Strengthening Disaster Management Capacity for Sustainable Geotourism Development: A Case Study of Bali Province

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Abstract

Sustainable geotourism management is a strategic step in maintaining a balance between economic growth and environmental preservation. Indonesia's diverse geological potential offers excellent opportunities for broader utilization, while prioritizing disaster risk reduction (DRR). Bali is one of the provinces with geotourism potential. Geotourism management, prioritizing disaster risk reduction, is crucial in Bali, as it is one of the regions prone to various disaster threats, including earthquakes, tsunamis, and volcanic eruptions. Furthermore, Bali is an international tourist destination, attracting not only domestic but also international tourists. The objective of this research is to analyze strategies that can serve as input for the sustainable management of Geotourism in Bali Province. The findings indicate a need for basic preparedness protocols, such as establishing horizontal and vertical evacuation routes, clarifying command and control structures, and enhancing coordination. For international MICE events, table-top exercises can be conducted to clarify roles and improve coordination among stakeholders.

Keywords: Geotourism, Disaster, Bali, TTX, MICE

A. INTRODUCTION

Economic growth in a region is sometimes inversely proportional to the condition of ecosystems and the environment, which should be well preserved. Increased economic activity often triggers the exploitation of natural resources without considering the balance and long-term impacts that may arise, such as disasters, which will later disrupt the lives and livelihoods of various segments of society. There is a need to balance economic growth and the sustainability of ecosystems (das Neves Almeida, Cruz et al. 2017). Efforts to preserve the environment are a challenge in various regions, especially those that derive direct economic income from exploiting their environmental conditions, such as tourism.

The tourism sector is highly vulnerable to causing environmental damage if it is not properly and sustainably managed. The impacts of tourism activities, such as the opening up of new areas, issues related to waste, environmental pollution, and an increase in the number of tourists, can lead to environmental degradation that has the potential to cause disasters. These conditions have resulted in a shift in the tourism paradigm, which initially, the focus was only on improving the economy and regional income, but then it became necessary to also consider balance with the environment and conservation-based development through geotourism.

Geotourism is tourism based on geological features, which is variously described as a type of tourism that is geologically or geographically oriented (Dowling and Newsome 2018). The development of geotourism emphasizes the interrelationship between geological, educational, socio-economic, and environmental sustainability aspects (Štrba, Palgutová et al. 2025). As a form

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of tourism that supports "responsible and sustainable tourism," geotourism is positioned to support environmental conservation, even though geotourism activities can take place in mining locations that tend to be associated with environmental destruction (Brahmantyo 2014).

