

Adaptive Tourism Management Strategies for Nature-Based Destinations in Ecological Disaster Mitigation: Evidence from Sibolga, Indonesia.

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Abstract-This study aims to analyze adaptive tourism management strategies in ecological disaster mitigation for nature-based tourism destinations in Sibolga, Indonesia. A case study approach was applied using qualitative methods supported by descriptive quantitative data collected through interviews, focus group discussions, field observations, and policy document analysis. The findings indicate that policy flexibility, stakeholder collaboration, and institutional learning have been partially implemented as adaptive practices, although the integration of ecological risk into destination planning remains weak. Adaptive tourism management plays a critical role in risk reduction and destination preparedness. The study concludes that embedding adaptive management within everyday destination governance can significantly enhance destination resilience to ecological pressures and support the long-term sustainability of coastal tourism.

Keywords: Adaptive tourism management; ecological disaster mitigation; nature-based tourism destinations; destination resilience; coastal tourism.

I. INTRODUCTION

Natural tourism destinations are currently facing increasingly complex challenges due to the increasing frequency and intensity of ecological disasters triggered by climate change, environmental degradation, and unsustainable tourism management. Nature-based tourism areas, especially coastal and marine areas, are particularly vulnerable to ecological risks such as coastal abrasion, flash flooding, degradation of marine ecosystems, and declining environmental carrying capacity. Previous studies have highlighted that climate change and anthropogenic pressures significantly increase the vulnerability of coastal tourism systems, especially in developing countries where governance capacity is often limited [1], [2].

Empirical evidence also indicates that most natural tourism destinations are located in disaster-prone zones and remain inadequately prepared to integrate ecological risk mitigation into tourism planning and management practices [3] [4]. This condition not only threatens environmental sustainability, but also has a direct impact on the sustainability of the tourism industry and the welfare of the local communities that depend on the sector. Therefore, tourism management needs to be directed at an adaptive approach that is able to integrate

destination development goals with ecological disaster mitigation efforts systematically.[1]

Indonesia as an archipelagic country with a large wealth of natural resources has many natural tourist destinations that are located in disaster-prone areas. Various studies show that the management of tourist destinations in Indonesia still tends to focus on increasing visits and economic growth, while aspects of ecological risk mitigation and disaster preparedness have not become an integral part of tourism management strategies. The city of Sibolga, located in the coastal area of North Sumatra, is one of the natural tourist destinations with high marine and coastal potential, but at the same time faces ecological vulnerability due to climate change, coastal environmental degradation, and pressure from human activities. This condition requires a tourism management strategy that is not only reactive post-disaster, but also adaptive and preventive in reducing the risk of ecological disasters [3].

Table 1. Indicators of Ecological Vulnerability and Disaster Risk in Indonesia's Coastal Tourism Destinations (2020–2024)

Year	Indicators of Ecological Vulnerability	National/Regional Data	Relevance to Sibolga	Source
1	Coastal areas prone to abrasion	± 70% of Indonesia's coastal areas	Sibolga is located in the west	Ministry of Marine Affairs and Fisheries



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	experience moderate-severe abrasion	coast of Sumatra which is prone to abrasion and high waves	me Affairs and Fisheri es [4]
2	Frequency of hydrometeorological disasters	> 80% of disasters in Indonesia are hydrometeorological disasters	Sibolga is affected by coastal flooding, extreme weather, and rising sea levels BNPB [5]
3	Destruction of coastal ecosystems	± 50% of Indonesia's coral reefs are in a damaged-moderate condition	Pressure on tourism and coastal activities increases the risk of degradation of Sibolga's marine ecosystem UNEP [6]
4	Tourist destinations in disaster-prone zones	± 60% of natural tourism destinations are in disaster-prone areas	Sibolga's natural tourist destination is in the coastal and hilly zone UNWTO [3]
5	Integration of disaster mitigation in tourism planning	< 40% of destinations integrate disaster mitigation formally	Indications of weak adaptive approaches in destination management Scott et al. [7]

Source: Processed researcher data from several sources

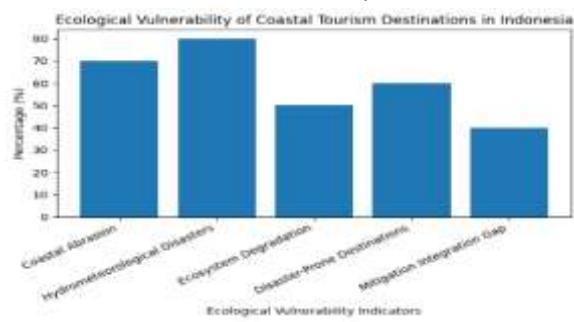


Figure 1 . Ecological Vulnerability Indicators of Coastal Tourism Destinations in Indonesia

