

A coastal tourism area spatial planning model based on disaster mitigation

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ARTICLE INFO	ABSTRACT
<i>Article history:</i> Received January 06, 2026 Received in revised form Marc. 23, 2026 Accepted May 02, 2026 Available online June 01, 2026 <i>Keywords:</i> Baru Beach tourism area Disaster mitigation Planning model	<i>Pantai Baru is one of the beaches on the southern coast of Bantul Regency, Yogyakarta Special Region. The construction of the Pandansimo Bridge paved the way for the development of Pantai Baru. On the other hand, the physical conditions and human behavior in Pantai Baru indicate high vulnerability to multiple disasters such as tsunamis, abrasion, tidal flooding, and sea intrusion. The study employed a qualitative method, integrating the concept of Integrated Coastal Zone Management (ICZM) and an ecological approach. This study aims to examine the coastal tourism area management model based on disaster mitigation by identifying key area characteristics, land use patterns, and disaster risks, with the goal of designing a safer and more sustainable area management model. The result of the modeling is the Pantai Baru Tourism Area Management Model based on disaster mitigation through integrated sustainable zoning. This model divides the area into three main zones: the Conservation Zone (0-100 meters) as a natural green belt; the Economic Zone for tourism facilities (swimming pool, food stalls, ATV Track); and the Parking and Support Zone (PLTB, conservation office, mosque, and souvenir shop) which pays attention to user circulation and disaster evacuation circulation. In addition to structural mitigation, this arrangement emphasizes the importance of non-structural mitigation through community education and multi-stakeholder collaboration. This model is expected to increase regional resilience to disasters, support sustainable tourism growth, and reduce conflict and socio-economic risks.</i>
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Introduction

Coastal areas constitute one of the most significant assets in tourism development, particularly in terms of marine tourism potential (Anah 2017). Tourism within the southern coastal region of the Special Region of Yogyakarta, especially at Pantai Baru in Bantul Regency, has experienced notable growth supported by improved accessibility and the enhancement of tourism infrastructure facilities (Amri, Giyarsih, and Ruslanjari 2024; Suhartapa and Sulisty

2021). One of the infrastructures expected to influence the development of Pantai Baru is the Pandansimo Bridge, which serves as a connector between Bantul Regency and Kulon Progo Regency (Sidik 2023). However, based on the National Disaster Risk Assessment of the Special Region of Yogyakarta Province 2022–2026, this area possesses considerable potential yet remains highly vulnerable to natural hazards such as tsunamis, coastal abrasion, and tropical storms. The impacts of disasters occurring in coastal tourism areas can result in severe consequences,



both socially and economically. Socially, they disrupt the lives and livelihoods of local communities (Fitria et al. 2023). Economically, they lead to damage to tourism infrastructure, a decline in tourist arrivals, loss of livelihoods, and high rehabilitation costs. In this context, Pantai Baru has also undertaken efforts to provide electricity facilities and initiatives aimed at improving community welfare (Widhyharto 2015).

Tourism is widely regarded as a strategic solution for enhancing national and regional economies, as well as supporting sustainable community livelihoods (Smith et al. 2023). Nevertheless, coastal development, particularly in relation to the intensification of socio-economic activities and increasing pressure from natural hazards, has contributed to environmental degradation and threatens both sustainability and the continuity of community livelihoods (Nurzaman, Shaw, and Roychansyah 2020). Consequently, coastal area development necessitates a disaster mitigation-based approach in alignment with the provisions of the Law of the Republic of Indonesia Number 26 of 2007 concerning Spatial Planning, in order to ensure sustainability and reduce socio-economic risks.

Research conducted by Arini and Pinasti (2021) highlights that the development of Pantai Baru as a tourism destination generates socio-economic impacts, with positive outcomes including employment opportunities, increased income, and improved welfare, while negative impacts encompass issues related to waste management, social deviation, and excessive consumptive behavior. Meanwhile, Yatusalechah and Pinasti (2019) discuss the role of Tourism Awareness Groups (Pokdarwis), which function strategically as local communities managing tourism through mitigation socialization, the development of early warning systems, and coordination with government institutions to achieve more resilient tourism management.

In optimizing the potential of coastal tourism, a sustainable approach that integrates disaster mitigation through spatial planning is required. Based on the aforementioned discussion, previous studies have not yet proposed a spatial arrangement model for public spaces grounded in disaster mitigation, which is essential given that tourism development must confront rapidly increasing disaster risks. This research aims to examine a disaster mitigation-based coastal area

spatial planning model by identifying area characteristics, land use patterns, and disaster risks in order to design a safer and more sustainable spatial arrangement model. The findings of this study are expected to provide policy recommendations that contribute to enhancing the resilience of coastal areas against disasters while supporting the sustainable growth of the tourism sector.

Coastal and marine ecosystems are interconnected with terrestrial systems through water flows (rivers, surface water, and groundwater) as well as human activities, creating overall complexity and vulnerability. Theoretically, this relationship is described as the interaction between human activities, terrestrial environments, and marine systems. However, the planning and implementation of coastal and marine resource development have traditionally been conducted in a fragmented and sectoral manner, despite the ecological interconnections, thereby necessitating integrated management. Integrated coastal management is defined as a process of utilizing coastal and marine resources and spatial areas while considering sustainability and conservation aspects. Thus, disaster mitigation-based coastal tourism area planning represents the management and organization of coastal tourism through the utilization of coastal resources and space with a priority on disaster mitigation to ensure sustainability.

The process of ensuring sustainable and optimal development in coastal regions is known as integrated coastal resource management (Dahuri 1996), in which coastal spatial planning adheres to the principles of sustainable development by considering ecological, social, and economic aspects. The theoretical framework employed in this study includes the concept of Integrated Coastal Zone Management (ICZM) and ecological approaches to regional planning, supported by theories related to tourism and disaster mitigation in order to understand the context of tourism areas that holistically consider disaster risks.

