Ann PUBLISHER
Journal of Tourism Sciences (Toursci)
e-ISSN 3046-7713
p-ISSN 3032-7539

Development of Ecotourism Based on Mangrove Conservation To Deal With Coastal Abrasion: Potential And Challenges In Cirebon

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Abstract
Background. The problem of coastal abrasion has become a serious threat to coastal areas in various regions in Indonesia, including Cirebon. Coastal abrasion, which is the erosion of coastlines caused by ocean waves, currents, and human activities, results in a reduction of land area and damages coastal ecosystems.
Aims. This research aims to address the issue of abrasion in the coastal area of Cirebon Regency by developing an ecotourism model centered on mangrove conservation.
Methods. The research methods used include field surveys, geospatial data analysis, and community involvement in the ecosystem rehabilitation process.
Result. The study's results show that rehabilitating mangroves covering an area of 10 hectares can reduce abrasion by up to 50%, while developing mangrove educational tourism routes can increase community income by up to 20%. Additionally, there has been a notable increase in public awareness of the importance of environmental conservation.
Conclusion. The contribution of this research includes the development of sustainable ecotourism models that not only support ecosystem conservation but also empower local economies.
Implementation. Integrating mangrove ecotourism development programs into regional development plans and providing incentives to the community and the private sector involved in the rehabilitation and management of mangrove areas.

Keywords: Ecotourism, mangrove conservation, coastal abrasion, community empowerment, sustainable tourism.

INTRODUCTION

The problem of coastal abrasion has become a serious threat to coastal areas in various regions in Indonesia, including Cirebon. Coastal abrasion, which is the erosion of coastlines caused by ocean waves, currents, and human activities, results in a reduction of land area and

damages coastal ecosystems. In Cirebon, the impact of this abrasion is further exacerbated by various factors, including the conversion of coastal land for commercial purposes, pollution from domestic and industrial waste, and global climate change, which causes sea level rise. The mangrove ecosystem, which was intended to be the natural protector of coastal areas from erosion, is now experiencing significant degradation. Mangroves possess a unique ability to resist erosion, sequester carbon, and provide habitats for a wide range of marine and terrestrial species. However, the exploitation of natural resources and the lack of public awareness about the importance of mangrove conservation have led to the destruction of these ecosystems. Based on preliminary data, around 25% of the coastal areas of Cirebon that were previously covered by mangroves are now in critical condition or have been lost. In addition to environmental impacts, abrasion also has a significant impact on the socio-economic life of coastal communities. Many people have lost agricultural land, ponds, and settlements due to coastal erosion. Populations that are primarily dependent on the fisheries sector also face declining catches due to the degradation of mangrove ecosystems. This condition affects the stability of the local economy and increases the risk of poverty in coastal areas. In the face of these challenges, various conservation initiatives have been undertaken by governments and non-governmental organizations. However, the approach is often focused on physical rehabilitation without considering the participation of local communities. Community involvement is key to the success of conservation programs, as it will be the primary actor in maintaining the sustainability of the ecosystem. Additionally, the economic potential of mangrove-based ecotourism has not been fully utilized to support conservation programs while enhancing the welfare of local communities.

Mangrove conservation-based ecotourism provides sustainable solutions to mitigate coastal erosion and enhance people's well-being. Ecotourism is a form of tourism that focuses not only on the exploitation of natural resources but also on environmental conservation and the empowerment of local communities. Through the development of mangrove educational tourism routes, the community can become involved in conservation activities, including mangrove planting, ecosystem maintenance, and tourist destination management. This not only provides environmental benefits but also creates new jobs and additional sources of income for the community.

LITERATURE REVIEW

Ecotourism

Ecotourism is a form of tourism that aims to visit natural places undisturbed by human activities, to understand the culture and natural history of the surroundings, while preserving the environment and improving the well-being of the local population. Ecotourism emphasizes environmental education, social responsibility, and economic benefits for local communities. is a tourism concept that integrates environmental, social, and financial aspects in a mutually supportive unit. Ecotourism not only offers a refreshing and educational experience for tourists but also plays a crucial role in nature conservation. For example, ecotourism can help fund conservation projects, providing an economic alternative to forest encroachment or other unsustainable practices. Additionally, by drawing global attention to biodiversity, ecotourism can increase awareness of the importance of protecting our ecosystems.

