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Planning and Development of Disaster-Resilient Tourism at Parangtritis Beach, Yogyakarta: Integrating Landscape Hazard Aspects and Tourist Attractions

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Abstract: This study formulates strategies for planning and developing disaster-resilient tourism at Parangtritis Beach, Bantul Regency, Yogyakarta, by integrating landscape-hazard considerations with tourist attractions. The area possesses substantial tourism potential, but is highly vulnerable to natural hazards, particularly earthquakes and tsunamis, due to its proximity to active subduction zones. A personal judgment method was employed using checklist sheets based on disaster preparedness parameters, including evacuation signage, building configuration, evacuation route conditions, and the availability of designated assembly points. The collected data were analyzed using a descriptive qualitative approach supported by photographic documentation. The findings indicate that Parangtritis Beach is equipped with several disaster-preparedness components, including evacuation signage, evacuation routes, and an early warning system (EWS). However, the evacuation routes remain in moderate condition and require improvement to ensure effective accessibility during emergencies. Furthermore, the existing building configurations within the tourism area have not been optimized to mitigate earthquake and tsunami risks, particularly with respect to their potential function as vertical evacuation facilities. Community involvement in disaster preparedness training also remains limited and should be strengthened to enhance mitigation effectiveness. Despite its status as a major tourist destination, Parangtritis Beach requires more comprehensive infrastructure development and preparedness measures. Therefore, this study recommends improving the quality of evacuation routes, conducting periodic building safety audits, and implementing regular disaster-preparedness training for both local communities and visitors to support the development of a safe and sustainable tourism destination in hazard-prone coastal areas.

Keywords: Disaster Resilient Tourism, Parangtritis Beach, Disaster Preparedness, Disaster Mitigation, Tourism Planning and Development

Introduction

Indonesia, the world's largest archipelagic country, possesses substantial potential for marine tourism. With a coastline extending approximately 99,093 km and a marine area of about 3.257 million km² (Senin & Sukadari, 2023; Prayoga, 2022), Indonesia has emerged as a major global tourism destination, particularly in coastal and marine-based tourism. Data from the Ministry of Marine Affairs and Fisheries of the Republic of Indonesia (2024), indicate that the country's marine conservation areas encompass 29.3 million hectares,

covering coastal zones, small islands, and deep-sea waters. Indonesia's strategic geographical position between two continents (Asia and Australia) and two oceans (the Indian and Pacific Oceans) further enhances its marine tourism potential. Nevertheless, alongside these advantages, Indonesia faces substantial risks from natural hazards, particularly earthquakes and tsunamis, which frequently affect coastal regions (Yulianto et al., 2020; Rezaldi et al., 2022; Benazir & Oktari, 2024; Pandadaran et al., 2024; Setyonegoro et al., 2024; Jumadi et al., 2025).

Located at the convergence of three major active tectonic plates—the Eurasian, Indo-Australian, and Pacific Plates—Indonesia lies within the Ring of Fire, rendering the country highly susceptible to seismic activity capable of generating earthquakes and tsunamis (Patria & Aulia, 2020; Sabah & Sil, 2023; Jumadi et al., 2025). The southern coastal region of Java Island is particularly vulnerable to submarine earthquakes that may trigger tsunamis (Patria & Aulia, 2020; Supendi et al., 2022; Supendi et al., 2023; Widiyantoro, 2020). According to data from the National Geophysical Data Center (NGDC, 2025), the southern coast of Java experienced 22 significant earthquakes over the past century, eight of which were associated with tsunamis that caused considerable infrastructure damage and loss of life (**Figure 1** and **Table 1**). This hazard poses a tangible threat to the Parangtritis Beach area, one of the primary tourist destinations in the Special Region of Yogyakarta (Juniansah et al., 2018; Nugroho et al., 2018; Alwi & Mutaqin, 2022; Asy-Syidiqie & Roostika, 2024).

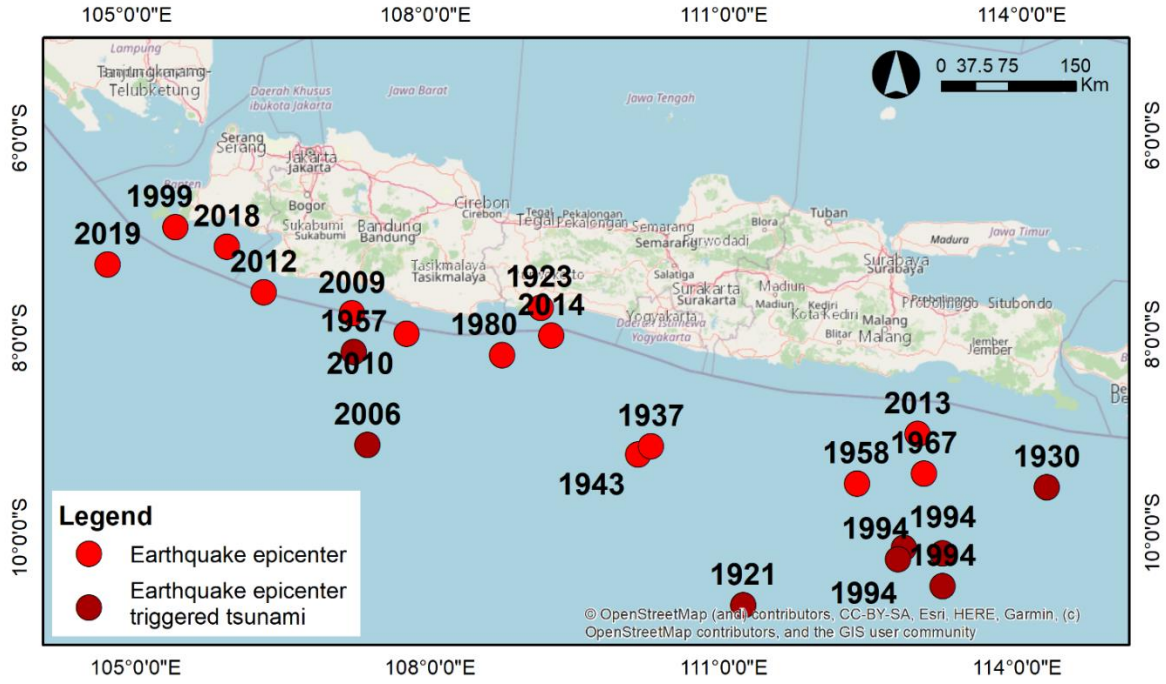

Figure 1. Epicenters of earthquakes in the Southern Java–Indian Ocean region over the past century
Source: NGDC, 2025

Table 1. Losses caused by tsunami events in the Southern Java–Indian Ocean region

No	Date	Tsunami hight	Loss	
1	September 11, 1921	0.1 m	-	-
2	July 19, 1930	0.1 m	-	-
3	September 26, 1957	0.7 m	-	-
4	June 2, 1994	13.9 m	238 deaths, 423 injured	1500 houses destroyed
5	June 3, 1994	3.7 m	-	-
6	June 4, 1994	-	-	-
7	June 5, 1994	3 m	-	-
8	July 17, 2006	20.9 m	802 deaths, 498 injured	1623 house destroyed

Source: NGDC, 2025

Parangtritis Beach, located in Kretek District, Bantul Regency, is one of the most popular coastal tourism destinations in Yogyakarta (Yulianto, 2017; Nora, 2018; Hisanah et al., 2022). Based on data from Statistics Indonesia (BPS) for the past five years (2020–2024), Parangtritis Beach recorded the highest number of visitors among other tourist attractions in Bantul Regency (**Table 2**). While the high volume of visitors contributes positively to the local economy, it simultaneously increases vulnerability to natural hazards, particularly tsunamis, which frequently threaten the southern coastal areas of Java (Canales et al., 2019; Hidayah et al., 2022; Prihartanto et al., 2023).

