

# Strengthening Tourism Destination Resilience Through Health, Safety, and Security: A Case Study of Batu Karas Beach, Pangandaran

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## Abstract

*Batu Karas Beach is a prominent marine tourism destination in Pangandaran, Indonesia, renowned for its surf-grade wave characteristics. However, these physical attributes harbor significant environmental risks, necessitating a robust safety management framework. This study employs a descriptive qualitative approach to evaluate the implementation of Occupational Safety, Health, and Security as a fundamental instrument of destination resilience. The conceptual framework integrates spatial-temporal visitor dynamics with hazard identification, specifically targeting dominant risk factors such as rip currents and breaking waves. The research further assesses the functional effectiveness of the Life Guard (Balawista) in incident mitigation and emergency response. Analysis reveals a critical discrepancy between field officer ratios and visitor fluctuations during peak seasons. While a supervisory structure exists, this operational imbalance increases maritime vulnerability and potential accident rates. The current safety infrastructure remains largely traditional, lacking integration with modern preventive systems. Research findings recommend integrating digital technologies such as QR-Code-based information systems and modernizing safety equipment to strengthen Health Safety and Security standards. Enhancing personnel capacity through international certification and preventive education for tourists are crucial prerequisites for establishing Batu Karas Beach as a safe, globally competitive, and sustainable destination.*

**Keywords** : Batu Karas, Marine Tourism, Pangandaran, Risk Assessment, Safety Load Ration

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## Introduction

Marine tourism in Indonesia has transformed significantly from a simple recreational activity to a significant economic aspect that requires high standards of safety. The high number of disasters, especially in coastal areas, has led to increased awareness of the significance of safety in tourism. This is evident in the change in attitude of tourists, where they now consider safety a priority in their tourism activities (Cisternas et al., 2024). This has led to a response by tourism managers to cater to the changing needs of their customers through different strategies, one of them being the incorporation of new safety standards in tourist sites (Alisjahbana & Murniningtyas, 2018; Lestari & Indrayati, 2022).

The implementation of Health, Safety and Security in the tourism industry, also referred to as HSSA not only a statutory requirement but also a basic necessity in terms of the concept of tourism destination resilience (Oktaviarni, 2018). In Indonesia, this practice has been in place since tourism destination understands at the ability of a tourism system to absorb disruptions, adapt to changes, and maintain its primary functions for the safety of visitors.



Some of the law about HSSA specifically for the tourism industry, is Law of the Republic of Indonesia Number 10 of 2009 concerning Tourism provides an explicit mandate in Article 23 that the government and local governments have an obligation to provide tourism information, legal protection, and security and safety for tourists. This obligation is reciprocal, whereby in Article 26, the same law requires tourism entrepreneurs to provide comfort, hospitality, security, and safety to every visiting guest. Not providing these aspects not only has legal implications but also directly affects tourist satisfaction and revisit intentions.

In West Java, for example, in the development of HSSA for tourists, there is an emphasis on integrating health security, infrastructure safety, and digital health insurance (Kartika et al., 2024). This development resulted in an increase in awareness of tourist safety in some tourist destinations, especially in areas where there is a high probability of disaster occurring, for example, in some areas in West Java Province located in coastal areas; in most of these areas, disturbances may originate from the extreme dynamics of the Indian Ocean, including rip currents, high waves, and biological hazards from marine organisms (Dikara et al., 2022).

The historical data indicate that in the southern coastal area of West Java Province, there is a high physical hazard index due to direct exposure to wave energy from the open sea. In 2023, The southern coast of West Java is characterized by a high physical hazard index, a direct consequence of its exposure to high-energy swells from the Indian Ocean. Recent data from 2023 underscores this vulnerability, with numerous marine accidents and fatalities recorded in the Pangandaran Regency, necessitating a rigorous re-evaluation of field-level risk management (Marpaung & Rahayu, 2025). Within this high-risk corridor, Batu Karas Beach serves as a critical focal point for study due to its dual nature: it is a premier international surfing hub that simultaneously acts as a high-density "human-environment" collision zone. While previous scholarship in the Pangandaran region has extensively mapped macro-scale geophysical threats—primarily focusing on tsunami inundation modeling and long-term coastal retreat—there remains a significant pedagogical and operational gap regarding active daily hazard mitigation. Existing studies often prioritize tourism development from an economic or infrastructural lens, frequently overlooking the Occupational Safety, Health, and Security (K3P) framework as a core component of destination resilience.