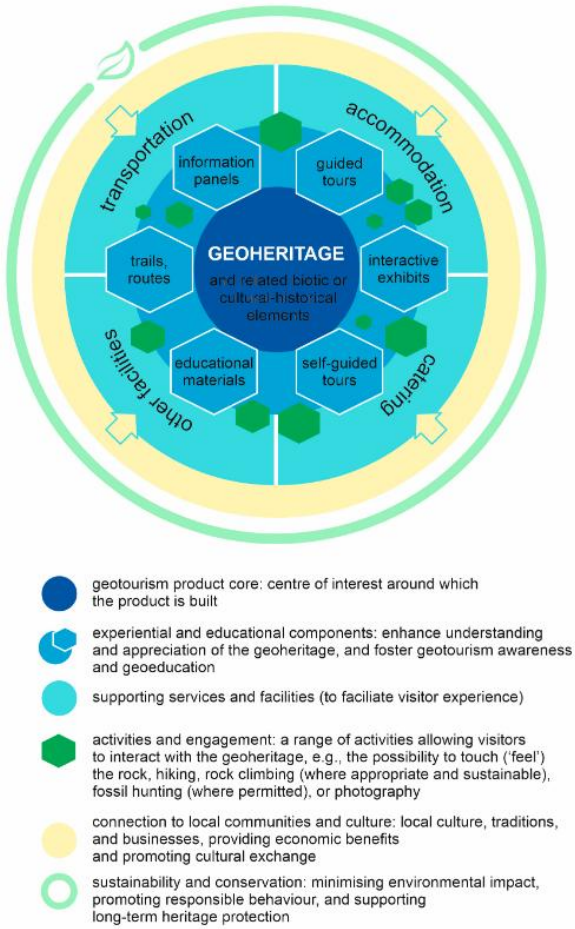

Figure 1. Model of a geotourism product.
Source: Štrba et al., 2025

Based on previous research, the term geotourism was introduced in the mid- 1990s by a geologist from Buckinghamshire Chilterns University in England named Tom Hose, through a paper titled "Geotourism, or can tourists become casual rock hounds: Geology on your doorstep" at the Geological Society in 1996 (Brahmantyo 2018). In Indonesia, geotourism is carried out to increase the attractiveness of domestic and foreign tourists (Riswanto and Andriani 2018).

Geotourism management needs to focus on five things, namely formulating the natural potential that can be used for geotourism activities, formulating destination criteria geotourism, geotourism management, formulating activities in geotourism, and geotourism output (Hermawan and Ghani 2018). One aspect of geotourism management that needs attention is disaster preparedness, because Indonesia's diverse geological conditions, which are also its attractions, bring disasters such as devastating earthquakes, tsunamis that hit the coasts, and volcanic eruptions that destroy areas (Brahmantyo 2018).

Weak disaster preparedness in the geotourism sector has led to high vulnerability to natural disasters in tourist destinations. The unpreparedness of various tourism actors, from the

government to the community, who depend on tourism activities for their livelihoods, has caused operational disruptions, economic losses, and even loss of livelihoods. Weak coordination between institutions and a lack of understanding of disaster risks often result in disaster management that is only reactive rather than preventive, while disaster risk reduction efforts should be integrated into geotourism planning and management.

One of Indonesia's geotourism destinations that attracts domestic and foreign tourists is Bali, as evidenced by Bali being named the world's best tourist destination by winning "The Best Island" title in the 2025 DestinAsian Readers' Choice Awards (Kemenpar 2025). In addition to being a tourist destination, Bali is also a favorite choice for MICE (Meetings Incentives Conferences and Exhibitions*)* activities, both nationally and internationally, such as the annual IMF-World Bank meeting (Kemensetneg 2018) and international music events (Kemenpar 2020).

However, Bali also has a variety of disaster potentials. These include earthquakes (Dewi, Febriani et al. 2024), tsunamis (Sakya, Frederik et al. 2023), volcanoes (Pratama, Koike et al. 2024), floods (Wangsa, Nada et al. 2022), and abrasion and accretion (Hastuti, Nagai et al. 2024). The high level of tourism activity combined with the potential for various disasters makes Bali one of the regions that is highly vulnerable to disasters. This condition can become a cross-border issue, considering that many of the tourists who visit come from other countries. Therefore, increasing disaster management capacity, especially in terms of disaster risk reduction, is an obligation that must be understood and implemented properly in the tourism sector. A collaborative and integrated approach through the integration of development planning with consideration of disaster risk information, as well as the implementation of Table Top Exercises (TTX) for MICE events, can be strategic steps to ensure the resilience of tourism in Bali.

B. RESEARCH METHOD

This research employs a case study design—an intensive, detailed, and in-depth approach aimed at generating rich contextual understanding (Fadli, 2021). A qualitative methodology was adopted to explore the dynamics of geotourism management and disaster risk reduction coordination in Bali. Data were collected through non-participant observation and document analysis, following established qualitative research practices (Malahati, Jannati et al., 2023).

Observations were conducted during the planning, implementation, and evaluation phases of the Table-Top Exercise (TTX) on disaster preparedness, held in support of the 7th Global Platform for Disaster Risk Reduction (GPDRR) in Bali. Field notes were systematically recorded, focusing on stakeholder roles, communication flow, decision-making processes, and gaps in emergency protocols.

