

Impact Analysis of Disaster Mitigation, Socio-Cultural Adaptation, and Natural Resources Management on Sustainable Tourism Destination in Borobudur Temple, Yogyakarta

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ABSTRACT

This study analyzes the impact of disaster mitigation, socio-cultural adaptation, and natural resource management on sustainable tourism at Borobudur Temple, Yogyakarta, a UNESCO World Heritage site. As tourism grows in culturally and ecologically significant destinations, sustainability practices become essential to preserving heritage and ensuring long-term viability. Using a quantitative approach, this study collected data from 190 respondents and analyzed it through Structural Equation Modeling-Partial Least Squares (SEM-PLS). The results demonstrate that each factor—disaster mitigation, socio-cultural adaptation, and natural resource management—significantly contributes to sustainable tourism, with natural resource management showing the strongest impact. These findings highlight the importance of a comprehensive approach in managing heritage tourism, incorporating disaster preparedness, cultural engagement, and resource stewardship. The study provides practical recommendations for stakeholders to enhance sustainability practices, supporting both cultural preservation and economic growth.

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1. INTRODUCTION

Sustainable tourism development at Borobudur Temple is a multifaceted endeavor requiring attention to disaster preparedness, socio-cultural integration, and resource management. Located near Mount Merapi, Borobudur necessitates comprehensive disaster mitigation strategies to safeguard the site and its visitors, ensuring safety and confidence, which directly influence tourism numbers [1]. Socio-cultural integration,

supported by well-trained tour guides, plays a pivotal role in preserving cultural treasures and enriching visitor experiences, as seen in the Cultural Village of Polowijen, where traditional arts integration fosters economic growth and cultural preservation [2], [3]. Resource management is also critical, as the political economy of tourism development at Borobudur underscores the need for a shared vision and coordinated institutional efforts to balance tourism with heritage preservation [4]. Sustainable practices must address

environmental impacts, such as waste management, while fostering communication between local communities and tourism managers for effective resource utilization [1], [5].

Socio-cultural adaptation is essential for communities around Borobudur to sustain tourism while preserving their cultural identity. The integration of traditional values and local arts into tourism, as demonstrated in the Cultural Village of Polowijen [6], highlights how cultural preservation can coexist with economic growth, exemplified by the preservation of Malangan masks, which enhances local engagement and economic benefits [3]. Similarly, the tradition of Perang Topat in Lombok underscores how strong social capital fosters interfaith harmony, attracts tourists, and supports cultural preservation and tourism sustainability [7]. Social capital, encompassing networks and trust, is vital for community resilience against external influences like climate change and can also strengthen cultural resilience in tourism [8]. The socio-cultural resilience framework developed for the Suku Laut community in Batam further illustrates the importance of integrating cultural identity into sustainable development to ensure that tourism supports rather than erodes local traditions [9].

Natural resource management is another critical component of sustainable tourism at Borobudur. As tourism increases, so does the demand on local resources, including water, energy, and waste management systems. Unregulated resource consumption can lead to environmental degradation, undermining the aesthetic and ecological appeal of the site. Responsible management of natural resources ensures that the environmental footprint of tourism remains within sustainable limits, allowing Borobudur Temple to maintain its appeal and integrity over the long term. This includes initiatives like managing waste, conserving water, and reducing energy usage, which collectively contribute to a balanced ecosystem that supports both tourism and local communities. This study aims to analyze

the combined impact of disaster mitigation, socio-cultural adaptation, and natural resources management on the sustainable tourism of Borobudur Temple.

2. LITERATURE REVIEW

2.1 *Sustainable Tourism Development*

Sustainable tourism is crucial for managing and preserving cultural and natural resources at heritage sites like Borobudur Temple. It focuses on protecting cultural heritage through strategies like experiential tourism and digital innovation to engage tourists while maintaining cultural integrity [10], [11]. In the Cultural Village of Polowijen, sustainable practices have balanced economic growth with cultural preservation, fostering local engagement [3]. Cultural tourism in Malang City demonstrates how sustainable tourism generates income and employment while safeguarding heritage [3]. Green tourism promoting local food, history, and heritage benefits both communities and tourists while emphasizing environmental conservation and avoiding greenwashing [12]. An indicator-based framework for sustainable cultural tourism enables the assessment of tourism impacts for a more balanced approach [13].

