Boosting Tourism Resilience Through Enhanced Disaster Mitigation: A Case Study of Batu City

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ABSTRACT

As one of the leading tourist destinations in East Java, Kota Batu faces significant challenges due to the abundance of tourist attractions that are vulnerable to disaster damage. This places the tourism sector, which is the backbone of the local economy, in need of special attention in policy planning. This study adopts a comprehensive approach, combining policy analysis, spatial analysis using Geographic Information Systems (GIS), and public perception research. Through this approach, the study identifies the most disaster-prone tourist areas and assesses the gap between policy planning and on-the-ground implementation. The research findings indicate that, although Kota Batu has a disaster management policy framework in place, its implementation still faces various challenges. Factors hindering the success of this policy include inadequate inter-agency coordination, limited competent human resources, minimal budget allocation, and low participation from the community and tourism industry stakeholders in disaster mitigation and adaptation processes. Furthermore, the significant economic reliance on the tourism sector means that any disruption caused by disasters has a significant impact on the welfare of the local community. This study also highlights the importance of better integration between the tourism sector and disaster mitigation policies. Stakeholders in the tourism sector, including the government, tourism operators, and the community, need to collaborate in enhancing the resilience of tourist areas through the development of adaptive infrastructure, strengthening the capacity of local human resources, and introducing more effective early warning systems. Increasing awareness of disaster risks among tourists is also a crucial element in maintaining the sustainability of tourism in Kota Batu. The conclusion of this research suggests that stronger collaboration between the tourism sector and disaster management is essential for maintaining economic and environmental sustainability in Kota Batu. The findings and insights from this study can serve as a guide for local governments in designing and implementing more effective disaster management policies, especially in areas that rely heavily on the tourism sector.

Keyword: Tourism/ Policy/ Disaster/ Collaboration development

1. INTRODUCTION

Tourism can be defined as temporary travel from one's place of residence to a specific destination. This activity is not intended for permanent settlement or livelihood, but rather for satisfying curiosity and exploring new environments [1]. According to [2], tourism encompasses all activities related to travel or visits to a particular area or place for purposes such as recreation, learning, or other goals, without the intention of settling or earning a living. Kota Batu, a leading tourist destination in East Java, faces significant natural disaster risks, including landslides, flash floods, and earthquakes. To achieve sustainable tourism, it is essential to strike a balance by involving all stakeholders and fostering collaboration to create environmentally friendly tourist sites, engage local communities, and attract visitors [3]. The flash flood that occurred in Kota Batu in 2017 demonstrated the widespread impacts of such disasters, not only causing physical damage to numerous tourist attractions but also leading to a significant drop in visitor numbers. The financial losses sustained by the tourism industry, along with the social impacts on communities reliant on the sector, underscore the urgency of addressing disaster vulnerability. This is particularly important given the vital role tourism plays as the backbone of Kota Batu's economy.

Therefore, disaster mitigation efforts in the tourism sector are crucial to ensuring the sustainability of this industry in the future. According to [4], mitigation refers to a series of actions taken to reduce disaster risks, including both physical infrastructure development and increasing public

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awareness and capacity in facing disaster threats. Tourism disaster resilience refers to a destination's ability to respond to, adapt to, and recover from disasters. This resilience relies heavily on preparedness, mitigation planning, and effective coordination between local governments, tourism industry stakeholders, and the community.

In the context of disaster mitigation, Kota Batu needs to implement systematic measures to minimize the negative impacts of disasters on tourism infrastructure. This includes developing disaster-resilient infrastructure, implementing early warning systems, and educating the public and tourism industry players about disaster risks and management methods. Additionally, fast and efficient recovery mechanisms are needed post-disaster to restore tourist destinations to their original state. Based on the analysis of several previous studies, various indicators and methods have been identified as key focus areas in the context of tourism and mitigation efforts (Table 1).