Document analysis included official materials such as the Disaster Risk Assessment of Bali Province, geotourism management policies, TTX scenario guidelines, after-action reports, and meeting minutes. These documents were analyzed alongside observational notes to provide contextual depth and cross-reference key findings.

Data analysis followed the six-phase thematic analysis approach proposed by Braun and Clarke (2006): (1) familiarization with the data through repeated reading of field notes and documents; (2) generation of initial descriptive codes; (3) organization of codes into potential themes; (4) review of themes against the full dataset; (5) refinement, definition, and naming of themes; and (6) production of the final analytical narrative. This systematic process ensured that the emerging themes were grounded in empirical evidence and aligned with the research objectives.

To enhance credibility and trustworthiness, the study employed data source triangulation by comparing findings from observational records with multiple document types. Additionally, member checking was conducted through informal discussions with key participants involved in the TTX to verify interpretations, and an audit trail was maintained to document analytical decisions throughout the research process.The research flow was carried out following the flow in Figure 2.

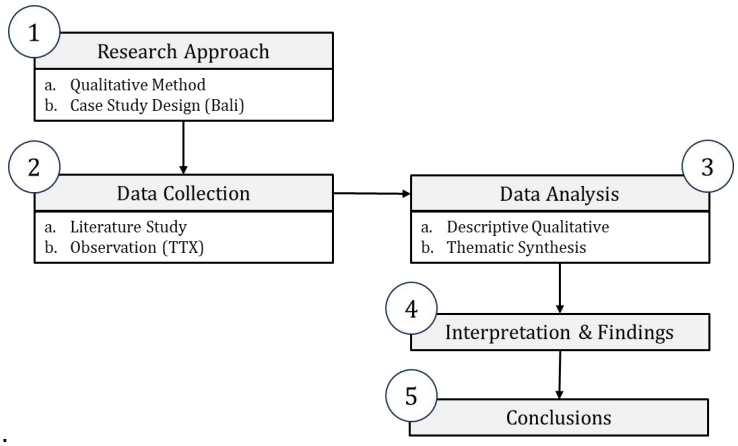

Figure 2. Research Flow

C. FINDINGS AND DISCUSSION

- Geotourism Potentials and Potential Hazards in Bali

Bali has geotourism and geotourism potential that can increase the attractiveness of domestic and foreign tourists. Each geotourism site has diverse characteristics and themes, while still prioritizing the principles of education (Adrianda, Sahara et al. 2025), sustainability (Gupta, Anand et al. 2024), and local economic benefits (Ginting, Rahman et al. 2021) for the surrounding community. These principles indicate that tourism should not be oriented solely towards the exploitation of natural resources, but should also be able to increase the knowledge of tourists and provide local economic benefits to the community as a strategy to maintain livelihoods. Some of the geotourism sites and potential geotourism sites in Bali include the Batur Geotourism Site (Arjana, Ernawati et al. 2020) in Bangli Regency, Buleleng Geotourism (Widiastini, Agastya et al.) in Buleleng Regency, Nusa Penida Geotourism (Agastya, Diwyastra et al. 2022) in Klungkung Regency, and Gianyar Geotourism (Ariantana, Agastya et al. 2018) in Gianyar Regency.