Figure 1 illustrates the high level of ecological vulnerability faced by coastal tourism destinations in Indonesia. National and international reports indicate that more than 70% of coastal areas are affected by abrasion, over 80% of disasters are hydrometeorological in nature, and approximately 60% of natural tourism destinations are located in disaster-prone zones. At the same time, less than 40% of destinations have formally integrated disaster mitigation into tourism planning, highlighting a critical governance gap that increases ecological risk exposure. Empirically, various national and international reports show that coastal tourist destinations in Indonesia have a high level of ecological vulnerability.

Data from the Ministry of Maritime Affairs and Fisheries and BNPB indicate that most of Indonesia's coastal areas are experiencing abrasion and hydrometeorological disasters, while UNWTO notes that more than half of natural tourism destinations are in disaster-prone zones. However, the integration of ecological disaster mitigation in tourism management strategies is still relatively low, especially in medium-scale natural tourism destinations such as Sibolga City. This condition strengthens the urgency of developing adaptive tourism management strategies as an instrument for mitigating ecological risks at the destination level [3], [4], [5].

In recent years, the concepts of adaptive tourism management and destination resilience have received increasing attention in the sustainable tourism literature. This approach emphasizes the importance of management flexibility, stakeholder collaboration, and integration of environmental and tourism policies in increasing the resilience of destinations to ecological disturbances. However, most studies still focus on major destinations or leading tourism areas, while empirical studies on the application of adaptive tourism management strategies in medium-scale natural tourism destinations and secondary coastal cities such as Sibolga are limited. In addition, previous research has focused more on post-disaster recovery aspects than the role of tourism management as an instrument for mitigating ecological disasters from the destination planning and management stage [6], [7].

Based on these conditions, this study aims to analyze adaptive tourism management strategies in the management of natural tourist destinations as an effort to mitigate ecological disasters in Sibolga City, Indonesia. This research seeks to identify



management practices, governance mechanisms, and adaptive approaches that contribute to ecological risk reduction while supporting the sustainability of tourism development. The findings of this study are expected to make a theoretical contribution to the development of adaptive tourism studies and destination resilience, as well as provide practical recommendations for policymakers and managers of natural tourism destinations in disaster-prone areas.

II. LITERATURE REVIEW

The development of tourism literature in the last decade shows a fundamental change in the way natural tourism destinations are managed, especially in the face of ecological risks and environmental disasters. Tourism is no longer seen as a stable and predictable system, but rather as a complex, dynamic, and vulnerable socio-ecological system to external disturbances such as climate change, ecosystem degradation, and hydrometeorological disasters. Hall, Scott, and Gössling emphasized that tourism destinations are now in good condition [8] *systemic vulnerability*, where ecological pressures and human activities reinforce each other, thus demanding an adaptive and resilience-based management approach. In this context, natural tourist destinations, especially coastal areas, are a critical point due to their high dependence on environmental quality and ecosystem stability.

Concept *Adaptive Management* which is rooted in ecological science and natural resource management and is then adopted in tourism studies to answer the uncertainty and complexity of destination systems. explains that adaptive management emphasizes continuous learning processes, policy flexibility, and the ability of systems to adapt to change without losing their basic functions. In the context of tourism, this approach translates into management strategies that are iterative, based on environmental monitoring, and responsive to ecological risks. It shows that coastal destinations that apply adaptive principles such as risk-based planning, tourism activity intensity regulation, and ecosystem protection have a better capacity to mitigate ecological disasters than destinations that rely on conventional management approaches [6], [9].

Along with the development of adaptive approaches, the tourism literature also increasingly emphasizes the importance of the concept *Destination Resilience* as a strategic destination for the

management of natural tourist destinations. Defining destination resilience as the ability of the tourism system to anticipate, absorb, and recover from disruptions, while adapting to face future risks. Resilience is determined not only by physical and environmental factors, but also by institutional capacity, governance quality, and the level of collaboration between stakeholders. Thus, an adaptive tourism management strategy plays an important role as a preventive ecological disaster mitigation mechanism, not just post-disaster responsiveness [10].