Ceballos-Lascurain (1996) defines ecotourism as responsible travel to natural areas that preserve the environment, maintain the well-being of local communities, and involve environmental interpretation and education. Thus, ecotourism not only aims to provide tourists with experiences but also to support environmental conservation efforts and community empowerment.

Mangrove Conservation

Mangroves, as one of the most critical coastal ecosystems, play significant ecological and economic roles. Ecologically, mangroves serve as abrasion barriers, carbon sinks, pollutant filters, and habitats for a wide range of species. According to Alongi (2008), the existence of mangroves can reduce wave speed by up to 75%, making it effective in protecting coastlines from erosion. Economically, mangroves support the sustainability of the fisheries sector and are the main attraction for ecotourism development.

Coastal Abrasion

Coastal abrasion is a type of erosion that occurs on the coastline due to the combined effects of waves, currents, and human activities. In Indonesia, coastal abrasion is a serious problem, especially in areas with degraded mangrove ecosystems. According to Smith et al. (2013), abrasion can result in land loss, infrastructure damage, and significant socioeconomic impacts. Efforts to handle abrasion include mangrove rehabilitation and the development of wave arrest infrastructure.

Community Empowerment

Community empowerment in the context of ecotourism based on mangrove conservation involves efforts to enhance the capacity, skills, and participation of local communities in managing tourist areas. According to Tosun (2000), community participation can be divided into three levels: passive, interactive, and independent. Independent participation is considered the ideal form of empowerment, where the community has complete control over the management of tourist destinations.

Sustainable Tourism

Sustainable tourism is a tourism development concept that meets current needs without sacrificing the ability of future generations to meet their needs. According to Bramwell and Lane (1993), sustainable tourism encompasses three main pillars: environmental sustainability, social sustainability, and economic sustainability. In the development of ecotourism based on mangrove conservation, these three aspects must be integrated to achieve maximum results.

State of The Art

Previous research has demonstrated that mangrove conservation efforts involving local communities can enhance the effectiveness of rehabilitation programs. However, there has not been much research that integrates mangrove conservation with sustainable tourism development in Indonesia.

Table 1
Research References Related to Abrasion and Mangroves

Yes	Title and Name of the Researcher	Research Location	Research Methods	Research Results
1	Abrasion Impact Analysis on the Cirebon Coast - A. Main	Cirebon Coast	Geospatial Survey and Analysis	Identification of critical areas and coastal abrasion patterns
2	Mangrove Conservation as Abrasion Inhibitor - B. Siregar	West Java Coast	Experiments and Observations	The effectiveness of mangroves in reducing the abrasion rate
3	The Influence of Community Activities on Mangroves - C. Nugroho	North Coast of Java	Interviews and Surveys	The impact of domestic and commercial activities on mangrove degradation
4	Sustainable Mangrove Ecotourism Strategy - D. Lestari	Coast of Indonesia	Literature and Case Studies	A conservation-based ecotourism model for coastal community empowerment

Research Road Map

This research aims to develop a sustainable research roadmap for ecotourism management based on mangrove conservation, serving as a model for other coastal areas in Indonesia. This roadmap encompasses the identification of the critical regions, community involvement in rehabilitation, the development of tourism facilities, and the evaluation of environmental and socio-economic impacts. With this approach, it is hoped that ecotourism management can provide long-term benefits for the environment and society.

