

Research article

Tourism Destination Resilience as a Key for Sustainable Tourism Development in Pesisir Barat Regency, Lampung Province, Indonesia

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Abstract

Assessing and enhancing resilience is key to developing sustainable tourism destinations. Evaluating the resilience of tourism destinations is crucial, as the tourism sector is highly vulnerable to disasters. This study assesses the resilience levels of seven coastal tourism destinations in Pesisir Barat Regency using a multidimensional approach, covering social, economic, institutional, community, infrastructure, and accommodation, and environmental sub-indices. Data were collected through field surveys and secondary data and analyzed using a standardized resilience index with statistical normalization based on the Disaster Resilience of Place (DROP) model. The findings reveal significant variations in resilience classification. Krui Beach demonstrates high resilience due to strong social, economic, and institutional support, whereas Way Jambu Beach and Walur Beach score low, primarily due to weak economic capacity, institutional support, and community preparedness. While the environmental dimension significantly contributes to most destinations, it fails to offset weaknesses in other dimensions. The analysis also indicates that coastal destinations with robust governance, adequate infrastructure, and empowered communities are better equipped to manage risks and disruptions, particularly in the context of climate change issues. The study highlights that destinations with robust governance, adequate infrastructure, and active community engagement are better equipped to manage disaster risks. However, resource limitations, policy inconsistencies, and stakeholder coordination gaps hinder resilience efforts. Strengthening governance, investing in climate-resilient infrastructure, and adopting community-based adaptation strategies are essential to enhancing tourism resilience. The findings provide insights for policymakers and stakeholders in designing strategic programs for sustainable coastal tourism. Additionally, this approach is a reference for future research, particularly in integrating environmental sustainability with disaster resilience in similar regions.

Keywords: tourism destination resilience; resilience; tourism disaster management; sustainable tourism; natural disasters.

1. Introduction

Indonesia is the largest archipelago country, with a coastline length of more than 81,000 km and a population residing in coastal areas of around 60% of the 250 million population (Widayatun, 2017). Increasing population density and activities in coastal areas heighten disaster risk, threatening both the economy and human lives due to rising sea levels (Neumann *et al.*, 2015; Neumann *et al.*, 2010). In addition, coastal areas are prone to disasters such as high waves and strong winds due to the influence of climate change (Sharifi & Yamagata, 2016; Zikra *et al.*, 2015). Furthermore, coastal areas are highly vulnerable to multiple threats, such as tidal floods combined with floods originating from land, which can increase disaster risk (Herbanu *et al.*, 2024). Increased activities and infrastructure development closer to the coast also increase vulnerability to disaster events (Almutairi *et al.*, 2020). Increased development and activities in coastal locations, including travel and the development of tourist destinations, make coastal tourist destinations highly vulnerable to disaster events. In addition, the frequency of disaster events in recent years has increased due to the influence of climate change (Hirabayashi *et al.*, 2013; Sahid, 2024). Furthermore, the geographical position at the plate confluence makes Indonesia's coastal areas vulnerable to volcanic eruptions, earthquakes, and tsunamis. About 77% of areas with coastlines are potentially vulnerable to tsunami hazards (BNPB, 2021).

Catastrophic events in coastal areas can result in massive deaths and economic losses. The 26 December 2004 Tsunami, with a wave height of up to 30 m in the Aceh coastal area, resulted in more than 163,650 people affected, along with an estimated huge economic loss (Borrero, 2005; Doocy *et al.*, 2007; Heger & Neumayer, 2019; Vidyattama *et al.*, 2021). The West Coastal region of Lampung Province faces significant earthquake and tsunami risks due to its location in the active megathrust subduction zone. This zone can produce massive earthquakes, with the Mentawai-Pagai megathrust estimated at a maximum of 8.9 magnitude, Enggano at 8.8 magnitude, and the Sunda-Banten Strait at 8.8 magnitude (National Earthquake Study Center (PusGen), 2017).



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The potential tsunami hazard in the Pesisir Barat Regency area of Lampung Province has been investigated by several studies, which state that the area has the potential to be affected by tsunamis (Amirudin *et al.*, 2021; Pratiwi & Fitri, 2021). In addition, the results of the Multi-Hazard Risk Index study in the area also show a high-risk index (BNPB, 2022).

Tourism is a leading sector that is vulnerable to hazards, both natural and non-natural disasters. The increasing vulnerability of the tourism industry due to natural disasters is inseparable from the effects of climate change. Bhaskara *et al.* (2021) stated that the tourism sector in the future will be more vulnerable to natural disasters; the increase in the number of natural disasters is inseparable from the climate change factors that occur globally. One of the six mega-trends that impacts tourism is extreme weather due to climate change (Buckley *et al.*, 2015). The losses incurred as a result of natural disasters in the tourism sector are enormous, such as the tsunami disaster that occurred in 2004 in the Phang Nga area of Thailand, more than 50% of tourism facilities were destroyed and failed to achieve tourist recovery after 2 years with a total decrease in local tourists -12% and foreign tourists -88.5% (Rucińska & Lechowicz, 2014). The magnitude of the impact and losses in the tourism sector due to disasters means that the tourism sector must be able to reduce the impact and increase its adaptive capabilities to deal with disasters and disturbances. The application and improvement of resilience capabilities in tourism destinations is the primary key to reducing the risk of significant losses due to disaster events (Bhaskara *et al.*, 2021).

Assessing and enhancing resilience is key to developing sustainable tourism destinations. Resilience refers to a system's ability to absorb disturbances, reorganize, and quickly return to normal after experiencing disruptions (Filimonau & De Coteau, 2020; Folke, 2006). Moreover, improving the capacity for learning from disturbances and adapting is essential to strengthening long-term resilience (Cutter *et al.*, 2008). Resilience in tourism has emerged as a crucial concept in sustainable tourism development. Holladay (2018) highlights resilience as the foundation of sustainable tourism, as every destination inevitably faces disruptions such as disasters and crises (Calgaro *et al.*, 2014; Holladay, 2018). In tourism, resilience is considered a critical factor that enables destinations and the tourism industry to survive and grow, even evolving into stronger ones after experiencing disruptions (Traskevich & Fontanari, 2021). Furthermore, adopting resilience-based approaches enables communities to build sustainable and adaptive systems that can effectively withstand various challenges (Khater & Faik, 2025).