- Integrated Coastal Zone Management (ICZM)
Hinrichsen (1998) in Kristiyanti (2016) explains that ICZM constitutes a comprehensive concept in coastal area management. Its objectives include addressing coastal development issues, empowering coastal communities, and ensuring equitable and sustainable economic growth. Integration and coordination are essential components of ICZM (Cicin-Sain et al. 1998;

[Bengen 2004](#)). The functions of ICZM include facilitating sustainable growth, protecting coastal areas, ensuring the sustainability of natural resources, and reducing threats from climate change. The principles of ICZM ([Clarke, Canto, and Rosando 2013](#)) encompass the uniqueness of regional potential, the preservation of water resources, integrated spatial planning, the importance of coastal setback zones, flexible boundary delineation, a focus on conservation and sustainability, integrated programs to reduce environmental degradation, the involvement of all levels of government, and management approaches that are adapted to natural conditions.

- **Ecological Approach in Regional Planning**

The structure of coastal and marine ecosystems is closely linked to upland areas due to river flows, surface water, groundwater, and human activities ([Bengen 2004](#)). This interconnection generates both complexity and vulnerability. Integrated coastal management is defined as the process of utilizing coastal and marine resources and space while considering sustainability and conservation aspects ([Bengen 2004](#)). Disaster mitigation-based coastal tourism area planning refers to the management and organization of coastal tourism through the utilization of coastal resources and spatial areas while incorporating disaster mitigation considerations. The utilization of coastal resources for national development purposes can only be successful if managed in an integrated manner (ICZM) to ensure sustainable and optimal development ([Dahuri 1996](#)). The strategic focus of coastal tourism area management in this study lies in addressing spatial utilization conflicts. The primary physical components emphasized in the spatial planning of public spaces within coastal tourism areas include land use, coastal setback lines, utilities, and supporting infrastructure. The standards corresponding to the physical elements of coastal areas to be examined are as follows:

- The unique potential of coastal tourism areas that can be showcased.
- Water resource management.
- Management of coastal setback zones.
- Flexibility in defining the boundaries of coastal tourism areas based on the issues to be addressed. In preserving local cultural values, the management of traditional coastal tourism areas must be maintained and accompanied by environmental impact analysis.

Therefore, the standards aligned with the physical elements of coastal areas to be studied are: 1) the unique potential of coastal tourism areas that can be presented, 2) water resource management, 3) management of coastal tourism setback zones, and 4) flexibility in determining coastal tourism area boundaries based on the issues being addressed.

- **Tourism**

Based on Law Number 10 of 2009 concerning Tourism, tourism is defined as a series of recreational activities supported by various facilities and services provided by businesses, the government, and local authorities. The main aspects of tourism according to ([Kurniawan et al. 2021](#)) are: 1) humans, 2) place or space, and 3) time. Tourism represents a major source of foreign exchange for Indonesia ([Rahmadio 2022](#)). Effective management generates significant economic benefits for local communities but requires strong collaboration between communities and related institutions ([Kurniawan et al. 2021](#)). To attract more visitors, [Mersyana and Hadilinatih \(2023\)](#) emphasize the need for tourism development through attractions, accommodation, service facilities, and accessibility, including diversification of tourism potential such as nature-based tourism (ecotourism, marine, mountain, and lake tourism) as well as cultural tourism. In this regard, the safety and comfort of tourists are crucial factors influencing destination choice ([Khalik 2014](#)).

- **Disaster Mitigation**

Natural disasters can cause significant damage and losses in tourism areas. According to Law Number 24 of 2007 concerning Disaster Management, disaster mitigation refers to a series of efforts to reduce disaster risks through physical development, awareness-raising through socialization, and the enhancement of community capacity in facing disasters ([Sandhyavitri et al. 2015](#)). In other words, disaster mitigation constitutes efforts to minimize the risks and impacts of natural hazards. Disaster mitigation-based coastal tourism area planning is a strategy to develop tourism areas that are safe, comfortable, and resilient to natural disasters. Coastal disaster mitigation includes structural measures (such as the development of green belts) and non-structural measures (such as risk-based land-use zoning and strengthening community

preparedness capacity) to reduce the impacts of hazards such as tsunamis, coastal abrasion, and tidal flooding (Noviantoro, Widjaja, and Ridwan 2022).

Disaster mitigation can be implemented through six steps as proposed by Jokowiarno (2011) in Haeril et al. (2021), namely: 1) undertaking protective measures for lives, infrastructure, and the environment; 2) enhancing public understanding and participation; 3) improving community preparedness; 4) strengthening coordination and institutional capacity; 5) establishing effective legal frameworks; and 6) promoting the sustainability of economic activities and improving welfare through mitigation efforts.

Disaster mitigation-based coastal tourism area planning aims to: 1) enhance the safety of tourists and local communities; 2) minimize damage to infrastructure and the economy; and 3) accelerate post-disaster recovery, as mitigation efforts can support faster recovery of tourism areas following natural disasters.

Methods

This study adopts a qualitative descriptive research design. According to Singarimbun and Effendi (1998), qualitative descriptive methods are employed to observe and understand phenomena in depth, with an emphasis on meaning rather than generalization. The approach applied is the Regional Complex Approach, which integrates spatial and ecological perspectives. This approach is utilized to analyze the interrelationships between environmental and human variables within regions characterized by unique attributes (Idhom 2025).

The spatial approach focuses on the distribution of existing and planned land use, including the analysis of natural hazards, in order to derive problem-solving strategies, identify causal factors, regional potentials, threats, and appropriate management strategies.

Data collection for the analysis of public space arrangement in disaster mitigation-based coastal tourism areas encompasses the following aspects:

- 1) Physical conditions that trigger disasters.
- 2) Community attitudes and behavior in environmental management.
- 3) Cultivation activities related to land-use conversion.

- 4) The relationship between cultivation practices and their impacts.
- 5) The distribution of existing land use.
- 6) The spatial distribution of required land uses.

The results of the analysis of the aforementioned data are subsequently utilized to formulate a model for public space arrangement in disaster mitigation-based coastal tourism areas. The research location is Pantai Baru, Srandakan District, Bantul Regency, Special Region of Yogyakarta.