Geographically, Batu Karas Beach is located in Batukaras Village, Cijulang District, and is commonly recognized as the "Bali of West Java" because of its unique blend of a peaceful rural environment and a stable wave condition that is appropriate for both amateur and professional surfers. The features of the beach, which have a sloping shoreline measuring approximately 600 meters, make it a big attraction for thousands of visitors every year. However, with the growing number of visitors, the health, safety, and security (K3) issues have become essential parameters that shape the image and sustainability of the site

Although Batu Karas Beach is morphologically safer than West Pangandaran Beach, the regular occurrence of rip currents and crashing waves during specific periods of the year still pose a threat that needs to be addressed by the concerned parties, especially the Water Tourism Rescue Agency (Balawista)

The focus of this study is Batu Karas Beach, where the conditions of the current occupational health and safety facilities, the profile of the risks of tourism activities, and the pattern of visits by tourists that impact the workload of the security system are evaluated. The objectives of this report, based on the integration of the statistical data of the visits of tourists from the Pangandaran Regency Tourism and Culture Office, along with technical reports from the Regional Disaster Management Agency (BPBD), are to provide a comprehensive overview of the degree to which Batu Karas Beach has fulfilled the criteria of being a safe tourist destination. The analysis, based on K3P perspective, in conformity with the parameters of environmental sensitivity, is expected to be a reference of strategic importance for marine tourism operators, tourist policy, enhancing the quality of safety services, the adoption of digital technology in disaster mitigation, and strengthening the position of Batu Karas on the map of international tourism.

## Method

This research was conducted at Batu Karas Beach, administratively located in Batukaras Village, Cijulang District, Pangandaran Regency, West Java Province. This location was selected as a destination for marine tourism, specifically water sports and surfing. The site is characterized by a sloping coastline stretching approximately 600 meters, which creates unique visitor dynamics (Saepul Milla & Fadlina, 2023). Furthermore, the selection of Batu Karas is underpinned by its significant physical risk profile, which necessitates a comprehensive resilience analysis compared to other conventional coastal destinations in the region

This study employs a Convergent Parallel Mixed-Methods design, integrating qualitative field observations with quantitative risk analysis. This dual approach allows for a comprehensive evaluation of the K3P framework by correlating subjective visitor experiences with objective physical hazard metrics. The research framework will be based on the following aspects of the existing system in terms of the tourism destination's resilience to the management of the existing physical hazards.

The process of gathering the required data for the research will be based on two different categories of data, namely, primary and secondary. Primary data will be gathered through A quantitative survey was administered to a purposive sample of 30 tourists directly engaged in marine activities (e.g., surfing). The instrument utilizes a Likert-scale questionnaire to quantify Risk Perception and Safety Compliance. Observation required through Physical hazards (rip currents, breaking waves) are evaluated using a Risk Matrix (Likelihood × Severity). This numerical scoring identifies "High-Risk Zones" based on historical accident data from 2023 and real-time wave energy observations. Reliability Internal consistency is verified using Cronbach's Alpha (where alpha > 0.70) to ensure the survey instrument yields stable and consistent results.

Secondary data collection was conducted through official documents and literature that are relevant to the study and Systematic monitoring of Balawista (Life Guard) operational maneuvers and visitor-guard ratios during peak and off-peak hours. This includes tourist visitation data from the year 2021-2024, which was collected from the Pangandaran Regency Tourism and Culture Office, operational data of the Balawista Task Force from the Regional Disaster Management Agency (BPBD), and literature about the oceanographic factors of the Southern West Java coast.