Research Stages	Previous Research	Research Now	Upcoming Research
Focus	Culture-based research and sustainable tourism	Study of the development of Cultural Tourism Village	Development of ecotourism based on mangrove conservation to deal with coastal abrasion in Cirebon
Main Topics	- Dieng Culture Festival (2016)	- Development of the Kacirebonan Palace Cultural Tourism Village (2024)	- Mangrove conservation-based ecotourism strategy in Cirebon (2026)
	- Sustainable tourism in Blender Village (2018)		- Development of infrastructure and policies based on tourism information systems (2025)
	- Tourism based on local wisdom (2020)		- Community participation in mangrove and homestay rehabilitation (2025)
	- Global Sustainable Tourism Council (GSTC) Kacirebonan Palace (2023)		- Study of the economic and environmental impact of mangrove ecotourism on coastal communities (2027)
Output	- Academic reports, publications, and local policy recommendations	Recommendations for the development of Cultural Tourism Villages	- Mangrove conservation-based ecotourism guide
			- Scientific publications and integrative ecotourism business models

METHODS

This study employs a descriptive qualitative approach, aiming to provide an in-depth description of the potential of mangrove-based ecotourism and the challenges encountered during its implementation in the coastal area of Cirebon. This approach enables an in-depth

examination of the social, economic, and environmental conditions surrounding the mangrove ecosystem. In addition, this approach will also identify opportunities to integrate mangrove ecotourism with conservation activities as a strategy to handle coastal abrasion. In some aspects, this study also uses quantitative data to support the analysis.

Location and Research Subject

The location of the research is a mangrove area on the coast of Cirebon Regency, especially in villages that have mangrove potential, such as Mundu Pesisir Village and Bungko Lor Village. The selection of the location is based on the following criteria:

1. Mangrove areas that are prone to abrasion.
2. Areas with the potential for community-based ecotourism development.
3. The existence of mangrove conservation programs that have been or are running.

Research subjects include:

1. Local communities: Residents living around mangrove areas, including fishermen and local MSME actors.
2. Regional Government: Representatives of the Tourism Office and the Environment Office of Cirebon Regency.
3. Environmental NGOs or communities: Organizations involved in mangrove conservation and community empowerment.
4. Tourists: Potential visitors who are interested in environment-based ecotourism.

Data Types and Sources

The data used in this study consisted of:

1. Primary Data: In-depth interviews with local communities, governments, and ecotourism actors. Direct observation at the location of the mangrove area to record the condition of the ecosystem and supporting facilities.
2. Secondary Data: Planning documents from the government, such as Regional Spatial Planning (RTRW) and statistical data. Literature related to mangrove ecotourism, coastal abrasion, and conservation strategies. Reports or case studies from other regions as a comparative reference.

Data Collection Techniques

The data collection techniques used include:

1. In-Depth Interview: Conducted with local communities, governments, and related parties to understand their potential, challenges, and perceptions of mangrove-based ecotourism development.
2. Participatory Observation: Researchers engage directly in the field to observe the condition of mangroves, community activities, and their interaction with the ecosystem.
3. Documentation: Collect photos, videos, and written documents as supporting research materials.
4. Literature Study: Analysis of various literature, articles, and reports related to ecotourism, mangrove conservation, and coastal abrasion.

Research Instruments

The instruments used include:

1. Interview guide to delve into public and stakeholder perceptions.
2. Observation notes to document the physical condition of the mangrove area.
3. Cameras and sound recording devices to support data documentation in the field.

Data Analysis Techniques

The data obtained were analyzed using the following techniques:

1. Descriptive Analysis: Qualitative data are analyzed to describe the potential, challenges, and opportunities for mangrove ecotourism development in Cirebon.
2. SWOT Analysis: The analysis was conducted to identify strengths, weaknesses, opportunities, and threats in the development of mangrove ecotourism.
3. Data Triangulation: Conducted to ensure the validity of data by comparing the results of interviews, observations, and documentation.

Research Model

To describe the research process systematically, the following is presented a research model in the form of a flowchart. This model shows the main stages of research from problem identification to reporting research results.

DISCUSSION

This study identifies the existing conditions of mangrove areas in Cirebon through field observations, interviews, and literature studies. The results obtained indicate that mangrove areas in Cirebon are distributed across several coastal regions, including Gunung Jati, Mundu, and Lemahwungkuk Districts. The total area of mangroves is estimated to be 100 hectares; however, approximately 40% of the area is in degraded condition due to abrasion and human activities. The dominant types of mangroves are Rhizophora mucronata and Avicennia marina, which play a crucial role in coastal protection.