Data collection methods

The data required in this study consist of primary and secondary data. Primary data are obtained directly from the field, while secondary data are collected from various existing sources. Data collection techniques employ methods considered appropriate to obtain accurate, comprehensive, and scientifically verifiable data, namely:

- Field Observation

Conducted continuously to obtain diverse data. The objective is to identify the physical conditions of the area, observe the activities of local communities and tourists at Pantai Baru, and verify secondary data in order to formulate a systematic model for disaster mitigation-based coastal tourism area planning.

- Interview

Conducted with informants selected using the snowball sampling technique. This technique is employed based on specific considerations, where information gathering begins with one or a few individuals or cases and expands through relational networks from the initial cases, with the aim of addressing particular considerations that may arise during the research process (Ahmadi 2014).

- Documentation

Involves the collection and review of relevant documents such as laws and regulations, planning documents, statistical data, previous studies, and literature related to the concept of Integrated Coastal Zone Management (ICZM) and ecological approaches in regional planning.

Data analysis method

The data analysis technique consists of four stages: data collection, data reduction, data presentation, and conclusion drawing and verification.

- 1) Data Collection: The initial stage involving the comprehensive gathering of primary and secondary data to establish the analytical foundation.
- 2) Data Reduction: The stage of simplifying, classifying, and eliminating irrelevant data to produce meaningful information and facilitate conclusions. This stage determines the relevance of data in relation to the research objectives.
- 3) Data Presentation: The stage of systematically organizing data (in the form of narrative text, matrices, graphs, networks, and diagrams) to structure relational patterns and enhance comprehension.
- 4) Conclusion and Verification: The stage of deriving meaning from relationships, similarities, and differences within the data, aligned with research objectives. Conclusions are initially tentative and subsequently validated with evidence, while verification ensures objectivity and credibility.

Coastal area planning refers to the principles of sustainable development that consider ecological, social, and economic aspects. The theoretical framework applied in this study includes the concept of Integrated Coastal Zone Management (ICZM) and ecological approaches in regional planning.

The strategic focus of coastal tourism area management in this study lies in spatial utilization conflicts. The primary physical components emphasized in public space arrangement within coastal tourism areas include land use, coastal setback lines, utilities, and supporting infrastructure. The standards aligned with the physical elements of coastal areas to be examined are:

- The unique potential of coastal tourism areas that can be presented.
- Water resource management.
- Management of coastal tourism setback zones.
- Flexibility in defining coastal tourism area boundaries based on the issues to be addressed.

To preserve local cultural sustainability, the management of traditional coastal tourism areas must be maintained, accompanied by environmental impact analysis within coastal areas.

Results and discussion

Physical conditions of Pantai Baru, Bantul Regency

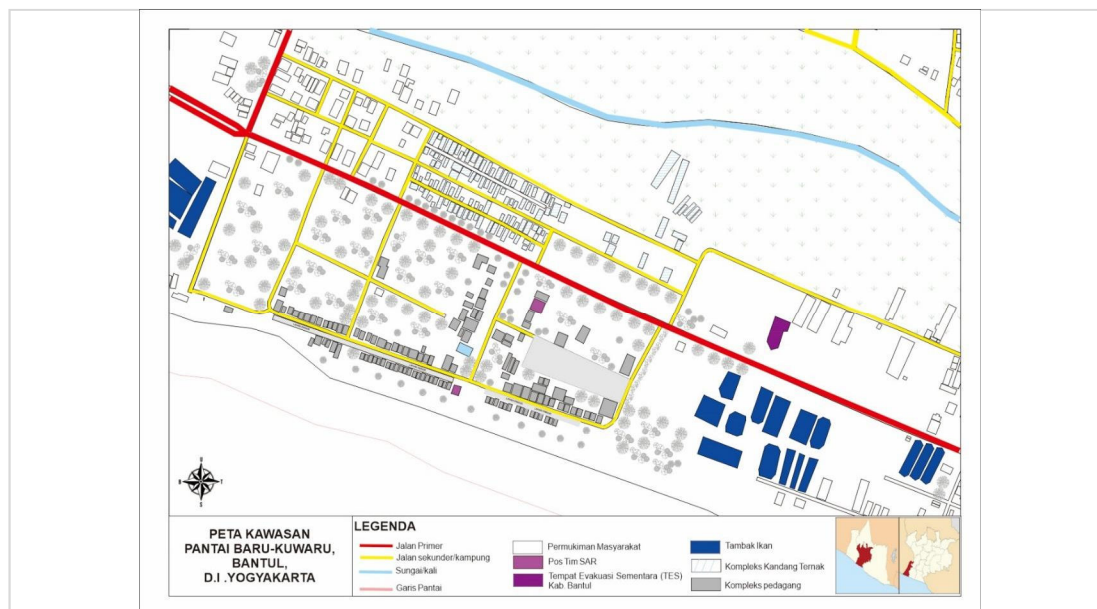


Figure 1. Map of Pantai Baru area

Pantai Baru is located in Poncosari Village, Srandakan District, Bantul Regency, Special

Region of Yogyakarta (see [figure 1](#)). This beach forms part of the southern coastline of Java Island,

directly bordering the Indian Ocean, and exhibits the typical physical characteristics of the dynamic and open southern coast. As one of the tourist beaches in the southern coastal region of Yogyakarta, Pantai Baru is recognized as an area with considerable disaster vulnerability (Irawati and Rif'an 2020). Prakoso (2018) in Kiswanto and Susanto (2020) notes that Pantai Baru is categorized as a black sand beach formed from alluvial deposits and fine volcanic materials transported by river flows, with relatively flat or gently sloping topography.

The open nature of the coastline results in high and strong waves, particularly during the

southwest monsoon season. The beach also features a relatively long shoreline with limited natural protection from the sea. This condition sustains active sedimentation processes, rendering the coast vulnerable to abrasion (see figure 2a), especially during the rainy season and tidal fluctuations (Kiswanto and Susanto 2020). Based on field observations, parts of Pantai Baru have been planted with protective vegetation, such as sea pine (cemara udang) and pandanus, to prevent abrasion and delineate coastal boundaries. However, several areas have experienced degradation due to development, cultivation, and tourism activities (see figure 2b).