Recent literature on tourism and disaster management shows a shift in focus from a reactive approach towards integrating risk mitigation into destination planning and management. emphasized that most of the impact of climate change on tourism can be minimized through adaptation policies implemented at the destination level, including space management, ecosystem protection, and diversification of tourism products. However, research also shows that the integration of ecological disaster mitigation into tourism management strategies is still weak, especially in natural tourism destinations in developing countries, where development pressures are often more dominant than environmental sustainability considerations [5].

In the context of coastal natural tourism destinations, management challenges are becoming increasingly complex due to the interaction between natural factors and human activities. The literature highlights that coastal abrasion, sea level rise, and damage to marine ecosystems are not only environmental problems, but also the failure of destination governance in regulating the sustainable use of space and tourism activities. Therefore, an adaptive tourism management strategy should include a cross-sectoral approach that integrates tourism, environmental, and disaster risk reduction policies. This approach places destination managers as key actors in mitigating ecological disasters through regulation, education, and local capacity building [11].

Although conceptual frameworks on adaptive tourism management and ecological disaster mitigation have developed significantly, empirical studies on medium-scale natural tourism destinations and secondary coastal cities are still relatively limited. Most research focuses on leading destinations or global tourist areas, so the local context in developing countries is often overlooked. This creates a knowledge gap on how adaptive tourism management strategies are applied in real life in the management of



natural tourism destinations for the purpose of ecological disaster mitigation. Therefore, a study focusing on Sibolga City is important to enrich the literature with empirical evidence from the local Indonesian context, as well as test the relevance of adaptive concepts and resilience in the management practices of coastal natural tourist destinations.

III. RESEARCH METHODS

This study is designed as a case study with a qualitative approach enriched by descriptive quantitative data to capture the complexity of adaptive tourism management strategies in mitigating ecological disasters in natural tourism destinations. The selection of the case study design is based on the characteristics of the phenomenon being studied, namely the management of tourist destinations as a socio-ecological system influenced by the interaction between policies, actors, the environment, and disaster risk. Case studies are considered most appropriate to explore contextual phenomena that are inseparable from their local conditions, as well as to understand how adaptive management strategies are applied in real-world practice at the destination level. Sibolga City was purposively chosen as the research location because of its position as a coastal natural tourism destination with a high level of ecological vulnerability and the dynamics of tourism management that are still developing, thus providing a relevant empirical context to test the concept of adaptive tourism management [12].

The analysis units in this study include key actors involved in the natural tourism destination management system, including destination managers, tourism stakeholders at the regional level, tourism business actors, and local community representatives. The involvement of these various actors reflects the collaborative governance approach that is heavily emphasized in the adaptive tourism literature and destination resilience. In addition to human participants, this study also analyzes policy documents, tourism development plans, and disaster reports as important data sources to understand the institutional and regulatory frameworks that shape tourism management practices at the destination level [13].

Data collection was carried out through a combination of semi-structured interviews, focus group discussions, field observations, and document analysis to ensure the depth and credibility of the findings. Semi-structured interviews are used to

explore the experiences, perceptions, and adaptive strategies applied by stakeholders, while also providing space for the emergence of contextual issues that were not fully predicted in the initial framework of the research. This approach is recommended in contemporary qualitative research because of its ability to bridge research structure and exploration flexibility. Targeted group discussions are used to capture collective dynamics, negotiation processes, and differences in interests between actors in the management of natural tourism destinations. Field observations are carried out to gain a direct understanding of environmental conditions, management practices, and potential ecological disaster risks faced by destinations. Document analysis is used as a complement to assess the extent to which the principles of disaster mitigation and ecological adaptation have been integrated into regional tourism policy and planning, as well as as a means of triangulating data [14].

Qualitative data analysis was carried out using a thematic analysis approach that is reflective and iterative. This approach was chosen because it allows researchers to identify patterns of meaning, strategies, and conceptual relationships that emerge from empirical data without being tied to a rigid theoretical framework [15]. The analysis process includes the stages of data familiarization, initial coding, theme development, theme review, and interpretation of findings in relation to the literature on adaptive tourism management and ecological disaster mitigation. Descriptive quantitative data obtained through supporting questionnaires were analyzed to provide an overview of stakeholders' perceptions of ecological risk levels, destination preparedness, and effectiveness of applied management strategies. The integration of qualitative and quantitative data is carried out at the interpretation stage to strengthen the understanding of the phenomenon and increase the validity of the research findings.

