

## Implementing Good Environmental Governance to Manage Coastal Abrasion in Bengkalis Regency, Indonesia



Sylvina Rusadi<sup>1,2\*</sup> , Rahman Mulyawan<sup>1</sup> , Utang Suwaryo<sup>1</sup> , Neneng Yani Yuningsih<sup>1</sup> 

<sup>1</sup> Doctoral Program in Administrative Studies, Universitas Padjadjaran, Bandung 45363, Indonesia

<sup>2</sup> Department of Government Science, Universitas Islam Riau, Riau 28284, Indonesia

Corresponding Author Email: [sylvinarusadi@soc.uir.ac.id](mailto:sylvinarusadi@soc.uir.ac.id)

Copyright: ©2024 The authors. This article is published by IIETA and is licensed under the CC BY 4.0 license (<http://creativecommons.org/licenses/by/4.0/>).

<https://doi.org/10.18280/ijstdp.190529>

### ABSTRACT

**Received:** 10 July 2023

**Revised:** 10 January 2024

**Accepted:** 3 February 2024

**Available online:** 29 May 2024

#### Keywords:

*good environmental governance, coastal abrasion, sustainable development, risk management, environmental sustainability, coastal management, community participation, stakeholder engagement, regulatory framework*

This study aims to investigate the application of the principles of Good Environmental Governance (GEG) in handling beach abrasion in Bengkalis Regency. The research method used is a qualitative phenomenological approach. This research involves collecting in-depth and descriptive data through interviews with relevant stakeholders, such as local governments, environmental institutions, local communities and related experts. A phenomenological approach allows researchers to understand individual views and experiences regarding handling coastal erosion, as well as look for thematic patterns that emerge from the various narratives provided. The collected data was then analyzed using an analysis tool, namely Nvivo 12 Plus. The study results show that implementing Good Environmental Governance (GEG) in handling beach abrasion in Bengkalis Regency has great significance and urgency. GEG principles, such as a strong rule of law, active participation of all stakeholders, access to information, transparency, accountability, decentralization, and justice, provide a comprehensive framework for maintaining coastal environmental sustainability. The principles (GEG) are implemented through cross-sector collaboration, effective coordination between related parties, and increasing stakeholder awareness of environmental interests. Apart from that, the application of risk management is also an integral part of enabling rational and effective decision-making in managing coastal erosion. Barriers such as ineffective coordination, limited resources, low awareness, and conflicts of interest are highlighted, providing insight into the challenges in implementing GEG. The contribution of this research lies in providing an adapted framework for sustainable and equitable coastal management in Bengkalis Regency. Although valuable, this study has limitations, including the regional data focus and interview subjectivity. Future research should broaden the scope and explore socio-economic impacts and the role of technology in mitigating coastal abrasion.

## 1. INTRODUCTION

The urgency of handling coastal abrasion is critical and can be explained for several reasons, including that coastal abrasion can cause significant economic losses [1]. Damaged coastal areas can lead to the loss of property values and tourism revenues important to the local economy [2]. In addition, coastal abrasion can also threaten the sustainability of natural resources [3], such as fishery products and renewable energy potential, which can affect people's livelihoods [4]. In addition, coastal abrasion can also endanger human safety and welfare. Severe coastal erosion can cause landslides and collapse of buildings, resulting in loss of life and injury to residents [5].

In addition, coastal abrasion can also increase the risk of flooding [6], especially during high tides or sea storms, which can threaten the safety of residents and coastal infrastructure [7]. Cases of beach abrasion also occur in several regions in Indonesia [8], especially in Bengkalis Regency [9]. Beach abrasion in Bengkalis Regency is a severe problem that

requires proper handling. In the last 26 years, abrasion has occurred on Bengkalis Island with an average abrasion rate of 59 hectares (ha)/year and a sedimentation rate of 16.5 ha/year. This shows that Bengkalis Island has experienced a fairly large reduction in land area, namely an average of 42.5 ha/year [10]. Bengkalis Regency is located in Riau Province, Indonesia, and has a long coastline, including beaches prone to abrasion [11]. Handling coastal abrasion is essential because the impact can be felt economically, socially and environmentally [12].

Thus, handling coastal abrasion is essential to maintain environmental sustainability [13]. Healthy coastal ecosystems are essential in maintaining biodiversity, protecting coastlines from storm damage, and providing essential ecosystem services, such as food provision, carbon sequestration, and water filtration [14]. Proper abrasion handling can reduce environmental damage, allowing coastal ecosystems to continue functioning correctly and providing long-term benefits for humans. Considering the urgency of handling coastal abrasion, the government and society need to work together to implement effective countermeasures, including

wise coastal management, protection of coastal infrastructure, and restoration of damaged coastal ecosystems [15].

Effective coastal erosion management is closely related to Good Environmental Governance (GEG) [16]. GEG emphasizes the importance of involving all relevant stakeholders, including the government, local communities, environmental agencies and other related sectors. In handling coastal erosion, stakeholder involvement is essential to identify problems, develop solutions, and implement appropriate actions. In addition, GEG also emphasizes transparency and accountability in making decisions and implementing actions to deal with coastal abrasion. By ensuring information transparency, involving the public in the decision-making process, and carrying out accurate monitoring, policies that are accountable and follow the interests of the environment and society can be realized [17].