Table 2. Number of visitors to tourist attractions in Bantul Regency, 2020–2024

No	Attractions	Visitors				
		2020	2021	2022	2023	2024
1.	Parangtritis Beach *(Pantai Parangtritis)*	1.463.420	1.182.000	1.838.200	2.219.880	2.015.490
2.	Samas Beach *(Pantai Samas)*	143.966	105.500	167.400	303.060	230.053
3.	Cemara Cave *(Goa Cemara)*	19.255	9.940	16.671	32.049	25.562
4.	Pandansimo Beach *(Pantai Pandansimo)*	63.330	53.850	73.300	101.940	69.353
5.	Kuwaru Beach *(Pantai Kuwaru)*	13.501	12.720	17.099	21.107	16.726
6.	Selarong Cave *(Goa Selarong)*	20.000	12.200	16.331	18.589	13.432
7.	Cerme Cave *(Goa Cerme)*	3.403	2.013	2.336	5.217	2.540

Source: BPS Bantul (2021, 2022, 2023, 2024, 2025)

The geographical position of Parangtritis Beach, directly facing the Indian Ocean and situated within an active subduction zone, makes the area highly susceptible to tsunami hazards (Alwi & Mutaqin, 2022; Kharimah et al., 2022; Asy-Syidiqie & Roostika, 2024). This susceptibility is further intensified by high tourism activity, which can significantly increase potential losses in the event of a disaster (Hidayah et al., 2022; Prihartanto et al., 2023; Amri et al., 2024). Fathianpour et al. (2023) emphasize that visitors in densely populated coastal tourism areas require comprehensive mitigation strategies, as disaster impacts may become

severe in the absence of effective evacuation planning and adequate disaster management infrastructure. Consequently, tourism development in such regions necessitates integrating disaster mitigation strategies into tourism planning.

In the context of tourism development, Fandeli and Nurdin (2021) identify two principal approaches: product-driven and market-driven. The product-driven approach emphasizes the development of tourism attractions based on the potential of natural and cultural resources. In contrast, the market-driven approach prioritizes visitors' needs, preferences, and perceptions as the foundation for tourism development. In disaster-prone destinations such as Parangtritis Beach, these approaches must be integrated harmoniously to ensure sustainable tourism development (Font & McCabe, 2017; Gardiner & Scott, 2018). Therefore, beyond attracting tourists, tourism development in this area must prioritize visitor safety by implementing effective disaster mitigation systems (Dewi, 2024; Rindrasih et al., 2024; Kausar & Agustan, 2025).

This study formulates strategies for planning and developing disaster-resilient tourism at Parangtritis Beach by integrating landscape-hazard considerations with tourist attractions. The research assesses regional preparedness for disaster threats by examining disaster-resilient tourism parameters, including evacuation signage, building configuration, evacuation route conditions, and the availability of designated assembly points (Pahleviannur et al., 2020). Furthermore, this study integrates tourism attraction development with disaster mitigation measures to support the creation of safe, comfortable, and sustainable tourism areas. The findings are expected to provide policy-relevant insights for local governments and tourism managers to enhance disaster preparedness while maintaining Parangtritis Beach as a leading tourist destination.

Methodology

Parangtritis Village is administratively located in Kretek District, Bantul Regency, Special Region of Yogyakarta, Indonesia. Geographically, the village is situated between 110°16′52″–110°20′37″ East Longitude and 7°59′15″–8°10′58″ South Latitude (**Figure 2**). Parangtritis Village encompasses a coastal area that serves as one of the leading tourism destinations in Bantul Regency (Yulianto, 2017; Hulu et al., 2019; Imaduddin et al., 2025). In addition to its coastal attractions, the village contains religious and cultural heritage sites, including the Tomb of Syeh Bela Belu *(Makam Syeh Bela Belu)* and the Tomb of Syeh Maulana Maghribi *(Makam Syeh Maulana Maghribi)*. The presence of tourism attractions and cultural heritage sites has contributed to increased economic activity within the area (Siswahto & Muryani, 2020; Elgin & Elveren, 2024; Solarin et al., 2024; Li et al., 2025). The existence of tourist attractions, cultural heritage sites, and the growing economic activities, Parangtritis Village is designated as a family beach tourist area and cultural heritage by the local

government (Peraturan Daerah Daerah Istimewa Yogyakarta Nomor 1 Tahun 2019 tentang Perubahan atas Peraturan Daerah Provinsi Daerah Istimewa Yogyakarta Nomor 1 Tahun 2012 tentang Rencana Induk Pembangunan Kepariwisataan Daerah Provinsi Daerah Istimewa Yogyakarta Tahun 2012–2025).