2.2 *Disaster Mitigation in Tourism*

Disaster mitigation is crucial for sustainable tourism in hazard-prone regions like Indonesia, where natural events such as earthquakes, volcanic eruptions, and floods are common. Risk assessments play a vital role in identifying

potential hazards, with multi-risk mapping in areas like Jailolo aiding in safer land use and risk reduction [3], [14]. Early warning systems, supported by GIS and predictive modeling, enhance preparedness and response capabilities [15]. Resilient infrastructure is also essential, as fortified buildings and tourism facilities designed to withstand specific hazards can mitigate disaster impacts, a need highlighted by infrastructure challenges in Bukittinggi [16]. Community engagement and education further strengthen local resilience, empowering communities to respond effectively to disasters [17]. Collaborative planning and governance, involving risk assessment, crisis management, and multi-stakeholder partnerships, are key to reducing tourism vulnerabilities and enhancing resilience in disaster-prone areas [17], [18].

2.3 Socio-Cultural Adaptation in Heritage Tourism

Socio-cultural adaptation is essential in managing interactions between tourists and local communities, especially in heritage-rich destinations like Borobudur Temple, as it aligns local traditions with tourism demands and educates visitors on cultural significance. In the Cultural Village of Polowijen, sustainable tourism has preserved Malangan masks, fostering economic growth alongside cultural preservation [3]. The Baduy Tribe's Saba Budaya Baduy initiative highlights cultural resilience by building strong host-guest relationships and enriching visitor experiences

[19]. Community-Based Tourism (CBT) in the Indian Sundarbans demonstrates how preserving cultural and natural heritage can drive socio-economic development through community engagement [20]. Similarly, cultural tourism in Tuyên Quang empowers ethnic minority groups, sustaining traditional arts and creating economic opportunities [21]. Although Dellys, Algeria, faces challenges in integrating cultural heritage into tourism, improved coordination could enhance heritage preservation efforts [22].

2.4 Natural Resource Management in Tourism

Effective natural resource management is essential for sustainable tourism, particularly in resource-limited areas like Yogyakarta, where high-traffic sites such as Borobudur Temple require careful management to maintain ecological balance. Environmental sustainability is a significant challenge for tourism, as seen in the Western Balkans, where increased protected areas and digital demand management are needed to safeguard natural resources [23]. Sustainable tourism can foster economic prosperity while preserving the environment and cultural values, exemplified by the successful management of the Tivat Salina Nature Reserve in Montenegro [24]. Strategic approaches, such as those implemented in Kozara National Park, emphasize holistic management to prevent resource degradation [25]. In South Asia, practices like green purchasing, waste management, and eco-friendly design significantly enhance sustainable tourism

performance, underlining their importance for tourism businesses [26]. However, in low-income countries, limited innovative capabilities pose challenges to natural resource management, though tourism growth may drive a shift toward less carbon-intensive economies [27].

2.5 Theoretical Framework and Hypothesis Development

This study is grounded in the Sustainable Tourism Development Theory, which emphasizes a balanced approach to tourism that integrates environmental, social, and

economic sustainability (Sharpley, 2009). In this research, three independent variables—disaster mitigation, socio-cultural adaptation, and natural resource management—are proposed to influence sustainable tourism at Borobudur Temple. Based on the literature, it is hypothesized that each variable positively affects sustainable tourism development, contributing to a holistic framework that supports the long-term viability of the site as a cultural and natural asset. The following hypotheses guide this study:

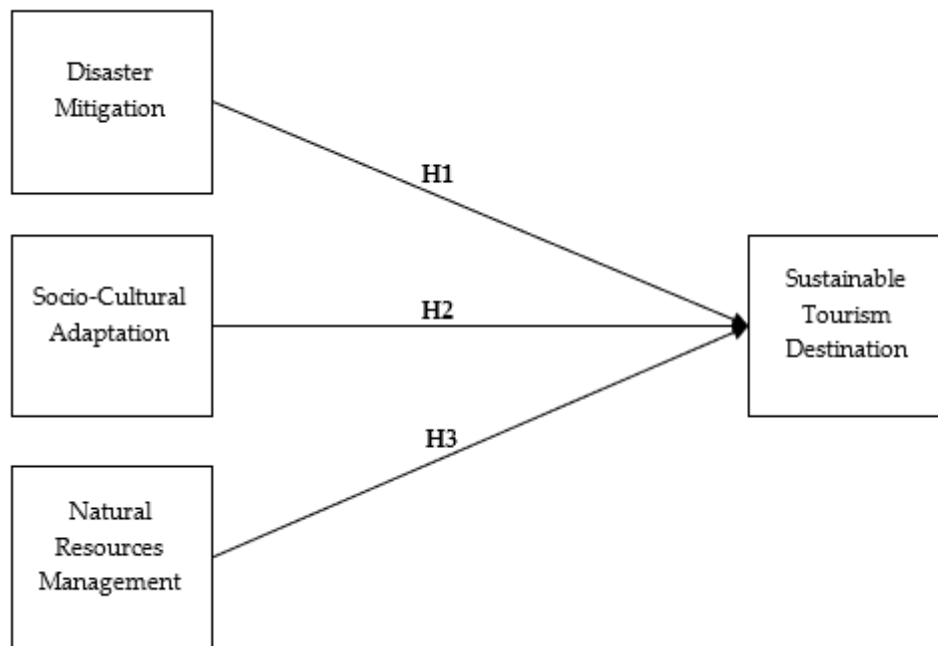


Figure 1. Conceptual Framework

- H1: Disaster mitigation has a significant positive impact on sustainable tourism at Borobudur Temple.
- H2: Socio-cultural adaptation has a significant positive impact on sustainable tourism at Borobudur Temple.
- H3: Natural resource management has a significant positive impact

on sustainable tourism at Borobudur Temple.

3. METHODS

3.1 Research Design

This study utilizes a quantitative research approach to analyze the impact of disaster mitigation, socio-cultural adaptation, and natural resource management on sustainable tourism at Borobudur Temple,

Yogyakarta. A cross-sectional survey design was employed, where data were collected at a single point in time to assess the relationships between the variables. Structural Equation Modeling-Partial Least Squares (SEM-PLS) was chosen for data analysis due to its effectiveness in handling complex models with multiple constructs and its suitability for exploratory studies (Hair et al., 2017). The SEM-PLS approach allows for robust analysis of both direct and indirect relationships, providing comprehensive insights into how each factor contributes to sustainable tourism at Borobudur Temple.

3.2 Population and Sample

The target population for this study comprises visitors to Borobudur Temple, as well as local residents and tourism stakeholders involved in the temple's management and conservation. A purposive sampling technique was applied, focusing on respondents who have adequate knowledge or experience related to tourism and sustainable practices in the area. The sample size for this study is 190 respondents, which is sufficient for SEM-PLS analysis, as it exceeds the minimum requirement for this type of analysis (Chin, 1998). This sample size provides adequate statistical power and supports the generalizability of the findings to the broader population of stakeholders involved in Borobudur's tourism sector.

3.3 Data Collection

Data were collected through a structured questionnaire distributed to the respondents at Borobudur Temple. The questionnaire was designed to measure the perceptions of respondents regarding disaster mitigation, socio-cultural adaptation, natural resource management, and sustainable tourism. The items in the questionnaire were developed based on existing literature and adapted to the context of Borobudur Temple. Each question was rated on a five-point Likert scale, ranging from 1 ("Strongly Disagree") to 5 ("Strongly Agree"), to capture the extent of respondents' agreement with various statements.

3.4 Data Analysis

Data analysis was conducted using SEM-PLS 3, an advanced tool for analyzing complex causal relationships and evaluating the reliability and validity of measurement models. The analysis process involved several key steps: first, the Measurement Model Assessment, which tested construct reliability and validity through confirmatory factor analysis. Internal consistency reliability was verified using Cronbach's alpha and composite reliability, with acceptable values above 0.7, while convergent validity was assessed using the average variance extracted (AVE) threshold of 0.5, indicating that constructs explain more than half of the variance of their indicators. Next, the Structural Model Assessment examined the hypothesized relationships between disaster mitigation, socio-cultural adaptation, natural resource management, and sustainable tourism. Path coefficients and t-values were generated through bootstrapping at a 0.05 significance level, allowing for an analysis of each independent variable's impact on sustainable tourism. Finally, in the Hypothesis Testing phase, each hypothesis was assessed based on the path coefficients derived from SEM-PLS, with hypotheses yielding p-values below 0.05 considered statistically significant, thus confirming the proposed relationships between the independent and dependent variables.