This is especially relevant in the context of disaster-prone regions, where governance structures, local capacity, and multi-stakeholder collaboration play a pivotal role (Putera *et al.*, 2025; Saputra *et al.*, 2024; Valentina, Putera, & Salsabila, 2025). Therefore, evaluating the resilience level of tourism destinations is essential, as the tourism industry will become increasingly vulnerable to natural disasters (Bhaskara *et al.*, 2021). The COVID-19 pandemic and the 2008-2012 global financial crisis further underscore tourism's vulnerability to systemic risks (Mirela Mazilu, Nita, Babat, Draguleasa, & Grigore, 2024). Studies have shown that regions with strong governance, adequate infrastructure, and a diversified economic base tend to exhibit higher resilience in post-crisis recovery (Holladay, 2018). A multidimensional approach, incorporating social, economic, institutional, infrastructure, and environmental factors, is essential for accurately assessing tourism resilience (Drăguleasa, Niță, & Mazilu, 2023; M Mazilu, Amalia, & Draguleasa, 2023). The Disaster Resilience of Place (DROP) model developed by Cutter *et al.* (2008) provides a valuable framework for assessing community resilience by integrating social, economic, infrastructure, and environmental factors. This model highlights both inherent resilience (pre-disaster conditions) and adaptive resilience (post-disaster recovery efforts), also using quantitative indicators and GIS-based spatial analysis enhances the accuracy of resilience assessments, making it a useful tool for evaluating tourism destinations' ability to withstand and recover from crises (Cutter, Burton, & Emrich, 2010).

The high hazards and risks make the Pesisir Barat Regency of Lampung Province very vulnerable, so assessing tourism destinations' resilience is necessary to ensure sustainability. As is known, the coastal area of Pesisir Barat Regency in Lampung Province is a renowned international tourism destination, famous for its high waves and perfect surf conditions. Its location along the path of the large currents of the Indian Ocean makes it an attractive destination for world surfers. In addition, the destination became a leading tourist area according to the Master Plan for Regional Tourism Development of Lampung Province in 2012 (Lampung Provincial Government, 2012). The high potential of tourism destinations in Pesisir Barat Regency, Lampung Province, faces significant threats and risks from natural disasters. These disasters will impact the tourism ecosystem and hinder the achievement of tourism performance targets (National Agency for Disaster Management - BNPB Indonesia, 2021). Disasters are among the factors that significantly impact

the rise and fall of demand in the tourism industry. The tourism industry is vulnerable to disaster events (Jiang & Ritchie, 2017).

Assessment of disaster resilience in tourist destinations is still very minimal. The availability of conceptual references and frameworks in the tourism sector on how the industry faces and reduces the impact of disasters is still limited (Chan, Nozu, & Zhou, 2022). Thus, this research aims to assess the resilience of tourism destinations in the Pesisir Barat Regency, Lampung, using a region-based disaster resilience assessment approach (DROP). The assessment used variables from the DROP model (Cutter *et al.*, 2008, 2010; Scherzer, Lujala, & Rød, 2019), considering disaster management principles before, during, and after a disaster event.

2. Research Methods

2.1. Study Area

This research focused on coastal tourism destinations in Pesisir Barat Regency, Lampung Province, including Pisang Island Beach, Krui Beach, Tanjung Setia Beach, Mandiri Beach, Walur Beach, Way Jambu Beach, and Melasti Beach (Figure 1). Pesisir Barat Regency is a prominent tourist area, as designated in the Lampung Province Regional Tourism Development Master Plan 2012 (Lampung Provincial Government, 2012). These locations were selected due to their high risk of multi-hazards, evident in the 2022 Indonesian Disaster Risk Index (BNPB, 2022), and their vulnerability to tsunamis (Amirudin *et al.*, 2021; Pratiwi & Fitri, 2021). Furthermore, these areas are potentially impacted by megathrust earthquakes originating from the active Mentawai-Pagai, Enggano, and Sunda-Banten Strait subduction zones, with maximum magnitudes of 8.9, 8.8, and 8.8, respectively (PusGen, 2017). Notably, Pesisir Barat Regency's disaster resilience has not yet been assessed by Indonesia's National Disaster Management Agency (BNPB) (Figure 1).