Table 1. Previous studies

Researcher	Indicator	Method and Analysis	Findings
Lasaiba, M. A. (2024)	• The use of early warning technology (earthquake sensors, weather radars, applications). • Resilient tourism infrastructure. • Public education and preparedness. • Comprehensive risk planning and management. • Monitoring and evaluating disaster risks using modern technology.	• Qualitative • Data Synthesis • Literature Selection	Disaster mitigation plays a crucial role in protecting lives and assets, as well as supporting the growth of tourism in island regions. Resilient infrastructure, public education and preparedness, and early warning technology have proven effective in reducing the impact of disasters and accelerating the recovery of the tourism sector. Case studies in Bali, Lombok, and North Sulawesi provide empirical insights into the importance of inter-agency collaboration in disaster mitigation efforts.
Wahyuwidyaningrum, W., and Kaseng, A. W. S. (2024)	• Classification of tourist destinations based on the type of tourism (nature, artificial, cultural, special interest). • Classification based on the type of threatening disaster (floods, landslides, forest fires, extreme weather). • Implementation of early warning systems (EWS) to identify disaster signs. • Provision of evacuation facilities and evacuation routes. • Accessibility of nearby healthcare facilities. • Provision of hazard detection devices and emergency communication tools.	• Qualitative • Observation, Interviews, and Literature Review • Qualitative Descriptive Analysis • Classification Analysis	There are eight types of disaster mitigation implemented at tourist destinations in Ngargoyoso District. These mitigation efforts include a combination of structural and non-structural measures, which have met the seven components of disaster mitigation. The study also identified that tourist destinations have implemented various strategies to enhance disaster resilience, such as early warning systems and the provision of evacuation facilities.

Source: Authors, 2024

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Table 1. Previous studies (cont.)

Researcher	Indicator	Method and Analysis	Findings
Utami, S., Ihsan, and Rasyid, A. R. (2018)	• Identification of tourist attractions, accommodations, restaurants, amusement rides, and photo spots. • Analysis of factors such as land use, infrastructure, rainfall, slope gradient, fault presence, and geology. • Mapping and time series analysis from 1995 to 2018.	• Qualitative & Quantitative • Observation, Interviews, and Documentation for Primary Data, as well as Literature Review for Secondary Data. • Spatial Overlay Analysis	The landslide vulnerability levels in Anggeraja District are categorized into three classes: low risk, moderate risk, and high risk, determined by factors such as slope gradient, rainfall, and fault presence. Additionally, the tourist area at Mount Nona has various facilities, including natural tourist attractions, accommodations, and amusement rides, which have the potential to increase visitor numbers but require effective disaster risk management. Landslide incidents in 2004 and 2017 caused significant infrastructure damage, primarily due to heavy rainfall and a lack of vegetation on the slopes, which reduced soil stability.
Hofisah, U. A., Sarjanti, E., and Suwarsito. (2020)	• Connectivity between attractions • Development and promotion of tourist sites • Travel time from the nearest terminal • Availability of public transportation • Location signage • Road conditions • Physical condition of tourist attractions • Environmental cleanliness • Safety • Disruptions from natural disasters	• Qualitative • Observation • Documentation • Classification Analysis • Class Interval	The tourism potential in Belik District has a varied classification. Based on the analysis, the internal potential is categorized into three classifications: low, moderate, and high, with predetermined maximum and minimum scores. Additionally, the external potential also shows similar results, where several indicators such as accessibility and support for the development of tourist sites contribute to the existing potential classification, indicating opportunities for further development in the tourism sector.