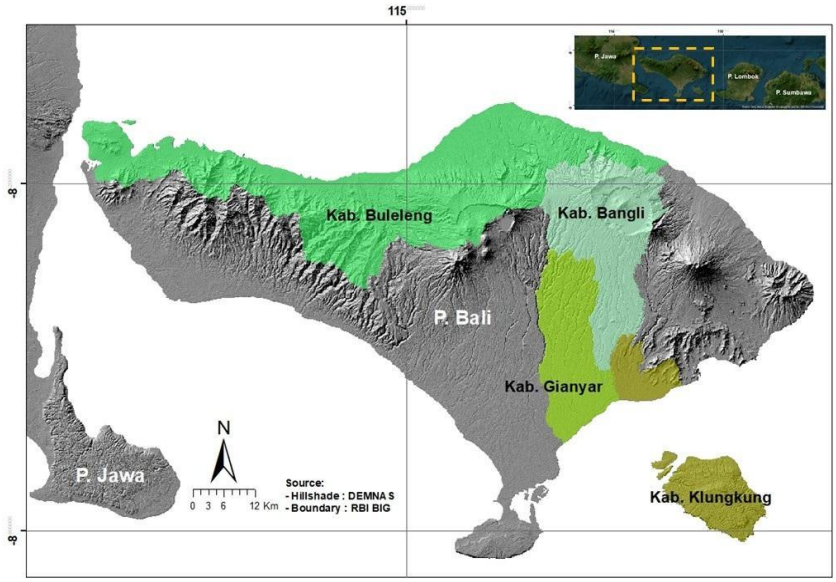

Figure 3. Geotourism Locations and Geotourism Potential in Bali

Source: Analysis, 2025

Tourism geographies are inevitably present when dealing with disaster risk (Kelman 2025). Tourists from various backgrounds need to understand the potential disaster risks in tourist areas, so it is necessary to provide complete and easily accessible disaster risk information by utilizing technological developments. Tourist visits to Bali are one of the leading sectors contributing to increasing local revenue. Therefore, tourism development needs to be managed properly so that new economic centers can emerge and there is no disparity between regions. The provision of infrastructure and technology to support disaster management is also necessary for sustainable tourism.