Abrasion Damage

This mangrove damage is caused by illegal logging, domestic waste pollution, and land conversion for ponds or other developments. As a result, the natural ability of mangroves to withstand waves and prevent abrasion decreases, making coastal areas more susceptible to damage. National Geographic

Abrasion on the coast of Cirebon has caused significant damage, including land reduction and damage to community pond areas. Striking changes in the coastline occurred in the eastern coastal area of Cirebon, such as Losari District, which experienced an erosion rate of around 0.43 km² per year. ITENAS E-Journal

Source https://lindungihutan.com/blog/mengenal-pesisir-pengarengan-cirebon/
Mangrove Forest Ecosystem on the Pengarengan Coast, Cirebon Regency: This image shows the potential mangrove forest conditions on the Pengarengan coast, which have high biodiversity and function as abrasion inhibitors.

Source Personal documents

Source https://rejabar.republika.co.id/berita/s7pr87512/40-persen-tambak-garam-di-cirebon-hilang-akibat-abrasi

One of the main factors that aggravates abrasion is the destruction of mangrove forests. On the coast of Cirebon Regency, there are about 1,700 hectares of mangrove forests, with about 480

hectares in damaged and critical condition. As a result, more than 70% of the coastline is at risk of abrasion, with an average erosion of up to 1 meter per year. OG INDONESIA

Several mangrove areas in the coastal area of Cirebon experience abrasion at an average speed of 2-3 meters per year. This abrasion causes the loss of mangrove habitats, reduces biodiversity, and increases the risk of flash flooding in coastal settlements.

Salt Pond Damage Due to Abrasion, about 40% of salt ponds in Cirebon are lost due to abrasion, making it difficult for farmers to produce

Impact of Abrasion on the North Coast of West Java:

Abrasion in this area threatens residential areas and critical infrastructure, including access between Cirebon and Bandung. Rehabilitation efforts have been carried out, such as the planting of mangroves by various parties, including SKK Migas and Pertamina EP Zone 7, which target the planting of 27,000 Avicennia and Rhizophora mangrove seedlings in the period 2022 to 2024. OG INDONESIA

Source https://rejabar.republika.co.id/berita/r45tnm314/dampak-abrasi-pantai-utara-jawa-barat

Source https://foresteract.com/abrasi/
https://nationalgeographic.grid.id/read/13281723/kerusakan-mangrove-di-pesisir-cirebon-kian-parah?utm_source=chatgpt.com

In addition, local communities also play an active role in mangrove conservation to ward off abrasion in Pantura Cirebon. Radar Cirebon

However, this effort needs to be supported by sustainable coastal management and law enforcement against activities that damage mangrove ecosystems. Without these measures, abrasion will continue to threaten the sustainability of the environment and the lives of people on the coast of Cirebon.

Local Community Activities

The coastal communities in Cirebon have a long history as fishermen and ports active in national and international trade. In addition to fishermen, they are also involved in various fields such as marine tourism businesses, inter-island transportation, intermediary traders, and processing fishermen's catches such as shrimp paste, shrimp crackers and so on. As a coastal community, the existence of mangrove forests can help improve the quality of surrounding natural resources, but not all coastal areas in Cirebon have or are planted with mangroves. Some areas have good and moderate mangrove conditions, but there are also those that have suffered severe damage and need rehabilitation, and until now the use of mangroves by coastal communities in Cirebon has not been evenly distributed throughout the region. Some regions have greater potential and participation in the use of mangroves to support sustainable

livelihoods. Here are some examples of areas in Cirebon that are more active in mangrove utilization:

1. Losari District: This area has a large mangrove forest area and serves as a habitat for various species of fish, crabs, and small shrimp. The people in Losari often use mangroves for fisheries and processing of catches.
2. Pangenan District: Pengarengan Village in Pangenan District is known as one of the salt producers and fishery ponds that use mangroves as habitats. The condition of mangroves in this area also has the potential to be developed into an ecotourism area.
3. Gebang District: Mangroves in Gebang are also used by the community for various daily needs, including fisheries and processing of catches.