The measurable variables in this study were formulated based on a critical synthesis of the latest literature on adaptive tourism management, destination resilience, and disaster risk reduction. Adaptive tourism management variables include indicators of policy flexibility, integration of ecological risks in destination planning, institutional learning capacity, stakeholder collaboration, and environmental monitoring and evaluation mechanisms. Meanwhile, ecological disaster mitigation is operationalized through indicators of



destination preparedness, ecosystem protection and restoration, control of the intensity of tourism activities, and systematic efforts to reduce environmental risks. The formulation of these variables and indicators is in line with the framework of destination resilience and climate change adaptation in the global tourism literature, and is adjusted to the characteristics of coastal natural tourism destinations in Sibolga City [1] [2] [3].

IV. RESULTS AND DISCUSSION

Results

The results of the data analysis show that the management of natural tourism destinations in Sibolga City has entered the early stages of implementing adaptive tourism management, although its implementation is still partial and has not been systematically integrated in the framework of ecological disaster mitigation. Thematic analysis of in-depth interviews, focus group discussions, field observations, and policy document reviews identified four main themes that shape adaptive tourism management strategies, namely destination management policy flexibility, stakeholder collaboration, integration of ecological risks in planning, and institutional learning capacity. These four themes represent a form of adaptive response of local actors to ecological pressures, while reflecting structural limitations in the governance of coastal natural tourism destinations.

Policy flexibility emerged as the most dominant adaptive dimension in the management practice of natural tourism destinations in Sibolga. Destination managers are actively making short-term operational adjustments, such as restrictions on tourism activities in extreme weather conditions, temporary closure of vulnerable coastal areas, and rearrangement of the use of tourist spaces. This practice shows a relatively good operational adaptation capacity. However, such flexibility has not been institutionalized in formal policies that explicitly integrate ecological disaster mitigation into medium- and long-term tourism planning. This condition reinforces the findings of Scott et al. (2023) that coastal tourist destinations tend to rely on ad hoc responses, so adaptation is still limited to reducing short-term impacts and has not been able to reduce ecological vulnerability structurally.

Stakeholder collaboration is also an important dimension in the management of Sibolga natural tourism destinations, especially in the context of limited institutional capacity of local governments.

Tourism business actors and local communities are actively involved in environmental management practices, such as cleaning activities of tourist areas and informal supervision of activities that have the potential to damage ecosystems. These findings are in line with those that emphasize that destination resilience is strongly influenced by social capital and the collective capacity of local actors. However, existing collaborations are still operational and have not been integrated into strategic decision-making mechanisms, so their contribution to long-term ecological disaster mitigation is still limited [16].

The integration of ecological risks in destination planning is the weakest aspect of adaptive tourism management strategies in Sibolga. Analysis of the document shows that regional tourism planning is still oriented towards increasing the attractiveness and accessibility of destinations, while ecological risk reduction has not become mainstream policy. Despite the increased awareness of local actors on the importance of protecting coastal ecosystems, this awareness has not been fully converted into structured adaptive policies. These findings expand on the results of the study by showing that the gap between ecological awareness and the implementation of adaptive policies tends to be larger in medium-scale natural tourism destinations [17].

Institutional learning capacity is a key finding that makes an important conceptual contribution to this study. The results of the analysis show that the experience of dealing with ecological disturbances encourages local actors to conduct post-event evaluations and adjust destination management patterns. This experiential learning practice reflects the key principles of adaptive management that emphasizes continuous learning as the basis for decision-making. However, these learning is still taking place informally and has not been systematically documented, so it has not served as an institutional basis for the formulation of sustainable ecological disaster mitigation strategies [18].

Discussion

Based on the description of the results, the synthesis of the relationship between the adaptive tourism management dimension and its implications for ecological disaster mitigation is summarized in Table 2.



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Table 2. Key Findings of Adaptive Tourism Management Strategy in Ecological Disaster Mitigation in Sibolga Natural Tourism Destinations

Adaptive Management Dimensions	Key Empirical Findings	Implications for Ecological Disaster Mitigation
Policy flexibility	Operational adjustments are situational	Reduce short-term, yet systemic impacts
Stakeholder collaboration	Involvement of local actors in environmental practices	Improving local responses, need to strengthen governance
Integration of ecological risks	Risks have not been integrated into formal planning	Mitigation is reactive
Institutional learning	Experiential adaptation	Strong potential for sustainable adaptive strategies

Source: Results of researcher analysis, 2026.