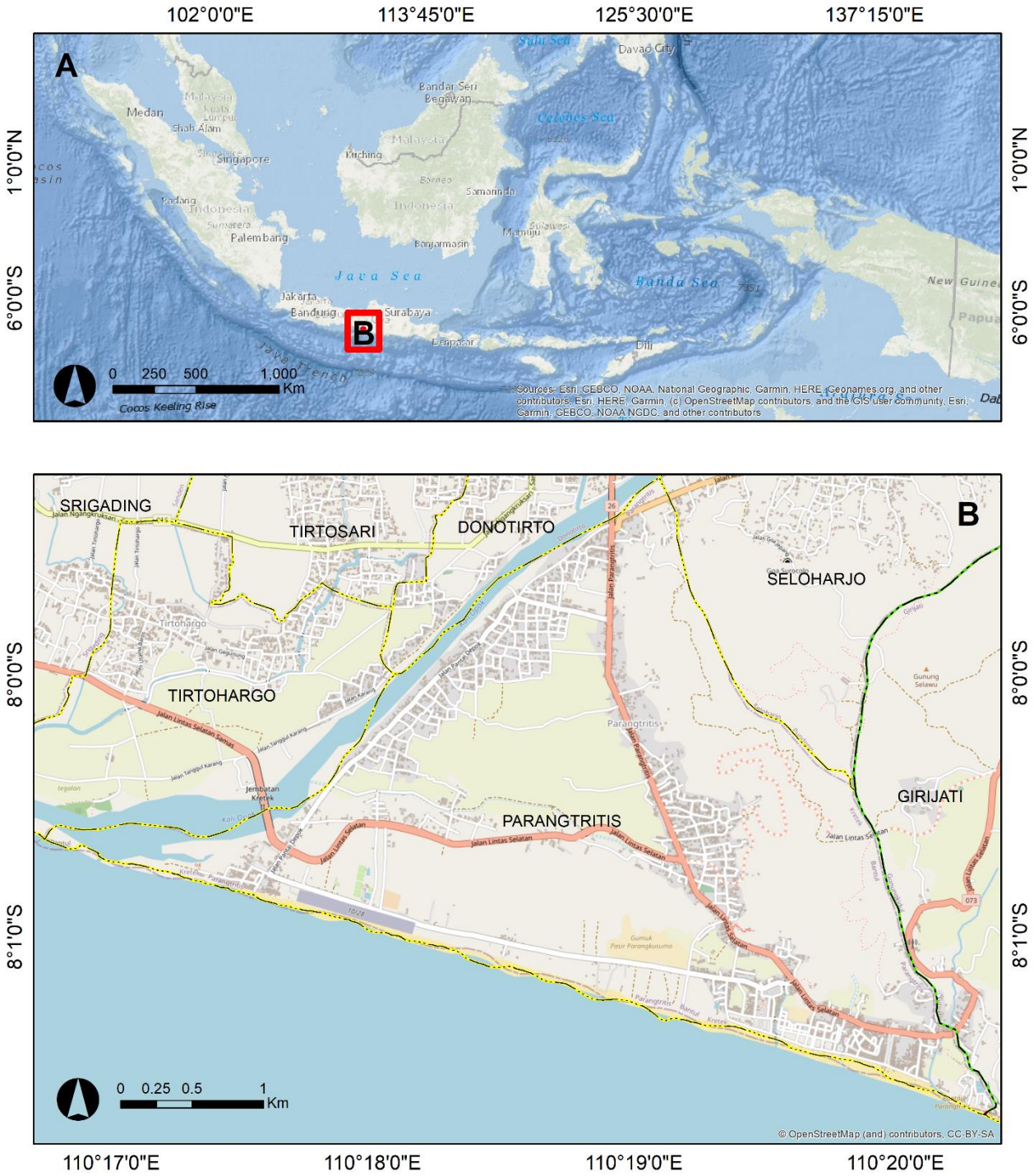

Figure 2. Location of the study area
Source: Author, 2025

The geographical position of Parangtritis Village, directly facing the Indian Ocean subduction zone, renders the area highly vulnerable to tsunami hazards (Kharimah et al., 2022; Asy-Syidiqie & Roostika, 2024). Furthermore, the intensity and diversity of tourism-related activities increase potential losses in the event of a disaster (Hidayah et al., 2022; Prihartanto et al., 2023; León et al., 2024). These conditions underscore the need for research focused on disaster-resilient tourism planning and development in Parangtritis Village.

The parameters employed to assess and support disaster-resilient tourism planning were derived from an evaluation of regional disaster preparedness. These parameters include evacuation signage, building configuration, evacuation route conditions, and the condition of designated assembly points, as adapted from Pahleviannur et al. (2020) (**Table 3**).

Table 3. Parameters for disaster-resilient tourism planning and development

No	Parameter	Indicator
1.	Evacuation Signage	Hazard warning signs
		Evacuation route signage
		Assembly point signage
		Coast Guard/SAR/BPBD posts
		Loudspeakers and Early Warning System (EWS)
2.	Building Configuration (houses, hotels, shops)	Single-storey buildings
		Two-storey buildings
		Buildings with more than two storeys
3.	Evacuation Route Conditions	Poor
		Moderate
		Good
4.	Condition of Assembly Points	Poor
		Moderate
		Good

Source: Pahleviannur et al. (2020)

The data collection process employed a personal judgment method supported by structured checklists and field documentation. The checklist instruments were developed based on disaster preparedness parameters proposed by Pahleviannur et al. (2020). Data analysis was conducted using a qualitative descriptive approach, relying on expert judgment and supported by photographic documentation of each observed parameter.

Results and Discussion

A. Disaster-Resilient Tourism Planning and Development

This study evaluates disaster-resilient tourism planning and development at Parangtritis Beach using disaster preparedness parameters, including evacuation signage, building configuration, evacuation route conditions, and the condition of designated assembly points. Field observations indicate that several evacuation facilities—such as evacuation route signage and designated assembly points—are already available and generally in good condition. Coast Guard posts and early warning systems (EWS) have also been installed at strategic locations along the coastal area. However, certain shortcomings remain, particularly regarding evacuation routes, which are classified as being in moderate condition and therefore require further improvement to ensure rapid and safe evacuation during emergencies. In addition, several buildings within the tourism area require structural evaluation and modification to enhance resistance to earthquakes and tsunamis. A summary of the observation results is presented in **Table 4**.

Table 4. Observation results on parameters of disaster resilient tourism planning and development

No	Parameter	Indicator	Checklist
1.	Evacuation Signage	Hazard warning signs	√
		Evacuation route signage	√
		Assembly point signage	√
		Coast Guard/SAR/BPBD posts	√
		Loudspeakers and Early Warning System (EWS)	√
2.	Building Configuration (houses, hotels, shops)	Single-storey buildings	√
		Two-storey buildings	√
		Buildings with more than two storeys	√
3.	Evacuation Route Conditions	Poor	-
		Moderate	√
		Good	-
4.	Condition of Assembly Points	Poor	-
		Moderate	√
		Good	-

Source: Author, 2025

1. Evacuation Signage

a. Hazard Warning Signs

Clear hazard warning signs are present throughout the Parangtritis Beach area. These warning signs primarily indicate disaster risks, particularly earthquakes and tsunamis, which frequently threaten the southern coast of Java. The availability of such signage is essential for informing visitors about potential hazards and enhancing situational awareness in coastal tourism areas.

Field observations indicate that Parangtritis Beach is equipped with hazard warning signs at several strategic locations, particularly in areas exposed to high waves and in zones where swimming is prohibited. These signs function as visual risk communication tools that alert visitors to potential natural hazards, including large waves and tsunami threats (Yasufuku et al., 2017; Marfai et al., 2019; Sofyan et al., 2025). Examples of warning and hazard signs identified at Parangtritis Beach are shown in **Figure 3**.