Source: Authors, 2024

Disaster management in the tourism sector of Kota Batu is intrinsically linked to the policies outlined in the Spatial Planning Regulation (RTRW). The RTRW serves as a crucial instrument for regional management, governing land use, including disaster risk mitigation measures. In Kota Batu's RTRW, spatial planning must encompass the identification and management of disaster-prone areas to prevent their inclusion in tourism infrastructure development, thereby reducing associated risks. However, a significant gap exists between policy formulation and its implementation in practice. One of the primary challenges is the insufficient integration of disaster mitigation planning within the RTRW and tourism development initiatives. As a result, numerous tourist destinations in Kota Batu, such as Jatim Park 2 and Taman Selecta, remain situated in high-risk zones, particularly vulnerable to landslides triggered by heavy rainfall.

Additionally, challenges in implementing these policies include a lack of coordination among agencies and low community participation in disaster mitigation planning. This study aims to address these challenges by conducting a thorough analysis of how the RTRW policy in

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Kota Batu has incorporated disaster mitigation aspects, specifically concerning the tourism sector. It also seeks to evaluate the existing discrepancies between policy and actual implementation. The research adopts a comprehensive approach, combining policy analysis, spatial analysis through Geographic Information Systems (GIS), and public perception studies to identify the most disaster-prone tourist areas and assess the effectiveness of the implemented mitigation strategies. The findings from this study are expected to provide strategic recommendations to enhance the resilience of Kota Batu's tourism sector against disaster threats. Moreover, it aims to strengthen the implementation of RTRW policies, ensuring that tourism development in Kota Batu is both sustainable and safe from disaster risks.

2. METHODOLOGY

2.1 Research framework

A conceptual framework is a logical flow used to explain the relationships between concepts or variables in a research study. It helps illustrate how theories, previous findings, or specific assumptions are connected to the research problem being investigated. In the conceptual framework, researchers outline the cause-and-effect or correlation relationships among variables, which then serve as the basis for formulating hypotheses. The framework also functions as a guide for data collection and analysis, helping to clarify the direction of the research to make it more focused and systematic [5]. Below is the conceptual framework for the research titled "Boosting Tourism Resilience through Enhanced Disaster Mitigation: A Case Study of Batu City".

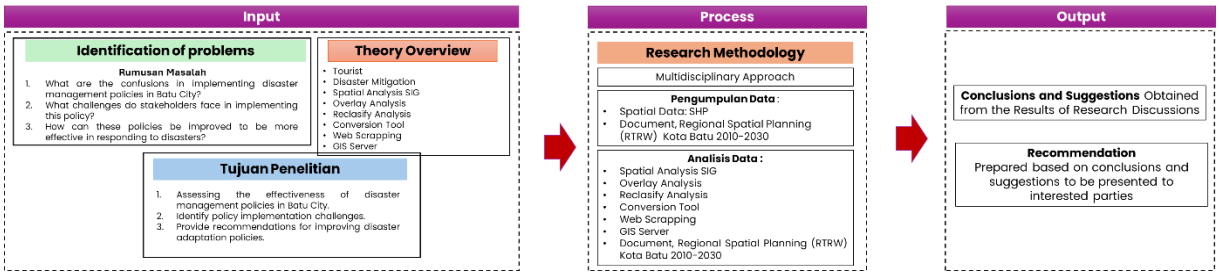

Figure 1. Research Framework

2.2 Research design

A multidisciplinary approach is a method for solving a problem by utilizing perspectives from various relevant disciplines. The disciplines used may come from the fields of Natural Sciences (IPA), Social Sciences (IS), or Humanities (IH) interchangeably. The application of these disciplines in addressing problems is carried out through diverse approaches [5].