Figure 2. (a) Impact of abrasion at Pantai Baru, (b) Degradation of protective vegetation due to cultivation and tourism at Pantai Baru

Pantai Baru is a coastal area that has developed rapidly as a tourism destination and center of coastal economic activities, despite being categorized as the youngest beach in Bantul Regency (Suhartapa and Sulistyo 2021). According to data from the Central Bureau of Statistics of Bantul Regency, tourist visits to the Pandansimo–Kuwaru coastal corridor reached 86,079 visitors in 2024 (Badan Pusat Statistik

Kabupaten Bantul 2025). The disaster-prone physical condition of the beach prohibits tourists from swimming in the sea (Sidik 2023). Nevertheless, the community offers alternative facilities, including wind turbines (PLTB / New Energy Power Plants), food stalls, parking areas, and recreational attractions such as ATV rentals and painting activities accompanied by direct coastal views (see figure 3).

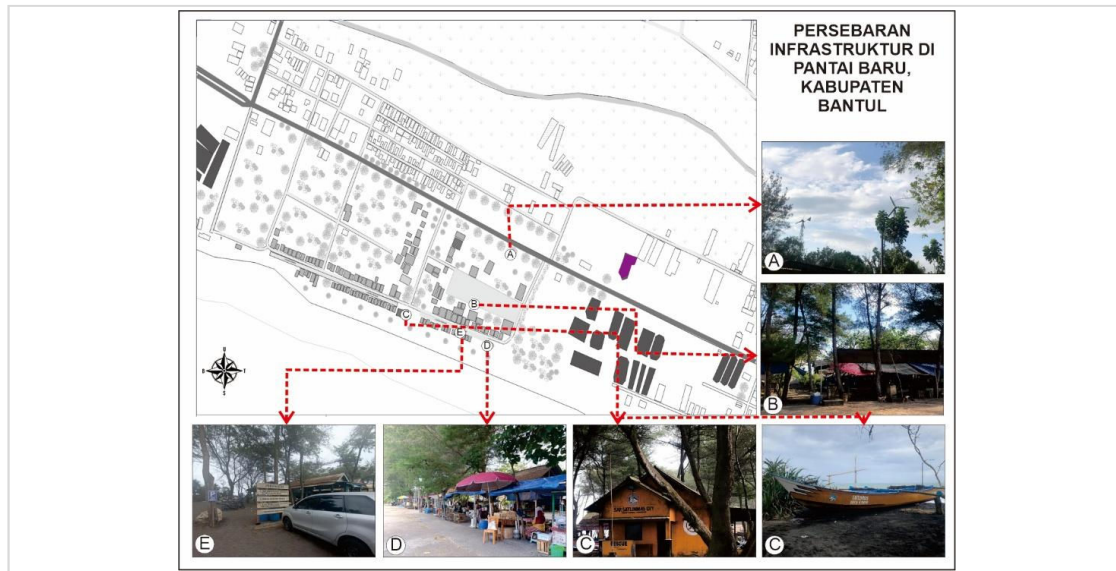


Figure 3. Distribution of infrastructure at Pantai Baru

As a disaster-prone area, Pantai Baru is also equipped with disaster mitigation infrastructure such as a Search and Rescue (SAR) post (see [figure 3](#)). However, this infrastructure has not fully addressed the existing vulnerabilities. Pantai Baru remains susceptible to various coastal hazards, including tsunamis due to its proximity to the active subduction zone of the Indian Ocean; coastal damage caused by large waves and tidal fluctuations; strong winds and tropical storms, particularly during the rainy season; and seawater

intrusion resulting from shoreline changes and degradation of natural vegetation. To address these challenges, local communities rely on the development of green belts through vegetation planting along coastal setback zones directly exposed to marine dynamics. Therefore, planning efforts must incorporate traditional mitigation practices already implemented by local communities, particularly through vegetation planting as a form of natural mitigation along the coastline.



Figure 4. Accessibility conditions at Pantai Baru

Accessibility at Pantai Baru sufficiently supports tourism activities (see [figure 4](#)). Paved roads provide relatively easy access from the center of Srandakan District. Within the coastal area, signage has been installed to direct visitors to parking areas, evacuation routes, assembly points, and provide information regarding disaster-prone conditions. However, evacuation routes and assembly points for disaster mitigation remain limited, particularly in terms of evacuation signage and access to higher ground. Additionally, parking areas at Pantai Baru are not yet well-organized. Based on interviews, parking locations situated near food stalls along the coastline are occasionally affected by tidal flooding. Furthermore, parking access routes, pedestrian pathways, and business circulation paths are not clearly differentiated, which may hinder overall accessibility. Disaster-related information at Pantai Baru strongly emphasizes the high tsunami risk, necessitating particular attention to: 1) hazard zone projection; 2) the development of efficient evacuation routes; and 3) dissemination of information to communities and tourists.

According to interviewed vendors, Pantai Baru is generally prone to wave-related hazards. This condition renders the entire coastal area vulnerable, particularly along the shoreline where wave interactions intensify, making certain points more hazardous than others. These conditions are difficult to predict, as wave convergence points shift dynamically. Common wave-related hazards include tidal flooding and coastal abrasion, with the most severe occurrences typically recorded between July and August. According to the head of the Tourism Awareness Group (POKDARWIS), consistent with the Disaster-Prone Map classification, the entire southern coastal area falls within the Alert Zone (Red Zone).

Wave activity, particularly during July–August, contributes to high wave events and abrasion. Abrasion has caused shoreline retreat, resulting in commercial areas and markets, originally compliant with government regulations requiring a 100–200 meter setback from the coastline, gradually shifting closer to the gently sloping shoreline. This condition is also evidenced by elevation differences between economic zones and the beachfront.

A mitigation-based spatial planning approach must be implemented to reduce development pressure and land-use conversion, particularly in

areas adjacent to the shoreline. Coastal development planning is expected to serve as a strategy to reduce disaster impacts and enhance human safety and livelihoods in coastal areas ([Monoarfa, Gobel, and Syukri 2023](#)). In this context, the reinforcement of natural vegetation such as mangroves and sea pine (cemara udang) is essential due to their function as protective zones. The physiographic or physical conditions of coastal areas include landform characteristics, soil properties, elevation, and the presence of natural ecosystems such as mangroves or coral reefs. These factors significantly influence the vulnerability of coastal regions to various natural hazards. The level of vulnerability is strongly determined by coastal physical conditions. The impacts of disasters such as tsunamis, abrasion, tidal flooding, and sea-level rise can be exacerbated by the interaction between natural factors (such as topography, geology, and ocean currents) and human activities (such as reclamation, vegetation clearing, and sand mining). Therefore, disaster mitigation and adaptation planning must incorporate physiographic elements in coastal management. However, based on interviews with local communities, although various types of vegetation have been planted as part of physiographic considerations, only sea pine (cemara udang) has demonstrated resilience. Consequently, this vegetation type is selected as the primary natural element within the proposed area planning model.