The principle of sustainable management is also essential in handling coastal erosion. GEG encourages management that considers social, economic and ecological aspects [18]. In this regard, strategies for ecosystem restoration and wise coastal management must be implemented to maintain the ecological balance of the coast while minimizing negative impacts on people and the environment. Furthermore, GEG also promotes law enforcement and compliance with relevant environmental regulations [19].

In handling coastal abrasion, law enforcement is needed to protect coastal areas from illegal practices that can exacerbate abrasion, such as excessive sand mining or development not following the rules [20]. With solid law enforcement and an effective monitoring system, coastal erosion can be handled sustainably and avoid actions detrimental to the environment. By incorporating GEG principles in handling coastal abrasion, a sustainable, fair framework can be created and produces optimal results for the environment and communities associated with coastal areas.

In the context of Bengkalis Regency, the application of Good Environmental Governance (GEG) principles in dealing with coastal erosion is very important, considering its impact involving the risk of flooding, especially during high tides or sea storms. The district has experienced coastal erosion at a significant rate, reducing its land area substantially in recent years. GEG is an important foundation in coastal erosion management, prioritizing stakeholder involvement, transparency of decisions, and law enforcement to protect coastal ecosystems and community interests. By integrating GEG principles, efforts to deal with coastal erosion can become more sustainable and provide optimal results for the environment and local communities.

This study explores the relationship between Good Environmental Governance (GEG) and the handling of beach abrasion in Bengkalis Regency. This research aims to analyse how applying GEG principles can contribute to the effective handling of coastal erosion in the region. Research questions to be answered in this context include: a) What is the level of abrasion vulnerability in Bengkalis Regency? b) What is the urgency of applying the GEG principle in handling beach abrasion in Bengkalis Regency? c) What are the obstacles to applying the GEG principle in handling beach abrasion in Bengkalis Regency?

To answer this question, this research uses a qualitative method with a phenomenological approach to explore the relationship between Good Environmental Governance (GEG) and handling coastal abrasion in Bengkalis Regency. The

phenomenological approach aims to understand individuals' subjective experiences and understanding regarding the observed phenomena, in this case, the handling of coastal erosion in Bengkalis Regency. In-depth and descriptive data was collected through interviews with relevant stakeholders, such as local governments, environmental institutions, local communities and related experts. Nvivo 12 Plus was used as an analytical tool to analyze interview data thematically, identifying thematic patterns and meanings that emerged from the interviews. A phenomenological approach allows researchers to understand individual views and experiences regarding handling coastal erosion and look for thematic patterns that emerge from the various narratives provided. Details of the method used will be explained in the next section.

## 2. METHOD

In this research, a qualitative method with a phenomenological approach is used, where interviews will be conducted with carefully selected informants, namely 14 informants. The sample will consist of a variety of stakeholders, including local governments, environmental agencies, local communities and relevant experts. The recruitment process will be carried out by considering inclusion and exclusion criteria. Inclusion criteria include informants who have knowledge and experience relevant to handling coastal erosion in Bengkalis Regency. In contrast, exclusion criteria may include informants who do not have direct involvement or sufficient understanding of the topic. The selection of informants will be carried out purposively to ensure a diversity of views and experiences regarding handling coastal erosion.

Interviews will be scheduled according to informant availability, and a phenomenological approach allows researchers to gain in-depth insight into individual perspectives and experiences regarding handling coastal erosion. The data collected will be analyzed thematically using Nvivo 12 Plus, enabling the identification of thematic patterns and meaning that emerge from the interviews. The findings of this research will provide in-depth insight into the contribution of Good Environmental Governance (GEG) in handling coastal erosion in the Bengkalis Regency. By understanding individual views and experiences regarding the application of GEG principles, this research can highlight key factors that support or hinder the effectiveness of GEG in the context of coastal abrasion management. From the research results, it is hoped that policy recommendations will emerge that can improve coastal management practices and strengthen GEG implementation, creating the basis for sustainable and optimal policies in protecting the coastal environment and the welfare of local communities.

## 3. RESULTS AND DISCUSSION

### 3.1 The level of abrasion susceptibility in Bengkalis Regency

Bengkalis Regency is an area with a high vulnerability to coastal abrasion. Its geographical location on the coast and directly affected by sea activity makes Bengkalis Regency vulnerable to coastal abrasion (see Table 1).

**Table 1.** Coastal abrasion vulnerability in Bengkalis Regency

Number	Location	Subdistrict	Abraded Beach Length (m)	Abrasion Rate per Year (m)	Abrasion Level
1	Muntai	Bantan	7.000	7	
2	Simpang Ayam	Bengkalis	6.000	7	
3	Pambang	Bantan	4.000	7	
4	Sepahat	Bukit Batu	4.500	6	
5	Tenggayun	Bukit Batu	3.000	5,5	
6	Kampung Tengah	Rupat	2.000	5,5	
7	Sungai Injap	Rupat	500	5,5	
8	Jangkang	Bantan	5.000	5	
9	Pasir Putih Desa Kadur	Rupat Utara	4.000	5	
<b>Amount</b>			<b>36.000</b>		<b>High</b>
10	Parit Lima Desa Bantan Air	Bantan	4.000	4	
11	Bantan Tengah	Bantan	3.000	4	
12	Tg Kudu Desa Bantan Air	Bantan	2.000	4	
13	Selat Baru	Bantan	2.000	4	
14	Tanjung Teguh	Rupat	2.000	3,5	
15	Teluk Lecah	Rupat	5.000	3	
16	Api-Api	Bukit Batu	1.500	3	
17	Pergam	Rupat	1.500	3	
18	Tanjung Medang	Rupat Utara	500	3	
<b>Amount</b>			<b>21.500</b>		<b>Medium</b>
19	Meskom	Bengkalis	500	2,5	
20	Makeruh	Rupat	4.000	2	
21	Pangkalan Nyerih	Rupat	3.000	2	
22	Teluk Rhu	Rupat Utara	2.000	2	
23	Tanjung Punak	Rupat Utara	2.000	2	
<b>Amount</b>			<b>11.500</b>		<b>Low</b>
<b>Total Length of Abraded Beach</b>			<b>69.000</b>		