Figure 3. Hazard warning signs at Parangtritis Beach
Source: Author

Benazir and Oktari (2024) argue that hazard signage is highly effective in delivering rapid risk information to visitors, particularly in densely populated coastal tourism areas. The strategic placement of these signs constitutes a form of location-based mitigation that can directly reduce risk during disasters. However, the effectiveness of hazard signage is strongly influenced by visual design, size, and clarity of language. Signs that rely solely on local language or culturally specific symbols may be less comprehensible to international tourists. Cui et al. (2023) emphasize that diverse user groups, including foreign visitors, should be able to understand disaster warning signs easily. Similarly, Bird et al. (2010) highlight that effective hazard signage should incorporate universal symbols and visual language to enhance inclusivity and comprehension for international travelers. Therefore, standardizing hazard sign design in accordance with international disaster risk communication principles is necessary to enhance the effectiveness of evacuation signage at Parangtritis Beach.

b. Evacuation Route Signage

Evacuation routes at Parangtritis Beach are marked with directional signage that guides visitors toward designated safe areas and assembly points located at higher elevations. The presence of evacuation route signs is critical during emergencies, as they provide clear guidance that reduces confusion and facilitates timely evacuation.

Field observations show that evacuation route signs are installed at multiple locations, including beach access points, tourist entrances, and road intersections. These signs indicate evacuation routes and direct visitors to safer zones away from the coastline. Examples of evacuation route signage observed at Parangtritis Beach are presented in **Figure 4**.

Figure 4. Evacuation route signage at Parangtritis Beach
Source: Author

Previous studies have demonstrated that clearly marked evacuation routes significantly reduce panic and disorientation during disaster events (Akizuki, 2024). Evacuation signage should therefore be strategically distributed across high-density tourist areas to ensure visibility and accessibility (Tanra et al., 2023; Utariningsih et al., 2023; Condeng et al., 2024; Sofyan et al., 2025). Chen et al. (2024) further emphasize that evacuation signs must be regularly maintained and equipped with adequate lighting to ensure visibility during nighttime emergencies. However, field observations at Parangtritis Beach reveal that some signs have begun to fade and are less visible at night due to insufficient lighting.

Gerster et al. (2025) emphasize that evacuation route signage should not only convey information but also remain legible across diverse environmental and lighting conditions. Their findings indicate that signage incorporating luminous and universally recognizable symbols is more effective in tourist areas with high visitor volumes. In addition, Cui et al. (2023) show that the success of tsunami evacuation scenarios is strongly influenced by how easily tourists can locate, interpret, and follow

evacuation signs. Consequently, improving signage quality, implementing routine maintenance, and utilizing reflective or luminous materials should be prioritized by local authorities and tourism managers. Furthermore, the integration of digital tools—such as interactive evacuation maps and mobile-based guidance systems—can complement physical signage and enhance evacuation efficiency (Rais et al., 2022; Han et al., 2023; Tada et al., 2024).

c. Designated Assembly Point Signage

Designated assembly points at Parangtritis Beach are marked at several strategic locations and are generally situated in elevated areas near major tourist zones. These locations are intended to serve as temporary safe zones during and after evacuation processes.

Figure 5. Assembly point signage at Parangtritis Beach
Source: Author

Fathianpour et al. (2023) report that clearly identified assembly points can significantly reduce casualties during disasters. However, they emphasize that assembly-point signage should provide additional information, including access routes and the capacity of the assembly area. Chen et al. (2024) further note that assembly points should be located in areas that are not exposed to secondary hazards, such as flooding or landslides.

Cetin et al. (2024) identify assembly points as critical components of evacuation management in coastal tourism destinations. They argue that such areas should not only be clearly marked but also equipped with basic supporting facilities, including potable water, shaded areas, and accessible pathways to accommodate vulnerable groups such as children and older adults. García-Catalá et al. (2022) emphasize that continuous evaluation of location suitability and facility improvement is necessary to ensure that assembly points are not only visually informative but also functional and effective under real emergency conditions.

d. Coast Guard/SAR/BPBD Posts

A Coast Guard post and a Search and Rescue (SAR) unit are already present at Parangtritis Beach. The existence of the Coast Guard post, along with the Regional Disaster Management Agency (BPBD), indicates that basic institutional preparedness for disaster response is in place. However, coordination and collaboration among these agencies require further strengthening, particularly through the implementation of routine disaster preparedness drills and simulation exercises. In addition, ensuring the availability and readiness of essential rescue equipment at the Coast Guard post—including lifeboats, buoys, and emergency radio communication devices—is crucial for effective emergency response. The Coast Guard, SAR, and BPBD facilities at Parangtritis Beach are shown in **Figure 6**.

Figure 6. Coast Guard Post/SAR/BPBD at Parangtritis Beach
Source: Author

Previous studies emphasize the critical importance of institutional synergy among coast guard units, SAR teams, and local disaster management agencies in responding to disasters in coastal tourism areas (Zheng et al., 2023). Although a lifeguard post is already established at Parangtritis Beach, its effectiveness depends on the adequacy of rescue equipment, including emergency communication radios, lifeboats, and flotation devices (Cui et al., 2023). Strengthening inter-agency cooperation is therefore essential to ensure rapid, coordinated, and efficient disaster response (Hutagalung et al., 2020; Manvi & Muhammad, 2022; Okunola, 2024; Akhirianto et al., 2025).

Furthermore, Biswas et al. (2021) highlight the importance of regular training programs for SAR teams and coast guard personnel to maintain a high level of preparedness for emergencies. Such training should include disaster simulation exercises that actively involve local communities and visitors. Implementing routine, inclusive simulation activities at Parangtritis Beach would enhance coordination among response agencies and improve overall preparedness for actual disaster events.

e. Loudspeakers and Early Warning System (EWS)

Early warning systems, including loudspeakers and tsunami sirens, have been installed at several strategic locations along Parangtritis Beach. The existing early warning system (EWS) is generally operational, with loudspeakers positioned to disseminate warning messages to beach visitors. However, periodic evaluations of system performance and sound coverage are necessary, particularly considering the high number of visitors and the wide spatial extent of the beach area. Loudspeakers must be capable of reaching all sections of the beach, including locations that are relatively remote or distant from the main activity centers. The loudspeakers and EWS infrastructure at Parangtritis Beach are presented in **Figure 7**.

Figure 7. Loudspeakers and early warning system (EWS) at Parangtritis Beach
Source: Author

Ariyachandra and Wedawatta (2023) demonstrate that early warning systems can significantly reduce casualties when integrated with clear evacuation routes and adequately prepared assembly points. However, the effectiveness of EWS largely depends on regular maintenance, reliable signal coverage, and redundancy across coastal areas, especially in crowded or hard-to-reach locations. Inadequate coverage or malfunctioning equipment can substantially reduce the effectiveness of warnings during critical moments.

Bird et al. (2010) identify community awareness and responsiveness as major challenges in implementing early warning systems. This underscores the importance of continuous public outreach, education, and routine evacuation simulations for visitors at Parangtritis Beach, ensuring that both tourists and local stakeholders understand appropriate actions when early warning signals are activated (Escaleras & Register, 2008; Adityawan et al., 2023).