Community attitudes and behavior in managing the natural environment

- Littering Behavior

Based on interview results with local communities as tourism actors, waste management has been conducted in an integrated manner. However, this has not provided a complete solution, as evidenced by field observations showing that both tourism actors and visitors still dispose of waste (plastic, household waste, and other refuse) into the beach or sea. This behavior contributes to coastal environmental pollution, degrades the aesthetic quality of the beach, and poses long-term threats to marine ecosystems. According to visitors, improper waste disposal is one of the primary causes of coastal environmental degradation; therefore, a simple solution lies in increasing awareness to collect personal waste and dispose of it in designated facilities.

According to tourism actors, further waste management efforts at Pantai Baru have included plans for separating organic waste (such as fish and vegetable residues) to be processed into compost, while non-organic waste is transported to the Final Disposal Site (TPA).

- **Overexploitation of Natural Resources**
Destructive fishing practices (such as the use of explosives or poisons), indiscriminate cutting of coastal vegetation such as mangroves or sea pine (cemara udang), and unauthorized sand extraction for personal use can disrupt ecosystem balance and accelerate coastal abrasion. Based on interviews with visitors, tree cutting is identified as a major form of environmental degradation associated with vegetation exploitation. However, this differs from the perspectives of traders and the Tourism Awareness Group (POKDARWIS), who indicate that conservation efforts have been undertaken since the 1990s through government-led vegetation planting programs, most of which failed except for sea pine (cemara udang), which has persisted and remains a key element in maintaining area stability and sustainability. Furthermore, there has been a failure in abrasion mitigation efforts by the government through the use of sand from Mount Merapi eruptions, which was instead exploited by communities around Merapi and sold, preventing it from reaching the coastal area. Additionally, the construction of the Pandansimo Bridge has triggered illegal sand mining through river normalization processes, contributing to environmental degradation, including damage to Pantai Baru.
- **Neglect of Spatial Planning and Zoning Regulations**
The condition of tourism areas becoming increasingly closer to the shoreline due to abrasion has encouraged communities to develop settlements, business facilities, or tourism infrastructure within disaster-prone or protected zones without adherence to spatial planning and zoning regulations. This practice risks damaging conservation areas and increasing environmental vulnerability.
- **Lack of Environmental Awareness and Consumptive Behavior in Tourism**
Apathy or lack of concern toward coastal cleanliness and sustainability, including low participation in conservation activities and disregard for environmental regulations,

exacerbates environmental degradation. Tourists often engage in irresponsible behaviors such as using single-use packaging, disposing of waste improperly, and ignoring conservation boundaries, thereby damaging coastal ecosystems due to insufficient awareness, knowledge, and concern. In response to these conditions, local communities as tourism actors have implemented several measures, including coastal security patrols conducted by POKDARWIS, SAR teams, and local residents. These patrols not only ensure safety, such as preventing swimming in hazardous areas, but also encourage visitors to comply with conservation regulations to prevent further environmental damage and promote responsible participation.

Based on the above points, this analysis identifies that community attitudes and behaviors significantly influence unsustainable land-use practices. Although the Pandansimo Bridge has contributed to natural resource exploitation, it simultaneously offers opportunities for sustainable tourism development. Therefore, collaborative efforts among business actors, local communities, and government institutions are essential in managing future area development.

Cultivation Activities and Land-Use Conversion

- **Aquaculture Development and Land Cover Change**

There is a strong tendency toward the conversion of natural ecosystems into productive land for aquaculture, a pattern that has been widely observed along the southern coast of Yogyakarta.

- **Blue Economy in Sustainable Tourism**

A study on the implementation of the Blue Economy concept in the coastal region of the Special Region of Yogyakarta (conducted between January–May 2023) highlights the significant potential of marine tourism in improving community welfare, provided that tourism development is balanced with environmental mitigation and sustainable management strategies. This approach emphasizes a balance between the exploitation of coastal resources for economic purposes and ecosystem conservation, where activities such as marine tourism can support local income while preventing environmental degradation through strict regulation.

According to coastal managers/POKDARWIS, environmental

degradation at Pantai Baru does not primarily originate from local communities, who are generally aware of conservation practices, but rather from the construction of the Pandansimo Bridge, which has triggered river normalization and its misuse for illegal sand mining. Economic-related cultivation activities have also led to land-use conversion in coastal areas, supported by the Sultan Ground regulation, which grants authority for coastal management aimed at improving community welfare (Hakim 2025). Nevertheless, local communities maintain conservation efforts by limiting expansion of built areas, although natural challenges such as coastal shrinkage impose management constraints. These efforts are carried out collectively at the village level.

Distribution of existing land use

Spatial utilization at Pantai Baru, particularly for trading areas and markets, is the result of collective agreements between traders and POKDARWIS. Through POKDARWIS, spatial arrangements, including trading areas, circulation routes, and parking, have been designed with consideration of development setbacks in accordance with government regulations, namely a distance of 100–200 meters from the shoreline. However, current conditions indicate that the distance between the shoreline and tourism areas is less than 50 meters due to repeated abrasion events. This proximity to the shoreline has resulted in tourism areas being affected by tidal flooding, thereby disrupting tourism activities. In this context, strengthening measures are required in areas adjacent to the shoreline through coastal vegetation planting and the reorganization of built structures in accordance with prescribed setback distances while considering future disaster risks. Consequently, spatial reconfiguration should include the provision of open space along the beachfront and the elevation of commercial structures to mitigate future tidal flooding.