The analysis of the data was conducted in an integrated process involving three stages:

First, the study aimed to organize statistical data about tourist visits to identify trends in seasonal visitor fluctuations and their relationship with safety management loads.

Second, potential risks were identified through a risk matrix involving probability parameters and severity levels, which were determined from annual marine accident data. More specifically, the risk analysis was conducted using the following formula where both probability and impact are scored on a scale of 1 to 5:

$$\text{Risk} = \text{Probability} \times \text{Impact}$$

To understand the total risk, we should look at two different dimensions:

1. Probability (Likelihood): How likely is it that the event will happen. This is usually measured on a scale (e.g., 1 to 5) or as a percentage.
2. Impact (Severity): If it does happen, how bad is the damage. This could be measured in financial loss, time delays, or damage to reputation.

Third, mixed method analysis was conducted to assess the effectiveness of the implementation of HSSA from the aspect of the resilience of Batu Karas Beach as a tourism destination. The results of the aforementioned stages were synthesized into a comprehensive

narrative that links the facts gathered in the field to strategic recommendations on technology-based mitigation and human resource capacity building.

## Results and Discussion

### Analysis of the Physical and Oceanographic Conditions of Batu Karas Beach

Batu Karas Beach features a unique longshore bar and trough morphology that dictates a "split" risk profile. While the sandbar acts as a natural breakwater by forcing wave energy to dissipate before the shoreline, it creates a false sense of security. The physical parameter of the trough—a deep channel between the bar and the shore—introduces a "Step-off" drowning hazard where depth increases abruptly. Furthermore, the interaction between the water mass and the seabed topography creates a pressure gradient; in gaps along the sandbar, this pressure is released as high-velocity rip currents. Operationally, this means the "calmer" areas are actually the most dangerous zones for lateral drift and offshore transport of swimmers.

The slope of Batu Karas ( $m = 0.02$ ) categorizes it as a gentle beach, but this low gradient significantly increases the horizontal reach of the tide. With a high tidal range of 2.562 meters and a maximum peak of 4.08 meters, the waterline moves rapidly across the flat terrain. This creates a high Probability of Entrapment: tourists venturing onto the coral reefs at low tide can be cut off from the shore as the water depth increases by over 2 meters in a single tidal cycle. The safety implication is clear: the "gentle" slope actually hides the speed of the incoming tide, requiring strict operational cut-off times for reef exploration.

The Australian Monsoon functions as the primary driver of wave energy flux, creating distinct seasonal safety tiers:

1. East Season (June – August): Constant 11.1-knot winds from the SE translate into high-frequency, high-amplitude plunging waves. Physically, these waves collapse their entire energy volume at once rather than over time, creating a high Impact risk for spinal injuries and "surf zone" accidents.
2. West Season (December – February): As the energy fetch shifts to the North, the Southern Coast experiences a "Shadow Effect," resulting in low wave heights. This period represents the highest level of Operational Safety, where the probability of high-energy events is at its annual minimum.
3. Transitional Season (May, Sept–Oct): This is a period of high Unpredictability. Specifically, the month of May is a "Risk Peak" where wind shifts can produce sudden, high-energy swells. Operationally, this requires a "High Vigilance" status, as the lack of a consistent monsoon direction makes wave patterns harder for tourists to read.

From this data we can conclude that:

<b>Physical Parameter</b>	<b>Safety Implication</b>	<b>Risk Category</b>
<b>Sandbar Gaps</b>	Rip Current Generation	High Probability
<b>Tidal Range (2.5m+)</b>	Reef Entrapment	High Impact
<b>11.1 Knot Winds</b>	Plunging/Destructive Waves	High Impact
<b>Gentle Slope (<math>m=0.02</math>)</b>	Deceptive Depth Changes	High Probability

### Dynamics of Tourist Visits in Batu Karas Beach

The number of tourist visits to Pangandaran Regency in general, as well as to Batu Karas Beach in particular, reveals a very dynamic pattern and is strongly affected by the national holiday season. Analysis of the data from the Tourism and Culture Office shows that:

<b>Year</b>	<b>Number of Tourist Visits (People)</b>	<b>Government Target (People)</b>	<b>Achievement (%)</b>
2021	3.461.384	3.104.536	111,5%
2022	4.113.221	4.437.915	92,7%
2023	3.548.354	3.569.501	99,4%
2024	270.681 (Jan-Feb)	1.810.382	-

**Source: Disbudpar Pangandaran (2024)**

Data shows that in 2022, there was a largest increase in visits after the Covid-19 pandemic, but there was a slight decrease in 2023 due to the recovery period of the purchasing power and marketing strategies that were still in the process of optimization. For Batu Karas Beach, these fluctuations created immense operational pressure during holidays, pushing the Safety Load Ratio (SLR)—the ratio of visitors to available lifeguards—well beyond manageable limits. For instance, during the Eid al-Fitr holiday in 2025, the number of visitors to the major holiday destinations in Pangandaran (including Batu Karas) surged to 395,000 in a short period of time, more than doubling the previous year. This spike represents a Saturation Point where the physical density of the crowd creates "visual noise," making it mathematically improbable for a limited number of officers to maintain effective surveillance over the vast shoreline.

The profile of the tourist population at Batu Karas is dominated by local residents of West Java, accounting for 87%, while foreign tourists make up about 13% of the total tourist population. Although the percentage of foreign tourists is low, their impact on the economy and safety standards is substantial, as they primarily engage in high-energy surfing activities. In these activities, the risk is linked to Wave Dynamics, where the probability of high-impact injuries from plunging waves is greater. In contrast, the domestic population, typically visiting in large family groups, presents a different safety challenge. Their lower level of beach safety literacy leads to a higher Probability of Incident regarding the beach's specific topography. Specifically, the "gentle" slope ( $m = 0.02$ ) creates a deceptive sense of safety, increasing the risk of children getting separated from their groups or recklessly swimming into the high-velocity rip currents found in the sandbar gaps.

The peak season of the tourist population at Batu Karas usually falls during April and December, aligning with public holidays and the year-end break. During this period, the tourist population reaches a physical saturation point where the Safety Load Ratio exceeds the capacity for safe human intervention. This density acts as a physical barrier to safety; visual surveillance by lifeguards is severely compromised as the sheer mass of people obscures the line of sight to the water's edge. The high visitor-to-officer ratio has been cited as the primary driver of "detection failure" during emergencies. When the beach is at capacity, the time required for a lifeguard to physically navigate through the crowd to reach a victim increases the Impact of any sea-based emergency, often turning a manageable rescue into a fatality due to delayed response times.

### **Identification of HSSA Implementation and the Role of Balawista**

The management of the safety management system at Batu Karas Beach is done in an organized manner through the Pangandaran Regency Water Rescue Agency (Balawista), operating under the coordination of the Regional Disaster Management Agency (BPBD). This body is a vital instrument in controlling the risk of sea accidents at the tourist destination.

#### **1. Structure and Staff of Supervision**

Balawista has set up a permanent guard post at Batu Karas Beach, which functions both as a monitoring tower and a tourism information center. The staff on duty comprises trained staff operating from 06:00 to 17:00 hours WIB daily. The number of staff is increased during long holidays through the deployment of additional members. However, the number of staff is still considered less than ideal. For example, during special holiday periods, only around 3 to 4 officers are available at the Batu Karas post to supervise thousands of visitors.

#### **2. HSSA Facilities and Infrastructure**

The application and implementation of K3 are also backed by the availability of standard rescue and safety equipment. Based on the facilities available as per the inventory, the facilities available are as follows:

1. Medical Facilities: First aid kits, stretchers, and temporary treatment rooms available at guard posts.

2. Rescue Equipment: Buoys (torpedo buoys), rescue surfboards, life jackets, and vehicles available for rescue purposes in the form of patrol motorcycles and rescue cars.
3. Operational Support Equipment: Available binoculars for long-distance observation, loudspeakers for making safety announcements, and radio communication equipment.
4. Visual Warning System: Flags indicating safe and dangerous zones are installed according to international norms. The meaning of these flags is as follows:
  - a. Red and Yellow: This means that the area is supervised by officers and is safe for swimming.
  - b. Single Red: This means that the area has high danger, and tourists are strictly prohibited from swimming.
  - c. Yellow: This means that the area has moderate danger, and tourists are expected to be extra cautious and careful. However, maintenance of information signs has not been done properly, and they have started to fade or are corroding due to seawater.