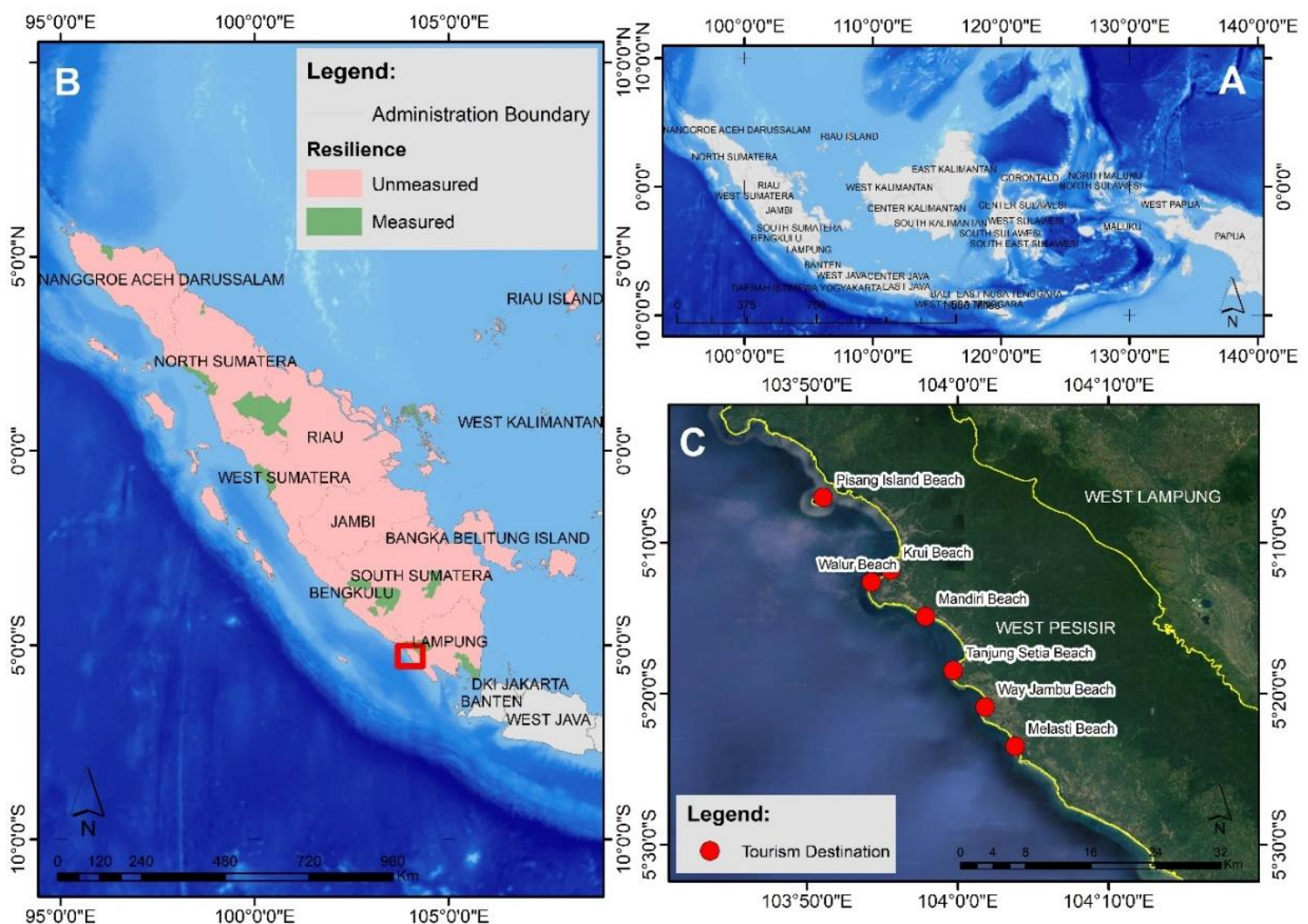


Figure 1. Map of the research location, figure A) Perspective map of the island of Sumatra in Indonesia, figure B) is the island of Sumatra with resilience measurements carried out by BNPB, figure C) Location of research tourist destinations in the Pesisir Barat Regency area.

The location of the coastal tourism destinations, namely Pulau Pisang Beach, Krui Beach, Walur Beach, Mandiri Beach, Tanjung Setia Beach, Way Jambu Beach, and Melasti Beach, was identified through field surveys and interviews with local managers. Each beach has starting and ending points that were marked using GPS to ensure the coverage of the administrative area of each beach. The coastal line data used to calculate the beach length was obtained from the Geospatial Information Agency (BIG).

The administrative location information along the coastline of each destination was used as the basis for analyzing the resilience level of each destination. As is known, a tourism destination is a space with physical and administrative boundaries that define its management, where tourists spend at least one night (Cooper, 2020). Hall *et al.* (2017) stated that a tourism destination is a subnational spatial unit determined by visitors, services such as accommodation and transportation used by tourists and residents, and regional governance that regulates services and sustainability. Based on these definitions, the unit of analysis used in this study is a tourism destination with its administrative management area (Table 1).

Table 1. Information on the Coastal Tourism Destinations and Their Administrative Areas of Study.

Tourism Destination	Beach Length (km)	District	Village
Pisang Island Beach	4.70	Island Pisang	Sukamarga
			Pekon Lok
			Bandar Dalam
			Pasar Pulau Pisang
			Sukadana
Krui Beach	3.50	Canter Pesisir	Labuhan
			Pasar Krui
			Kampung Jawa
Walur Beach	2.10	South Krui	Seray
			Way Redak
			Walur
Mandiri Beach	3.90	South Krui	Walur
			Way Suluh
			Balai Kencana
			Mandiri Sejati
Tanjung Setia Beach	2.00	South Krui	Tulung Bamban
Way Jambu Beach	1.60	South Krui	Negeri RatuTanumbang
Melasti Beach	1.30	South Krui	Tanjung Setia
			Way Jambu
			Marang

2.2. Measurement Approaches

Resilience is the ability of a system, community, or society exposed to hazards to withstand, absorb, adapt, and recover from the impact of hazards efficiently and promptly, including through the preservation and restoration of its essential structures and functions (UNISDR, 2009). The application and improvement of resilience in the tourism sector enables it to maintain its sustainability. Birkmann (2013) explains that building resilience is a key strategy for social, community, individual, or social-ecological systems to adapt and thrive in a dynamic environment and socio-economic conditions. Additionally, increasing adaptability from the learning process due to disruption is needed to increase the ability to defend against disruption (Cutter *et al.*, 2008).

Resilience is key to achieving the Sendai Framework for Disaster Risk Reduction, the Paris Agreement on the Framework Convention on Climate Change, and the Sustainable Development Goals (Cutter, 2016). Given that resilience is crucial for enhancing the capacity of tourism destinations to cope with climate change and disruption, measuring resilience in these destinations is necessary. This assessment aims to determine the initial resilience levels, identify areas for improvement, and ensure that resilience improvement programs are both appropriate and effectively implemented.

A quantitative methods approach was used to assess the level of resilience using the disaster resilience of place (DROP) model (Cutter *et al.*, 2008, 2010; Scherzer *et al.*, 2019). The DROP model assesses the capacity of communities by evaluating social, economic, institutional, infrastructure, community, and environmental factors to cope with and recover from disasters. This approach is particularly relevant for tourism destinations as the DROP model assesses the level of place-based resilience that considers the local context of an area.