2. Building Form

Various types of buildings are present within the Parangtritis Beach tourism area, predominantly consisting of one- to two-storey structures. Taller buildings are generally more susceptible to seismic impacts; therefore, careful attention must be given to structural design and construction quality to enhance earthquake resistance (Rizzo et al., 2024; Koosha et al., 2025). In addition to their structural vulnerability, multi-storey buildings can serve as vertical evacuation facilities during tsunami events, provided they are designed to accommodate evacuation loads and disaster conditions (Usman & Sari, 2019; Soviana et al., 2024). A building with more than two storeys in the Parangtritis Beach area is illustrated in **Figure 8**.

Figure 8. Multi-storey buildings at Parangtritis Beach
Source: Author

Marfai et al. (2019) observed that buildings with multiple storeys are more vulnerable to earthquake-induced damage, particularly when not constructed in accordance with earthquake-resistant design standards. Their study further highlights that buildings intended for vertical evacuation must be structurally capable of supporting additional dynamic loads imposed by large numbers of evacuees during emergencies. At Parangtritis Beach, although several multi-storey buildings exist, there is no clear evidence that these structures have been specifically engineered to function as vertical evacuation shelters.

Furthermore, Cho and Choi (2024) emphasize the importance of conducting regular building safety audits in disaster-prone tourism areas to ensure compliance with structural and safety standards. Such evaluations are highly relevant for Parangtritis Beach, particularly for buildings that may serve as temporary evacuation shelters or that have the capacity to accommodate large concentrations of people during disaster events.

3. Evacuation Route Conditions

The evacuation routes at Parangtritis Beach are generally classified as being in moderate condition, with several segments requiring improvement, particularly in terms of accessibility, road width, and surface quality. Field observations indicate that although evacuation routes are available and passable, they are not yet optimal for emergency use. Several roads leading to designated assembly points remain narrow, uneven, unpaved, and insufficiently illuminated. In addition, not all evacuation routes are equipped with clear, continuous, and barrier-free markings, which may impede rapid evacuation during emergencies (**Figure 9**).

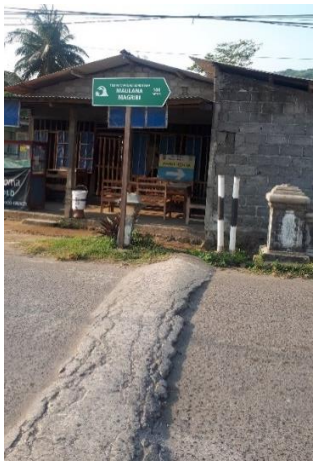

Figure 9. Road conditions along evacuation routes at Parangtritis Beach
Source: Author

Previous studies emphasize that the effectiveness of evacuation routes is strongly influenced by accessibility, capacity, and their ability to accommodate vulnerable groups, including children, older adults, and persons with disabilities (Arabi et al., 2023). The quality and connectivity of evacuation routes play a critical role in determining evacuation success in coastal areas exposed to tsunami hazards (Husa & Damayanti, 2019; Ferreira et al., 2024; Ilham et al., 2025). Well-maintained evacuation routes that are sufficiently wide, clearly marked, and free from physical obstacles have been shown to significantly reduce evacuation time and potential fatalities (Li et al., 2019; Utariningsih et al., 2023).

Furthermore, Bahmani et al. (2025) highlight the importance of integrating evacuation routes with existing local infrastructure, such as village roads, stairways, and access paths to higher ground, to expedite evacuation. This integration is particularly crucial in regions with limited evacuation time. Triyoso et al. (2025) note that the southern coast of Java is highly susceptible to tsunamis with very rapid arrival times, thereby necessitating evacuation routes that enable swift and unobstructed movement.

At Parangtritis Beach, several physical constraints remain evident. Road narrowing, insufficient lighting, uneven surfaces, and traffic-calming devices, such as speed bumps, impede mobility along evacuation routes. These conditions may significantly slow evacuation flows, especially during nighttime or high-density tourist periods. Consequently, physical improvements—including road widening, surface reinforcement, adequate lighting, removal or redesign of obstructions, and standardized evacuation route signage—are urgently required. In addition to infrastructure upgrades, periodic evacuation simulations involving local communities and visitors are essential to enhance familiarity with evacuation routes and improve overall evacuation effectiveness (Ito et al., 2020; Yamada & Yamasaki, 2021).

4. Condition of the Assembly Point

The assembly points at Parangtritis Beach are generally in moderate condition, with several aspects requiring improvement in terms of facilities and capacity to accommodate large numbers of visitors during emergency situations. Although designated assembly points are available, some locations lack adequate supporting facilities, such as shaded areas, clean water sources, and sufficient space to manage large crowds. In addition, access routes leading to the assembly points require further improvement to facilitate rapid and safe movement from coastal zones to higher ground. The condition of several assembly points at Parangtritis Beach is illustrated in **Figure 10**.

Figure 10. Conditions of selected assembly points in Parangtritis Village
Source: Author

The moderate condition of the assembly points at Parangtritis Beach is consistent with the findings of Tsioulou et al. (2021), who emphasize that the availability of well-equipped assembly points, including clean water, shade, and emergency communication facilities, is a critical factor in ensuring successful evacuation processes. Such facilities become particularly important during disaster events, when visitors may be required to remain at assembly points for extended periods while awaiting further assistance or evacuation support.

Furthermore, Cetin et al. (2024) highlight that assembly points should be located at sufficiently high elevations and at safe distances from the coastline to minimize the risk of tsunami inundation. In the case of Parangtritis Beach, the spatial location of existing assembly points generally meets these safety criteria, as they are situated away from zones directly exposed to tsunami impact. However, improvements in facility provision and access management remain necessary to enhance their functional effectiveness.

Overall, disaster preparedness infrastructure at Parangtritis Beach has demonstrated notable progress. Nevertheless, the findings indicate that several components still require enhancement to achieve optimal preparedness. In particular, evacuation routes remain in moderate condition, assembly point facilities require strengthening, and buildings within coastal tourism zones need to be evaluated for their potential function as safe vertical evacuation structures. The effectiveness of disaster mitigation is determined not only by physical infrastructure but also by public awareness and the capacity of tourism managers to implement preparedness measures. Therefore, tourism development at Parangtritis Beach should be complemented by continuous educational programs for visitors and routine evacuation simulations involving all relevant stakeholders to ensure a comprehensive and effective disaster-resilient tourism system (Fathianpour et al., 2023; Cisternas et al., 2024).

B. Integration of Landscape Hazard Aspects and Tourist Attractions with Product-Driven and Market-Driven Approaches

1. Product-Driven Approach: Strengthening Infrastructure and Mitigation-Based Tourism Products

The product-driven approach emphasizes the development and enhancement of tourism products by considering the inherent characteristics of natural resources and their associated vulnerabilities. In disaster-prone tourism destinations such as Parangtritis Beach, this approach prioritizes the strengthening of physical tourism infrastructure to support disaster preparedness and risk reduction. By integrating mitigation functions into tourism products, disaster resilience can be embedded directly within the tourism landscape.

a. Evacuation Infrastructure as a Mitigation-Based Tourism Product

Parangtritis Beach is already equipped with disaster preparedness infrastructure, including evacuation signage, evacuation routes, and designated assembly points. However, field observations indicate that the overall condition of this infrastructure remains moderate and requires further improvement to function effectively during emergency situations. Beyond its primary safety function, evacuation infrastructure can also be developed as part of an educational tourism product that raises disaster

awareness among visitors.