Source: Environmental Service in Bengkalis Regency, 2022

From the data above, it can be seen that there are various levels of damage to the coastline of Bengkalis Regency. It can be seen that the fastest abrasion rate is located in 3 villages, namely Muntai Village, Bantan District, Simpang Ayam Village, Bengkalis District, Pambang Village, and Bantan District, which is 7 meters per year. The total length of 69,000 abrasion beaches is data that indicates a significant level of vulnerability to beach abrasion. This number reflects the extent to which the coastline is affected by erosion and beach degradation. Knowledge of the abrasion beach length is essential in planning and implementing effective beach abrasion countermeasures.

The 69,000-meter-long abrasive beach in Bengkalis Regency carries a significant risk. The following is an empirical description of the impact of abrasion seen in Figure 1.



**Figure 1.** Abrasion on Bengkalis Island

Loss of infrastructure is also one of the main risks, where coastal abrasion can damage roads, bridges and other structures along the coastline. The following documentation

found can be seen in Figure 2.



**Figure 2.** Abrasion on Bengkalis Island resulted in damage to infrastructure such as roads

The abrasion on Bengkalis Island has caused severe damage to the infrastructure, especially the roads around the island. Abrasion is the process of beach erosion or erosion caused by sea waves, tides, and other natural factors. Bengkalis Island, located in Riau Province, Indonesia, is vulnerable to abrasion impacts due to its position by the sea. The impact of abrasion on infrastructure, especially roads, is very significant. Strong and continuous sea waves hit the island's shoreline, gradually eroding the soil and sand. As a result, the roads built along the coast and close to the shoreline suffered severe damage. The road surface became uneven, cracked, and, in some cases, even destroyed.

Damage to roads on Bengkalis Island is not only a threat to local population mobility but also affects economic and social activities on the island. The damaged roads make accessibility difficult, especially for motorized vehicles. This impedes the movement of people and goods, including the activities of the

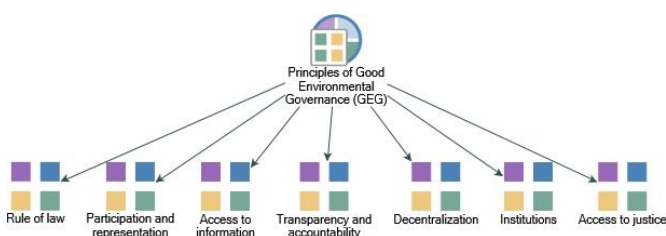
transportation and distribution of goods. In addition, the tourism sector on Bengkalis Island was also affected because the poor road conditions made tourists reluctant to visit.

In addition, ecosystem loss is also a severe impact, with coastal erosion threatening mangrove forests, coral reefs and coastal biodiversity. Social and economic impacts also occur, considering settlements and community livelihoods around the coastline are more vulnerable to natural disasters and seawater intrusion. Conflicts of interest and changes in coastal spatial planning can also arise due to abrasion of the length of the beach. To reduce these risks, effective coastal abrasion management measures are needed.

By taking into account the size of the affected area, coastal protection and rehabilitation efforts can also be directed to the areas most in need, as well as minimizing negative impacts on coastal infrastructure and ecosystems. With a better understanding of the length of the abrasive beach, Bengkalis Regency can develop appropriate strategies to protect the coastline and maintain the overall sustainability of the coastal environment. From the data above, there is a need for fast handling to overcome the abrasion problem on the coast of Bengkalis Island because, of course, it will have a broad impact on the lives of the surrounding community.

### 3.2 The urgency of applying the GEG principle in handling beach abrasion in Bengkalis Regency

Applying the principles of Good Environmental Governance (GEG) in handling coastal abrasion in Bengkalis Regency is essential in maintaining the coastal environment's sustainability. GEG is an approach that aims to create good environmental governance, which involves the active participation of all stakeholders, transparency, accountability, fairness and sustainability in decision-making and implementation of policies related to the environment [21]. The GEG principle mapping is explained as follows in Figure 3.



**Figure 3.** Principles of Good Environmental Governance (GEG) in handling beach abrasion in Bengkalis Regency

Good Environmental Governance (GEG) includes several essential principles that are much needed for effective environmental management. These principles include the rule of law, participation and representation, access to information, transparency and accountability, decentralization, institutions and organizations, and access to justice [22]. The rule of law emphasizes the need for a clear and effective legal framework to regulate environmental protection. Participation and representation highlight the importance of involving all stakeholders in decision-making and considering multiple perspectives. In addition, access to information is needed to ensure the availability of relevant environmental information openly and transparently shared.