Basurto-Cedeño & Pennington-Gray (2018) explained that the use of models in assessing the level of resilience in destinations must be applicable at different scales, considering that tourism destinations have varying regional scales. The use of this model will help identify the specific

vulnerabilities and strengths of a destination. Quantitative data, including demographic statistics, economic indicators, institutional, community, infrastructure, and environmental data, are utilized to map the measurable attributes and contextual factors of resilience classification in tourism destinations. This approach supports the development of tourism destinations that are sustainable and resilient in the face of disasters.

2.3. Indicator Selection and Data Preprocessing

This study employs a rigorous approach to indicator selection and data pre-processing, utilizing the Baseline Resilience Indicators for Communities (BRIC) as an operational framework derived from the Disaster Resilience of Place (DROP) model developed by Cutter *et al.*, (2008, 2010). The selection of these models is particularly relevant for coastal tourism destinations in Indonesia, which face multiple hazards such as tsunamis, wave abrasion, and climate change impacts. Several indicators, including social, economic, institutional, infrastructure, and community capital, serve as key measures of a destination's ability to withstand and recover from disasters.

However, to better fit the context of coastal tourism destinations, this study incorporated additional variables related to tourism dependency (e.g., the number of hotels and accommodations), infrastructure accessibility (e.g., road density and evacuation routes), and environmental vulnerability (e.g., flood, landslide, tsunami, earthquake, wave abrasion, extreme weather). Scherzer *et al.*, (2019) emphasized the importance of rigorous indicator selection, prioritizing theoretical relevance and data availability. The final indicator set was developed by combining variables and indicators based on Cutter *et al.*, (2010) and Scherzer *et al.*, (2019) resulting in a framework encompassing social, economic, institutional, infrastructure, community, and environmental resilience variables, ensuring relevance for assessing resilience in coastal tourism destinations (Table 2).

At the initial stage, 43 potential indicators for assessing tourism destination resilience were identified from the previous studies (Cutter *et al.*, 2010; Scherzer *et al.*, 2019) and adapted to the specific characteristics of the destinations. A selection process was conducted to evaluate data completeness. Indicators with inadequate or inconsistent data were eliminated, such as incomplete data acquisition and the unavailability of data obtained from the collection process, including the percentage of insured buildings, disaster management budget, and the percentage of buildings aged before 1970 and after 1994.

The selection process resulted in 40 indicators that met the criteria for data completeness and relevance to the research objectives. The data of selected indicators were obtained directly from relevant stakeholders through field surveys and interviews. The data collection process involved engaging with local disaster management officers, tourism practitioners, tourism community representatives, and other institutions, ensuring that the indicators reflected locally observed conditions and destination capacities (Table 2). Data used in this research were quantitative and collected directly from field observations, government reports, and institutional data provided by relevant stakeholders, including local disaster management agencies and tourism authorities. This grounded, field-based quantitative approach ensured the relevance and applicability of each indicator to the real-world disaster resilience landscape of the study area.

Furthermore, during the analysis process, the measurement scale of several indicators was reversed to maintain consistent analysis, where a higher value consistently represents a greater level of resilience, namely the percentage of individuals with disabilities, the rate of female employees, the distance to hospitals, and the distance to airports (Table 2). Additionally, some indicators exhibited identical values across the destinations, such as Indonesian language mastery, Health Insurance, disaster mitigation plan documents, the Gini index, the percentage of the population covered by disaster mitigation plans, and the frequency of hazards. Consequently, these indicators were not processed further as they could not undergo min-max transformation. Subsequently, the selected indicators that met the criteria were normalized using the min-max transformation method to ensure consistency across variables. This approach generated an indicator framework that is not only theoretically sound but also practically applicable, providing a robust foundation for resilience analysis in tourism destinations.

2.4. Resilience Index Construction

Indicator scores were normalized using the Min-Max rescaling method (Equation 1). This normalization standardized scores between zero (0) and one (1), facilitating relative performance comparison. This approach also involved reversing the contribution order for indicators, with higher values indicating lower resilience (Cutter *et al.*, 2010; Scherzer *et al.*, 2019). Subsequently, indicators within each resilience sub-domain were summed and averaged to create a sub-index

score (Equation 2). Finally, the normalized sub-index scores were aggregated to produce a composite resilience score (BRIC score) (Equation 3). Disaster resilience assessments, informed by this approach, can significantly contribute to the development of strategies for enhancing tourism destination resilience to disaster risks.

$$\text{Transformation min} - \text{max } x = \frac{x - x_{\min}}{x_{\max} - x_{\min}} \quad (1)$$

$$\text{Score sub-index} = \left(\frac{1}{N} \sum_{i=1}^N x_i \right) \quad (2)$$

$$\text{BRIC score} = \text{Soc}R_m + \text{Econ}R_m + \text{Inst}R_m + \text{Com}C_m + \text{Inf}R_m + \text{Env}R_m \quad (3)$$

The final tourism destination resilience class was determined by analyzing the BRIC score and its corresponding standard deviation. A low resilience class was assigned to destinations with a standard deviation below 1.5, a medium resilience class with a standard deviation between -0.5 and 0.5, and a high resilience class with a standard deviation exceeding 1.5 (Cutter *et al.*, 2010). Subsequently, the resilience class of each tourism destination was visualized using Geographic Information System (GIS) software to provide an overview of the spatial distribution of resilience across the study area.

3. Results and Discussion

3.1. Sub-Indices

This study evaluated the resilience level of seven beach destinations in the Pesisir Barat Regency using six main sub-indices: social, economic, institutional, community, infrastructure and accommodation, and environmental. Each sub-index was analyzed based on specific indicators that describe the adaptive capacity and vulnerability of each destination. Based on social dimensions, the proportion of the population under 55 years old ranged from 43.32% in Pulau Pisang to 90.62% in Walur, indicating demographic disparities that may affect adaptive capacity. Access to communication technology, as reflected by mobile phone usage, also varied significantly, from 28.76% in Pulau Pisang to 60.99% in Walur. The economic variable revealed disparities in employment and land ownership. The percentage of the working population was highest in Melasti (36.20%) and lowest in Pulau Pisang (18.17%). Female labor force participation ranged from 20.20% to 26.51%, while land ownership exceeded 95% in all destinations.