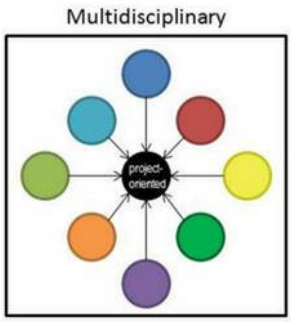

Figure 2. Multidicipline Approach (Source: https://shorturl.at/InbVs)

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2.3 Policy review

2.3.1 RTRW Kota Batu 2010- 2030

Table 2. Disaster-Prone Areas & Tourist Areas in Batu City

Protected Area	Disater Prone Areas	1. Disaster-prone areas include those susceptible to landslides and floods. 2. The areas at risk of natural disasters from landslides and floods include: a. The northern region of Kota Batu, which consists of the Mount Pusungkutuk, Mount Welirang, Mount Kembar, Mount Anjasmoro, and Mount Rawung areas in Sumber Brantas Village. The land use for this area includes forest, green open spaces, agriculture, tourism, residential areas, and warehouses, with a slope classification of less than 40%. b. The southern region of Kota Batu, which includes the Mount Panderman, Mount Bokong, Mount Punuksapi, and Mount Srandil areas in Oro-Oro Ombo Village. c. The western region of Kota Batu, which consists of the Mount Banyak area in Gunungsari Village; Mount Jeruk and Mount Kerumbung in Tulungrejo Village; and Mount Preteng in Gunungsari Village. d. The eastern region of Kota Batu, which includes the Mount Pucung area in Bulukerto Village and the Mount Gede area in Bumiaji Village. e. The residential area prone to landslides in Temas Village.
Cultivation Area	Tourism Area	1. The tourism areas consist of: a. Mountain nature tourism; b. Man-made tourism; and c. Cultural tourism.
		2. Mountain nature tourism includes: • Coban Rais Waterfall • Ecotourism at Cangar Hot Springs and the Arboretum in Sumber Brantas • Village • Paragliding festival and off-road circuit at Mount Banyak • Hiking activities at Mount Panderman • Mountain biking activities in Bumiaji Village • Village tourism • Agrotourism
		3. Man-made tourism includes: • Flower Garden in Sidomulyo Village • Zoo • Jatim Park recreation park, Selecta, and recreational gardens • Songgoriti, Batu Night Spectacular, and recreational gardens • Tirta Nirwana • Miniature World and animal museum in Oro-Oro Ombo Village • Cable car
		4. Cultural tourism includes: • Sedekah Bumi • Grebeg Desa • Sembrama Dance • Maulud of the Prophet Muhammad SAW • Dokar (traditional horse cart) tourism • Supo Temple in Songgoriti • Ganesha Statue • Tomb of Tuan Denger • Bima Sakti Selekta Lodge • Kartika Wijaya (Heritage Hotel) • Cangar Japanese Cave • Tlekung Japanese Cave • An-Nur Mosque • Old Church of Jago

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- Kertarajasa Buddhist Vihara
- Dewi Kwam Im Thong Temple
- Tomb of Mbah Wastu
- Tomb of Mbah Pathok

Source: Document, Regional Spatial Planning (RTRW) Kota Batu 2010-2030

2.4 Spatial analysis SIG

Geographic Information System (GIS) is a computer system designed to efficiently store and manage geographic information. This system allows users to manipulate geographic data in ways that support location-based analysis and decision-making. By using GIS, various types of information related to space and location can be managed, thereby supporting a wide range of applications in fields such as urban planning, environmental monitoring, and resource management . A similar viewpoint is expressed by Maguire , who emphasizes GIS from a technological perspective, focusing on functional aspects such as maps, databases, and spatial analysis. From these experts' perspectives, it can be concluded that GIS has a strong connection with computers and geospatial data.

As a system, GIS consists of various subsystems that form a whole. According to Maguire, the subsystems in GIS include various elements, starting from data input:

a. Data Input is the stage that involves the collection, preparation, and storage of spatial data or its attributes from various sources.
b. Data Output is the stage that serves to display or produce all or part of the database in either softcopy or hardcopy, in formats such as tables, graphs, or maps.
c. Data Management is the way the system organizes both spatial data and attribute tables into a database for easy access (retrieval).
d. Data Manipulation and Analysis is the stage that determines the information generated by the Geographic Information System (GIS).