Transparency and accountability are also essential to encourage responsible decision-making and enable better

monitoring of environmental policies. Another crucial aspect is decentralization, which includes delegating authority and responsibility to local governments and communities in environmental management. Institutions and organizations have an essential role in providing a practical framework for implementing environmental policies and actions and coordination between sectors and levels of government. Finally, access to justice guarantees fair access for people to seek justice if they are negatively affected by environmental policies or actions. These principles collectively promote sustainable and inclusive environmental management practices, facilitate collaboration, and protect the well-being of both ecosystems and society.

Applying the principles of Good Environmental Governance (GEG) in handling coastal erosion in Bengkalis Regency is very relevant and essential. In handling coastal abrasion, the GEG principle can provide a comprehensive framework for dealing with this problem sustainably and equitably. Applying the principle of the rule of law in handling coastal erosion in Bengkalis Regency ensures a clear legal framework to regulate coastal protection activities. Proper regulation will protect the beach from illegal practices that can exacerbate abrasion, such as excessive sand mining or inappropriate development.

Participation and representation are essential in involving all relevant stakeholders, such as local governments, environmental agencies, local communities and other related sectors, in making decisions and implementing policies for handling coastal erosion. Their active participation allows the handling of coastal erosion based on a more comprehensive understanding and considering the various interests. Access to information and transparency in handling coastal erosion also allows all stakeholders to obtain clear and easy-to-understand information about beach erosion issues and related policies. Transparent information enables effective participation, evidence-based decision-making, and accurate monitoring of the implementation of coastal erosion management policies.

Accountability in handling coastal abrasion ensures that decisions and related actions can be accounted for by those who are responsible. Through strong accountability, the implementation of coastal erosion management policies can be monitored effectively, and violators can be prosecuted according to applicable law. In addition, applying the principle of decentralization can involve local governments and local communities in making decisions regarding the handling of coastal erosion. This enables more relevant decision-making to local conditions and involves communities directly in decision-making processes that affect their environment.

In this case, solid institutions and institutions support effectively handling coastal erosion. Adequate institutions provide a framework for implementing policies and actions to deal with coastal erosion and ensure good coordination between various sectors and levels of government. Finally, the principle of access to justice ensures fair access for people to seek justice if they are negatively affected by policies or actions to deal with coastal erosion. Communities must have access to an effective and accessible justice system to resolve environmental disputes and fight for their rights related to coastal erosion. By applying the principles of GEG in handling beach abrasion in Bengkalis Regency, it is hoped that a holistic framework will be created, involving all relevant stakeholders, ensuring transparency and accountability, and maintaining fairness and sustainability in decision-making and policy implementation related to handling beach abrasion in the



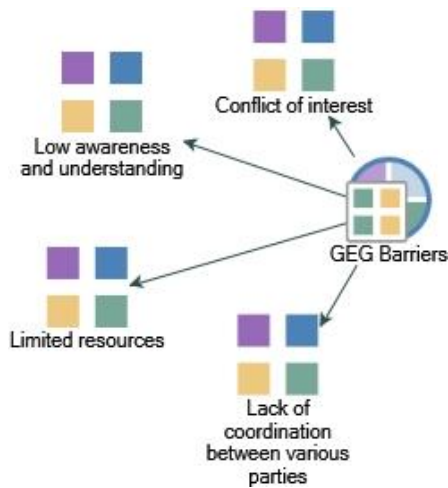
Bengkalis Regency.

In general, this can also be observed from one informant who stated that "As part of a coastal community, we feel it is important to be involved in decision making regarding handling coastal erosion. Through active participation, we can provide insight into local conditions and ensure implemented policies take into account environmental needs and sustainability." (Interview, 2023).

Based on the results of interviews with stakeholders in Bengkulu Regency, the application of Good Environmental Governance (GEG) principles is very relevant in handling coastal erosion. Informants emphasized the importance of active participation from coastal communities in decision-making regarding handling coastal erosion, in line with GEG's principles of participation and representation. Through this participation, local conditions can be better understood, and policies implemented can better take into account environmental needs and sustainability. Apart from that, informants also reflected the importance of open and transparent access to information related to coastal erosion in accordance with GEG's information access principles. Thus, the results of the interviews provide concrete support for the application of GEG principles in holistic efforts to handle coastal erosion in the Bengkulu Regency.

### 3.3 Bengkulu Barriers to the application of the GEG principle in handling beach abrasion in Bengkulu Regency

Despite the importance of applying the principles of Good Environmental Governance (GEG) in handling beach abrasion in Bengkulu Regency, several barriers can hinder its effective implementation. Some of the identified obstacles are outlined in Figure 4.



**Figure 4.** Barriers to implementing Good Environmental Governance (GEG) in handling beach abrasion in Bengkulu Regency

These obstacles need to be considered so that handling steps can be faced and overcome correctly. One of the obstacles faced is the need for coordination between various related parties. Handling coastal erosion requires cooperation and synergy between local governments, environmental agencies, communities, and other sectors [23]. With effective coordination, implementing the GEG principles may be improved and avoid misalignment in decision-making and response actions.

Furthermore, limited resources in finance, human

resources, and infrastructure are also obstacles to implementing the GEG principle. Handling coastal abrasion requires significant investment in terms of technology [24], monitoring [25], ecosystem rehabilitation [26], as well as increasing human resource capacity [27]. With adequate resources, it may be easier to implement the GEG principle in handling coastal abrasion optimally. In addition, low awareness and understanding of the importance of GEG principles is also an obstacle that needs to be overcome. Stakeholders in handling coastal erosion, including local governments, environmental agencies and communities, may need to fully understand the benefits and implications of applying the GEG principle. Appropriate education, training and awareness campaigns are needed to increase this awareness and understanding.