Spatial distribution for multifunctional use

Coastal areas represent regions with diverse strategic functions encompassing ecological, social, and economic dimensions. Ecologically, coastal zones play a vital role in maintaining

environmental balance through ecosystems such as mangroves, seagrass beds, and coral reefs, which function as natural buffers against abrasion and habitats for marine biodiversity. Pantai Baru is also recognized as a turtle landing site within Bantul Regency. From a social perspective, coastal areas serve as residential zones for fishing communities whose livelihoods depend on marine resources. Economically, coastal areas are utilized for tourism activities, capture fisheries, aquaculture, and even marine-based industries.

However, this multifunctionality can lead to overlapping spatial utilization if not properly regulated. Unstructured spatial distribution may result in conflicts among user groups, such as traditional fishermen, aquaculture operators, tourism managers, and government authorities. Moreover, uncontrolled management increases the risk of environmental degradation, including coastal ecosystem deterioration, pollution, and reduced carrying capacity. To address these challenges, clear and structured spatial planning is essential. Through the implementation of zoning in accordance with the Regional Spatial Plan (RTRW) and Coastal Zoning Plans, each activity can be allocated to appropriate locations, thereby supporting sustainable utilization. Zoning not only prevents conflicts but also clarifies rights and responsibilities among stakeholders, including government, communities, and business actors.

Disaster mitigation-based spatial planning model for Pantai Baru

Based on the preceding discussion, it can be concluded that a disaster mitigation-based spatial planning model for Pantai Baru is necessary to reduce vulnerabilities to tsunamis, abrasion, tidal flooding, and seawater intrusion through sustainable zoning. The previous sub-sections, covering physical conditions, community behavior, cultivation activities, spatial distribution, and multifunctional space, serve as key determinants in developing the model, as summarized in [table 1](#) to highlight the main factors influencing spatial planning. The implications for the proposed model are presented in [table 1](#) (see [table 1](#)).

Table 1. Summary of subsections and their implications

Sub chapter	Aspect	Main conclusion	Implications for the coastal area spatial planning model
1	Physical Coastal Conditions	The coastal condition is characterized by a gently sloping topography, with volcanic sand types that are highly susceptible to abrasion and high wave action; the presence of degradation in coastal protective vegetation; infrastructure that has not adequately supported the area, particularly in terms of circulation systems including transportation, human movement, and disaster-related aspects (evacuation); as well as an area that is highly vulnerable to multiple hazards, especially tsunami events (Red Zone) and tidal flooding during seasonal wind periods.	Prioritizing a natural green belt (0–100 m); elevating building structures, particularly food stalls; and providing efficient evacuation routes.
2	Community Attitude and Behavior	The attitudes and behavior of the community, both as tourism operators and visitors, include habitual littering, overexploitation of natural resources (deforestation and illegal mining), and neglect of zoning regulations within coastal setback areas, despite the involvement of POKDARWIS in spatial planning efforts and waste management practices carried out by business actors.	Enhancing collaboration among business actors, tourists, and government institutions to maintain environmental sustainability.
3	Cultivation Activities and Land Use Conversion	There has been a conversion of natural land into shrimp aquaculture ponds; negative impacts arising from development projects (Pandansimo Bridge); and the potential of the Blue Economy concept to support sustainable tourism development.	Strengthening land-use zoning management; promoting environmentally friendly cultivation practices; and implementing multifunctional zoning without conflict.
4	Distribution of Existing Spatial Use	The spatial arrangement of the area has been developed through deliberation with POKDARWIS; however, it remains inadequately organized, particularly regarding parking areas, pedestrian pathways, and business activities that are concentrated within a single zone.	Aligning spatial planning with the Regional Spatial Plan (RTRW); separating parking circulation, pedestrian movement, and commercial activities to improve functionality and flow.
5	Distribution of Space for Multifunctional Use	The area encompasses ecological functions (Casuarina equisetifolia vegetation and sea turtle conservation), social functions (fishermen settlements), and economic functions (tourism and aquaculture), which pose risks of conflict and environmental degradation if not properly zoned.	Establishing clear zoning divisions for conservation (ecological areas), economic activities (food stalls and tourism activities), as well as parking and administrative zones.

Based on the table above, it can be observed that the area modeling emphasizes the concept of Integrated Coastal Zone Management (ICZM) and ecological approaches in regional planning.

Prior to developing the spatial model, it is necessary to understand the context of existing zoning distribution at Pantai Baru (see [figure 5](#)).



Figure 5. Existing Zoning of Pantai Baru

The figure above (see figure 5) illustrates zoning based on land-use utilization. Four dominant zones characterize the area: fishermen settlements, fish ponds, livestock-agricultural areas, and the economic zone represented by Pantai Baru itself. At Pantai Baru, parking areas are constrained by adjacent commercial zones (restaurants), some of which are located close to the green belt area within the coastal setback zone (100 meters from the shoreline). This condition increases vulnerability to tidal flooding during sea-level rise. Therefore, spatial planning within the coastal setback zone must prioritize

conservation areas as a form of structural-natural or traditional mitigation through the use of sea pine (cemara udang), the only vegetation capable of thriving at Pantai Baru. This conservation zone also serves as a restricted activity area due to its classification as a high-risk (red zone) and its function as a turtle conservation area. Furthermore, parking areas should be located near the main road (northern part of Pantai Baru) to facilitate evacuation during disasters. The central area thus functions as a transitional economic zone that still considers the site's vulnerability to hazards.