GIS can depict a model of the real world on a computer screen, similar to how maps on paper represent the real world. Among the various subsystems of GIS, one feature that distinguishes it from other software is its ability to perform spatial and attribute analysis. The process of answering questions within GIS involves processing and managing large volumes of spatial and non-spatial data, which are then mathematically integrated by applying various arithmetic and logical operations to produce solutions or answers [8]

2.4.1 Overlay analysis

Overlay is an important process in (GIS) analysis. It refers to the ability to place the graphics of one map on top of the graphics of another map, and then display the results on a computer screen or in printed form. In short, overlay involves stacking one digital map over another digital map, along with their attributes, to create a composite map that contains attribute information from both maps. Overlay is the process of merging data from different layers. Simply put, overlay can be described as a visual operation that requires more than one layer to be physically combined [8].

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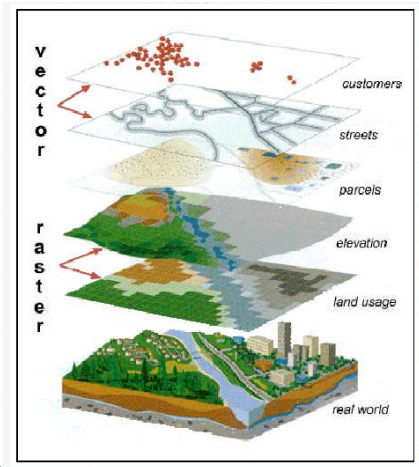

Figure 3. Example of Overlay picture in SIG

Referring to Figure 3, one of the implementations of GIS in this paper is to determine zones that support tourism resilience through enhanced disaster mitigation. This approach is carried out by utilizing GIS applications combined with various spatial data, including indicators that affect tourism resilience, which are then weighted. Thus, the analysis produced can assist in formulating more effective mitigation strategies.

2.4.2 RECLASIFY Analysis

Reclassification is the process of reclassifying data to produce new spatial data tailored to specific criteria or attributes. In this process, data that originally had various values or categories is reorganized or regrouped according to the desired analysis objectives. This grouping allows the data to be more easily interpreted and used in spatial analysis, as the different values in the original data are reduced or restructured into new categories that are more relevant to the user's needs. The result of this reclassification is a new map or spatial data that is more focused and aligned with the specific criteria that have been established.

Functions and Objectives of Reclassification:

1. Data Simplification: Reclassification is used to simplify raster data by grouping the original values into new classes. This helps users in analyzing the data in a more comprehensible manner.

2. Reclassification: This process allows users to reclassify data by changing the ranges of values or categories, for example, transforming elevation, rainfall, or population density data into specific categories such as low, medium, and high.

3. Spatial Analysis: Reclassification is useful in spatial analysis to determine areas that meet or do not meet certain criteria. For instance, in hazard zoning mapping, users can classify risk values from low to high.

4. Decision Making: The results of reclassification can aid in decision-making across various fields, such as spatial planning, environmental conservation, agriculture, or disaster mitigation, by simplifying complex data.

2.4.3 Conversion tool

The Conversion Tool is a feature used to convert or transform spatial data from one format to another within the context of GIS. Mapping often involves the use of various types of geographic data, whether in vector, raster, or other attribute formats, and sometimes it is necessary to convert this data to meet the needs of further analysis or processing.

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Types of Data:

1. RasterData: This is pixel- or grid-based data, such as satellite imagery, topographic maps, and other grid-based maps. Each pixel in a raster has a value representing specific information, such as elevation, temperature, or disaster intensity.
2. VectorData: Data that represents geographic features in the form of points, lines, or polygons. Examples include roads, rivers, administrative boundaries, and buildings. Vector data is more structured and precise compared to raster data, as it represents features with clear geometry.

2.4.5 Web scrapping

Web scraping is a technique used to automatically gather information from websites without having to copy it manually. The goal of a web scraper is to search for specific information and then collect it in a new web format. Web scraping focuses on obtaining data through retrieval and extraction. The benefits of web scraping include allowing the information collected to be more targeted, thus making it easier to search for specific content. Web scraping applications focus solely on how to acquire data through the retrieval and extraction of data with varying sizes.