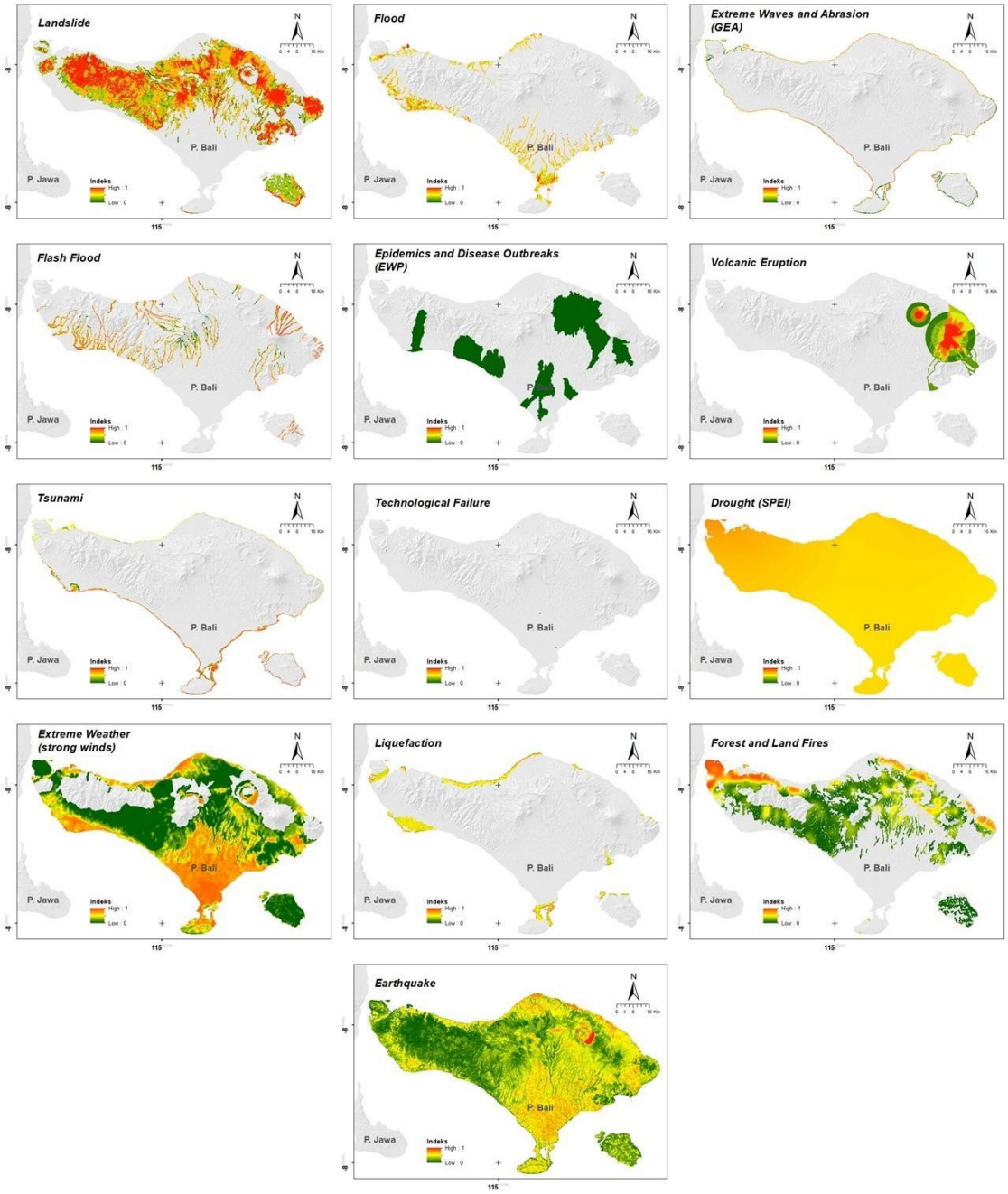

Figure 4. Hazard map in Bali
Source: (BNPB 2021)

The National Disaster Management Authority has mapped the potential disaster risks on the island of Bali. These maps are available in the Bali Province Disaster Risk Assessment for the period 2022-2026. The disaster risk assessment combines an analysis of the hazards, vulnerabilities, and capacities that exist in the province of Bali. Based on the results of the assessment, it was found that the types of disasters in Bali include floods, flash floods, tsunamis, earthquakes, liquefaction, technological failures, droughts, disease epidemics, forest and land fires, extreme weather, volcanic eruptions, extreme waves and abrasion, and landslides ranging from

low to high severity (Figure 3). When linked to geotourism sites and potential geotourism sites, the potential risks for each type of disaster can be observed in Table 1.

Table 1. Potential Hazards and Risks at the Geotourism Site

No.	Disaster	Classes of Hazard and Disaster Risk							
		Hazard				Risk			
		Buleleng	Bangli	Gianyar	Klungkung	Buleleng	Bangli	Gianyar	Klungkung
1	Flood	Moderate	-	High	High	Moderate	-	Moderate	High
2	Flash Flood	High	High	High	High	High	Moderate	Low	High
3	Extreme Weather	High	Moderate	High	High	High	Moderate	High	High
4	Extreme Waves and abrasion	High	-	High	High	Moderate	-	Moderate	Moderate
5	Earthquake	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
6	Liquefaction	Moderate	-	-	Moderate	Moderate	-	-	Moderate
7	Forest and Land Fire	High	Moderate	Low	Moderate	High	Moderate	Low	Low
8	Volcanic Eruption		High	-	Low	-	High	-	Low
9	Drought	High	Moderate	Moderate	Moderate	High	Moderate	Moderate	Moderate
10	Landslide	High	High	High	High	High	High	Moderate	High
11	Tsunami	High		High	High	Moderate	-	Moderate	High
12	Epidemic and Disease Outbreak	-	Low	Low	-	-	Low	Low	-
13	Technological Failure	Low	-	-	-	Low	-	-	-

Source: BNPB, 2021

- **Tabletop Exercise (TTX) for MICE events**

A Tabletop Exercise (TTX) is a discussion-based training method conducted based on a specific scenario. Its purpose is to generate dialogue among participants in order to deepen conceptual understanding, identify strengths and weaknesses in existing systems, and encourage changes in perceptions of disaster response plans, policies, or procedures (FEMA 2020). TTX provides an opportunity for participants to review and test emergency response plans in a safe and controlled environment. Through discussion-based simulations, participants can identify weaknesses in existing procedures and strengthen coordination between relevant parties without facing the real risks associated with field exercises (Skryabina, Betts et al. 2020). In addition, TTX can be implemented at a relatively low cost and with relatively few resources, yet it remains effective in improving team preparedness, communication, and decision-making capabilities when facing emergency situations (Pandya, Kharel et al. 2024). In the context of geotourism destinations hosting international MICE events, TTX serves as a strategic tool for testing safety protocols and evaluating preparedness in handling emergency situations, given the complexity of multi- stakeholder involvement and the diversity of disaster threats faced.