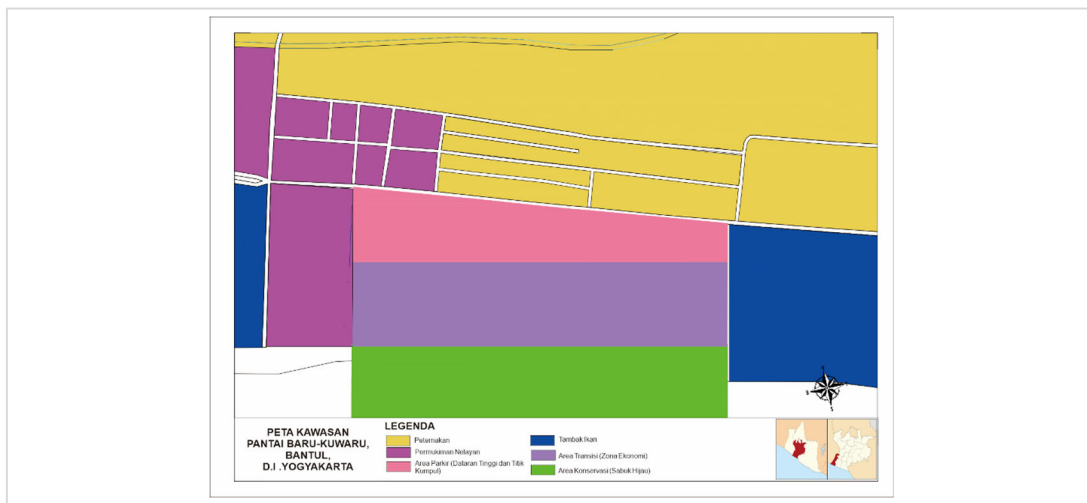


Figure 6. Zoning Model of Pantai Baru Area

The zoning arrangement has been systematically incorporated into the spatial model of Pantai Baru. This division also serves as a strategy to attract tourists, aligning with the objectives of the Pandansimo Bridge

development, which aims to increase visitor numbers. The disaster mitigation-based spatial planning model for Pantai Baru is illustrated in figure 7 below.

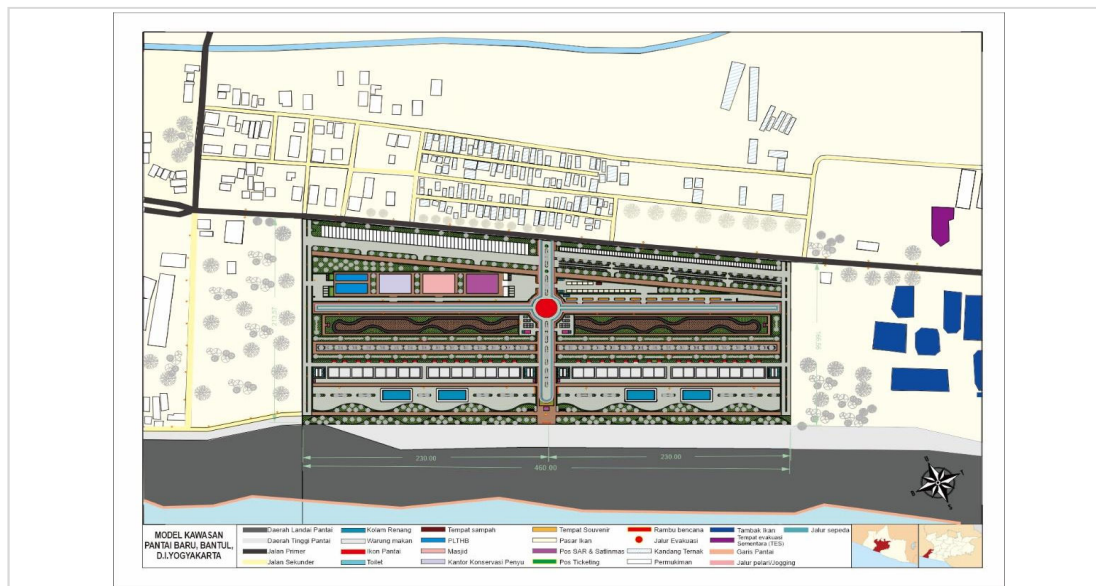


Figure 7. Disaster mitigation-based spatial planning model of Pantai Baru

In the proposed spatial model, the front coastal zone (0–100 meters from the shoreline) are designated as a non-development area. This zone functions as a conservation area with minimal activity, consisting of sea pine vegetation zones, turtle conservation areas (nesting seasons), and boat storage areas for fishermen. Sea pine (*cemara udang*) is a significant coastal species that serves as a wind barrier, supports green landscapes, tourism, culinary activities, and shading functions (Syahbudin, Adriyanti, Bai, Ninomiya, and Osozawa 2013). This zone also accommodates the SAR post located centrally within the conservation area. The middle zone serves as the economic zone, consisting of swimming pools, parks, food stalls, and ATV areas. The park area functions as a development zone, which can be utilized for outbound activities, camping grounds, and similar purposes. The final zone comprises parking and supporting facilities, including bus parking, car parking, motorcycle parking, PLTB offices, Satlinmas offices, turtle conservation

offices, mosques, fish markets, and souvenir shops. These facilities are located in the northern area to reduce land pressure near the shoreline and to separate functional circulation from tourism activities.

The new spatial model introduces differentiated circulation systems, separating pedestrian pathways, cycling tracks, jogging routes, and providing a central iconic space for Pantai Baru. Existing transportation circulation, which previously overlapped with pedestrian movement, is reorganized so that parking is relocated to the northern zone, reducing vehicular access within the tourism area. However, service circulation remains available for loading, maintenance, and operational needs in commercial and administrative zones. Additionally, direct circulation routes to the beach are maintained for emergency preparedness. The transportation circulation model is illustrated in figure 8.

