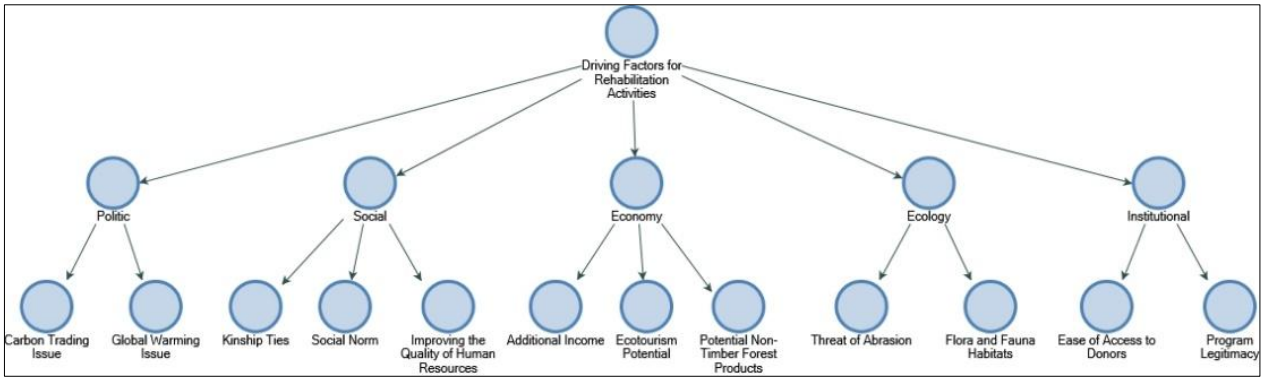


**Figure 3.** Project map of driving factors for mangrove rehabilitation activities.

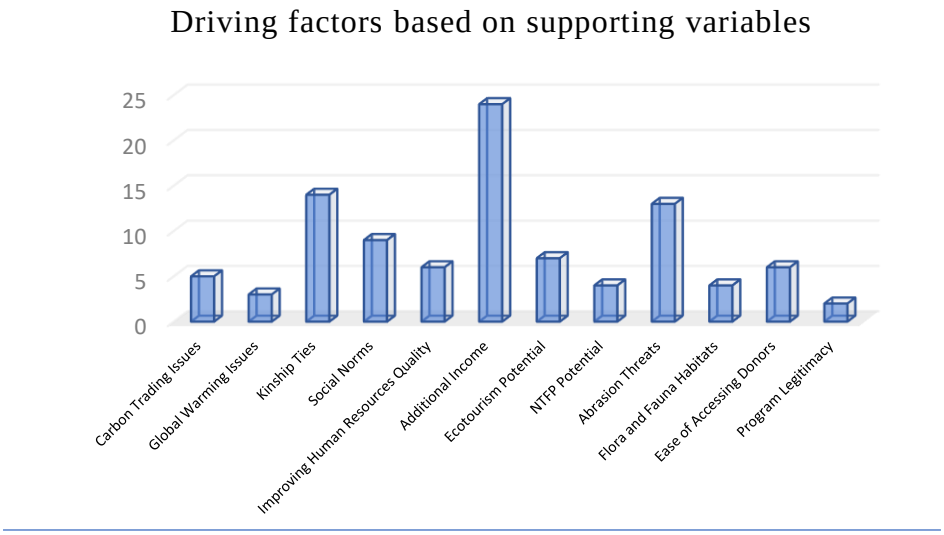


**Figure 4.** Graph of driving factors based on supporting variables.

provides evaluation for each program carried out by the community.

*3.2.2. Target Accuracy*

Based on studies, environmental improvement, and community empowerment are the main parameters for target accuracy. This is because environmental improvement and community empowerment must go hand in hand to achieve the goals. The rehabilitation activities carried out by stakeholders in Teluk Pambang Village focus on improving land quality and the ecosystem due to erosion and sedimentation in the mangrove ecosystem area. Community empowerment in rehabilitation activities is still on a small scale, including activities such as seedling production, planting, and monitoring. The community's involvement in the rehabilitation program has had a positive impact. This is evident in the rehabilitation activities, where planting in eroded areas has become an economic empowerment effort through seedling production, planting, and monitoring activities, leading the community to perceive the rehabilitation program as well-targeted.

*3.2.3 Activity Management*

Activity management in rehabilitation efforts is closely tied to the importance of collaboration between stakeholders and the community. The supporting factors from stakeholders and the community include timeliness and accurate financing. Proper financing and timely payment for the work significantly affect the effectiveness of the tasks; conversely, if the financing does not match the work done, it can hinder the implementation of activities.

Based on observations and interviews, a mangrove management group in Teluk Pambang Village still faces challenges meeting activity deadlines due to a lack of commitment and responsibility toward the agreed-upon plans. This has resulted in unmet targets and delays and then affects the performance of the stakeholders acting as donors.

*3.2.4. Achieving Objectives*

Based on studies, the success indicators for the objectives of the rehabilitation activities have not been

fully achieved in Teluk Pambang Village. This is because many of the stakeholders implementing rehabilitation programs are still focused on meeting the targets set by donor institutions. The community empowerment model has not yet focused on utilizing mangroves, resulting in a lack of independence among the community when rehabilitation programs are not in place. A livelihood-based approach to local alternatives will reduce community resilience to resources [16]. Managing the mangrove ecosystem through an empowerment scheme can reduce the community's dependence on rehabilitation programs provided by partners. The organizational structure of the mangrove management groups is designed to manage each program funded by partners, ensuring the institution's sustainability.

Based on the study, the community perceives the current institutional structure as ineffective and suboptimal, particularly regarding communication and coordination among members. The lack of institutional harmonization, characterized by weak financial transparency and minimal communication regarding collaborative activities, has led to a decline in community trust in the rehabilitation program. This has implications for member performance and the sustainability of institutions in mangrove management [17]. Stating that institutions must aim to provide welfare and benefits through community participation in sustainable mangrove conservation programs.

*3.2.5. Tangible Changes*

Tangible changes in rehabilitation activities refer to the degree to which the success of the rehabilitation program has a direct and sustainable impact. One significant implication is the increased awareness among the community due to the mangrove rehabilitation program, which has contributed to reducing the intensity of illegal mangrove logging. Studies have shown that this change is influenced by the implementation of regular patrol programs conducted by mangrove management groups, making those who might engage in illegal logging feel monitored by these patrol activities.

Another factor supporting tangible changes includes creating new job opportunities for the community as program partners during rehabilitation activities, aligning with the program plans established by the partners.

## 4. Conclusions

The community's main driving factors and motivations for mangrove rehabilitation activities are economic factors because rehabilitation increases additional income. Ecologically, community awareness increases along with the high abrasion and potential for seawater intrusion into the mainland. Political factors with carbon trading issues, social factors due to kinship ties, and institutional factors that play a role in easy donor access. The evaluation of the effectiveness of mangrove rehabilitation revealed mixed results. Indicators such as program comprehension, targeting accuracy, activity management, and tangible changes demonstrated positive outcomes. However, the program fell short of achieving broader goals, such as empowering the community and improving environmental quality comprehensively. This study contributes to the existing body of knowledge by emphasizing the multifaceted motivations for mangrove rehabilitation and providing a nuanced evaluation framework. Its findings underscore the significance of integrating socio-economic, ecological, political, and institutional considerations into conservation efforts. Future research should explore sustainable mangrove management strategies, particularly focusing on long-term empowerment models and enhanced environmental outcomes. By addressing these gaps, subsequent studies can further strengthen the effectiveness and sustainability of mangrove rehabilitation initiatives.

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