In addition, conflicting interests and conflicts between various stakeholders can also hinder applying the GEG principle. There are different interests between the economic, environmental and local community sectors in handling coastal erosion. Conflict resolution and the search for balance between these different interests are challenges that need to be faced to apply the GEG principles effectively. By understanding these obstacles, strategic steps can be taken to overcome them and ensure the practical application of the GEG principles in handling coastal erosion in the Bengkulu Regency. Thus, efforts to deal with coastal abrasion can be carried out sustainably and provide optimal benefits for the environment and local communities.

Addressing these barriers requires a collaborative effort involving all relevant stakeholders, including local government, environmental agencies, local communities, the private sector, and civil society [28]. Relevant stakeholders should work together to identify the root causes of beach erosion in the affected areas. This can involve environmental studies, coastal mapping, and analysis of factors influencing abrasion [29]. Stakeholders must also share the information and knowledge they have about beach abrasion. This includes coastal data, research results, and local experiences that can provide better insight into the problem and possible solutions. In addition, the parties involved must also work together to develop a comprehensive strategic plan for handling coastal abrasion. This plan should cover coastal protection, restoration, and management [30].

Another important aspect, namely through education, training, and raising awareness about coastal abrasion and the importance of applying the GEG principle, is also crucial. Education and training on environmental issues are critical because they provide a deep understanding, spread awareness, and prepare individuals to take environmentally responsible actions [31]. Through education and training on environmental issues, communities and governments can understand the importance of maintaining a healthy environment, adopting sustainable practices, and participating in collective environmental protection efforts [32]. This is essential for creating a sustainable future for future generations.

In addition, it is necessary to overcome conflicts of interest that may arise. Conflict of interest in sustainable environmental management is a common challenge due to different goals, values and needs between various stakeholders [33]. Creating a space for open dialogue and effective communication between all relevant stakeholders is essential [34]. This includes active listening, sharing clear and accurate information, and establishing open and transparent communication channels [35]. Good dialogue helps identify

differences in interests, find points of common ground, and reach a common understanding.

In difficult conflict situations, mediation and negotiation can be practical tools to reach an acceptable agreement for all parties [36]. A neutral and trained mediator can assist in identifying problems, exploring underlying interests and finding solutions that meet the needs of all stakeholders. It is important to remember that addressing conflicts of interest in environmental management is complex and requires commitment from all concerned. Collaborative approaches, effective communication, participation, and a better understanding of environmental issues are the keys to achieving sustainable solutions and maintaining a balance between different interests [37]. By overcoming these obstacles, applying the GEG principle in handling coastal abrasion can become more effective and sustainable.

In addition, this study explores another essential aspect needed in implementing Good Environmental Governance (GEG) related to handling beach abrasion in the Bengkalis Regency, namely risk management. Risk management is another crucial aspect in implementing Good Environmental Governance (GEG) in handling beach abrasion in Bengkalis Regency. The risk management approach enables more effective and rational decision-making in managing coastal erosion by considering the associated risk level [38].

Risk management involves identifying, assessing, and managing risks associated with coastal abrasion [39]. Risk identification involves identifying the potential hazards and vulnerabilities associated with coastal abrasion, such as erosion rates, infrastructure losses, and ecological impacts. Risk assessment involves determining the risk level by considering the likelihood of the risk occurring and the resulting impact. Risk management involves developing strategies and mitigation measures to reduce the identified risks.

Risk management in the context of handling coastal erosion in Bengkalis Regency has specific relevance to the application of the principles of Good Environmental Governance (GEG). In facing the challenge of coastal erosion, risk management enables the identification, assessment and management of associated risks, such as coastal erosion, infrastructure loss and ecological impacts. By detailing potential hazards and vulnerabilities, response actions can be developed to mitigate the identified risks. Implementing risk management also produces more effective and rational decisions, ensuring transparency in the decision-making process. Specifically, the benefits include more optimal resource allocation, better prioritization of coastal erosion mitigation, and reduced negative impacts on the coastal environment and local communities. Thus, the integration of risk management with GEG principles not only increases environmental resilience to coastal erosion but also encourages policies that are more sustainable and support the interests of all stakeholders.

Considerations regarding the integration of risk management with the application of Good Environmental Governance (GEG) principles in managing coastal erosion in Bengkalis Regency can be a proactive step recognized by all parties involved. By incorporating a risk management approach into the GEG framework, parties involved can plan a more targeted response to the risk of coastal erosion, maintaining a balance between environmental needs and community interests. Benefits that can be felt include increased resilience to negative impacts, more efficient resource allocation, and broader community involvement in

decision-making processes. By considering these benefits, the parties involved can jointly achieve sustainable solutions and actively involve the community in protecting the Bengkalis coast, creating long-term positive impacts on the environment and local communities.

The implementation of integrated risk management with the principles of Good Environmental Governance (GEG) in managing coastal erosion in Bengkalis Regency has the potential to have a significant positive impact. Involving related parties in efforts to identify, assess and manage risks transparently and inclusively can increase coastal resilience to abrasion. Using GEG as a guide in managing risks ensures fairness, community participation and accountability in environmental decision-making. Additionally, by prioritizing actions based on risk level, resources can be allocated more effectively, increasing the efficiency of coastal abrasion mitigation programs. It also creates opportunities to strengthen community engagement, raise awareness of environmental risks, and create a positive impact on environmental sustainability and the lives of local communities. Thus, the integration of risk management with GEG principles can create a holistic and sustainable framework for dealing with coastal abrasion challenges in the Bengkalis Regency.