Web scraping involves several steps, including:

1. Create Scraping Template: The developer studies the HTML document of the website from which information is to be extracted to identify the HTML tags that surround the desired information.
2. Explore Site Navigation: The developer analyzes the navigation techniques of the website to be scraped to replicate them in the web scraper application to be created.
3. Automate Navigation and Extraction: Based on the information obtained in steps 1 and 2, the web scraper application is created to automate the retrieval of information from the specified website.
4. Extracted Data and Package History: The information obtained from step 3 is stored in a database table.

2.5 Research data

This study involves the use of various types of data and different data sources, the details of which can be seen in the following table.

Table 3. Research Data

Data	Source	Description
RTRW City of Batu Policy Data 2010-2030	Public Works and Public Housing Office of Batu City	• Public Works and Public Housing Office of Batu City • Data obtained 24 September 2024,
Administrative Boundaries	Global Administrative Areas (GADM)	• Level 3 (District) and Level 4 (Village) administrative boundaries • Data accessed on September 25, 2024, downloaded from https://gadm.org/download_country_v.html
Distribution of Facilities	Google point of interest (POI)	• Using web scraping techniques via Instant Data Scraper • Data collected includes commercial facilities • Data accessed on September 25, 2024
Disaster Hazards	National Disaster Management Agency (BNPB)	• Using GIS Servers for connecting data • Data accessed on September 24, 2024, downloaded from https://gis.bnpb.go.id/server/rest/services

Source: Analysis Result, 2024

3. RESULTS AND DISCUSSION

3.1 Disaster hazards of Batu City

Batu City, known as a charming natural tourist destination, also faces various threats from natural disasters that can impact the safety of the community and the sustainability of its tourism sector. Located in a mountainous region with varied topography, Batu City is vulnerable to nine types of disasters: Flash

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Floods, Floods, Extreme Weather, Earthquakes, Landslides, Forest Fires, Droughts, Volcanic Eruptions, and Multi-Hazards. The nine types of disasters can be seen on the following map.