Institutional resilience demonstrated the most pronounced variation among all dimensions. Although disaster mitigation documents were reportedly available across all destinations, their availability was solely based on administrative records provided by the Regional Disaster Management Agency (BPBD) of Pesisir Barat Regency. Community involvement in disaster preparedness activities also varied considerably, ranging from as low as 4.21% in Mandiri Beach to as high as 44.74% in Krui Beach, indicating differing levels of social mobilization and disaster awareness capacity across communities. The community dimension, particularly the percentage of tourism workers trained in disaster response, revealed significant gaps. Most destinations reported minimal participation (e.g., 7.69%), with only Krui achieving a significantly higher figure (46.15%). Access to community support facilities such as legal advisory firms and communication stations remained limited across sites.

In terms of infrastructure and accommodation, the number of shelters, health facilities, hotels, and schools varied sharply. For example, hospital bed availability ranged from 0 to 0.02 beds per 1,000 people, and shelter availability reached a high of 70% in Krui but was nonexistent in most other destinations. Accessibility, measured by proximity to hospitals and airports, also indicated stark contrasts. Lastly, the environmental dimensions highlighted spatial disparities in hazard exposure and land use. Flood-free areas ranged from 50.84% in Walur to 100% in Pulau Pisang, while tsunami risk zones varied considerably, with tsunami-free areas as low as 1.20% in Walur and as high as 80.79% in Mandiri. Open space availability also differed significantly, from 1.07 hectares in Pulau Pisang to 23.97 hectares in Way Jambu.

The resilience sub-index includes the highest, lowest, and average scores across social, economic, institutional, community, infrastructure and accommodation, and environmental variables. This reflects a destination's ability to withstand and recover from various potential disasters and crises. The obtained scores indicate a high level of preparedness in handling changes and crises, strengthening overall community and environmental resilience. A detailed explanation of each variable's score is presented in Table 3.

Table 2. Summary Statistics of Indicators in the Resilience Sub-Index.

Variable	Indicators	Data Size	Mean	Min	Max	Data Source
Social	Education Level	Ratio of the number of undergraduate and non-graduate graduates	0.06	0.03	0.12	Population and Civil Registration Office Pesisir Barat Regency
	Age Level	Percentage of population aged <= 55 years (non-elderly people)	81.24	43.32	90.62	Population and Civil Registration Office Pesisir Barat Regency
		Percentage of Employee Age <= 55 Years	75.13	70.86	81.42	Population and Civil Registration Office Pesisir Barat Regency
	Vehicle access	Percentage of population using Vehicles (2/4)	10.83	1.12	40.58	Transportation Office of Pesisir Barat Regency
	Communication Capacity	Percentage of the population using mobile phones	55.17	28.76	60.99	BAPPELITBANGDA of Pesisir Barat Regency
	Language Mastery	Percentage of population using Bahasa Indonesia	100	100	100	BAPPELITBANGDA of Pesisir Barat Regency
	Special Needs/Disability	Percentage of population with disabilities	0.72	0	1.6	Social Service of Pesisir Barat Regency
	Health Insurance	Percentage of population with health insurance	100	100	100	Health Office of Pesisir Barat Regency
Economy	Land Ownership	Percentage of Home Ownership	98.31	95.73	99.58	https://bhumi.atrbpn.go.id
	Employee Percentage	The percentage who are working	30.88	18.17	36.2	Population and Civil Registration Office Pesisir Barat Regency
		Percentage of female employees	23.29	20.2	26.51	Population and Civil Registration Office Pesisir Barat Regency
	Total Revenue	Gini Index	0.32	0.32	0.32	BAPPELITBANGDA of Pesisir Barat Regency
	Percent of employees working in the tourism sector	Percentage of population not working in agriculture, fishing, forestry, and extractive industries	41.07	27.98	71.47	Population and Civil Registration Office, Pesisir Barat Regency
	Large to Small Business Ratio	Ratio of large and small businesses	0	0	0.01	DKUKMP Pesisir Barat Regency
	Number of Medical Personnel	Number of medical personnel (per 1k people)	0.01	0	0.02	Health Office of Pesisir Barat Regency
	Number of Banks	Number of banks (per 1k people)	0.001	0	0.004	DKUKMP Pesisir Barat Regency
Institutional	Disaster mitigation plan document	Percentage of population covered by disaster mitigation plans	100	100	100	Regional disaster management of Pesisir Barat Regency
	Disaster Services	Percentage Number of disaster services	14.29	5	30	Regional disaster management of Pesisir Barat Regency
	Percent of People Involved in Disaster Aware Communities	Percentage of people involved in disaster-aware communities	14.29	4.21	44.74	Regional disaster management of Pesisir Barat Regency
	Government's role in disaster management	Percentage of disaster institutions/institutions	14.29	0	100	Regional disaster management of Pesisir Barat Regency
Community	Employees attend training	Percentage of employees who have participated in Disaster training	14.29	7.69	46.15	Regional disaster management of Pesisir Barat Regency
	Firm	Number of Legal Counsel (per 1k people)	0	0	0.001	Population and Civil Registration Office, Pesisir Barat Regency
	Place of Worship	Number of places of worship (per 1k people)	0.01	0	0.02	Central Bureau of Statistics, Pesisir Barat Regency
	Sports Field	Number of Sports Fields (per 1k people)	0	0	0	Central Bureau of Statistics, Pesisir Barat Regency
	Communication Station	Number of Communication Stations per 1k people)	0.01	0	0.02	Central Bureau of Statistics, Pesisir Barat Regency
Infrastructure and Accommodation	House/accommodation type	Percentage Number of permanent houses/accommodations	14.29	0	42.68	Tourism Office of Pesisir Barat Regency
	Shelter/Evacuation	Percentage of Shelter / Evacuation	14.29	0	70	Regional disaster management of Pesisir Barat Regency
	Number of hospital rooms	Number of hospital rooms (per 1k people)	0	0	0.02	Health Office of Pesisir Barat Regency

Table 2. (Continued).