The findings of this study provide in-depth insight into the research questions posed. First, regarding the level of abrasion vulnerability in Bengkalis Regency, the data in Table 1 illustrates a significant level of vulnerability, especially with the highest abrasion rates in several locations, such as Muntai, Simpang Ayam, and Pambang. The total length of the coast affected by abrasion is 69,000 meters, reflecting a serious level of vulnerability. From this, measures to deal with coastal abrasion need to be implemented immediately to protect the coastal environment and local communities.

Second, the urgency of implementing the principles of Good Environmental Governance (GEG) in handling coastal erosion in Bengkalis Regency has been made very clear. Data analysis shows that the application of GEG principles can provide a comprehensive and sustainable framework for dealing with coastal erosion. GEG principles, such as participation, transparency, accountability and access to information, prove relevant and important in this context. By connecting the research findings with informant interviews, active participation in coastal communities and open access to information are key elements in implementing GEG principles.

However, a number of obstacles were identified in implementing GEG principles in the Bengkalis Regency, as depicted in Figure 4. These obstacles involve ineffective coordination, limited resources, and conflicts of interest. In closing, these overall findings underline the urgency of applying GEG principles in overcoming the problem of coastal erosion while also identifying challenges that must be overcome so that the implementation of GEG principles can achieve optimal results. With a better understanding of local conditions and the needs of coastal communities, actions to deal with coastal erosion can be more focused, fair and sustainable in Bengkalis Regency.

The implications of the findings in handling coastal erosion in Bengkalis Regency have a significant impact on interested parties, both practically and academically. For local governments, active and effective involvement of all relevant parties, including local governments, environmental institutions, local communities, the private sector and civil society, is the key to overcoming obstacles and ensuring sustainable management of coastal erosion. Academically,

these findings provide in-depth insight into the implementation of Good Environmental Governance (GEG) principles in a concrete context, enriching knowledge about coastal environmental management. In practical terms, the integration of risk management in the implementation of GEG provides a stronger basis for decision-making in handling coastal erosion, with the potential to provide long-term benefits for the coastal environment and the welfare of local communities.

This study has several limitations that need to be considered in interpreting and generalizing the findings. First, data on beach erosion in Bengkalis Regency may only partially cover the diversity of beach conditions in this region, given the limited resources and scale of research. In addition, there is potential for bias in the interview data because the informants' subjective perceptions and interpretations may influence the results. Despite efforts to mitigate potential bias by involving multiple stakeholders, subjective interpretation remains a factor influencing the validity of the findings. Limitations of the interview data may also arise from the level of diversity in respondents' knowledge and understanding regarding environmental issues and GEG. Therefore, while the findings of this study provide valuable insights, generalizations should be made with caution, and the results should be considered as initial guidance for similar contexts in the future.

#### 4. CONCLUSIONS

The findings of this research answer three crucial research questions related to coastal erosion in the Bengkalis Regency. First, through research on the level of abrasion susceptibility, it is known that the total length of the coast that has been abrasion in the area is 69,000 meters, with varying levels classified as high, medium and low. In particular, areas such as Muntai Village, Simpang Ayam Village, and Pambang Village experienced the fastest abrasion rate of 7 meters per year. Second, in assessing the urgency of implementing the GEG principles, it is evident that the implementation of these principles is very important for sustainable coastal management. The research details how the GEG principles, including strong law enforcement, active participation of all parties, access to information, transparency, accountability, decentralization, and justice, can provide a comprehensive framework for handling coastal erosion in the Bengkalis Regency. Finally, by exploring barriers to GEG implementation, this research highlights challenges such as coordination problems, limited resources, low levels of awareness, and conflicts of interest among stakeholders.

The research findings emphasize the importance of applying GEG principles in managing coastal erosion. Specifically, this research contributes by emphasizing the urgency of active community participation, transparent decision-making, and the formation of strong institutions. The identified barriers provide insight into the challenges that need to be overcome to make GEG principles more effective in the context of the Bengkalis Regency. The significance of this research lies in offering a tailored framework for sustainable and equitable coastal management, taking into account the specific conditions and challenges of the region.

Despite its contributions, this study has limitations that need to be acknowledged. The regional focus of the data may not capture the full diversity of coastal conditions, and the subjective nature of the interviews introduces the potential for

bias. Future research should explore a variety of coastal environments in the region and consider additional data sources to increase the power of the study. Additionally, further investigation into the socio-economic impacts of coastal erosion and the potential role of emerging technologies in mitigation efforts could provide valuable insights.