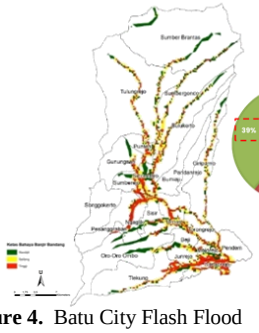

Figure 4. Batu City Flash Flood

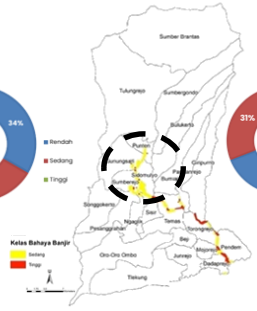

Figure 5. Batu City Flood Danger

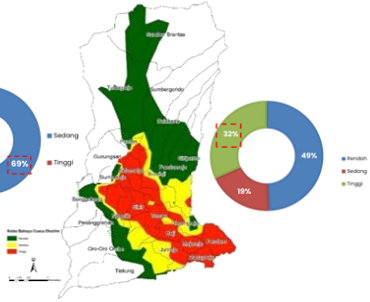

Figure 6. Batu City Extreme Weather

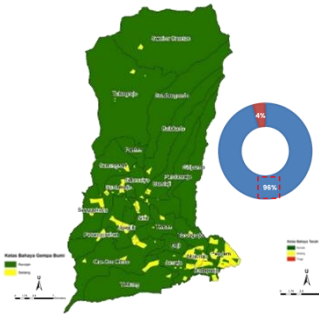

Figure 7. Batu City Earthquake

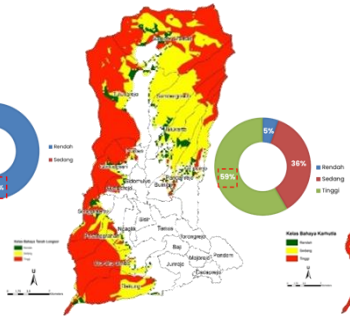

Figure 8. Batu City Landslide

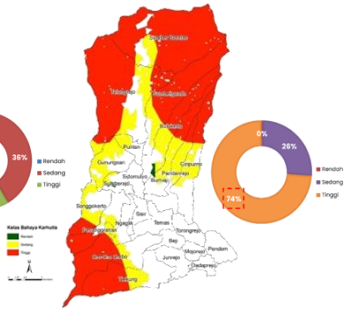

Figure 9. Dangers of Forest and Land Fires in Batu City

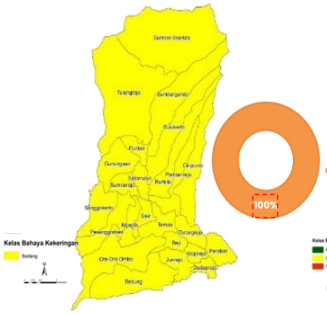

Figure 10. Drought in Batu City

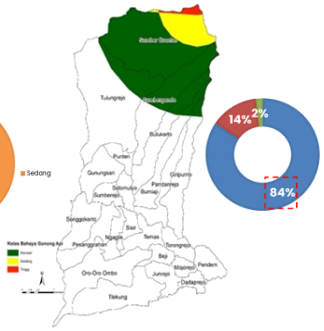

Figure 11. Batu City Volcano

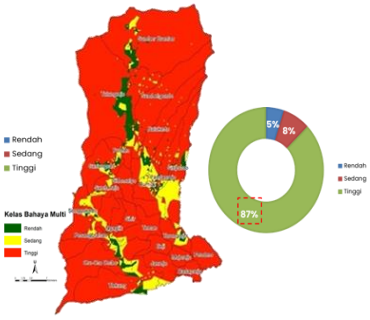

Figure 12. Multi Dangers of Batu City

Source: Inarisk BNPB, Processed 2024

The overlay analysis results regarding disaster hazards in Batu City indicate that most areas are categorized as having a high risk level for nine types of disasters, including flash floods, flooding, earthquakes, landslides, forest fires, and volcanic activity. In this context, the Batu City Spatial Planning Policy (RTRW) 2010-2030 plays a crucial role in formulating effective mitigation strategies. The RTRW includes sustainable spatial planning that directs the development of infrastructure and tourism areas to safer locations, thereby reducing disaster risks. The tourism sector, as one of the pillars of the local economy, needs protection from disaster impacts. Therefore, collaboration between the government and the community is vital in implementing mitigation measures, such as disaster risk monitoring, infrastructure improvement, and education about potential hazards. With this proactive approach, it is hoped that the negative impacts of disasters can be minimized, and the sustainability of the tourism sector in Batu City can be maintained.

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3.2 Disaster hazards in Batu City tourism

In addition to conducting overlay analysis to assess potential disaster hazards, data collection was also carried out regarding the existing tourist destinations in Batu City using web scraping analysis. This tourism data was then overlaid with information about the types of disasters that are most vulnerable or pose a high risk in the research area/Batu City. This way, we can better understand the relationship between tourist locations and the potential disaster threats that may arise in those areas. The types of disaster risks include: Multi Disaster, Flash Floods, Extreme Weather, Forest Fires, and Landslides. Below is the table data resulting from the web scraping of Batu City's tourism, which is overlaid with disaster hazards.