Variable	Indicators	Data Size	Mean	Min	Max	Data Source
Environ- ment	Availability of evacuation routes	Road length/square kilometer	109.4	4.52	700	https://tanahair.indonesia.go.id
	Number of hotels/inns	Number of hotels/inns	11.29	0	32	Tourism Office of Pesisir Barat Regency
	Number of schools	Number of schools	10	2	27	Central Bureau of Statistics, Pesisir Barat Regency
	Distance to hospital in meters	Distance to hospital in kilometers	17.24	6.7	30	https://tanahair.indonesia.go.id
	Distance to the airport in meters	Distance to the airport in kilometers	19.23	4.6	36.4	https://tanahair.indonesia.go.id
	Percentage of areas not affected by flooding	Percentage of areas not affected by flooding	79.5	50.84	100	https://inarisk.bnpb.go.id
	Percentage of areas not affected by landslides	Percentage of areas not affected by landslides	87.75	53.05	100	https://inarisk.bnpb.go.id
	Percentage of areas not affected by the Tsunami	percentage of areas not affected by the tsunami	51.54	1.2	80.79	https://inarisk.bnpb.go.id
	Percentage of areas not affected by the earthquake	Percentage of areas not affected by earthquakes (low seismic hazard)	4.83	0.66	9.53	https://inarisk.bnpb.go.id
	Percentage of areas not affected by Extreme Weather	Percentage of areas not affected by Extreme Weather	10.54	0.23	48.95	https://inarisk.bnpb.go.id
	Percentage of areas not affected by extreme waves and abrasion	Percentage of areas not affected by extreme waves and abrasion	90.92	63.35	98.64	https://inarisk.bnpb.go.id
	Percentage of areas not affected by forest and land fires	Percentage of areas not affected by forest and land fires	23.79	9.32	39.46	https://inarisk.bnpb.go.id
	Open area	Open area (ha)	13.69	1.07	23.97	https://tanahair.indonesia.go.id
	Hazard frequency	Number of hazard frequencies	5.5	5.5	5.5	Regional disaster management of Pesisir Barat Regency

3.1. Overall resilience score

The total sub-index results highlight how disparities in institutional strength, community capacity, and infrastructure quality drive overall resilience gaps among the destinations. Krui Beach ranks highest across nearly all dimensions, particularly institutional (0.93) and infrastructure (0.90), illustrating how integrated governance and investment in disaster-ready facilities directly enhance destination resilience. These findings align with Putera *et al.*, (2025), who emphasize the importance of decentralized, participatory governance in enabling effective tourism disaster management. Conversely, Walur Beach and Way Jambu Beach, despite showing relatively strong performance in the social dimension (0.88 and 0.44, respectively), significantly face challenges in institutional, community, and infrastructure aspects. The combination of weak local governance, limited community engagement, and inadequate basic services reflects the governance fragmentation challenges (Valentina *et al.*, 2025). These deficiencies hinder the ability to prepare for, respond to, and recover from natural disasters and crises, thereby placing destinations at greater risk amid escalating climate change threats, particularly in coastal tourism areas.

Furthermore, the economic resilience scores, ranging from 0.27 to 0.63 across all destinations, suggest a widespread dependency on traditional or undiversified sectors. This economic vulnerability aligns with the broader literature emphasizing the role of economic diversification and local capacity building in reducing exposure and accelerating recovery (Saputra *et al.*, 2024). Interestingly, the environmental sub-index demonstrates relatively balanced performance among the destinations (0.47 to 0.69), indicating a more uniform distribution of ecological conditions, such as natural buffers and hazard exposure levels. However, this also highlights a key insight: strong environmental conditions alone do not guarantee resilience without the support of governance, infrastructure, and community systems (Cutter *et al.*, 2010). The results show that destinations with better social, economic, and institutional capacities tend to have higher resilience levels. Krui Beach, with the highest scores in most sub-indices, exemplifies effective governance, adequate infrastructure, and strong community capacity. However, destinations such as Melasti Beach and Way Jambu exhibit significant gaps across multiple dimensions, requiring targeted improvements. These results support the findings of Scherzer *et al.* (2019), who argue that a multidimensional

approach is essential for comprehensively assessing community resilience. Addressing one dimension in isolation is insufficient; only by integrating social, economic, institutional, community, and infrastructural aspects can a destination build meaningful adaptive capacity. Integrating risk mitigation, community empowerment, and infrastructure strengthening is key to enhancing tourism destination resilience. Consistent with this, further research by Basurto-Cedeño & Pennington-Gray (2018) suggests that exploring the relationship between environmental sub-indices and a destination's adaptive capacity can lead to more holistic resilience strategies. Collectively, the findings underscore the interdependence of resilience dimensions and the necessity of holistic interventions. Enhancing disaster resilience requires not only investing in infrastructure but also strengthening institutions, mobilizing communities, and embedding sustainability in economic and tourism development policies.

Table 3. Total Score of the Tourism Destination Resilience Index.

Tourism Destinations	Social	Economy	Institutional	Community	Infrastructure and Accommodation	Environment	Resilience Index Total Score
Krui Beach	0.76	0.63	0.93	0.80	0.90	0.61	4.64
Mandiri Beach	0.52	0.42	0.27	0.57	0.49	0.58	2.86
Walur Beach	0.88	0.31	0.10	0.05	0.24	0.47	2.06
Tanjung Setia Beach	0.48	0.38	0.02	0.05	0.31	0.69	1.93
Pisang Island Beach	0.12	0.42	0.42	0.13	0.24	0.56	1.89
Melasti Beach	0.51	0.37	0.03	0.33	0.07	0.49	1.81
Way Jambu Beach	0.44	0.27	0.01	0.22	0.04	0.50	1.49

3.1. Resilience Score Classification

The result of the resilience sub-index assessment and the total resilience score will result in a resilience score ranking in tourism destinations. Overall, the resilience score ranking can be influential in providing an overview of how resilient destinations are to survive and adapt in the face of disasters, as well as how they can strengthen their capacity to recover faster and more effectively after a disaster occurs. The higher the total resilience index score, the better prepared the destination is for potential disasters. The ranking of resilience scores per destination can be seen in Figure 2.