Wibowo (2023), in a study conducted in Labuan Bajo, demonstrated that mitigation infrastructure such as evacuation towers and tsunami shelters can serve dual functions as both safety facilities and tourism attractions with educational and symbolic value. Similarly, Cetin et al. (2024) emphasized that enhancing the educational dimension of disaster mitigation facilities contributes to increased visitor awareness while simultaneously enriching the overall tourism experience. In this context, evacuation infrastructure at Parangtritis Beach holds potential not only as a protective measure but also as a value-added tourism product that supports disaster-resilient tourism development.

b. Utilization of Natural Hazards as a Tourism Narrative

The potential threat of tsunamis can be reframed as an educational narrative within tourism product development. For instance, evacuation routes may be designed as "Tsunami Education Routes," assembly points can function as locations for evacuation simulations, and warning signage can be transformed into interactive learning media. In addition, the establishment of a local disaster information center or museum could further support public education on coastal hazards.

According to Triyoso et al. (2025), the southern coast of Java is located within a megathrust subduction zone capable of generating large-magnitude earthquakes (Mw 8.5–9.0). This geological context highlights the importance of integrating risk narratives into tourism product design. International experiences from countries such as Japan and New Zealand demonstrate that incorporating disaster risk education into tourism products can enhance visitor awareness without diminishing destination attractiveness (Triyoso et al., 2025). Therefore, strengthening hazard-based narratives within tourism products at Parangtritis Beach represents a strategic application of the product-driven approach to disaster-resilient tourism development.

2. Market-Driven Approach: Addressing Tourist Needs and Strengthening Community Engagement

The market-driven approach prioritizes tourists' needs, perceptions, and expectations by placing visitor experience at the center of regional tourism development. Within the framework of disaster-resilient tourism, this approach emphasizes the involvement of local communities and stakeholders in designing mitigation strategies that are not only technically effective but also socially acceptable and positively perceived by visitors.

a. Involvement of Local Communities as Educational Agents

Local communities surrounding tourism areas play a crucial role as risk communicators and informal educators in disaster-resilient tourism. Through appropriate training, community members can effectively convey information regarding evacuation routes, designated safe areas, and local disaster histories to tourists. Such community-based communication enhances trust and improves visitors' understanding of disaster risks within the destination.

Benazir and Oktari (2024) demonstrate that the active involvement of coastal communities in early warning systems and disaster education significantly increases the effectiveness of mitigation efforts. Consequently, tourism experiences are not only recreational but also contribute to raising visitors' awareness of natural hazards, thereby fostering a culture of preparedness among tourists.

b. Simulation and Experience-Based Disaster Education

Evacuation simulations involving tourists can be developed as interactive educational attractions, such as guided tsunami evacuation simulations led by trained community members or volunteers. This form of experiential learning aligns with the growing demand for educational and experiential tourism, where visitors seek meaningful and participatory activities during their travel.

Gerster et al. (2025) highlight that multicriteria spatial approaches to risk mapping can support the design of evacuation and educational travel routes that are both safe and engaging. Tourists are more likely to revisit destinations that successfully integrate recreational activities with educational content, particularly when such experiences are participatory and well-facilitated.

c. Perceived Safety and Tourist Satisfaction

Tourists' perceptions of safety represent a critical determinant of destination competitiveness and long-term tourism sustainability. The availability of clearly marked evacuation routes, accessible assembly points, and transparent risk communication mechanisms enhances visitors' sense of security, which in turn contributes to higher levels of tourist satisfaction.

Bahmani et al. (2025) emphasize that perceived disaster safety is a key factor in tourists' evaluations of coastal destinations. Accordingly, integrated communication strategies—combining visual signage, digital platforms such as early warning applications, and interpersonal communication through local communities—should be developed to respond effectively to visitors' safety expectations and information needs.

Conclusion

The management of coastal tourism destinations located in disaster-prone areas requires an approach that extends beyond attraction-oriented development and systematically incorporates disaster risk mitigation. As one of the leading tourism destinations along the southern coast of Yogyakarta, Parangtritis Beach faces substantial challenges related to tsunami hazards amid high levels of domestic and international tourist visitation.

The application of a product-driven approach enables the strengthening of disaster preparedness infrastructure—such as evacuation signage, evacuation routes, assembly points, and other supporting facilities—while simultaneously positioning these elements as part of tourism products with educational value. In parallel, the market-driven approach promotes destination management that is responsive to tourists' needs and risk perceptions through community involvement, the provision of inclusive and accessible risk information, and the creation of a tourism experience that remains safe and reflective despite existing disaster threats.

The integration of product-driven and market-driven approaches supports the development of destination management systems that are not only adaptive to tourism market dynamics but also resilient to sudden and destructive natural hazards. This integrated strategy reinforces Parangtritis Beach's potential to function as a model of sustainable, resilient, and participatory coastal tourism within a risk-aware development framework.

The transformation of Parangtritis Beach into a disaster-resilient tourism destination necessitates an integrated and cross-sectoral policy framework. Local governments—particularly the Tourism Office and the Regional Disaster Management Agency (BPBD)—are required to formulate a disaster mitigation master plan for tourism areas that is not merely technocratic, but also responsive to patterns of vulnerability and existing tourism potential. Periodic audits of evacuation infrastructure, including evacuation routes, signage, assembly points, and early warning systems, should be conducted systematically and involve relevant stakeholders to ensure that evaluation results effectively inform planning and development interventions. Moreover, disaster mitigation measures must be formally embedded within spatial planning instruments and regional tourism policies so that safety considerations become an integral component of sustainable tourism development.

Local communities play a strategic role as primary actors who interact continuously with both the environment and visitors. Community empowerment through routine preparedness training, capacity building for local volunteers in disaster mitigation education, and direct participation in activities such as evacuation simulations is essential. Synergistic collaboration among communities, academic institutions, and government

agencies is crucial for developing innovations grounded in local knowledge, including educational tourism products that communicate disaster narratives in informative and engaging formats, such as evacuation tours, local tsunami history storytelling, and participatory disaster information centers.

Visitors also contribute significantly to the realization of safe and risk-aware tourism destinations. Tourists require clear and easily understandable disaster mitigation information, disseminated through multiple formats, including on-site signage as well as digital and printed media. Such information enables visitors to recognize evacuation routes, assembly points, and emergency procedures when required. Destination managers are therefore encouraged to develop experiential risk education facilities—such as interactive information boards, basic simulations, and disaster guidance applications—that enhance visitor experience while simultaneously strengthening disaster awareness without diminishing the recreational value of tourism. Through strong policy integration, active community participation, and informed visitor engagement, Parangtritis Beach holds considerable potential to serve as a pilot model for coastal tourism destinations that are not only aesthetically attractive, but also resilient, educational, and adaptive to disaster risk.