4. RESULTS AND DISCUSSION

4.1 Demographic Profile of Respondents

This study gathered data from 190 respondents visiting Borobudur Temple, Yogyakarta, representing a diverse group of visitors, local residents, and tourism stakeholders. The demographic profile encompassed a range of characteristics, such as age, gender, education level, and stakeholder category, providing a comprehensive understanding of perspectives on sustainable tourism at Borobudur. In terms of age distribution, respondents included 18–24 years (18.4%), 25–

34 years (36.8%), 35–44 years (26.3%), 45–54 years (13.2%), and 55+ years (5.3%), with the largest group being 25–34 years, indicating active adult participants with diverse experiences and expectations. Gender distribution was nearly balanced, with 51.6% male and 48.4% female, ensuring reduced gender bias and a robust generalization of findings. Education levels ranged from high school to doctoral qualifications, with most respondents holding a bachelor's degree (55.3%), indicating a relatively educated sample, while postgraduate respondents (26.4%) added depth to the insights provided. Stakeholder categories included tourists (40.0%), local residents (35.3%), and tourism stakeholders (24.7%), offering a balanced mix of views from tourists, community members, and those directly involved in tourism

management. Local residents and stakeholders constituted nearly 60% of the sample, contributing valuable insights on the impact of tourism and sustainability practices at Borobudur.

4.2 Measurement Model Assessment

The measurement model assessment is essential for evaluating the reliability and validity of the constructs used in this study, including disaster mitigation, socio-cultural adaptation, natural resource management, and sustainable tourism destination. This assessment ensures that the constructs accurately capture the intended variables, supporting the robustness of subsequent analysis.

Table 1. Measurement Model Assessment

Variable	Code	Loading Factor	Cronbach's Alpha	Composite Reliability	Average Variant Extracted
Disaster Mitigation	DMT.1	0.862	0.881	0.918	0.738
	DMT.2	0.875			
	DMT.3	0.866			
	DMT.4	0.832			
Socio-Cultural Adaptation	SCA.1	0.875	0.878	0.916	0.733
	SCA.2	0.873			
	SCA.3	0.855			
	SCA.4	0.820			
Natural Resources Management	NRM.1	0.826	0.896	0.924	0.709
	NRM.2	0.907			
	NRM.3	0.896			
	NRM.4	0.850			
	NRM.5	0.718			
Sustainable Tourism Destination	STD.1	0.805	0.882	0.910	0.629
	STD.2	0.807			
	STD.3	0.731			
	STD.4	0.826			
	STD.5	0.806			
	STD.6	0.778			

Source: Data Processing Results (2024)

The study evaluates reliability and validity through indicators like loading factor, Cronbach's alpha, composite reliability (CR), and average variance extracted (AVE), ensuring each construct consistently represents its intended concept. All items show strong loading factors above 0.70,

supporting high reliability. Cronbach's alpha values exceed 0.70 across constructs—Disaster Mitigation (0.881), Socio-Cultural Adaptation (0.878), Natural Resource Management (0.896), and Sustainable Tourism Destination (0.882)—demonstrating robust internal consistency. CR values also

surpass 0.70, indicating consistent item grouping, while AVE values above 0.50 confirm convergent validity, with each construct explaining over half of its indicator variance. Construct-specific analysis reaffirms reliability: Disaster Mitigation, Socio-Cultural Adaptation, Natural Resource Management, and Sustainable Tourism Destination constructs show high loading factors, alpha, CR, and AVE, accurately capturing sustainable tourism aspects at Borobudur Temple.

4.3 Discriminant Validity

Discriminant validity is crucial to ensure that each construct in the study—

disaster mitigation, socio-cultural adaptation, natural resource management, and sustainable tourism destination—captures a unique aspect of sustainable tourism without significant overlap with other constructs. This validity was evaluated using the Fornell-Larcker criterion, which requires that the square root of the Average Variance Extracted (AVE) for each construct exceed its correlations with other constructs. In this study, the square root of the AVE values (shown on the diagonal) demonstrates strong discriminant validity, as each is higher than the correlations between constructs.

Table 2. Discriminant Validity

	Disaster Mitigation	Natural Resources Management	Socio-Cultural Adaptation	Sustainable Tourism Destination
Disaster Mitigation	0.859			
Natural Resources Management	0.771	0.842		
Socio-Cultural Adaptation	0.753	0.772	0.856	
Sustainable Tourism Destination	0.815	0.791	0.858	0.793

Source: Data Processing Results (2024)

Discriminant validity is confirmed for each construct, as the square root of the Average Variance Extracted (AVE) exceeds correlations with other variables, per the Fornell-Larcker criterion. Disaster mitigation (AVE = 0.859), natural resource management (AVE = 0.842), socio-cultural adaptation (AVE = 0.856), and sustainable tourism destination

(AVE = 0.793) each show higher AVE values than their respective correlations with other constructs, affirming their distinctiveness within the model.