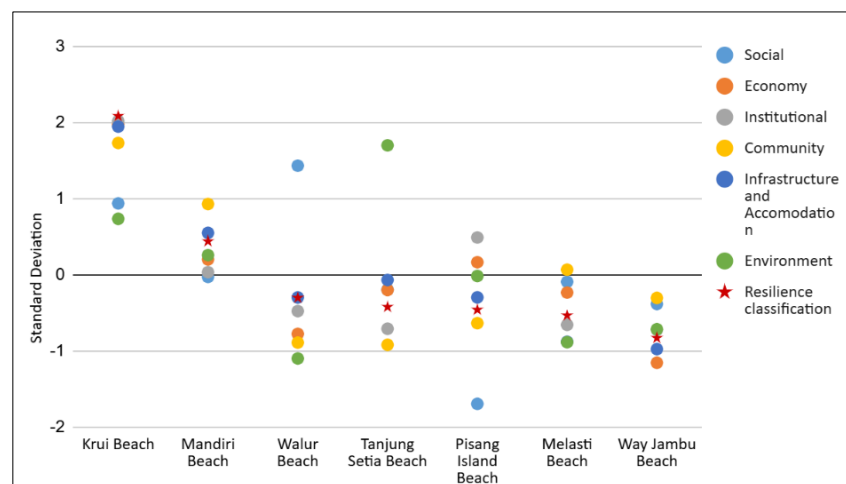


Figure 2. Resilience Score Rating Based on Standard Deviation.

Standardized resilience scores reveal substantial disparities in the resilience profiles of the seven coastal tourism destinations (Figure 3). Krui Beach stands out with the highest total resilience score (2.090) due to it consistently performing strongly across all dimensions, most notably institutional (2.022), economic (1.978), and infrastructure and accommodation (1.950). This finding indicates a robust governance structure, a diversified economic base, and a well-developed infrastructure network. Such conditions are critical for post-crisis recovery, as also emphasized by Scherzer *et al.* (2019), who argue that resilient destinations demonstrate strength across multiple, interconnected domains. The case of Krui also supports insights from Traskevich & Fontanari (2023), who highlight that multi-level institutional support and infrastructure investments enable tourism areas to maintain adaptive functionality under systemic stress. In contrast, Way Jambu Beach ranks lowest (−0.826), as it exhibits negative scores across all dimensions, particularly in

economy (−1.152) and infrastructure (−0.973). This suggests significant structural vulnerabilities and limited capacity to respond to and adapt to disasters. These weaknesses reflect findings by (Valentina *et al.*, 2025), who emphasize that fragmented local governance, lack of coordination, and limited disaster management integration often hinder resilience development in rural or peripheral coastal areas.