References

Adityawan, M. B., Nurendyastuti, A. K., Purnama, M. R., Arianto, M. S., Farid, M., & Kuntoro, A. A. (2023). Development of a tsunami early warning system on the coast of Palu based on maritime wireless communication. *Progress in Disaster Science, 19*, 100290. https://doi.org/10.1016/j.pdisas.2023.100290

Akhirianto, N. A., Ma'rufatin, A., Wardani, K. S., Kayadoe, F. J., & Kongko, W. (2025). Bridging policy and practice in tsunami disaster risk reduction: Evaluating local implementation challenges in eastern Indonesia. *International Journal of Disaster Risk Reduction, 124*, 105491. https://doi.org/10.1016/j.ijdrr.2025.105491

Akizuki, Y. (2024). Evacuation route design based on visibility for reducing evacuation delays. *Fire Safety Journal, 144*, 104099. https://doi.org/10.1016/j.firesaf.2024.104099

Alwi, M., & Mutaqin, B. W. (2022). Geospatial mapping of tsunami susceptibility in the Parangtritis coastal area of Yogyakarta, Indonesia. *Arabian Journal of Geosciences, 15*, 1332. https://doi.org/10.1007/s12517-022-10608-2

Amri, I., Giyarsih, S. R., & Ruslanjari, D. (2024). Tsunami risk awareness, hazard warning knowledge, and intended evacuation behavior among beach users in Bantul, Indonesia. *International Journal of Disaster Risk Reduction, 109*, 104594. https://doi.org/10.1016/j.ijdrr.2024.104594

Arabi, M., Hyun, K. K., & Mattingly, S. P. (2023). Identifying the most critical evacuation links based on road user vulnerabilities. *Natural Hazards Review, 24*(2), 04023006. https://doi.org/10.1061/NHREFO.NHENG-1667

Ariyachandra, M. R. M. F., & Wedawatta, G. (2023). Digital twin smart cities for disaster risk management: A review of evolving concepts. *Sustainability, 15*(15), 11910. https://doi.org/10.3390/su151511910

Bahmani, H., Ao, Y., Yang, D., Wang, D., Li, M., Long, Y., & Peng, P. (2025). Implications for improving evacuation safety in primary school corridors: A video-based analysis on evacuees' speed and density. *Engineering, Construction and Architectural Management, 32*(12), 8472–8493. https://doi.org/10.1108/ECAM-01-2024-0017

Benazir, & Oktari, R. S. (2024). Assessing tsunami risk along the Aceh coast, Indonesia: A quantitative analysis of fault rupture potential and early warning system efficacy. *Natural Hazards, 120*(3), 4875–4900. https://doi.org/10.1007/s11069-024-06401-x

Bird, D., Gisladottir, G., & Dominey-Howes, D. (2010). Volcanic risk and tourism in southern Iceland: Implications for hazard, risk and emergency response education and training. *Journal of Volcanology and Geothermal Research, 189*, 33–48. https://doi.org/10.1016/j.jvolgeores.2009.09.020

Cetin, M., Kaya, A. Y., Elmastas, N., et al. (2024). Assessment of emergency gathering points and temporary shelter areas for disaster resilience in Elazıg, Turkey. *Natural Hazards, 120*, 1925–1949. https://doi.org/10.1007/s11069-023-06271-9

Chen, Z., Han, P., He, Z., Yang, Z., & Liang, Y. (2024). Enhancing cinema evacuation efficiency: Impact of flashing lights on emergency egress performance and fire safety. *IEEE Access*. https://doi.org/10.1109/ACCESS.2024.3446238

Cho, H., & Choi, N. (2024). Analyzing vulnerabilities of disaster risk management systems of local governments in South Korea. *Systems, 12*(3), 76. https://doi.org/10.3390/systems12030076

Cisternas, P. C., Cifuentes, L. A., Bronfman, N. C., Repetto, P. B., & Castañeda, J. V. (2024). Earthquake and tsunami preparedness between residents and tourists in coastal communities. *Progress in Disaster Science, 23*, Article 100343. https://doi.org/10.1016/j.pdisas.2024.100343

Condeng, B., Amyadin, S. A., Malik, I., Iwan, & Saleh, A. (2024). Peningkatan kapasitas kesiapsiagaan masyarakat menghadapi bencana tsunami di Desa Wani Satu. *Jurnal Kolaboratif Sains, 7*(7), 2655–2665. https://doi.org/10.56338/jks.v7i7.5703

Cui, A., Fountain, J., & Espiner, S. (2023). Communicating natural hazard risks to Chinese visitors: A case study from New Zealand. *Frontiers in Sustainable Tourism, 2*, 1192124. https://doi.org/10.3389/frsut.2023.1192124

Dewi, D. S. K. (2024). Digital innovation in disaster management and sustainable tourism. *Journal of Governance Innovation, 6*(2), 165–173. https://doi.org/10.36636/jogiv.v6i2.4735

Elgin, C., & Elveren, A. Y. (2024). Unpacking the economic impact of tourism. *Journal of Cleaner Production, 478*, 143947. https://doi.org/10.1016/j.jclepro.2024.143947

Fandeli, C., & Nurdin, A. (2021). *Perencanaan pariwisata berkelanjutan*. UGM Press.

Ferreira, M. A., Oliveira, C. S., & Francisco, R. (2024). Tsunami risk mitigation: The role of evacuation routes, preparedness and urban planning. *Natural Hazards, 121*(6), 6719–6751. https://doi.org/10.1007/s11069-024-07061-7

Font, X., & McCabe, S. (2017). Sustainability and marketing in tourism. *Journal of Sustainable Tourism, 25*(7), 869–883. https://doi.org/10.1080/09669582.2017.1301721

Gerster, J., & Shibayama, A. (2025). School memorials as sites of memory and the dynamics of remembrance after the Great East Japan Earthquake. *Social Science Japan Journal, 28*(2), jyaf029. https://doi.org/10.1093/ssjj/jyaf029

Han, D. C., Takabatake, T., Esteban, M., & Shibayama, T. (2023). Development and implementation of a smartphone application for tsunami evacuation. *International Journal of Disaster Risk Reduction, 96*, 103915. https://doi.org/10.1016/j.ijdrr.2023.103915

Hidayah, Z., Rohmah, N., & Wardhani, M. K. (2022). Coastal vulnerability study of the potential impact of tsunamis and community resilience in Pacitan Bay, East Java. *Forum Geografi, 36*(1), 66–79. https://doi.org/10.23917/forgeo.v36i1.17160

Hisanah, S., Rozak, F., & Warlina, L. (2022). Strategi pemulihan pariwisata Pantai Parangtritis pasca pandemi COVID-19 melalui promosi kearifan lokal. *Majalah Ilmiah UNIKOM, 20*(1), 3–13. https://doi.org/10.34010/miu.v20i1.7709