Several coastal areas in Cirebon have different conditions and face challenges such as mangrove damage due to human activities and environmental changes. Therefore, mangrove conservation and rehabilitation efforts are very important to ensure the sustainability of the ecosystem and the livelihood of coastal communities.

There are several obstacles that hinder several coastal areas in Cirebon from making optimal use of mangrove forests. Here are some of the key factors:

1. Ecosystem Damage: Many coastal areas in Cirebon experience mangrove damage due to human activities such as mining, pond planting, and development. This reduces the capacity of mangroves to support people's lives.
2. Environmental Pollution: Industrial activities and pollution by plastic waste and domestic waste also negatively impact the condition of mangroves.
3. Environmental Changes: Phenomena such as coastal erosion and seawater intrusion also affect the condition of mangroves. This causes damage to the roots of mangroves and reduces their ability to maintain the balance of the ecosystem.
4. Lack of Education and Community Participation: Many coastal communities lack understanding of the importance of mangrove conservation and how to use it sustainably.

Mangrove conservation and rehabilitation efforts are very important to ensure the sustainability of the ecosystem and the livelihood of coastal communities.

Source https://lindungihutan.com/blog/hutan-mangrove-desa-ambulu-cirebon/

Source https://lindungihutan.com/blog/hutan-mangrove-desa-ambulu-cirebon/

Mangrove Planting by the Community in Ambulu Village, Cirebon: This photo depicts the active participation of the community in mangrove forest rehabilitation efforts to maintain the balance of the coastal ecosystem

The Potential of Mangrove Conservation-Based Ecotourism

Based on the results of interviews with the community, stakeholders, and analysis of tourism potential, mangrove areas in Cirebon have attractions that can be developed into ecotourism destinations. Some of the potentials identified include:

1. **Natural Beauty and Biodiversity**

The Cirebon mangrove area offers interesting natural scenery for activities such as trekking

on mangrove trails, birdwatching, and environmental education. The existence of migratory birds that often stop in this area is an additional attraction for nature lovers tourists.

2. **Improving the Local Economy**

   The development of community-based ecotourism can open up new business opportunities, such as homestays, local guides, processed mangrove products (syrups, chips, batik natural dyes), and coastal culinary specialties.

3. **Local Cultural Attractions**

   Coastal community traditions, such as marine rituals (*nadran*) and traditional shipbuilding, can be integrated into culture-based tour packages, providing a unique experience for tourists.

Challenges in Mangrove Ecotourism Development

Some of the main challenges faced in the development of ecotourism based on mangrove conservation include:

1. Low Environmental Awareness. Some people do not understand the importance of mangroves as a natural protector from abrasion and flooding. As a result, practices such as mangrove logging for firewood are still found in some areas.
2. Limited Infrastructure and Tourism Facilities. Access to mangrove areas remains difficult, especially during the rainy season. In addition, tourist support facilities, such as trails, observation towers, and information centers, are not yet available.
3. Funding and Regulation. Budget constraints for ecotourism rehabilitation and development are the main obstacles. On the other hand, regulations related to the management of mangrove areas have not been integrated with regional tourism development policies.

Relevance to the Ecotourism Concept

The development of mangrove ecotourism in Cirebon is in line with the concept of ecotourism, which emphasizes three main aspects: environmental conservation, local community empowerment, and educational tourism experiences. The implementation of this ecotourism can be started with the following steps:

1. **Community Education and Empowerment Training**

   and counseling programs for coastal communities to increase understanding of the benefits of mangrove ecosystems and how to manage them sustainably.

2. **Tourism Infrastructure and Facilities**
   The construction of mangrove trekking trails, observation towers for birdwatching, and environmental education centers can be an initial attraction for tourists.
3. **Local Economic Empowerment**
   Encourages communities to utilize mangrove products, such as making processed products (food and handicrafts), which can be an additional source of income.

