



Verdant Economy: Financial Benefit Analysis of Mangrove Ecosystem Restoration in Riding Panjang Village, Bangka Regency

Lisma Dwi Susanti^{1*}, Bani Ibrahim², Basit Sucipto³, Nizwan Zukhri⁴, and Ari Agung Nugroho⁵

^{1,2,3,4,5} Faculty of Economics and Business, Universitas Bangka Belitung, Bangka Belitung Province 33172, Indonesia

*lismadwisusanti2204@gmail.com

Abstract. Mangrove ecosystem restoration in Riding Panjang Village, Bangka Regency is an example of the implementation of a green economy that aims to achieve sustainable development. This study aims to analyze the financial benefits generated from mangrove rehabilitation efforts. The research methodology combines quantitative and qualitative approaches, with data collection through field surveys, in-depth interviews with local communities, and secondary data analysis. The results of the study indicate that mangrove rehabilitation in Riding Panjang Village has increased community income through the fisheries sector, with significant economic value. In addition, efforts to diversify fisheries products and develop ecotourism have also made a positive contribution to local economic welfare. This ecosystem restoration not only provides environmental benefits through carbon sequestration and coastline protection, but also successfully reaches Break Even Point (BEP) in a short time, demonstrating the success of this project in creating sustainable financial benefits. Thus, mangrove restoration in Riding Panjang Village can be used as an effective model to support an inclusive and sustainable green economy.

Keywords: Green Economy, Financial Benefits, Mangrove Rehabilitation.

1 Introduction

The verdant, or green, economy is an economic development model focused on improving human well-being and social equity while minimizing environmental risks and resource depletion [25]. It aims for long-term prosperity without environmental harm by promoting economic growth alongside reduced carbon emissions, increased resource efficiency, and social inclusion. In Indonesia, the green economy is exemplified by initiatives like the mangrove restoration program in Riding Panjang Village, Bangka Regency, which seeks to restore mangrove ecosystems while providing economic benefits to local communities. This article attempts to show how ecosystem restoration strategies able to contribute to sustainable green economic development. In addition to

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being a basis for better policy making, the results of this article can also be used as a model for other regions facing similar problems, thus supporting ecosystem restoration efforts at the national and international levels.

2 Methods

This research uses a combination of quantitative and qualitative methods to evaluate the financial and environmental benefits of mangrove ecosystem restoration in Riding Panjang Village. Data were collected through field surveys assessing the ecological state of the mangroves and in-depth interviews with locals on the economic impact, particularly in fisheries and ecotourism. Secondary data from reports and literature supported the analysis, focusing on mangroves' role in carbon sequestration and climate change mitigation. The study assesses both economic and ecological outcomes, emphasizing increased community income and the project's financial sustainability, evidenced by reaching the Break-Even Point (BEP).

3 Results and Discussion

Mangroves hold significant strategic value as ecosystems that need to be managed properly to maximize the benefits they provide. Field observations reveal that in the Bangka Belitung Islands, mangroves are predominantly found in estuary areas where freshwater from rivers meets seawater. These mangroves typically grow along the coastline, extending into river areas. According to the 2023 update of the National Mangrove Map by the Indonesian Ministry of Environment and Forestry (KLHK) in 2024, the existing mangrove area in the Bangka Belitung Islands Province covers 66,583.38 hectares, with an additional 9,607.12 hectares identified as potential mangrove areas. Using this data, the KLHK initiated a mangrove rehabilitation program aimed at environmental restoration in Bangka Belitung Province, starting in 2019.



Fig. 1. Mangrove conditions before rehabilitation

One of the targeted locations is the eastern coast of Bangka Island, specifically Riding Panjang Village in Merawang District, which covers an area of 21.1 km² and has a population of 2,562 people. According to KLHK data, 70 hectares of mangrove forests have been planted in this area, with planting efforts beginning in 2019 across 10 hectares, expanding to 50 hectares in 2020, and covering another 10 hectares in 2021.



Fig. 2. Mangrove conditions after rehabilitation

Mangrove rehabilitation in Riding Panjang, conducted from 2020 to 2023 and funded by the Ministry of Environment and Forestry through the Cerucuk Baturusa River Basin Management Center, has positive ecological impacts. The restoration attracts marine life, including fish and crabs, as healthy mangrove ecosystems provide a suitable habitat for these species.

Interviews with members of the farmer group revealed that before the mangrove plants were established, crabs were difficult to find. However, after the introduction of mangroves, crabs became much easier to catch. Community group members reported two primary methods for catching crabs: using the "bubu" trap and catching them directly by hand.