Hulu, M., Baiquni, M., Fandeli, C., & Wirasanti, N. (2019). Community participation on tourism development in Parangtritis tourism area, Bantul Regency. *E-Journal of Tourism, 6*(2), 225–234. https://doi.org/10.24922/eot.v6i2.46717

Husa, N., & Damayanti, A. (2019). Evacuation route and evacuation shelter planning for tsunami hazard in Pangandaran District. *IOP Conference Series: Earth and Environmental Science, 311*(1), Article 012023. https://doi.org/10.1088/1755-1315/311/1/012023

Ilham, I., Safani, J., Muliddin, M., Sulistian, T., & Koesuma, S. (2025). Estimation of tsunami hazard and evacuation sites using the Cornell multigrid coupled tsunami method in South Buton Regency. *Indonesian Journal of Applied Physics, 15*(1), 204–215. https://doi.org/10.13057/ijap.v15i1.97008

Imaduddin, F. R., Wilopo, W., & Harum, D. S. (2025). Groundwater vulnerability to seawater intrusion in Parangtritis Beach, Yogyakarta Special Province, Indonesia. *IOP Conference Series: Earth and Environmental Science, 1451*(1), Article 012015. https://doi.org/10.1088/1755-1315/1451/1/012015

Ito, E., Kawase, H., Matsushima, S., & Hatayama, M. (2020). Tsunami evacuation simulation considering road blockage by collapsed buildings. *Natural Hazards, 101*, 959–980. https://doi.org/10.1007/s11069-020-03903-2

Jumadi, J., Priyono, K. D., Amin, C., Saputra, A., Gomez, C., Lam, K.-C., Rohman, A., Patel, N., Sattar, F., Nawaz, M., & Wardani, K. S. (2025). Tsunami risk mapping and sustainable mitigation strategies for megathrust earthquake scenarios in Pacitan coastal areas. *Sustainability, 17*(6), 2564. https://doi.org/10.3390/su17062564

Juniansah, A., Tyas, B. I., Tama, G. C., Febriani, K. R., & Farda, N. M. (2018). Spatial modelling for tsunami evacuation route in Parangtritis Village. *IOP Conference Series: Earth and Environmental Science, 148*(1), Article 012003. https://doi.org/10.1088/1755-1315/148/1/012003

Kausar, D. R. K., & Agustan. (2025). Disaster management in tourism: Public-private collaboration and early warning innovations in Bali and Yogyakarta. *Jurnal Kajian Bali, 15*(2), 582–600. https://doi.org/10.24843/JKB.2025.v15.i02.p06

Kementerian Kelautan dan Perikanan. (2024). *PNBP sektor pengelolaan ruang laut capai Rp325 miliar di semester I*. https://kkp.go.id/news/news-detail/pnbp-sektor-pengelolaan-ruang-laut-capai-rp325-miliar-di-semester-i.html

Kharimah, I., Legowo, E., Bangun, E., & Widana, I. D. K. K. (2022). Preparedness of the Bantul District Regional Disaster Management Agency for tsunami hazards. *Technium Social Sciences Journal, 28*(1), 551–560. https://doi.org/10.47577/tssj.v28i1.5890

Koosha, A., Pahlavan, H., & Shamekhi Amiri, M. (2025). Probabilistic seismic performance assessment of tall RC frame-core buildings. *The Structural Design of Tall and Special Buildings, 34*, e70053. https://doi.org/10.1002/tal.70053

León Canales, J., Vicuña del Río, M., & Gubler, A. (2019). Increasing tsunami risk through intensive urban densification. *International Journal of Disaster Risk Reduction, 41*, Article 101312. https://doi.org/10.1016/j.ijdrr.2019.101312

León, J., Martínez, C., Inzunza, S., Ogueda-Oliva, A., & Urrutia, A. (2024). Improving tsunami risk analysis by integrating spatial resolution and evacuation capacity. *International Journal of Disaster Risk Science, 15*(2), 1001–1016. https://doi.org/10.1007/s13753-024-00607-0

Li, M., Fan, Y., Guo, C., & Li, X. (2025). Tourism prosperity and high-quality economic development. *International Review of Economics & Finance, 101*, 104246. https://doi.org/10.1016/j.iref.2025.104246

Li, Z., Yu, H., Chen, X., Zhang, G., & Ma, D. (2019). Tsunami-induced traffic evacuation strategy optimization. *Transportation Research Part D, 77*, 535–559. https://doi.org/10.1016/j.trd.2019.09.008

Manvi, K. I., & Muhammad, F. (2022). Collaborative governance in natural disaster mitigation management. *Jurnal Kepariwisataan, 6*(2), 166–178. https://doi.org/10.34013/jk.v6i2.882

Marfai, M. A., Cahyadi, A., Fatchurohman, H., Rosaji, F. S. C., & Wibowo, Y. A. (2019). Tsunami preparedness and environmental vulnerability analysis. *IOP Conference Series: Earth and Environmental Science, 256*(1), Article 012025. https://doi.org/10.1088/1755-1315/256/1/012025

National Geophysical Data Center. (2021). *Historical earthquake and tsunami events in Southern Java*. NOAA. https://www.ncei.noaa.gov/

Nora, A. Y. (2018). Analisis sikap masyarakat terhadap kunjungan wisatawan asing. *Journal of Tourism and Economic, 1*(1), 48–54. https://doi.org/10.36594/jtec/8j61f096

Nugroho, V. A. P., Muntasib, E. K. S. H., & Samosir, A. M. (2018). Hazard management in Parangtritis Beach tourism destination. *IOP Conference Series: Earth and Environmental Science, 196*, Article 012022. https://doi.org/10.1088/1755-1315/196/1/012022

Okunola, O. H. (2024). Stakeholder engagement in disaster recovery. *International Journal of Disaster Risk Reduction, 114*, 104960. https://doi.org/10.1016/j.ijdrr.2024.104960

Pahleviannur, M. R., Wulandari, D. A., Sochiba, S. L., & Santoso, R. R. (2020). Strategi perencanaan pengembangan pariwisata menuju destinasi tangguh bencana. *Jurnal Pendidikan Ilmu Sosial, 29*(2), 116–126. https://doi.org/10.23917/jpis.v29i2.9692

Pandadaran, S. H., Yanagisawa, H., Shibazaki, B., Fujii, Y., Miyagi, T., & Gold, D. P. (2024). Solving the puzzle of the 1996 Biak tsunami. *Earth, Planets and Space, 76*, 104. https://doi.org/10.1186/s40623-024-02041-4

Zheng, Y., Wang, J., & Li, X. (2023). Integrating evacuation behavior and spatial planning for tsunami-prone tourism destinations. *International Journal of Disaster Risk Reduction, 89*, 103565. https://doi.org/10.1016/j.ijdrr.2023.103565