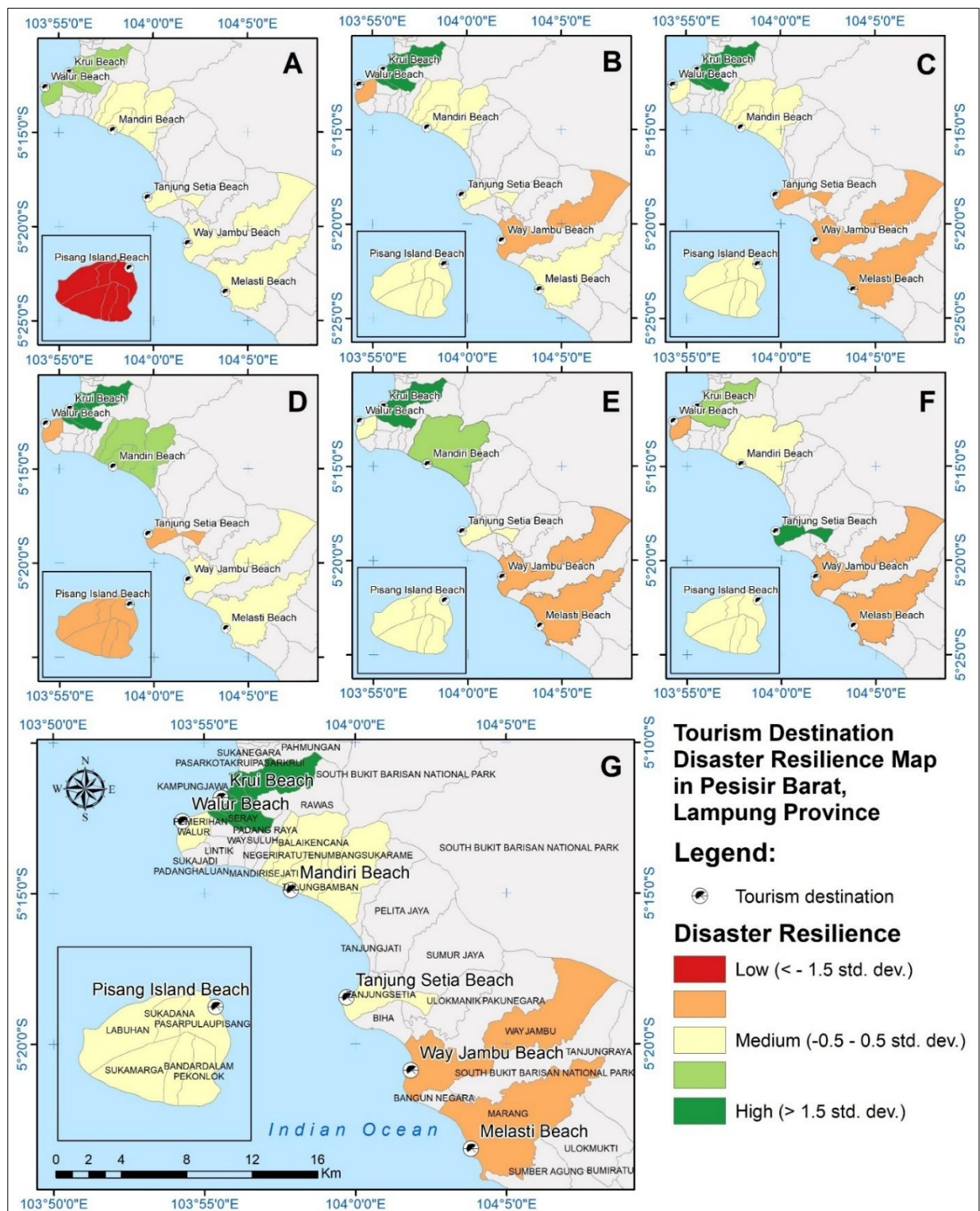


Figure 3. Results of destination resilience analysis, (Figure A) Social resilience class, (Figure B) Economic resilience class, (Figure C) Institutional resilience class, (Figure D) community resilience class, (Figure E) Infrastructure and Accommodation resilience class, (Figure F) environmental resilience class, and (Figure G) disaster resilience class in the study area destinations.

Moreover, such institutional deficits parallel the governance and planning barriers identified by Holladay (2018), who emphasized the importance of proactive disaster risk governance in sustaining tourism operations. Similarly, Melasti Beach and Pisang Island Beach display low

resilience scores, primarily driven by weak institutional capacity and limited environmental safeguards. These destinations illustrate the concern raised by Calgaro *et al.* (2014) and Valentina *et al.* (2025), who found that destinations with minimal institutional engagement and limited investment in environmental risk reduction struggle to maintain operational continuity during and after disasters. Furthermore, such systemic weaknesses mirror the internal gaps in leadership, absorptive capacity, and knowledge-sharing mechanisms identified by Saputra *et al.* (2024) as critical barriers to adaptive resilience. The observed low scores also resonate with Mazilu *et al.* (2024), who argue that inadequate ecosystem-based planning in tourism zones compromises both resilience and long-term sustainability.

Interestingly, Tanjung Setia Beach performs relatively well in environmental resilience (1.703), yet significant deficiencies in institutional and community engagement keep its overall resilience low. This underscores the importance of a balanced and multidimensional approach to resilience building, where strong performance in one domain cannot fully offset weaknesses in others (Cutter *et al.*, 2010; Scherzer *et al.*, 2019). The observed imbalances reaffirm findings from Holladay (2018), who argued that resilient destinations require coordinated investment in both ecological safeguards and institutional frameworks. Though moderately resilient (0.443), Mandiri Beach demonstrates potential for improvement, especially if it enhances institutional readiness and infrastructure accessibility. Its community score (0.933) indicates high local engagement, which can serve as a foundation for capacity-building initiatives. This finding supports the work of Putera *et al.*, (2025), who emphasized the importance of empowering local communities as a pillar of disaster resilience in tourism areas. Likewise, Traskevich & Fontanari (2023) noted that community-based adaptation can enhance both social cohesion and long-term sustainability. These findings highlight the necessity for targeted interventions in destinations with low resilience. Specifically, stakeholders must strengthen governance, improve infrastructure, and foster inclusive community participation.

Furthermore, Krui Beach's strong performance offers a benchmark for best practices that can inform policy replication in similar contexts. As Khater & Faik (2025) and Mazilu *et al.*, (2024) suggest, integrating ecosystem-based adaptation with participatory governance mechanisms provides a strategic pathway toward resilient and sustainable tourism destinations in the face of escalating climate risks. Destinations that demonstrate higher levels of these capacities are better positioned to achieve long-term resilience. These results underscore the importance of inclusive governance, active local engagement, and continuous institutional development in coastal tourism planning. The findings also support Cutter *et al.*, (2010), who argue that a multidimensional approach is essential for designing holistic adaptation strategies in tourism destinations. Strengthening social, economic, institutional, community, infrastructure, and environmental dimensions emerges as a crucial step in enhancing destination resilience against potential risks. Given these findings, targeted interventions are necessary to address the weakest dimensions in low-resilience destinations, including institutional capacity-building, improved access to essential services, and better utilization of environmental assets to support adaptive strategies.

4. Conclusion

This study reveals significant disparities in resilience levels across seven coastal tourism destinations in Pesisir Barat Regency. Krui Beach demonstrates the highest resilience, while Way Jambu and Melasti Beaches record the lowest. Among the assessed sub-indices, the environmental dimension makes a substantial positive contribution to most destinations, particularly in mitigating floods, landslides, and coastal hazard risks. However, institutional, community, and infrastructure-related weaknesses remain critical challenges for low-resilience destinations. These findings are particularly relevant in the context of climate change, as coastal destinations increasingly face threats such as sea level rise, shoreline erosion, and extreme weather events. Such risks threaten not only the attractiveness of tourism destinations but also the social stability and economic sustainability of communities dependent on tourism. This study reinforces the need for a multidimensional resilience framework that integrates social, economic, institutional, community, and infrastructure to reduce vulnerability and enhance adaptive capacity. To support the development of resilient destinations, targeted interventions should focus on strengthening local institutions, promoting ecosystem-based adaptation, improving infrastructure accessibility, enhancing community participation, and embedding sustainable tourism practices in local development policies. The results of the resilience assessment can serve as a practical foundation for identifying priority areas and designing evidence-based policies tailored to each destination's specific vulnerabilities. These strategies are essential to maintain tourism competitiveness while safeguarding the well-being of host communities. The findings provide actionable insights for destination managers and policymakers in designing adaptive strategies tailored to local contexts.

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Conflict of interest

All authors declare that they have no conflicts of interest.

Data availability

Data is available upon Request.

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Future research should prioritize longitudinal evaluations of resilience dynamics and investigate how stakeholder collaboration and cross-sectoral partnerships can amplify the adaptive capacity of tourism governance systems.

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