Fig. 3. Catching crabs using the “bubu”

The community's crab-catching efforts generated an annual income of IDR 1,260,000,000 from direct catches, while using the "bubu" traps yielded an additional IDR 369,600,000. Altogether, the total income from crab harvesting amounted to IDR 1,629,600,000 per year as presented in Table 1.

Table 1. Financial Benefits of Mangrove Rehabilitation

Income from crab catches for 1 year after RHL	
Crab catch	Rp 1.260.000.000
Using the “bubu” tool	Rp 369.600.000
Total income	Rp 1.629.600.000
RHL activity costs covering an area of 60 Ha (for 3 years)	
Planting (1st year)	Rp 1.035.180.000

Maintenance Year 1 (2nd year)	Rp 217.120.000
Maintenance Year 2 (3rd year)	Rp 131.820.000
Total income	Rp 1.384.120.000
Profit	Rp 245.480.000

From a financial perspective, mangrove restoration activities will reach BEP within a 3-year activity period. In the atmosphere, playing a significant role in mitigating climate change. Studies indicate that mangroves can hold up to four times more carbon per unit area compared to other tropical forests [5].

Table 2. The Calculation of Carbon Stocks After Rehabilitation

Pos	Location	Above ground Carbon			Total	Below ground Carbon		Total
		Above ground Carbon (ton/ha)	Dead organic carbon (ton/ha)	Litter carbon		Below ground carbon (ton/ha)	Ground carbon (ton/ha)	
1	Riding Panjang	65,30	3×10^{-7}	4×10^{-5}	65,30	17,80	50,36	68,16
Total					65,30	17,80	50,36	68,16

The results of the calculation of carbon stocks for aboveground carbon and below-ground carbon according to research by the University of Bangka Belitung in 2023 on mangroves in Riding Panjang Village, Merawang District, Bangka Regency in tons/ha are presented in the Table 2 above with a total carbon of 68.16 (tons/ha).

3.1 Mangrove Conservation and Rehabilitation

- 1. Ecosystem Mapping and Assessment:** Utilizing GIS (Geographic Information System) and drone technology enables precise and efficient mapping of mangrove ecosystems. These technologies provide detailed spatial information on the distribution and health of mangrove forests, which is crucial for effective planning and management [13].
- 2. Rehabilitation Program:** To ensure successful mangrove rehabilitation, it is crucial to select plant species that are compatible with the local environment, taking into account factors like soil type, salinity, and tidal variations. This increases the chances of successful adaptation and growth. Additionally, bio-engineering methods are used to restore degraded habitats by employing artificial structures or natural modifications to stabilize sediments, prevent erosion, and improve conditions for mangrove growth. Effective bio-engineering solutions often include building fortifications or barriers to shield the planting areas from destructive waves and currents [14].
- 3. Monitoring and Maintenance:** Implementing a technology-driven monitoring system enables real-time tracking of mangrove growth and ecosystem conditions. This system involves the use of sensors, cameras, and IoT (Internet of Things) devices connected to a network that continuously transmits data. As a result, any changes in

environmental conditions and the health of mangroves can be detected at an early stage, facilitating prompt intervention when necessary [6].

3.2 Sustainable Ecotourism Development

1. **Ecotourism Infrastructure:** Building infrastructure for ecotourism, including wooden walkways for exploring mangrove forests, bird-watching towers, and educational centers about mangroves, is essential. These amenities enhance the visitor experience and serve as educational resources to raise awareness about mangrove conservation. Implementing effective waste management practices and using eco-friendly building materials are examples of sustainable measures that should be incorporated into ecotourism infrastructure [11].
2. **Local Community Training:** Providing training for local residents in areas such as tour guiding, waste management, and mangrove conservation equips them with essential skills to participate effectively in the ecotourism sector. Involving locals as tour guides, homestay operators, and other service providers ensures that the economic advantages of ecotourism are directly experienced by the community. Such engagement not only enhances the community's economic conditions but also fosters a sense of ownership and accountability for the protection of their local environment [23].
3. **Promotion and Marketing:** Successful promotion and marketing through platforms such as social media, websites, and brochures facilitate the broad and engaging dissemination of information about mangrove ecotourism destinations. Such partnerships not only broaden the promotional reach but also ensure a steady stream of visitors to the mangrove sites [2].