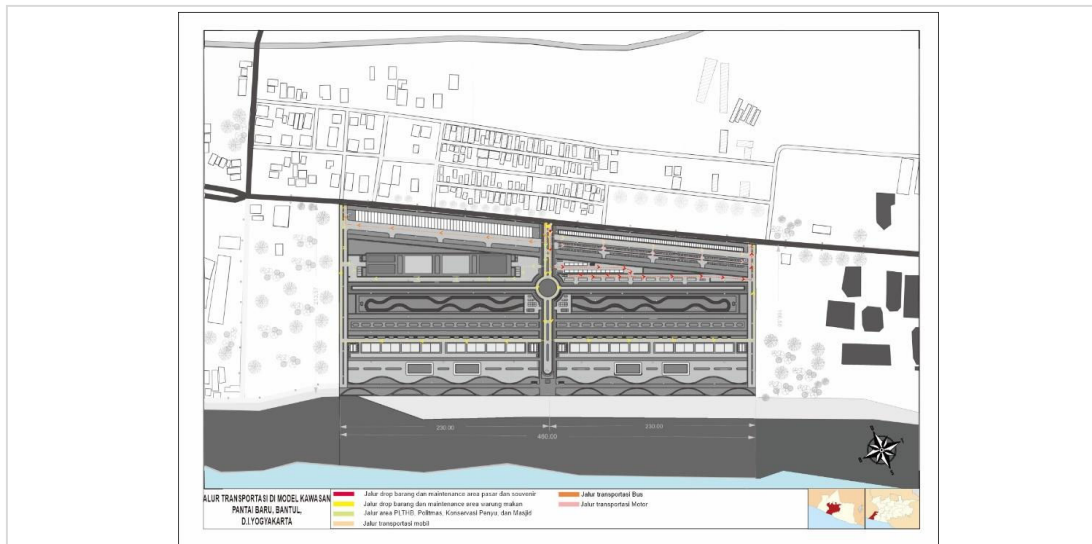


Figure 8. Transportation flow in the Pantai Baru spatial model

As a red-zone area prone to multiple hazards, particularly tsunamis, Pantai Baru relies on Temporary Evacuation Sites (TES) located in Poncosari Village. Therefore, spatial planning must prioritize evacuation routes, signage, and accessible disaster information across all activity

zones. Coastal pathways connecting to settlements and aquaculture areas must also be equipped with disaster signage. The evacuation flow within the Pantai Baru model is presented in [figure 9](#).

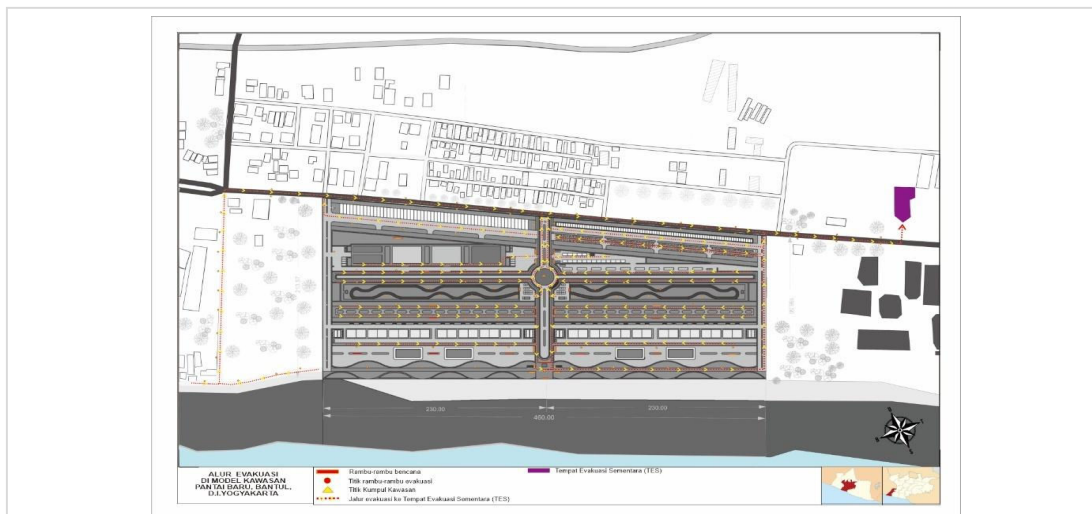


Figure 9. Evacuation flow in the Pantai Baru spatial model

Tsunami evacuation routes, according to Dito & Pamungkas (2015) in [Lessy et al. \(2021\)](#), must consider at least four aspects: the number of people active and residing in coastal areas, available road access to safe zones, topographical conditions, and the determination of safe assembly zones.

Beyond the spatial model, effective collaboration among local communities, tourism actors, visitors, and government institutions is essential. This collaboration includes environmental maintenance and efficient disaster management, particularly in mitigation efforts, to ensure the sustainable development of Pantai Baru. Strengthening disaster awareness through

information dissemination and individual responsibility in maintaining the coastal environment is also crucial. Furthermore, policy reinforcement is necessary to support disaster mitigation-based spatial planning, especially considering that all coastal areas in Bantul Regency are classified as disaster-prone zones, particularly for tsunamis.

Conclusions

Pantai Baru is one of the coastal areas in Bantul Regency, Special Region of Yogyakarta. This study aims to examine a disaster mitigation-based coastal spatial planning model by identifying area characteristics, land-use patterns, and disaster risks to develop a safer and more sustainable spatial model. The research is based on primary and secondary data analysis through field observations, interviews, and documentation, integrated with the concept of Integrated Coastal Zone Management (ICZM) and ecological approaches in regional planning.

The physical condition of Pantai Baru indicates high vulnerability to multiple hazards, including tsunamis, abrasion, tidal flooding, and seawater intrusion. This vulnerability is influenced by its flat topography, alluvial-volcanic sand composition, and degradation of protective vegetation (sea pine). Community attitudes and behaviors remain insufficient in supporting environmental sustainability, as evidenced by littering, excessive natural resource exploitation, and disregard for coastal zoning regulations, despite existing efforts that have not yet ensured long-term sustainability. Furthermore, the distribution of multifunctional land use remains poorly organized and has the potential to generate spatial conflicts.

Based on these findings, the proposed disaster mitigation-based spatial planning model integrates sustainable zoning into three main areas: a conservation zone (0–100 meters from the shoreline) utilized as a natural green belt, turtle conservation area, and SAR post; an economic zone consisting of swimming pools, parks, food stalls, and ATV tracks; and a parking and supporting zone including vehicle parking areas, PLTB facilities, turtle conservation offices, mosques, Satlinmas offices, fish markets, and souvenir shops. The model also incorporates separated circulation systems for transportation,

service activities, and pedestrian movement (walking, cycling, and jogging). Evacuation routes are designed to be more efficient, facilitating access to Temporary Evacuation Sites (TES).

This spatial planning model must be complemented by non-structural mitigation measures such as community education and collaboration among business actors, tourists, and government institutions. The model is expected to enhance the resilience of coastal areas against disasters, particularly in light of future development opportunities following the construction of the Pandansimo Bridge. Ultimately, disaster mitigation-based spatial planning supports sustainable tourism development while reducing socio-economic risks and spatial conflicts.

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