In support of the 7th Global Platform for Disaster Risk Reduction (GPDRR) in Bali in 2022, the National Disaster Management Authority (BNPB) together with the Bali Provincial Disaster Management Agency (BPBD) held a Tabletop Exercise (TTX) on Disaster Preparedness on May 17, 2022, at the Grand Sovereign Hotel, Kuta, Bali (BNPB 2022). The GPDRR event, held on May 23–28, 2022, in the Nusa Dua area (BNPB 2022), is a global forum to review progress in disaster risk reduction, involving approximately 4,000 participants physically and 2,000 participants online, including 200 participants with disabilities (Riyanto, Supriyati et al. 2023). This TTX involved various stakeholders at the local and national levels, including BNPB, TNI, Polri, BPBD Bali Province, BPBD Badung Regency, Kodam IX/Udayana, Polda Bali, BMKG, Bali Province Tourism Office, Bali Tourism Board, venue managers (BICC, BNDCC, ITDC), hotel and restaurant associations, and other related parties. This activity was designed to simulate earthquake and tsunami disaster scenarios that could potentially occur during the international event (BNPB 2022).

TTX was designed with a worst-case scenario of an earthquake with a magnitude of 8.5 that could cause a tsunami 3-6 meters high in the Nusa Dua area, with the earthquake estimated to reach an intensity of VII MMI and the tsunami arriving within 20-30 minutes after the earthquake occurred (BNPB 2022). The exercise was carried out through two moves focusing on three crucial aspects, namely an integrated information and communication system including tsunami early warning, a mechanism for evacuating delegates from the venue taking into account the needs of 200 participants with disabilities, and multi-stakeholder command and control coordination. The TTX produced a number of important findings that can be applied in sustainable geotourism management, including the importance of integrated management of delegate and tourist data and a backup communication system using radio in case of internet network disruption, the provision of horizontal and vertical evacuation routes considering the time constraints that are highly relevant for coastal geotourism destinations such as Nusa Penida, and clarity of the command and control structure between various parties. Technical aspects such as the installation of multilingual evacuation signs and disaster preparedness certification for venues are also important considerations, where ITDC practices can serve as an example for other destinations (BNPB 2022).

Figure 5. Tabletop Exercise (TTX) on Disaster Preparedness in Support of the 7th GPDRR
Source: BNPB, 2022

TTX with basic material related to preparedness, such as evacuation mechanisms, sign installation, control and command, needs to be implemented before holding MICE as a form of the Indonesian government's commitment to disaster risk reduction (BNPB 2022). This is one of the strategies to increase disaster management capacity to improve the quality of geotourism in MICE events in Bali, which can be replicated by other geotourism locations to increase public confidence in attracting tourists to hold MICE events at geotourism locations.

D. CONCLUSION

Economic diversification will increase regional fiscal resilience, maintain regional income stability, and promote sustainable development even in the event of a future global crisis (Pradnyana and Saskara 2025). Dependence on a single economic sector, such as tourism, makes it vulnerable to disasters. Integrating disaster risk reduction into geotourism development planning is not merely an option but an urgent necessity to ensure tourist safety, protect local livelihoods, and maintain Bali's reputation as a world-class tourist destination. The findings of this study provide practical contributions for policymakers in formulating regulations and operational standards for geotourism destinations, as well as theoretical contributions to enriching the literature on the integration of disaster risk reduction in sustainable geotourism management. Future research could examine disaster preparedness models or evaluate disaster management efforts in geotourism areas.

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