3.3 Enhancing the Fisheries Economy

1. **Sustainable Fisheries Management:** By controlling where and when fishing occurs, fish populations are allowed to grow and reproduce, which helps maintain healthy fish stocks. Additionally, using eco-friendly fishing gear that minimizes habitat damage is crucial. Therefore, developing innovative, selective fishing gear with minimal environmental impact is essential. This approach not only safeguards marine habitats but also promotes the economic sustainability of communities reliant on fisheries [19].
2. **Diversification of Fisheries Products:** Promoting the cultivation of high-value mangrove crabs, shrimp, and fish using environmentally sustainable methods can be an effective alternative in diversifying fisheries products. It's important to manage this cultivation in a way that maintains ecosystem balance and avoids damaging the mangrove habitat. In addition, developing processed seafood products such as fish chips, fish floss, and other value-added items can significantly enhance economic returns [8].
3. **Market Access:** Developing an effective distribution network is essential for expanding the market reach of local fishery products, both domestically and interna-

tionally. This can be accomplished by forming partnerships with distributors, retailers, and e-commerce platforms to broaden sales channels. Organic certification appeals to consumers who prioritize sustainability and health, potentially allowing these products to command higher prices. Strong branding also plays a crucial role in creating a positive image and fostering consumer trust in local fishery products, thereby bolstering their competitiveness in the global market [20].

3.4 Environmental Education and Awareness

1. **Education Program:** Developing a specialized curriculum that focuses on mangrove ecology for schools located in coastal areas can help instill environmental awareness in children from a young age. This curriculum should cover topics such as the ecological importance of mangroves, their economic benefits, and methods for conservation and restoration. By educating both young people and adults, communities can cultivate a deeper appreciation for mangroves and actively participate in conservation efforts [18].
2. **Public Awareness Campaign:** Awareness campaigns conducted through various media channels such as mass media, social media, and community events like beach clean-ups can effectively disseminate information regarding the significance of mangroves. Mass and social media serve as potent instruments for reaching a wide and diverse audience, while community initiatives actively involve locals in direct actions, nurturing a sense of accountability and stewardship towards their environment. By integrating awareness campaigns with adoption programs, the conservation of mangroves can garner broader support and engagement from all sectors of society [15].

3.5 Collaboration and Economic Empowerment

1. **Partnership and Collaboration:** Fostering collaborations among governmental entities, non-governmental organizations, the corporate sector, and local communities can yield substantial synergies for the preservation of mangroves. The government can offer regulatory frameworks and policy backing, while NGOs can concentrate on community education and mobilization. The private sector can provide financial resources and technological acumen, and local communities can offer invaluable indigenous knowledge and actively engage in conservation endeavors. This cooperative approach ensures active engagement and contributions from all parties towards the common objective of mangrove conservation [17].
2. **Economic Incentives:** Offering economic incentives, such as subsidies for mangrove rehabilitation projects, can alleviate the financial burden on project implementers and enhance the scope and effectiveness of restoration efforts. Tax incentives for businesses involved in mangrove-based ecotourism can attract more investment and promote sustainable development in this sector. Besides financial support, recognizing successful conservation initiatives through awards and certifications is crucial. These accolades not only acknowledge achievements but also promote best practices and innovation. Certification can enhance the reputation and market value

of products or services, motivating continued investment in mangrove conservation [24].

3. **Sustainable Funding:** Establishing sustainable funding mechanisms through partnerships with donor agencies, governments, and the private sector can ensure a stable and long-term financial foundation for mangrove rehabilitation and conservation projects. This collaboration can involve grants, soft loans, and co-investments targeted at environmental initiatives. Implementing payment for ecosystem services (PES) schemes can offer direct financial incentives to those contributing to mangrove conservation. These mechanisms support conservation efforts while providing economic benefits to local communities engaged in maintaining and restoring mangroves [10].
4. **Community Empowerment:** Empowering local communities through the provision of training and access to capital for small enterprises focused on mangrove-related activities can significantly enhance their capacity to sustainably manage and utilize mangrove resources. Training initiatives encompass a wide range of topics including mangrove cultivation, seafood processing, and ecotourism. Moreover, the establishment of cooperatives or collaborative ventures can elevate economic prospects by consolidating resources, tapping into broader markets, and amplifying negotiation power. By empowering communities in this manner, a mutually beneficial cycle is initiated, bolstering both mangrove conservation efforts and economic advancement, thereby fortifying environmental and social outcomes [3].

4 Conclusion

The verdant, or green economy, represents a development model that combines economic growth with environmental sustainability. The mangrove rehabilitation efforts in Riding Panjang serve as a promising example of this principle and deserve further advancement. These initiatives are expected to provide financial benefits to the local community and are projected to reach Break-Even Point (BEP) within four years of starting the rehabilitation.

To ensure the long-term sustainability of the verdant economy in Riding Panjang, a series of strategic initiatives must be diligently pursued. These initiatives include the preservation of mangroves, the promotion of sustainable ecotourism, the enhancement of the fisheries industry, the dissemination of environmental education and awareness, and the strengthening of collaborative economic efforts.

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