### 3. Cross-Sectoral Synergy

The security in Batu Karas also gets support from the Pangandaran Police Water and Air Police Unit (Satpolairud), which carries out humanitarian patrols along the coast. This includes securing parking areas to ensure that no criminal activities take place, regular checks of CCTV cameras by the police information technology team, as well as supporting tourists in dangerous activities. This way, security aspects will be in line with safety aspects.

### 4. Human Resource Capacity Building

Balawista Pangandaran actively engages its members to undergo professional training, which includes Bronze Medallion International Certification in conjunction with the International Surf Life Saving Association (ISLA). This training includes cardiopulmonary resuscitation techniques, handling victims of bone fractures due to high waves, and emergency evacuation handling. Regular training sessions are also conducted at the local level to enhance the physical and mental conditions of the officers in the field.

To conclude all the option, evaluative metrics can be shown on the following:

Operational Area	Current Status	Evaluative Metric	Safety Implication
Staffing	3-4 Officers / Peak	Safety Load Ratio	Severe "Blind Zone" during surges.
Signage	Corroded/Faded	Conspicuity Level	High probability of accidental entry into danger zones.
Certification	Bronze Medallion	Technical Competency	High life-saving potential <i>if</i> detection occurs.
Infrastructure	CCTV / Patrols	Response Efficiency	Improved situational awareness via cross-agency data.

(Source: Author, 2026)

### Risk Analysis of Tourism Activities at Batu Karas Beach

Marine tourism activities are associated with certain risks that can compromise the physical safety or health of the tourists. Using data on past incidents and environmental factors, a scoring analysis can be carried out to identify the risks associated with Batu Karas, using a scale of 1-5.

No	Type of Risk	Probability	Impact	Risk Scale	Category
1	Rip Current	4	5	20	Very high
2	Surfing Collisions	3	3	9	Moderate
3	Marine Biota Stin	3	2	6	Low

	(Jellyfish/Sea Urchin)				
4	<i>Heatstroke</i> & Dehidration	4	3	12	High
5	Tourists Separated from Their Group	4	2	8	Moderate
6	Overturned Tourist Boat	2	5	10	Moderate

**Source: Risk Score Analysis by Author**

**Rip Current Risk**

The threat of being swept away by currents is the primary fatal hazard at Batu Karas Beach. Although the breaking waves may appear small, the morphological parameter of water channels between sandbars generates high-velocity exit currents directed toward the deep sea. The Probability is rated 4 because these currents trigger predictably during the 12:00 p.m. to 5:00 p.m. tidal transition. The Impact is rated 5 (Fatal) because the physical velocity of the water exceeds human swimming capacity (>1m/s), leading to rapid exhaustion and drowning for non-expert swimmers unless immediate professional rescue is initiated.

**Risk of Heat Exposure and Dehydration**

The scarcity of natural shade trees along the main coastline exposes tourists to extreme Thermal Load. With average temperatures of 30°C and high UV exposure, the Probability is rated 4 as most visitors remain unsheltered for over 4 hours. This is categorized as High Risk (12) because heatstroke acts as a physiological "Risk Multiplier"—dehydration induces sudden muscle fatigue and cognitive decline, which directly increases the likelihood of a swimmer being unable to navigate even minor wave energy, potentially leading to secondary drowning.