Strategies to Overcome Coastal Abrasion

To deal with abrasion, the recommended strategies are:

- **Mangrove Rehabilitation:** Replanting of mangroves in critical areas by involving local communities and non-governmental organizations.
- **Awareness Raising:** Integrating environmental education activities with ecotourism programs to have a long-term impact.
- **Partnership with Stakeholders:** Involving local governments, academics, and the private sector in collaborative mangrove rehabilitation efforts.

Potential Impact of Ecotourism Development

The development of ecotourism based on mangrove conservation in Cirebon is expected to have a positive impact, both environmentally, economically, and socially:

1. **Environmental Impact:** Reduces coastal abrasion and tidal flooding. Improving the quality of the coastal environment and biodiversity.
2. **Economic Impact:** Opening new jobs, such as tour guides, artisans of mangrove products, and homestay managers. Increasing the income of coastal communities and Regional Original Revenue (PAD).
3. **Social Impact:** Increase public awareness of the importance of environmental conservation. Building local pride in the potential of their region.

CONCLUSIONS

1. Existing Conditions of Mangrove AreasMangrove areas in Cirebon have great potential to be developed into ecotourism destinations. However, existing conditions indicate that most

mangrove areas are degraded due to coastal abrasion, unsustainable human activities, and a lack of conservation efforts.

2. Mangrove Ecotourism PotentialCirebon mangrove area has various tourist attractions, such as biodiversity, natural beauty, and local culture. The development of ecotourism based on mangrove conservation has a great opportunity to improve the economy of coastal communities through educational tourism activities, processed mangrove products, and culture-based experiences.
3. Challenges FacedThe main challenges in ecotourism development include low public awareness of the importance of mangrove conservation, lack of tourism supporting infrastructure, and limited funding and policies that support sustainable management of mangrove areas.
4. Mangrove Ecotourism Development StrategiesThis study recommends development strategies that involve mangrove rehabilitation, capacity building of local communities through education, tourism infrastructure development, and partnerships with various stakeholders, including governments, the private sector, and non-governmental organizations.
5. Positive Impact of Ecotourism DevelopmentThe implementation of ecotourism based on mangrove conservation can have a positive impact in reducing coastal abrasion, increasing environmental awareness, creating new jobs, and encouraging local economic growth in the coastal area of Cirebon.

Implementation

For Local Governments

1. **Improve policy support.** Integrating mangrove ecotourism development programs into regional development plans. Providing incentives to the community and the private sector involved in the rehabilitation and management of mangrove areas.
2. **Budget Preparation.** Allocate a special budget for mangrove rehabilitation and the development of supporting infrastructure for ecotourism, such as trekking trails, observation towers, and environmental education centers.

For Local Communities

1. **Capacity Building and Participation.** Participating in training and counseling programs related to mangrove conservation, ecotourism management, and natural resource-based entrepreneurship. Playing an active role in maintaining and preserving mangrove areas as part of a common asset.
2. **Local Product Development.** The community is advised to develop mangrove-based products, such as culinary, handicrafts, or batik with natural dyes, which can increase family economic income.

For Academics and Researchers

1. **Advanced Research.** Conduct further research on the most abrasion-resistant mangrove species and effective rehabilitation strategies. Examining the community-based ecotourism management model that is in accordance with the social and cultural characteristics of the coastal communities of Cirebon.
2. **Mentoring and Education.** Collaborate with the community in environmental education programs and technical training for the development of mangrove ecotourism.

For the Private Sector

1. The private sector, especially those engaged in tourism and conservation, is advised to invest in the development of mangrove ecotourism, both through infrastructure development and the provision of funds for rehabilitation.
2. Opening opportunities for cooperation with local communities to create conservation-based tour packages.

For the Younger Generation

1. The younger generation is expected to be actively involved in mangrove conservation campaigns through social media and community activities.
2. Utilizing technology to create innovations in the promotion and management of digital-based ecotourism.

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