Table 4. Results of Tourism Web Scraping in Batu City Overlayed with High Disaster Hazards

Disaster Hazard Type	Number of Natural Tourist Attractions	Number of Man-Made Tourist Attractions
Multi-Hazard	49	49
Flash Flood	9	5
Extreme Weather	36	21
Forest Fires	2	0
Landslide	11	0
Total	107	75

Source: Scraping Analysis Results, 2024

Based on the data presented in the table, it can be observed that the total number of natural and artificial tourist destinations potentially affected by high-risk disaster hazards is significant. The natural attractions in Batu City encompass 107 destinations, while artificial attractions comprise 75 destinations. This information is crucial in relation to the Spatial Planning Policy (RTRW) of Batu City, as land management and planning must consider vulnerability to disasters. Within the RTRW policy, protecting natural tourist areas located in disaster-prone regions should be prioritized, given the high number of affected natural tourist destinations. Spatial planning in Batu City must align with disaster mitigation efforts to ensure the sustainability of the tourism sector and the safety of visitors. Furthermore, artificial attractions scattered across various areas also require attention in the context of infrastructure protection and risk management, ensuring that tourism development remains in accordance with the sustainability principles outlined in the RTRW.

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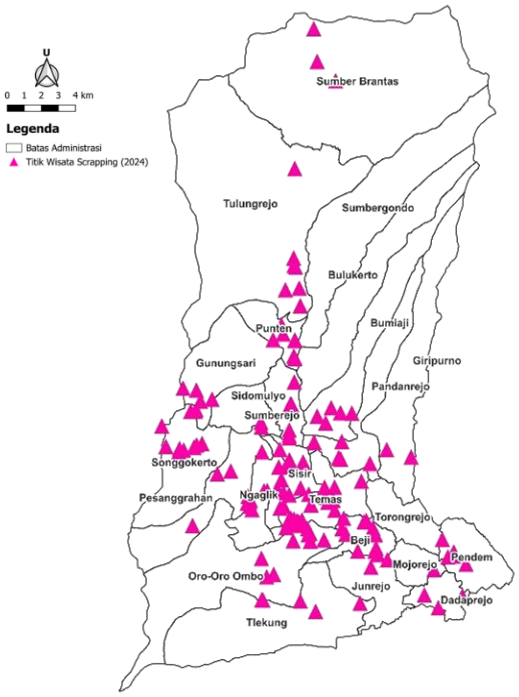

Figure13. Map of Batu City Tourism Scrapping Results (Source: Webscrapping Results, 2024)

4. CONCLUSIONS

The tourism sector in Batu City faces significant challenges related to disaster risks, particularly landslides triggered by heavy rainfall and insufficient vegetation. Despite the implementation of the Regional Spatial Planning (RTRW) Batu City as a mitigation measure, a gap persists between policy and real-world application, with numerous tourist destinations situated in high-risk areas. Additionally, the situation is worsened by a lack of coordination among agencies and low community participation in planning efforts.

This research employs a comprehensive approach that combines policy analysis, risk mapping using GIS, and public perception studies to identify disaster-prone areas. The study aims to recommend strategic measures, including:

1. Disaster Risk Challenges: The tourism sector faces significant threats, particularly from landslides due to heavy rainfall and insufficient vegetation.
2. Policy Gaps: Although the RTRW Batu City has been established as a disaster risk mitigation tool, there are discrepancies between policy planning and on-the-ground implementation, resulting in many tourist sites remaining in high-risk zones.
3. Lack of Coordination: The effectiveness of disaster mitigation policies is hindered by inadequate coordination among government agencies and minimal community involvement in planning.
4. Comprehensive Approach: This research integrates policy analysis, spatial GIS analysis, and public perception studies to pinpoint the most vulnerable tourist destinations.
5. Strategic Recommendations: It is crucial to undertake systematic steps in mitigation planning, such as developing resilient infrastructure, implementing early warning systems, and educating the community about disaster risks.
6. Sustainable Development: The recommendations aim to enhance the tourism sector's resilience to disaster threats and ensure that tourism development in Batu City is sustainable and safeguarded against risks.

By addressing these key areas, the study seeks to promote a more resilient and sustainable tourism sector in Batu City.

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