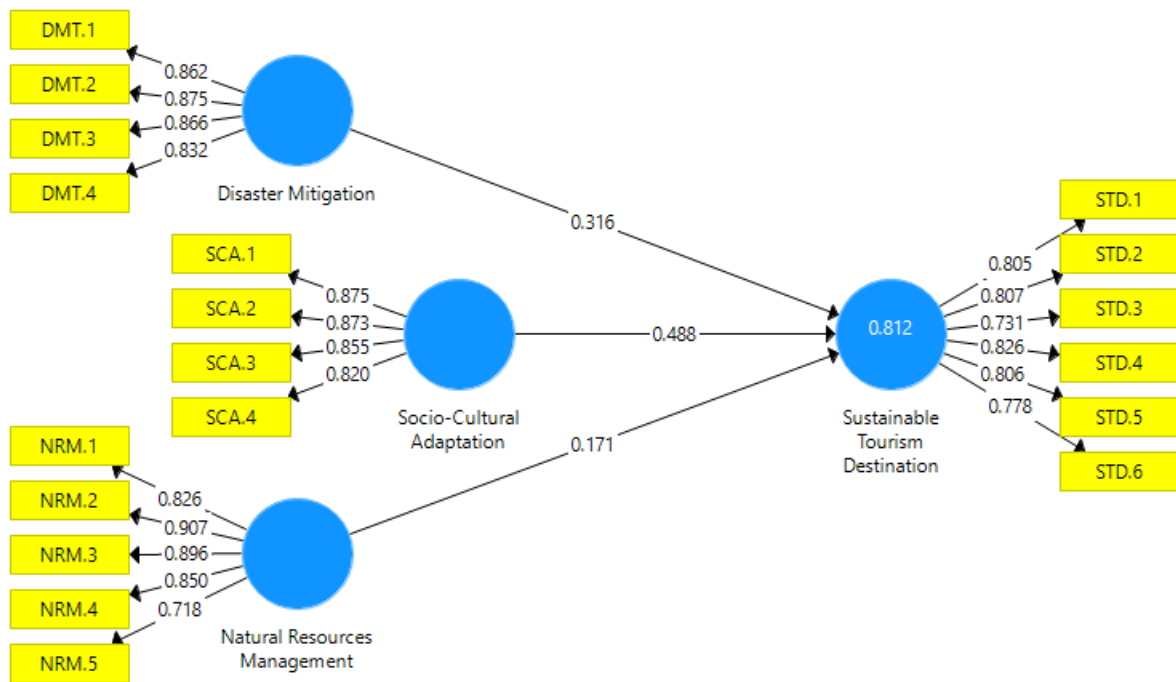


Figure 2. Model Results

Source: Data Processed by Researchers, 2024

4.4 Model Fit Assessment

Model fit assessment is crucial in evaluating how well the data aligns with the hypothesized model in Structural Equation Modeling (SEM). It indicates of whether the specified relationships and structure in the model are representative of the observed data.

In this study, model fit was evaluated using several key indicators, including the Standardized Root Mean Square Residual (SRMR), d_ULS, d_G, Chi-Square, and the Normed Fit Index (NFI). These indices collectively provide a comprehensive assessment of the model's fit.

Table 3. Model Fit Results Test

	Saturated Model	Estimated Model
SRMR	0.097	0.097
d_ULS	1.775	1.775
d_G	1.211	1.211
Chi-Square	717.678	717.678
NFI	0.683	0.683

Source: Process Data Analysis (2024)

The Model Fit Indices provide insights into the model's fit. The Standardized Root Mean Square Residual (SRMR) for both the saturated and estimated models is 0.097, slightly above the ideal threshold of 0.08, indicating moderate discrepancy but still acceptable for complex exploratory models (Hair et al., 2017). Squared Euclidean Distances (d_ULS and d_G) are 1.775 and 1.211, respectively, with relatively low values suggesting acceptable fit and alignment

between the saturated and estimated models. The Chi-Square value is 717.678 for both models, appearing high due to sample size and model complexity; hence, alternative measures like SRMR and NFI offer more relevance here. The Normed Fit Index (NFI) of 0.683, while below the ideal of 0.90, remains moderately acceptable in exploratory research, reflecting the complexity of constructs such as disaster mitigation, socio-cultural adaptation, and sustainable tourism.