#### REFERENCES

- [1] Alexandrakis, G., Manasakis, C., Kampanis, N.A. (2015). Valuating the effects of beach erosion to tourism revenue. A management perspective. *Ocean and Coastal Management*, 111: 1-11. <https://doi.org/10.1016/j.ocecoaman.2015.04.001>
- [2] Scott, D., Simpson, M.C., Sim, R. (2012). The vulnerability of Caribbean coastal tourism to scenarios of climate change related sea level rise. *Journal of Sustainable Tourism*, 20(6): 883-898. <https://doi.org/10.1080/09669582.2012.699063>
- [3] Hossain, M.S., Gain, A.K., Rogers, K.G. (2020). Sustainable coastal social-ecological systems: how do we define "coastal"? *International Journal of Sustainable Development and World Ecology*, 27(7): 577-582. <https://doi.org/10.1080/13504509.2020.1789775>
- [4] Sampantamit, T., Ho, L., Echelpoel, W. Van, Lachat, C., Goethals, P. (2020). Links and trade-offs between fisheries and environmental protection in relation to the sustainable development goals in Thailand. *Water*, 12(2): 399. <https://doi.org/10.3390/w12020399>
- [5] Ruslan, N.F.N., Goh, H.C., Hattam, C., Edwards-Jones, A., Moh, H.H. (2022). Mangrove ecosystem services: Contribution to the well-being of the coastal communities in Klang Islands. *Marine Policy*, 144: 105222. <https://doi.org/10.1016/j.marpol.2022.105222>
- [6] Alves, B., Angnuureng, D.B., Morand, P., Almar, R. (2020). A review on coastal erosion and flooding risks and best management practices in West Africa: What has been done and should be done. *Journal of Coastal Conservation*, 24(3): 1-22. <https://doi.org/10.1007/s11852-020-00755-7>
- [7] Antunes do Carmo, J.S. (2019). The changing paradigm of coastal management: The Portuguese case. *Science of the Total Environment*, 695: 133807. <https://doi.org/10.1016/j.scitotenv.2019.133807>
- [8] Marfai, M.A., Winastuti, R., Wicaksono, A., Mutaqin, B.W. (2022). Coastal morphodynamic analysis in Buleleng Regency, Bali—Indonesia. *Natural Hazards*, 111(1): 995-1017. <https://doi.org/10.1007/s11069-021-05088-8>
- [9] Tampubolon, H. (2022). Shoreline change cause of abrasion in Bantan district bengkalis island as the outstanding beach area. *Lecture Notes in Civil Engineering*. [https://doi.org/10.1007/978-981-16-7949-0\\_4](https://doi.org/10.1007/978-981-16-7949-0_4)
- [10] Sutikno, S. (2014). Analisis laju abrasi pantai pulau bengkalis dengan menggunakan data satelit. *Pertemuan Ilmiah Tahunan (PIT) HATHI (Himpunan Ahli Teknik Hidraulik Indonesia)*, 22-24.
- [11] Purwanto, W., Hidayat, R., Ajar, S.B. (2022). Disaster management effort in peatland and coastal areas through cross sectoral collaboration, case study in Bukit Batu District, Bengkalis Regency, Riau Province. *IOP Conference Series: Earth and Environmental Science*,