To strengthen these findings, the results of qualitative data processing through thematic analysis showed differences in the intensity of the emergence of each adaptive theme. Policy flexibility and stakeholder collaboration had the highest frequency of emergence, while the integration of ecological risks showed the lowest frequency. This confirms that adaptation at the destination level is more social-operational than institutional-strategic [19]. A summary of the thematic data processing is presented in Table 3.

Table 3. Processing Data Thematic Analysis of Adaptive Tourism Management Strategies

Main Themes	Frequency of Occurrence	Dominant Data Sources	Analytical Meaning
Policy flexibility	Height	Interviews, observations	Reactive operational adaptation
Stakeholder collaboration	Very high	Interviews, FGDs	Strong social capital
Integration of ecological risks	Low	Policy document	Mitigation has not been mainstreamed
Institutional learning	Medium	Interview	Learning has not been institutionalized

Source: Researcher's qualitative data processing, 2026.

In addition to qualitative data, the results of descriptive quantitative data processing show that stakeholders' perceptions of adaptive management strategies are at varying levels. Stakeholder collaboration obtained the highest score, while ecological risk integration obtained the lowest score, indicating the weak mainstream of ecological disaster

mitigation in regional tourism policies. A summary of these results is presented in Table 4.

Table 4. Stakeholder Perceptions of Adaptive Management Strategies (Scale 1–5)

Dimensions	Average Score	Interpretation
Policy flexibility	3,6	Quite adaptive
Stakeholder collaboration	4,1	Adaptive
Integration of ecological risks	2,8	Less adaptive
Institutional learning	3,2	Quite adaptive

Source: Researcher's questionnaire data processing, 2026.

Conceptually, the relationship between adaptive tourism management strategies and ecological disaster mitigation in Sibolga natural tourism destinations emphasizes that tourism management functions as a mediation mechanism between ecological pressure and destination resilience. This relationship is visualized in Figure 2, which shows how policy flexibility, stakeholder collaboration, and institutional learning shape preventive ecological disaster mitigation pathways.

Conceptual Framework of Adaptive Tourism Management in Ecological Disaster Mitigation for Nature-Based Tourism Destinations



Figure 2 . Conceptual Frame Work
Source. Results of Researcher's Processing 2026

The main novelty of this research lies in the empirical proof that adaptive tourism management can function as an instrument for ecological disaster mitigation that is preventive and integrated in daily destination management, not just a post-disaster recovery mechanism. By presenting empirical evidence from medium-scale coastal natural tourism destinations in developing countries, this study expands the literature on sustainable tourism and destination resilience that has been dominated by studies on large-scale leading destinations.

V. CONCLUSIONS AND SUGGESTIONS

This study concludes that adaptive tourism management has a strategic role as an instrument for ecological disaster mitigation in the management of natural tourism destinations, especially in the context



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of medium-scale coastal destinations such as Sibolga City. The findings of the study suggest that although adaptive practices have begun to be implemented, the effectiveness of ecological risk mitigation is largely determined by the level of institutional integration and formal policy support. Thus, ecological disaster mitigation in tourism cannot be understood solely as an operational response to environmental disturbances, but rather as a managerial process that requires continuous learning, cross-stakeholder collaboration, and integration of ecological risks in destination planning.

The main contribution of this research to the development of knowledge lies in strengthening the perspective that tourism is not only a sector affected by ecological disasters, but can also serve as an active actor in disaster risk reduction. This study expands the literature on sustainable tourism and destination resilience by presenting empirical evidence from the context of developing countries, which have been underrepresented in international studies. In addition, this study emphasizes the importance of an adaptive approach that is preventive, where tourism management strategies are systematically integrated into ecological disaster mitigation efforts, rather than only focused on post-disaster recovery.

Based on these findings and conceptual implications, further research is suggested to explore the application of adaptive tourism management to different types of natural tourism destinations with different levels of ecological vulnerability to strengthen the generalization of the findings. Further studies also need to examine more deeply the role of public policy and multi-level governance in institutionalizing adaptive learning and ecological risk mitigation in the tourism sector. In addition, the use of quantitative approaches or longitudinal methods is recommended to assess the long-term impact of adaptive management strategies on reducing ecological vulnerability and increasing the resilience of natural tourism destinations.

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