Table 4. Coefficient Model

	R Square	Q2
Sustainable Tourism Destination	0.812	0.807

Source: Data Processing Results (2024)

Assessing the model's predictive power is crucial to determine how well the independent variables—disaster mitigation, socio-cultural adaptation, and natural resource management—explain the variance in the dependent variable, sustainable tourism destination. The R Square (R^2) value for sustainable tourism destination is 0.812, indicating that 81.2% of its variance is explained by these three factors, which is considered strong in social science research (Chin, 1998). This high R^2 highlights the critical role of these variables in building a sustainable tourism framework for Borobudur Temple, confirming the model's validity. The Q^2 (predictive relevance) value of 0.807, calculated through PLS-SEM's blindfolding procedure, further supports the model's predictive accuracy, showing that it not only explains the variance in sustainable tourism destination but also provides reliable predictions. This high predictive relevance

indicates the model's practical applicability, allowing tourism authorities to make informed decisions about sustainable tourism practices based on the included factors.

4.5 Hypothesis Testing

Hypothesis testing in Structural Equation Modeling (SEM) is used to assess the significance and strength of the relationships between the independent variables (disaster mitigation, socio-cultural adaptation, and natural resource management) and the dependent variable (sustainable tourism destination). The results for hypothesis testing are evaluated based on the Original Sample (O), Sample Mean (M), Standard Deviation (STDEV), T Statistics, and P Values. In this study, hypotheses are supported if the T Statistic is greater than 1.96 (for a 95% confidence level) and the P Value is less than 0.05.

Table 5. Hypothesis Testing

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics	P Values
Disaster Mitigation -> Sustainable Tourism Destination	0.316	0.317	0.102	3.102	0.001
Socio-Cultural Adaptation -> Sustainable Tourism Destination	0.271	0.274	0.079	2.464	0.004
Natural Resources Management -> Sustainable Tourism Destination	0.488	0.486	0.093	5.253	0.000

Source: Process Data Analysis (2024)

The study confirms the significance of three hypotheses linking disaster mitigation, socio-cultural adaptation, and natural resource management to sustainable tourism destination. For Hypothesis 1 (Disaster Mitigation -> Sustainable Tourism Destination), the path coefficient is 0.316 with a T Statistic of 3.102 and a P Value of 0.001, indicating a significant positive impact, suggesting that disaster preparedness enhances tourism sustainability at Borobudur

Temple. Hypothesis 2 (Socio-Cultural Adaptation -> Sustainable Tourism Destination) also shows a significant effect, with a path coefficient of 0.271, T Statistic of 2.464, and P Value of 0.004, indicating that aligning cultural practices with tourism contributes positively to sustainability. Hypothesis 3 (Natural Resource Management -> Sustainable Tourism Destination) is highly significant, with a path coefficient of 0.488, T Statistic of 5.253, and P Value of 0.000,

highlighting that effective resource management has a strong positive impact on tourism sustainability, particularly in maintaining ecological balance. All three hypotheses are supported, confirming the essential roles of these factors in sustainable tourism.

Discussion

The discussion section interprets the results of the hypothesis testing and explores the implications of disaster mitigation, socio-cultural adaptation, and natural resource management on the sustainability of tourism at Borobudur Temple. This study provides evidence that each of these factors significantly contributes to sustainable tourism, reinforcing their importance in the effective management of cultural heritage sites.

The Role of Disaster Mitigation in Sustainable Tourism

The findings reveal a significant positive relationship between disaster mitigation and sustainable tourism at Borobudur Temple, with a path coefficient of 0.316 and high statistical significance ($T = 3.102$, $P = 0.001$), highlighting the importance of disaster preparedness in supporting resilience and sustainability at heritage sites prone to natural disasters. Implementing strategies like emergency plans, safety protocols, and effective risk communication ensures visitor safety and structural preservation, thereby boosting visitor confidence and satisfaction, as tourists favor destinations perceived as safe. This aligns with previous research underscoring disaster resilience's role in tourism [14], [28], [29]. The results imply that tourism authorities and local governments should prioritize investments in disaster management infrastructure, including early warning systems and safety education, to strengthen Borobudur's resilience and enhance its reputation as a safe and sustainable destination.