- 986(1): 012018. <https://doi.org/10.1088/1755-1315/986/1/012018>
- [12] Balica, S.F., Wright, N.G., van der Meulen, F. (2012). A flood vulnerability index for coastal cities and its use in assessing climate change impacts. *Natural Hazards*, 64. <https://doi.org/10.1007/s11069-012-0234-1>
- [13] Rostika, R., Purba, N. P., Lutfi, M., Kelvin, J., Silalahi, I. (2016). The managing plan for abrasion in coastal area of garut regency. *Procedia Environmental Sciences*, 33: 512-519. <https://doi.org/10.1016/j.proenv.2016.03.104>
- [14] Sutton-Grier, A.E., Sandifer, P.A. (2019). Conservation of wetlands and other coastal ecosystems: A commentary on their value to protect biodiversity, reduce disaster impacts, and promote human health and well-being. *Wetlands*, 39(6): 1295-1302. <https://doi.org/10.1007/s13157-018-1039-0>
- [15] Hyun Kang, Y., Dieperink, C., Hegger, D. (2022). Policy translation and dynamics: The role of Dutch ideas in developing South Korea's coastal management policies. *Ocean and Coastal Management*, 221: 106102. <https://doi.org/10.1016/j.ocecoaman.2022.106102>
- [16] Armitage, D., De Loë, R., Plummer, R. (2012). Environmental governance and its implications for conservation practice. *Conservation Letters*, 5(4): 245-255. <https://doi.org/10.1111/j.1755-263X.2012.00238.x>
- [17] Gale, F. (2008). Tasmania's Tamar valley pulp mill: A comparison of planning processes using a good environmental governance framework: Research and evaluation. *Australian Journal of Public Administration*, 67(3): 261-282. <https://doi.org/10.1111/j.1467-8500.2008.00586.x>
- [18] Albitar, K., Borgi, H., Khan, M., Zahra, A. (2022). Business environmental innovation and CO2 emissions: The moderating role of environmental governance. *Business Strategy and the Environment*, 32: 1996-2007. <https://doi.org/10.1002/bse.3232>
- [19] Purniawati, P., Kasana, N., Rodiyah, R. (2020). Good environmental governance in Indonesia (Perspective of environmental protection and management). *The Indonesian Journal of International Clinical Legal Education*, 2(1): 43-56. <https://doi.org/10.15294/ijicle.v2i1.37328>
- [20] Filho, W.L., Hunt, J., Lingos, A., Platje, J., Vieira, L.W., Will, M., Gavriletea, M.D. (2021). The unsustainable use of sand: Reporting on a global problem. *Sustainability*, 13(6): 1-16. <https://doi.org/10.3390/su13063356>
- [21] Li, W., Puppim de Oliveira, J.A. (2021). Environmental governance for sustainable development in Asia. *Journal of Environmental Management*, 290: 112622. <https://doi.org/10.1016/j.jenvman.2021.112622>
- [22] Belbase, N. (2010). Environmental good governance in the future constitution of Nepal. Nepal: IUCN. [http://cmsdata.iucn.org/downloads/environmental\\_good\\_governance\\_in\\_the\\_future\\_constitution\\_of\\_nepal.pdf](http://cmsdata.iucn.org/downloads/environmental_good_governance_in_the_future_constitution_of_nepal.pdf).
- [23] Nitivattananon, V., Srinonil, S. (2019). Enhancing coastal areas governance for sustainable tourism in the context of urbanization and climate change in eastern Thailand. *Advances in Climate Change Research*, 10(1): 47-58. <https://doi.org/10.1016/j.accre.2019.03.003>
- [24] Klein, R.J.T., Nicholls, R.J., Ragoonaden, S., Capobianco, M., Aston, J., Buckley, E.N. (2001). Technological options for adaptation to climate change in coastal zones. *Journal of Coastal Research*, 17(3): 531-543.
- [25] Kerguillec, R., Audère, M., Baltzer, A., et al. (2019). Monitoring and management of coastal hazards: Creation of a regional observatory of coastal erosion and storm surges in the pays de la Loire region (Atlantic coast, France). *Ocean and Coastal Management*, 181: 104904. <https://doi.org/10.1016/j.ocecoaman.2019.104904>
- [26] Winterwerp, J.C., Albers, T., Anthony, E.J., et al. (2020). Managing erosion of mangrove-mud coasts with permeable dams-lessons learned. *Ecological Engineering*, 158: 106078. <https://doi.org/10.1016/j.ecoleng.2020.106078>
- [27] Gomez, M.L.A., Adelegan, O.J., Ntajal, J., Trawally, D. (2020). Vulnerability to coastal erosion in The Gambia: Empirical experience from Gunjur. *International Journal of Disaster Risk Reduction*, 45: 101439. <https://doi.org/10.1016/j.ijdr.2019.101439>
- [28] Beunen, R., Patterson, J.J. (2019). Analysing institutional change in environmental governance: Exploring the concept of 'institutional work.' *Journal of Environmental Planning and Management*, 62(1): 12-29. <https://doi.org/10.1080/09640568.2016.1257423>
- [29] Arefiev, N., Badenko, V., Nikonorov, A., Terleev, V., Volkova, Y. (2015). Bank protection on storage reservoirs for municipal coastal areas. *Procedia Engineering*, 117(1): 20-25. <https://doi.org/10.1016/j.proeng.2015.08.118>
- [30] Gracia, A., Rangel-Buitrago, N., Oakley, J.A., Williams, A.T. (2018). Use of ecosystems in coastal erosion management. *Ocean and Coastal Management*, 156: 277-289. <https://doi.org/10.1016/j.ocecoaman.2017.07.009>
- [31] Le Roux, C., Ferreira, J.G. (2005). Enhancing environmental education teaching skills through in-service education and training. *Journal of Education for Teaching*, 31(1): 3-14. <https://doi.org/10.1080/02607470500043516>
- [32] Ngotho, M., Fincham, R., Quinn, N. (2004). Government, business and the public: The role of environmental education in creating sustainable urban places. *Environmental Education Research*, 10(3): 313-329. <https://doi.org/10.1080/1350462042000258161>
- [33] De Wit, M.P., Crookes, D.J., Van Wilgen, B.W. (2001). Conflicts of interest in environmental management: Estimating the costs and benefits of a tree invasion. *Biological Invasions*, 3(2): 167-178. <https://doi.org/10.1023/A:1014563702261>
- [34] Ibrahim, A.H.H., Baharuddin, T., Wance, M. (2023). Developing a forest city in a new capital city: A thematic analysis of the Indonesian government's plans. *Jurnal Bina Praja*, 15(1): 1-13. <https://doi.org/10.21787/jbp.15.2023.1-13>
- [35] Lestaluhu, S., Baharuddin, T., Wance, M. (2023). Indonesian policy campaign for electric vehicles to tackle climate change: Maximizing social media. *International Journal of Sustainable Development and Planning*, 18(8): 2547-2553. <https://doi.org/https://doi.org/10.18280/ijstdp.180826>
- [36] Janssen, M.A., Goosen, H., Omtzigt, N. (2006). A simple mediation and negotiation support tool for water management in the Netherlands. *Landscape and Urban Planning*, 78(1-2): 71-84. <https://doi.org/10.1016/j.landurbplan.2005.05.005>
- [37] Malik, I., Prianto, A.L., Roni, N.I., Yama, A., Baharuddin, T. (2023). Multi-level governance and digitalization in climate change: A bibliometric analysis.



International Conference on Digital Technologies and Applications, pp. 95-104.

[38] Jozaei, J., Mitchell, M., Clement, S. (2010). Using a resilience thinking approach to improve coastal governance responses to complexity and uncertainty: A Tasmanian case study, Australia. *Journal of Environmental Management*, 253: 109662.

<https://doi.org/https://doi.org/10.1016/j.jenvman.2019.109662>

[39] Rangel-Buitrago, N., Neal, W.J., de Jonge, V.N. (2020). Risk assessment as tool for coastal erosion management. *Ocean and Coastal Management*, 186: 105099. <https://doi.org/10.1016/j.ocecoaman.2020.105099>