**Surfing Risks**

Surfing, while a major attraction, introduces the risk of kinetic collisions in high-density zones. The Probability is rated 3, driven by the "crowding effect" where beginner surfers lose board control. The Impact is rated 3 (Moderate), involving lacerations or blunt force trauma from fiberglass boards. While the fatality rate is lower than rip currents, the frequency of injuries spikes during holiday seasons when the rental volume of surfing equipment exceeds the safe "carrying capacity" of the designated surfing zones.

**Analysis of Actual Incidents in 2023-2025**

According to data from the police and Balawista, there were 39 marine accidents in the Pangandaran area in 2023 with 10 victims. During the Eid al-Fitr holiday of 2025, a specific Safety Load failure was observed: 62 tourists were involved in marine accidents and 124 children were separated from their groups. These metrics highlight a "Surveillance Gap" where the physical density of the crowd (395,000 visitors) prevents lifeguards from maintaining the Visual Detection Threshold necessary to identify emergencies before they escalate to fatalities.

**Destination Resilience Strategy Through Digital Technology Integration**

To strengthen Batu Karas, management is shifting toward an Adaptive Safety Model using QR Code-based information. This digital integration bypasses the "Maintenance Decay" of physical signs (which corrode in salt air). By scanning the code, tourists access Real-time Hazard Maps and emergency contacts. The transparency of this system depends on Network Reliability; hence, improving telecommunications in the Cijulang area is a critical infrastructure requirement. The goal is to reduce "Information Asymmetry," ensuring tourists are aware of the P x I values of their surroundings in real-time.

The resilience of Batu Karas is anchored by its Logistical Connectivity. Strategic proximity to Nusawiru Airport allows for "High-Impact" mitigation through air medical evacuation. Furthermore, the Environmental Sensitivity of the management—demonstrated by the proactive closure of dangerous zones during extreme weather—shows a transition from reactive rescue to proactive risk avoidance. This flexibility ensures that the "Safety Load" is managed before the physical parameters of the ocean reach a catastrophic level.

## Conclusions and Suggestions

Batu Karas Beach represents a high-complexity marine tourism environment where the interaction between longshore bar and trough morphology and Indian Ocean energy creates a deceptive safety profile. While the beach slope is physically gentle, the hydrodynamic trigger of the East Monsoon transforms the area into a high-energy zone characterized by plunging waves and localized rip currents. The implementation of Health, Safety, and Environment in Tourism through the Balawista operational system provides a robust legal and structural framework; however, its efficacy is physically constrained by the Safety Load Ratio (SLR) during peak holiday surges. At these saturation points, the sheer density of the tourist population creates visual occlusion effectively neutralizing even the most advanced manual surveillance techniques.

Risk analysis confirms that the primary threats are not just isolated events but are driven by the specific physical parameters of the site. To move beyond the limits of manual observation, this study argues for a transition toward an Integrated Surveillance Model. By reinforcing traditional Balawista patrols with Digital Information Systems (such as QR-based hazard mapping) and modern telemetry, the destination can mitigate the "Information Asymmetry" that currently leads to tourist non-compliance. These technological layers do not replace human lifeguards but act as a force multiplier that lowers the Probability of Detection Failure when the beach reaches its physical carrying capacity.

.Based on the analysis results, some recommendations are given to managers and local governments:

1. Modernization of HSSA Facilities: Periodically modernize safety signs and observation towers to maintain optimal conditions of clarity and operation. The installation of CCTV equipment in areas that are prone to marine accidents is highly recommended to assist in visual observation.
2. Strengthening Human Resource Capacity: More Balawista officers should be deployed, especially during peak season, and international certification of officers should be continued to equip them with emergency medical response standards that are at par with those of international destinations.
3. Development of Shade Infrastructure: More vegetation, such as coconut trees, should be developed around rest areas of tourists to prevent dehydration and heatstroke.
4. Digital Technology Optimization: The stability of internet network infrastructure should be improved, especially along the coasts, and a QR code-based safety information system should be incorporated into all tourist entrance tickets so that safety literacy can be promoted.
5. Preventive Education: Local businesses, such as surf services and accommodation operators, should be engaged to become "safety agents" who provide brief educational information on marine danger zones to all their guests.

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