Socio-Cultural Adaptation and Sustainable Tourism

The findings reveal a significant positive relationship between disaster mitigation and sustainable tourism at Borobudur Temple, with a path coefficient of 0.316 and high statistical significance ($T = 3.102$, $P = 0.001$), highlighting the importance of disaster preparedness in supporting resilience and sustainability at heritage sites prone to natural disasters. Implementing strategies like emergency plans, safety protocols, and effective risk communication ensures visitor safety and structural preservation, thereby boosting visitor confidence and satisfaction, as tourists favor destinations perceived as safe. This aligns with previous research underscoring disaster resilience's role in tourism [14], [28], [29]. The results imply that tourism authorities and local governments should prioritize investments in disaster management infrastructure, including early warning systems and safety education, to strengthen Borobudur's resilience and enhance its reputation as a safe and sustainable destination.

The Impact of Natural Resource Management on Sustainable Tourism

Natural resource management has the strongest positive impact on sustainable tourism destination, with a path coefficient of 0.488 ($T = 5.253$, $P = 0.000$), underscoring the vital role of managing resources like water, energy, and waste to reduce tourism's environmental footprint and maintain ecological balance around heritage sites. Effective resource management is key to ensuring that tourism at Borobudur remains within environmental limits, preserving its landscape and appeal for future generations. This aligns with studies emphasizing environmental conservation in sustainable tourism [30]–[32]. With Borobudur's high visitor numbers, responsible resource management helps minimize pollution, conserve biodiversity, and maintain the site's aesthetic and ecological integrity. Recommended actions include adopting sustainable practices, such as reducing water

use, managing waste, and promoting eco-friendly transport. For Borobudur, prioritizing sustainable practices through partnerships with environmental organizations, resource-efficient infrastructure, and encouraging sustainable tourist behaviors will help ensure the site's long-term sustainability as a heritage destination.

Practical Implications for Tourism Management

The findings of this study offer several practical implications for tourism stakeholders, including local governments, tourism operators, and community members involved in managing Borobudur Temple. **Strengthen Disaster Preparedness:** Tourism authorities should invest in disaster preparedness by developing infrastructure and protocols to minimize risks, while training programs for staff, guides, and the community enhance resilience and boost visitor confidence. **Promote Socio-Cultural Engagement:** Integrating cultural heritage into tourism experiences deepens visitor appreciation of Borobudur Temple, with cultural education programs and local involvement in tourism planning supporting socio-cultural adaptation and providing economic benefits. **Implement Sustainable Resource Management:** Effective resource management policies should focus on reducing water and energy use, promoting waste reduction, and maintaining environmental cleanliness, with encouragement for tourists to engage in eco-friendly practices to help preserve the site's environmental integrity.

Limitations and Suggestions for Future Research

While this study offers valuable insights, some limitations should be noted. The cross-sectional design captures only a single point in time, potentially overlooking

shifts in perspectives on sustainable tourism, which longitudinal studies could illuminate. Additionally, the study's focus on Borobudur Temple may limit the generalizability of results to other heritage sites with distinct environmental and cultural contexts. Future research could address these limitations by including variables like government policies or visitor behavior that may impact sustainable tourism, and by conducting comparative studies across multiple heritage sites to provide a broader understanding of sustainable tourism in diverse cultural and environmental settings.

5. CONCLUSION

This study highlights the significant roles of disaster mitigation, socio-cultural adaptation, and natural resource management in promoting sustainable tourism at Borobudur Temple, showing that these factors collectively foster a resilient and sustainable tourism environment that balances visitor satisfaction, cultural respect, and ecological preservation. Natural resource management proved the most impactful, emphasizing the importance of environmental stewardship in maintaining the site's appeal and health. Disaster mitigation and socio-cultural adaptation further ensure a safe and culturally respectful setting, crucial for sustainable heritage tourism. The practical implications stress the need for an integrated tourism management approach encompassing disaster preparedness, cultural engagement, and sustainable resource practices. These strategies support Borobudur's sustainability, enhance its value for future generations, and strengthen its reputation as a responsible heritage site. Future research could expand on this model by exploring additional variables and applying it to other heritage sites, broadening insights into sustainable tourism in culturally significant locations.

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